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STUDYING SCIENCE: STUDENTS GAINING ACCESS TO THE COMMUNITY OF PRACTICE OF ENVIRONMENTAL STUDIES

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BY

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ABSTRACT

Although nearly equivalent percentages of black and white students entering college aspire to earn degrees in science, technology, engineering, and mathematics (STEM), a much smaller percentage of black students than white undergraduates complete STEM degrees (HERI, 2010). Thirty-six percent of black undergraduates who initially pursue STEM fields and go on to earn bachelor's degrees switch to non-STEM majors, and 29.3 percent leave college before graduating, a rate 10 percentage points higher than that of their white counterparts (19.8 percent) (Chen, 2013). In the environmental sciences, of the 4,802 degree recipients in 2010, 81 percent (3,879) were white and only 2 percent (97) were black (NSF Table 5-7, 2010). As has long been recognized, America is producing too few scientists and far too few from the groups historically underrepresented in higher education. The situation is especially acute in the environmental sciences. Interventions designed to address these disparities have concentrated on programmatic and pedagogical enhancements, but most lack a theoretical explanation for the positive outcomes they claim to achieve.

This study employed interviews with fifteen black and white undergraduates who enrolled in introductory environmental science/studies at a selective liberal arts college. Applying the theory of Community of Practice, along with insights and concepts from Critical Race Theory and Stereotype Threat, the study shows how interactions with faculty and peers affected the extent and quality of involvement students had with the field of environmental sciences. Looking at the factors that discouraged students from participating in the Community of Practice of the environmental sciences, the study draws conclusions about effective practices and

makes recommendations for attracting students from underrepresented groups to scientific fields and the careers for which degrees in those fields can prepare them.

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STATEMENT OF THE PROBLEM

Global climate change and the associated problems call for scientific intervention (Geissman, 2012, Schmidt & Wolfe, 2009). The Pew Research Center (2009) reports that although 84% of scientists agree that the earth is warming because of human activity, and 70% of scientists regard global warming as a very serious problem, less than half of the U.S. public (47%) agrees with them. Despite changing weather patterns, the general public remains unaware of the urgent need for a collective approach to reversing these trends.

Although almost equivalent percentages of black and white students aspire upon entering college to earn degrees in science, technology, engineering, and mathematics (STEM) fields, far fewer black than white undergraduates complete STEM degrees (HERI, 2010). Of American bachelor's degrees awarded in STEM in 2010, only .28 percent (or 4,698) went to students in the Earth, Atmospheric, and Oceanographic Sciences (EAO) (NSF Table 212, 2010). In the environmental sciences, of the 4802 EAO bachelor's recipients in 2010, 81 percent, or 3879, were white, and only 2 percent, or 97, were black (NSF Table 5-7, 2010). Similarly, less than 1 percent (.82) of the undergraduate degrees conferred by postsecondary institutions in 2011–2012 were in the overall field of natural resources and conservation (Digest Table 318.30, 2013). The pattern of degree completion in the sciences in the U.S. is cause for concern. The low numbers in natural resources and conservation and in EAO are evident in other fields of science as well, except the health professions. The most recent data available show that over the past four decades, bachelor's degrees awarded

in the "physical sciences and science technologies" have made only modest gains relative to 3- and 6-fold increases in degrees in the health professions and business programs. While there was a 15 percent increase in the number of bachelor's degrees awarded to students in the physical sciences and science technologies (from 21,410 in 1970–1971 to 24,712 in 2010–2011), U.S. colleges and universities awarded far more degrees in the health professions and related fields (increasing from 115,396 in 1970–1971 to 365,093 in 2010–2011) and in business (increasing from 25,223 in 1970–1971 to 143,430 in 2010–2011) (Digest Table 313, 2013). Further complicating the situation is the racial pattern of attrition from STEM disciplines among undergraduates who originally aspire to earn STEM degrees. More than a third (33.6 percent in 2006) of black college freshmen express an intention of majoring in science and engineering, which is consistent with the percentage of intention expressed by white freshmen (29.6 percent in 2006) (U.S. Census, 2014; NSF Table 2-6, 2010). Likewise the percentage of black undergraduates who earn degrees in STEM fields (30.3 percent or 39,409 graduates in 2006) is comparable to the percentage of white undergraduates who earn such degrees (31 percent or 306,191 graduates in 2006) (NSF Table 4, 2009). But almost a third (29.3 percent) of black undergraduates who fail to carry out their intention of majoring in STEM fields also drop out of college, a rate 10 percentage points higher than that of their white counterparts (19.8 percent), and 36 percent of the black undergraduates earning bachelor's degrees have switched to non-STEM majors, versus 28.1 percent of whites (Chen, 2013). In the environmental sciences, of the 4,802 EAO degree recipients in 2010, 81 percent (3,879) were white and only 2

percent (97) were black (NSF Table 5-7, 2010). That a larger proportion of black[1] than white[2] undergraduates who are initially interested in STEM fail to earn degrees in those fields, resulting in an even smaller share of the recipients of the meager numbers of degrees awarded in the environmental sciences, suggests a problem. America is producing too few scientists, and too few of these belong to the groups historically underrepresented in higher education.

There is need for further investigation of the disparity between intention and follow-through in STEM fields among undergraduates. Although there has been a noticeable improvement in the percentages of blacks and members of other historically underrepresented groups entering the study of science and engineering, a sizable and consistent racial gap persists. Since 2005, black students on average earn approximately 5 percent of the science bachelor's degrees awarded every year, with 70 percent of those degrees going to whites (NSF Table 5-13, 2010). Given black undergraduates' initial interest in STEM, their attrition rate, considerably higher than that of whites, calls for concerted attention in higher education.

Professional and federal organizations and agencies associated with the earth sciences have become increasingly concerned about the low percentage of professionals entering these fields. White males historically dominate the fields of geoscience. Meanwhile, the U.S. is experiencing a shift in the racial and ethnic composition of its population. Day (1996) projected that "the non-Hispanic White

[1] The Federal Government uses the term "black" to refer to "a person having origins in any of the black racial groups of Africa" (U.S. Census, 2005).

[2] The Federal Government uses the term "white" to refer to "a person having origins in any of the original peoples of Europe, North Africa, or the Middle East" (U.S. Census, 2005).

share of the U.S. population will steadily fall from 74 percent in 1995 to 72 percent in 2000, 64 percent in 2020, and 53 percent in 2050." Currently, in the overall U.S. population, the percentage of non-Hispanic whites over the age of 65 is 16 percent and the percentages of older Hispanics, blacks, and Asians are 6, 8, and 9 respectively, the inverse of the percentage of the younger population (under 18), in which Hispanics, blacks, and Asians represent 34, 30, and 26 percent of the population respectively. As of 2009, non-Hispanic whites represented only 21 percent of those under the age of 18 (U.S. Census, 2009). This demographic reality suggests that the groups traditionally and currently underrepresented in STEM will increasingly be needed in future science careers. The same census showed that "for all children under 18, 44 percent were a minority and 22 percent were Hispanic" (U.S. Census, 2009). The importance of supplying the U.S. workforce with people trained to tackle the nation's environmental problems has intensified the urgency to address the racial disparities in the field by developing strategies to increase the participation of blacks and other underrepresented groups.

In 2002 the American Geophysical Union's Committee on Education and Human Resources (CEHR) proposed a multi-society conference to tackle the issue of diversity in the earth sciences. CEHR established three goals: 1) to educate the scientific community about the need to increase diversity in various fields of earth science; 2) to identify successful strategies to increase diversity in those fields; and, 3) to coordinate a coalition on diversity that would bring together multiple organizations. The conference became the hub of efforts to meet the other two goals set forth by CEHR. The Joint Society Conference on Increasing Diversity in the Earth and Space

Sciences (IDEaSS) took place in June of 2002 in College Park, Maryland, sponsored by NASA, the National Science Foundation, the National Oceanic and Atmospheric Administration, the U.S. Geological Survey and the U.S. Environmental Protection Agency. The conference participants included a coalition of scientists and staff from 27 different scientific organizations and 6 federal agencies. The conference anchored its purpose in a set of pragmatic reasons for attending to issues of diversity in the earth sciences. These reasons included the recognition that "in an era of declining student enrollments, loss of geoscience departments, upcoming 'Baby Boomer' retirements and turbulent employment conditions, the need to strengthen and revitalize the geo-scientific workforce has taken on new urgency" (Karsten, 2003, p. 20). The impact of the participants' deliberations on the retention of underrepresented students in the geosciences is not yet clear. The group established as a main goal the development of a web-based repository of research and best practices concerned with diversifying the earth sciences and the development and promotion of culturally sensitive career information and biographies or profiles of scientists and other professionals in the earth and space sciences (Karsten, 2003, p. 23).

The Directorate for the Geosciences (GEO) is a working group of the National Science Foundation, the scientific research arm of the U.S. government. The GEO's 2011–2016 Geosciences Education and Diversity Strategic Plan includes

> the strengthening [of] experiential programs that provide authentic, hands-on geosciences research experiences that promote the Earth System Science literacy concepts, [the] expansion [of] research experiences for undergraduates, (REU) programs to reach a wider population of undergraduate students,

> including those at community colleges, support scientists' professional development to strengthen their impact in education and outreach, and support and expand effective programs that provide mentoring, networking, and leadership development—particularly for women professionals and minority scientists and students" (NSF AC GEO, 2012, pp. 2-3).

The strategic plan concluded by asserting that the obstacles to increasing diversity in the geosciences emanate from the lack of engagement on the part of under-represented groups in the geosciences (NSF AC GEO, 2012, p. 3).

In order to effectively respond to these challenges, colleges and universities must develop a clearer understanding of the social context in which undergraduates from diverse backgrounds experience the geosciences and other earth sciences in college.

The way these general challenges are expressed at liberal arts colleges contributes to the difficulty black students encounter in engaging in the environmental sciences. The Carnegie Classification System offers a way to organize the characteristics of U.S. colleges and universities and recognize the patterns of philosophical and pedagogical approaches that influence early specialization in an academic area such as the environmental sciences. According to McCormick and Zhoa (2005), the Carnegie Classification System has been used as a framework for distinguishing characteristics among schools since 1970. It identifies five main types of schools: 1) doctorate-granting institutions (with a range of four levels of research, from heavy to limited emphasis), 2) comprehensive colleges, 3) liberal arts colleges (broken into two levels of selectivity), 4) two-year colleges and institutes, and 5) professional schools and other specialized institutions (which include theological

seminaries, medical schools, engineering and technology schools, schools focused on business, arts, law, and teacher-training, and other specialized institutions). A given school's characteristics influence the social context in which students experience college. For instance, a focus on the liberal arts rather than on vocational applications of the curriculum affects the ways faculty advise students, advocating for exploration of the full curriculum rather than the early specialization that is beneficial to students pursuing STEM degrees. Certain characteristics of an institution, such as its racial diversity, also influence the ways students interact with their peers. Bowen and Bok (1998) note that undergraduates, including students at liberal arts institutions like the one where my study was conducted, reported that they most frequently interacted with students from another race during class or study groups, in their dorm or residential community, at parties and other social activities, and while taking part in extracurricular activities. Despite the frequency of overall interaction, it is as yet unknown to what degree black undergraduates' participation in activities related to the study and exploration of the environmental sciences influences the decision to withdraw from college or switch to non-STEM majors. The testimonies from students about experiences that encourage or discourage their continued pursuit of STEM disciplines warrant particular investigation.

In regard to faculty and institutional roles in influencing undergraduate patterns of attrition in STEM fields, three types of curricular and programmatic strategies are commonly employed. These strategies, which involve instructional and support enhancements, are being promoted by professional organizations, federal agencies, and colleges to enhance teaching and learning for all students, especially

students from underrepresented backgrounds in the sciences. The first involves modification of courses, including a change in introductory science formats from large lecture-based courses to small discussion-based seminars employing active learning strategies (Hamilton, 2013; Micari, et al., 2010). The second involves the introduction of supplemental experiential research laboratory and field experiences with faculty researchers and graduate students, which have been found to provide critical training for students interested in studying science (Caccavo, 2009). These activities create opportunities for students—especially those from racial minorities and low-income backgrounds—who may have had limited opportunities to learn science through a process of discovery that resembles the process used by scientists, and to become familiar with the interpersonal experiences of the laboratory or other settings where scientists work. The third includes programmatic initiatives that introduce and retain underrepresented students in the sciences, including the specific discipline of earth sciences. Examples include the Meyerhoff Scholars Program and SOARS, both of which assemble groups of students from underrepresented backgrounds and place them in mutually supportive cohorts of peers. These programs assert that they provide opportunities for students to acquire knowledge on a range of topics and learn strategies that aid in their retention in the sciences. The activities associated with the pedagogical enhancements, the research and laboratory activities, and the enrichment programs offer promising remedies to the attrition in college science, but the process by which they affect students' experiences remains unclear. The social context, which includes the physical setting (e.g., a seminar room versus a lecture hall, and a research laboratory or field trip versus a classroom) and the organizational settings in which

enrichment programs conduct their activities, influences the function of these strategies. Closer inquiry into the social aspect of learning may shed light on why some black students are successful in the introductory environmental science/studies courses and go on to major in the field, while other students do not have successful experiences in the introductory courses and become likely to refrain from further enrollment in environmental studies and science courses.

That professional scientific organizations, federal agencies, and higher-educational institutions are working on these issues, yet the problem of low participation of blacks in the sciences persists, and raises many questions. Numerous studies have examined a variety of correlational and even experimental issues, yet few have documented students' testimonies as to their experiences in introductory science courses. A key question is, "What do students say about their experiences in introductory courses?" This study addresses that question by analyzing interviews with students who volunteered to participate in my research. The participants include male and female black undergraduates and several white female undergraduates enrolled in a highly selective liberal arts college in New England. That two participants in the study are international students who identify as black caused me to use the term "black," referring to people of African descent, rather than the more common "African-American." It is important to recognize that persons who are black and have been socialized in the United States have experiences of race and racism very different from those of blacks born and raised in other countries. The insights gained from analyzing both subtle and pronounced differences between the statements provided by the international participants and those of domestic participants will show

the nuances that must be understood as we seek to improve educational outcomes not only for at-risk students but for all undergraduates.

CHAPTER 2
REVIEW OF LITERATURE

Studies Part 1—Relevant Literature

Although there has been noticeable improvement in the percentages of blacks and other groups traditionally underrepresented in the study of science and engineering, there remains a consistent gap between the percentages of blacks and whites. According to the 2010 U.S. Census, whites comprise 77 percent of the population, while blacks comprise 13 percent. While white students attain 70 percent of all STEM degrees, a somewhat lower percentage than their proportion of the population, black students attain only 5 percent of all STEM degrees, which is a remarkably lower percentage than their proportion of the population (U.S. Census Bureau, 2011a; U.S. Census Bureau, 2011b).

That scientific professional organizations, federal agencies, and higher educational institutions are seeking to remedy the low participation of blacks in the sciences, yet the phenomenon persists, raises several questions: Is there something in the social context of learning in the sciences that discourages black students from realizing their aspirations towards the sciences? With respect to the environmental sciences in particular, do white undergraduates enroll in college with greater previous exposure to the material and norms of the field that makes the study of environmental sciences more familiar and easier? Do black undergraduates enroll in college with limited exposure to environmental science courses and weak commitment to environmental causes? Does familiarity with the issues and the community of environmental science affect how black and white undergraduates experience

introductory courses in the environmental sciences? Are some forms of instruction more effective than others in acclimating these students, and are others actually detrimental?

The underrepresentation of certain racial and ethnic groups in the study of the environmental sciences at the bachelor's level has a number of serious consequences. First and foremost, it results in a shortage of science teachers who can serve as role models in the U.S. to whom schoolchildren and students of the present and future can relate on the basis of shared race and ethnicity (Ladson-Billings, 1999; Delpit, 1995). It also accounts for the small presence in scientific research, and its applications, of scientists sensitive to the populations most vulnerable to environmental problems in the U.S. and abroad (Quimby et al., 2007; Ladson-Billings & Tate, 2006; Coburn, Osleeb, & Porter, 2006; Kozol, 1991). Although this underrepresentation has been studied extensively (Tyler-Wood, Ellison, Lim & Periathiruvadi, 2012; O'Connell & Holmes, 2011; Charles, 2009; Perry, Steele, & Hilliard, 2003; von Hippel, Lerner, Gregerman, Nagda, & Jonides, 1998; Bowen & Bok, 1998; Allen, 1992), the percentage of blacks who pursue the environmental sciences remains low.

In this chapter I will first review empirical studies and intervention efforts that offer some insight into strategies that purport to increase the retention of underrepresented minorities in the sciences. Then I will discuss several theoretical concepts and frameworks relevant to my study. These theories and concepts are the theories of Community of Practice (Lave, 1991; Lave & Wenger, 1991; Lave, 1996; Wenger, 1998), Critical Race Theory (Delgado & Stefancic, 2001), and the concept of

Stereotype Threat (Aronson, Lustina, Good, Keough, Steele & Brown, 1999; Steele, 1997, 2003, 2010; Steele & Aronson, 1995; Spencer, Steele & Quinn, 1999).

Studies Part 1, Section 1

Instructional Barriers Influencing Black Undergraduate Participation in the Environmental Sciences

In institutions of higher learning, professors teaching science courses employ a range of pedagogical strategies to convey content knowledge to undergraduates. Yet the diversity of interests and backgrounds those students possess, especially in the introductory courses, poses significant challenges to faculty. One challenge is determining the correct degree of rigor and the balance between foundational and more advanced concepts. The problem of determining the ideal level of rigor is particularly acute in the introductory environmental science/studies courses because of the wide range of academic backgrounds and personal familiarity with the subject matter (Hoisch & Bowie, 2010) that students bring and the variety of reasons that impel students to enroll in the introductory courses (Gilbert et al., 2012). Some students choose introductory environmental science/studies courses to fulfill distribution requirements. Others enroll out of a general interest in the environment. Still others enroll because they plan to pursue the major. The combination of these motivations creates a high demand for introductory courses in the environmental sciences. When institutions are unable to offer additional course sections, they expand course size, although smaller classes have been shown to offer more effective settings for the study of science (Demaree & Li, 2009). The large course enrollment in introductory science courses tends to result in a lecture-based format in which

discussion is the exception rather than the rule (Lord, 1999). Large enrollments and the resulting recourse to lecturing, along with the variety in students' motivation and background, pose pedagogical challenges for faculty and barriers to learning for students.

Despite the high demand for seats in introductory environmental science/studies courses, the percentage of students who graduate with degrees in the discipline remains low. A study of students enrolled in introductory geology courses at Northern Arizona University identified factors that affect the number of majors and ultimately the low rates of graduation in the field. Hoisch and Bowie (2010) assert that "ignorance about the field and the ignorance about employment prospects" contributed to students' reluctance to pursue the major. These researchers suggest that geology is suffering from a public-relations image problem and argue that high-school curricula do not adequately cover topics related to geology. Exposure to the field is limited to discussions of earth science, to the exclusion of social-welfare and health considerations such as preservation of green spaces and the quality of water and air in urban settings. They contend that this emphasis explains why so few high school students enroll in Advanced Placement environmental science courses. The narrow exposure to the geosciences in high school stands in stark contrast to the exposure that students receive to other areas in science. Hoisch and Bowie (2010) contend that there are three key aspects of the (in)visibility of, or students' early exposure to, geoscience that ultimately influence college participation in the field. Geology is relatively invisible because 1) students have limited exposure to the field in most high school curricula; 2) there are few student-led campus geoscience organizations, in

comparison to chemistry and physics clubs, engineering societies, and pre-health-professions interest groups; and 3) few professors in other fields understand geoscience well enough to advise freshmen to pursue the degree (Hoisch & Bowie, 2010). Overall, this relative invisibility presents a large perceptional barrier to studying the discipline. The invisibility of the field also results in ignorance about possible ways to apply a degree in this field to aspects of one's life and career. Many students believe that geology will lead to underpaid employment (Hoisch & Bowie, 2010). Hoisch and Bowie also point out that family and social pressures factor far more heavily into students' desire to pursue a particular major than advice from faculty, including experts in a field.

Today's liberal arts students are career- and employment-minded in ways that previous generations perhaps were not. Therefore, it is far more likely that students will be thinking, even as freshmen, about how a particular college degree may prepare them for future employment. That family and social pressures influence students to pursue majors and careers outside of the environmental sciences suggests the need for close attention to the interpersonal factors that affect undergraduates' learning in the context of the environmental sciences.

Lord (1999) offers insights into some of the social aspects of learning in college science courses. Lord looked at undergraduates enrolled in two sets of environmental science courses in order to explore the effects of course size and small-group activities on the development of content knowledge, on course evaluations, and on engagement in environmental issues. The study compared two lecture-based courses (n = 46 and n = 45) to two discussion-based courses (n = 48 and n = 42).

Although all four courses used identical materials, learning resources, student questionnaires, and examinations, and were similar in size, the students enrolled in the discussion-based groups performed significantly better on examinations than the students who participated in the lecture-based courses. They also rated the courses higher than the students in the lectures. The study found that the differences in students' performance on the examinations could be attributed to the small-group activities in which students worked together on thought-provoking scenarios and critical-thinking exercises or constructed concept maps illustrating the information of the day (Lord, 1999). Such activity did not occur in the lecture-based courses. Lord also noted that the students who had taken the lecture-based course were less likely to participate in campus and regional environmental efforts.

If small-group activities for students enrolled in introductory college science courses contribute to enhanced learning, yet the percentage of blacks who pursue the environmental sciences remains low relative to other races, even when black students can participate in such activities, we must ask whether students' racial identity influences their benefit from these small-group activities. A search for literature about the role of race in student participation in small-group activities in U.S. college science courses proved fruitless. It is undeniable, however, that blacks in the U.S. are less likely than their white counterparts to complete bachelor's degrees in the environmental sciences/studies. Research into the phenomenon of low participation in the field by blacks in the U.S. suggests that black students may have perceptual barriers that prevent them from exploring the environmental sciences, barriers that in

turn influence students' confidence (Cohen, Steele & Ross, 1999), personal activities, and career aspirations (Quimby et al., 2007, and Wechsler et al., 2005).

One explanation for the ways in which race acts as a psychological barrier for academically ambitious members of racial and ethnic minorities, as well as for members of other groups, can be found in the phenomenon of stereotype threat (ST), identified by Steele and Aronson (1995). Stereotype threat is a psychological response—which may be debilitating—that American blacks and members of other identity groups experience when they think that their performance may be judged on the basis of negative assumptions about their race (Aronson, Lustina, Good, Keough, Steele & Brown, 1999, Steele & Aronson, 1995) or gender (Spencer, Steele & Quinn, 1999). (Numerous other identities are vulnerable to stereotype threat.) Activation of stereotype threat in the minds of black students can create a psychological barrier to their participation in the fields of science, including the environmental sciences, and mathematics. The activation of stereotype threat may lead black students to misinterpret or discount advice from faculty, administrators, and peers who, they believe, expect low performance from them based on their race.

Cohen, Steele, and Ross (1999) performed seminal research in the area of performance anxiety. They document differences in the ways that white and black students responded to what they call "un-buffered" and "buffered" criticism from white professors. As reflected in students' evaluations of their professors and their assignments, black students were far more likely than white students to be positively affected by feedback that included honest criticism buffered with additional information that diminished the negative effect of the criticism. Black students

responded well to professors' statements that included encouragement and expressions of confidence that the students were capable of performing at a higher level, while such buffers did not show any measurable effect on the white students' evaluation of the professor or the assignments.

Quimby et al. (2007) studied a sample of undergraduates (124 white and 36 ethnic minority) to determine whether there were racial patterns in the ways students responded to a survey dealing with seven areas: self-efficacy, role-model influence, outcome expectations, career interest in environmental science, career supports, career barriers, and environmental concerns. They found no difference in the ways that whites and members of ethnic minorities responded to questions about "identification with role models in environmental careers" ($t(150) = .39$, $p > .05$). They did find differences in the responses members of ethnic minorities gave to certain questions. These responses included the perception among ethnic minorities of greater barriers to pursuing a career in environmental science ($t(150) = -2.51$, $p < .05$), limited concern about environmental problems ($t(150) = 2.31$, $p < .05$) and 3), and less interest in the environmental sciences ($t(150) = 3.62$, $p < .0001$).

The National Science Foundation funded the Geoscience Diversity Enhancement Program for three years as part of an effort to attract minority students from local community colleges and high schools to the geosciences. They hoped to do so by exposing the students to research and educational experiences during an intensive summer research experience at California State University Long Beach (Wechsler et al., 2005). This program included features typical of research opportunities in the natural sciences, as well as features specific to the field of

geoscience. Components of the program included a research project, participation in on-campus workshops and off-campus tours to enhance awareness of research, and instruction in study skills, presentation techniques, and web design. Students discussed with college faculty in geoscience matters such as ethical issues in scientific work and the nature of scientific collaboration. Students were introduced to labs and technology specific to the field of geoscience, including global positioning systems, geographic information systems, and remote sensing technology. A survey was used to gauge the influence of the program on student attitudes about studying the geosciences. The study revealed that high school students in the program reported increased intention to pursue study of science and mathematics, and the community college students reported that the program helped them become more familiar with environmental issues (Wechsler et al., 2005).

Studies Part 1, Section 2

Racial Discrimination as a Barrier Influencing Black Undergraduate Participation in the Environmental Sciences

Although the lecture-based format of many introductory environmental science courses and the lack of information that college freshmen have about career opportunities in the environmental sciences may explain some of the barriers to the field, there are also historical and institutional factors that continue to limit the access of U.S. blacks to high-quality P-12 schools (Kozol, 1991) and limit exposure to activities associated with science enrichment and the environmental sciences. Delgado and Stefancic (2001), Ladson-Billings (1999, 1994), and Solorzano (1998) have used the framework of Critical Race Theory (CRT) to explore the larger historical context

that has caused some black students to feel alienated from the sciences, to not visualize black people as scientists, and to fail to have meaningful interactions with science. Likewise, the phenomenon of Stereotype Threat (Aronson, Lustina, Good, Keough, Steele & Brown, 1999; Steele, 1997, 2003, 2010; Steele & Aronson, 1995; Spencer, Steele & Quinn, 1999) has been shown to determine the ways in which black students respond to experiences that they believe may expose them to being judged on the basis of their race. Critical Race Theory and Stereotype Threat illuminate the broader social context in which black people in the U.S., including undergraduates, parents, teachers, and professors, have been socialized to see black youth as incapable of studying and excelling in academic endeavors, especially in the sciences and mathematics. A more detailed review of the theory of Community of Practice, Critical Race Theory, and Stereotype Threat will be provided in part 2 of this chapter. For now, I will review some methods that have been used to increase the participation of black youth in the sciences.

Studies Part 1, Section 3

Programmatic Initiatives and Opportunities for Black Undergraduate Participation in the Environmental Sciences

Awareness of the problem of low percentages of blacks who pursue degrees in the environmental sciences has led to the establishment of a host of federal and privately funded programmatic initiatives (Bingham et al., 2003; Windham et al., 2004; Francisco, 2006; Summers & Hrabowski, 2006).

In 1991 the National Science Foundation funded the Minorities in Marine Science Undergraduate Program (MIMSUP) at Western Washington University's

Shannon Point Marine Center (Bingham et al., 2003). The program established cohorts of eight students selected from applications from colleges in the U.S. In the program, undergraduates participated in two ten-week quarters (winter and spring) at the university devoted to course instruction, experiential learning and research opportunities, skill-building, and mentoring in the field of marine science.

MIMSUP strove to introduce students to the "relatively informal" environment of a marine laboratory and to the methodology of research in marine science (Bingham et al., 2003). MIMSUP focused on ways to foster the students' confidence in their own abilities, to create increased comfort with the support structure of the program, and to further an understanding of the level of commitment the program demanded. Additionally, MIMSUP recognized the wide range of cultural and academic backgrounds that the students brought to the program, and used daily mentoring, which, according to Bingham and colleagues (2003), included frequent formal and informal contact and other strategies to cultivate a sense of community among the students, faculty, and staff. Attention to the cultivation of community was a central focus during the first two weeks, when students were becoming accustomed to the institutional, geographical, cultural, and interpersonal setting in which the program was taking place. The remote, sparsely populated, and racially homogeneous character of western Washington provided a context that was often quite unlike the social and institutional setting most familiar to the students in the program.

RISE is another example of the types of program designed to inspire traditionally underrepresented minority students to pursue careers in environmental science (Francisco, 2006). The National Science Foundation sponsors the Research

Internships in Science of the Environment (RISE) program located at Arkansas State University. Three years after the establishment of the program in 2003, it had worked with 29 students, many of whom had been underperforming at community colleges and had had limited access to research opportunities prior to enrollment in the program. Francisco (2006) discusses a review of the program, including a three-year (2003–2006) success rate in which out of 29 bachelor's degrees attained, 17 were in environmental science, with 8 out of the 17 degree recipients accepted into master's and Ph.D. programs. RISE is described as a program designed to dismantle "the imposter syndrome," a term the director of the program uses to describe the students' belief that they cannot become professional scientists—a plausible idea, since few of the participants have ever seen people of color who are active, productive researchers in their chosen fields (Francisco, 2006).

In 1996, the U.S. Department of Energy's Global Change Education Program and the University of Colorado's Cooperative Institute for Research in Environmental Sciences established the Significant Opportunities in Atmospheric Research and Science program (SOARS) to help retain and eventually increase the number of participants from underrepresented minority groups in the atmospheric and related sciences. In 2001, SOARS was recognized as one of ten programs to receive the sixth annual Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring, which honors people and institutions promoting participation and achievement among women, minorities, and persons with disabilities in science and engineering careers. According to Windham, Stevermer, and Anthes (2004), the program is designed to bring together cohorts of undergraduate students, most of

whom are members of underrepresented minorities majoring in the sciences, to participate in ten-week programs over several consecutive summers. A report of the demographic composition of the group from 1996 through 2003 demonstrates that 41 percent of the students who had participated since the program's inception were African-American, 34 percent were Hispanic/Latino, and more than half of the participants were female (66 percent) (Windham et al., 2004).

The multi-year program is described as "a community-oriented student-centered experience" (Windham et al., 2004, p. 44). Through a partnership with the National Center for Atmospheric Research, students learn laboratory research and presentation skills and are supported by a community team that includes a community mentor, a peer mentor, a science research mentor, and a scientific writing and communication mentor. A self-described extended learning community, "SOARS tries to inspire protégé[s] to take on tasks that may require new skills" (Windham et al., 2004, p. 45). The program attributes its success in retaining students in the sciences to a framework that inspires performance and resiliency.

As is typical of programs seeking to increase minority participation in the environmental sciences, the students are placed in a research community of scientists, often in a lab and always with a faculty member. During the ten-week summer residential program, students attend seminars and workshops on environmental policy issues, science careers, gender and minority issues, science ethics, research presentation skills, and the graduate-school application process. Science writing and presentation skills are developed, with the students presenting their research orally and in poster form at the university, as well as at regional and national conferences.

Students are introduced to the collaborative environment of research labs, and the program emphasizes the formation of support groups comprising minority guest speakers, faculty mentors, and graduate students. These support groups are available to students during and sometimes after the program ends.

Another important initiative has been the Meyerhoff Scholars Program. Established in 1988, it has been the leading producer of black science and engineering doctorates in the country for the last two decades and has achieved extraordinary success in retaining undergraduates from unrepresented groups in the study of science and mathematics (Rotherham, 2011). Summers and Hrabowski (2006) and Hrabowski, Maton, and Greif (1998) credit much of the success of the Meyerhoff Program to consistent emphasis on academic and social integration, knowledge and skill development, support and motivation, and close monitoring and advising. Academic and social integration includes fostering a sense of academic belonging, promoting intellectual development, maintaining contact with students' families, and emphasizing commitment to the school (Hrabowski et al., 1998). The program requires parental involvement, even though the students are enrolled in college. The staff practice an approach to academic and personal advising that they refer to, without embarrassment, as "intrusive." To be successful in the program, participants must feel comfortable discussing personal and academic issues with the staff. The Meyerhoff Program espouses an approach to teaching and learning that makes use of experiential activities, problem-based learning, small classes, and students' attendance at scientific conferences. Additionally, the program fosters group discussion and peer cohort cohesion (Summers & Hrabowski, 2006). All these measures serve to encourage a

sense of community among the students, as well as among the faculty and staff engaged in supporting the science and mathematics students.

Although minority recruitment initiatives such as MIMSUP (Bingham et al., 2003), SOARS (Windham et al., 2004), RISE (Francisco 2006), and the Meyerhoff Scholars Program (Hrabowski, Maton, & Greif, 1998; Summers & Hrabowski, 2006), purport to increase interest and preparation for studying the environmental sciences in a matter of months by engaging students in research and experiential learning activities, these programs also attempt to promote community formation, which often includes faculty, graduate students, and undergraduates.

The theory of Community of Practice (CoP), (Lave, 1991, 1996; Lave & Wenger, 1991; Wenger, 1998; Wenger et al., 2002) provides a theory of social learning that ascribes central importance to the role that the social context plays in learning. CoP theory focuses on learners rather than on pedagogy, and emphasizes the ways that learners become increasingly involved participants in a social and discipline-specific setting. The term Lave and Wenger (1991) use for this phenomenon is "legitimate peripheral participation," or LPP, and the view of the context for learning is called a “community of practice.” Communities of practice are “groups who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in the area by interacting on an ongoing basis” (Wenger et al., 2002, p. 4). A detailed review of CoP will be provided in the next part of this chapter.

Studies Part 1, Section 4

Models of Research that Used the Community of Practice (CoP) as a Theoretical Framework to Study Post-Secondary Education in the Sciences

Few studies have utilized the theory of Community of Practice (Lave, 1991, 1996; Lave & Wenger, 1991; Wenger, 1998; Wenger et al., 2002) as a framework for analyzing learning and career development among college students enrolled in science courses. However, several research studies have explored issues that can be viewed as barriers to and opportunities for students in their pursuit of science. Research studies by Brandt (2008), Demaree and Li (2009), Hunter, Laursen, and Seymour (2006), and McGinn and Roth (1999) are summarized below. These studies advanced the idea that learning in the context of performing authentic science, the type of learning that happens in a research lab, results in more positive outcomes for students studying the sciences than lecture-based instruction, and highlight the effects of small-group activities in fostering learning among all students, especially minority students, in science courses in college.

Brandt (2008) conducted a case study involving the senior-year experience of a female Navajo science major at the University of New Mexico, where in 2000 Native Americans represented 5 percent of the student population. The study offers insight into the student's encounters with cultural and conceptual barriers. For example, she struggled with the contradiction between the scientific theory of evolution and Navajo creation stories, with the use of concepts such as the "virus," and with certain metaphors that have no counterparts in Navajo culture. Brandt conducted interviews over the span of four months. The analysis suggested that the interviewee had initially

experienced cultural isolation and found it difficult to follow her courses, all of which used a lecture format exclusively. At the time of the study, the student was working as a research assistant in a university molecular biology research laboratory. Brandt contended that only gaining this access to the CoP of molecular biology enabled the student to complete her major. While her previous experience with scientific discourse had been limited to listening to her professors lecture and reading textbooks, Brandt noted that working in the lab allowed the student to make the discourse her own and see herself as a legitimate participant in the discipline.

Demaree and Li (2009) used the concept of LPP, a feature of the theory of Community of Practice that represents learning as increasing participation and changing identity, to explore student learning in an introductory college science course. The course employed social learning strategies, such as peer-to-peer discussions about course topics, to enhance students' learning. Demaree and Li discovered that students who were reluctant to speak in a calculus-based introductory physics course at a liberal arts college benefited from talking about the physics concepts with their immediate neighbors in the classroom. The study provided several insights into the benefits of small-group activities in such courses: they improved the students' ability to provide multiple explanations of physics concepts, and the students learned how to initiate in-depth dialogue about course content. Demaree and Li (2009) used the CoP framework to analyze the types of students who enrolled in the course and concluded that the students fit into the following categories: 1) those who felt uncertain about their knowledge of physics, or, in CoP terms, thought they did not belong in the community of practice of physics and were intimidated by it; 2) those

who were interested in physics but often seemed tentative about their pursuit of the field; and 3) those who thought they already knew what they needed for the physics major and did not see any necessity to belong to the community of the course (Demaree & Li, 2009). Insight from this study promises to be valuable for exploring how peer relations affect the academic performances of college students in science.

Hunter, Laursen, and Seymour (2006) documented the phenomenon of LPP, a central concept in the theory of Community of Practice, in research laboratories at four liberal arts colleges. Analysis of individual student interviews conducted when students were juniors, seniors, and graduates, along with interviews of faculty mentors, revealed several themes related to student gains: thinking and working like a scientist; becoming a scientist; personal and professional gains; clarification, confirmation, and refinement of career/educational paths; enhanced preparation for career or graduate school; and gains in skills. Notably, over three-quarters (86 percent) of the comments made by the faculty members in interviews and over half (58 percent) of the student comments referred to improvement in the category of thinking and working like a scientist. The data suggest that laboratory activities accounted for the greatest gains in the application of science knowledge to hands-on research. A quarter (24 percent) of the students mention that participating in the lab improved their depth of knowledge and understanding of science. Another notable finding of the study is that more than half (52 percent) of the faculty described changes they observed in students' conduct and manner, noting how students began to exhibit the behaviors and attitudes that underpin research work, such as curiosity and initiative, while becoming less fearful of being wrong and more willing to take risks. The

researchers also found that over half (57 percent) of the student responses related to becoming a scientist described increases in confidence (Hunter et al., 2006). This study highlights the subtle and tacit ways in which the students' experiences in the lab increased their participation in the field of science.

McGinn and Roth (1999) argue that the concept of LPP, as a way of describing how experiential learning contributes to intellectual and emotional transformation, provides a promising approach to improving students' experiences in the study of science and technology. They explain that science courses need to allow students to engage meaningfully in scientists' work practices, so the students acquire content knowledge and are better prepared for deeper levels of professional participation and civic engagement. They call for dispelling "myths" that they contend situate science and scientists in a realm out of reach for ordinary people. According to these researchers, training in the practice and discourse of science serves as preparation for competent participation in a wide range of scientific endeavors. They view scientific research as "situationally contingent" and maintain that "scientific knowledge emerges from a nexus of interacting people, agencies, materials, instruments, individuals and collective goals/interests, and the histories of all these factors" (McGinn & Roth, 1999, p. 15). They argue for creating knowledge-producing communities in which the discourse mirrors that used by scientists in professional laboratories.

Studies Part 1, Section 5

Model of Research Using Critical Race Theory (CRT) as a Theoretical Framework to Study Post-Secondary Education

Solorzano (1998) employed CRT to examine the ways that a sample of high-performing undergraduates described their experiences with race at their home institutions. Solorzano defines CRT in education "as a framework or set of basic perspectives, methods, and pedagogy that seeks to identify, analyze, and transform the structural, cultural, and interpersonal aspects of education that maintain the subordination of scholars of color" (p. 5). CRT is relevant, according to Solorzano, because it challenges "the traditional claims of the educational system and its institutions to objectivity, meritocracy, color and gender blindness, race and gender neutrality, and equal opportunity" (p. 4).

The researcher administered surveys to 12 students from underrepresented groups who were participating in the Ford Fellowship Program, a highly selective academic fellowship program for high-performing undergraduates. By examining the responses from the students through the lens of CRT, Solorzano identified three recurring themes in the student responses: 1) feeling out of place in the academy because of their race and or gender; 2) feeling that their teachers/professors had lower expectations for them than for other students; and 3) accounts of subtle and not so subtle racist and sexist incidents. The study suggests that even for high-performing students institutional barriers continue to limit their participation in academia.

Studies Part 2—Theories and Frameworks

The Theory of Community of Practice

The theory of Community of Practice (CoP) is a social theory of learning developed by Jean Lave and Etienne Wenger (Lave, 1991, 1996; Lave & Wenger, 1991; Wenger, 1998). Lave (1996) summarizes the argument on which the theory rests as follows:

> Learning is an aspect of changing participation in changing "communities of practice" everywhere. Wherever people engage for substantial periods of time, day by day, in doing things in which their ongoing activities are interdependent, learning is part of their changing participation in changing practices. This characterization fits schools as well as tailor shops. There are no distinguishable "modes" of learning, from this perspective, because however educational enterprises differ, learning is a facet of the communities of practice of which they are composed (p. 150).

The theory of Community of Practice treats "learning as a social, collective, rather than individual, psychological phenomenon" (Lave, 1996, p. 149), which is relevant to any study of learners in a school setting, for instance undergraduates who enroll in specific college courses. Lave (1996) provides a critique of modern Western forms of schooling that situate learning as the outcome of teaching, arguing instead that learning is a byproduct of social relations. The following discussion will be a brief review of the theory of Community of Practice. First I will explain the origins of the theory. Then I will discuss how Lave and Wenger (1991) conceptualized learning in

ways that built on insights gained from studying traditional cultures, and how the theory rests on a reconfiguration of the relationship between teaching and learning, teacher and student. The focus on students and learning, rather than on teachers and teaching/instruction, places students in the position of subjects rather than objects of schooling, and suggests that students and teachers are engaged collectively in activity that has the potential to change all involved. Next I will describe components of the theory. The rest of the discussion will be dedicated to a review of various critical aspects of the theory and its use as a framework for analysis.

The theory was initially based on studies of the ways in which novices, whom Lave calls "newcomers," learn a traditional craft by serving as apprentices to masters of the craft, whom Lave calls "old-timers," and the ways in which the process of doing the craft alters the meaning that newcomers come to associate with aspects of the enterprise of the craft. The process allows the newcomer to enter into the community of the enterprise of the craft; changes what things come to mean to the newcomer in enterprise of the craft, and ultimately changes who the newcomer becomes in the community (Lave 1991, 1996). Lave & Wenger (1991), and Wenger (1998) subsequently laid the foundation for more extensive applications of the ideas that constitute the conceptual framework of Community of Practice. They regard learning as the focus of the framework and conceive of the process of learning as involving the interaction of people with a high degree of expertise in an enterprise, whom they refer to as masters, with people who initially have little to no expertise in an enterprise, whom they refer to as newcomers, and various other people situated inside and outside of the social context, who interact and care about the enterprise. Wenger (1998)

explains that the process of learning occurs in a social context, or domain involving one or more specific and related activities, disciplines, or organizations, that he called an enterprise. Lave (1991, 1996) describes tailoring apprenticeships in Liberia and legal learning in Egypt as situations in which the theory of CoP helps explain how people learn by constructing identities specific to those enterprises. Lave's seminal ethnographic research describing how traditional craftspeople acquire knowledge and expertise about their crafts without literary or formal instruction is a cornerstone of the theory of CoP. Lave (1991, 1996) and Lave and Wenger (1991) call this process of learning legitimate peripheral participation (LPP). In the case of the aspiring tailor, the newcomer not only learns the mechanics of tailoring but also the art of interacting with customers, and absorbs other business and social conventions, none of which the master may ever articulate, but that the newcomer picks up as a byproduct of interaction with other craftspeople, customers, suppliers, and the craft itself. Analysis of this process reveals the tacit and explicit ways in which people learn. Lave and Wenger (1991) describe the process thus:

> To begin with, newcomers' legitimate peripherality provides them with more than an "observational" outlook post: It crucially involves participation as a way of learning—of both absorbing and being absorbed in—the "culture of practice." An extended period of legitimate peripherality provides learners with opportunities to make the culture of practice theirs. From a broadly peripheral perspective, apprentices gradually assemble a general idea of what constitutes the practice of the community. This uneven sketch of the enterprise (available if there is legitimate access) might include who is involved; what

> they do; what everyday life is like; how masters talk, walk, work, and generally conduct their lives; how people who are not part of the community of practice interact with it; what other learners are doing; and what learners need to learn to become full practitioners. It includes an increasing understanding of how, when, and about what old-timers collaborate, collude, and collide, and what they enjoy, dislike, respect, and admire. In particular, it offers exemplars (which are grounds and motivation for learning activity), including masters, finished products, and more advanced apprentices in the process of becoming full practitioners (p. 95).

The masters in these contexts do not develop a curriculum to convey knowledge to novices, as they would in contemporary Western schools. In fact the master does not modify his or her behavior at all. Rather, the newcomer learns the craft by participating in the craft. Wenger (1998) applied the insight and conceptual framework to an analysis of an organization of medical-claims processors, who, he argued, constituted a community of practice. In this study, he laid the foundation for the use of the framework to analyze other contemporary enterprises such as the Western university context in which my study was conducted.

Learning. In the theory of Community of Practice, Lave (1996) refers to the "situated character of activity in the daily practices of people's lives" (p. 154) as communities of practice. A Community of Practice is "a set of relations among persons, activities, and world, over time and in relation with other tangential and overlapping communities of practice" (Lave & Wenger, 1991, p. 98). Lave (1991, 1996), Lave and Wenger (1991), and Wenger (1998) view learning as the outcome of

social interactions, and suggest that regardless of what intentions people have about conveying and acquiring knowledge, human interactions will result in the production and exchange of knowledge, which can be thought of as learning. Lave (1991) "takes learning to be an aspect of participation in socially-situated practices" (p. 150). Wenger (1998) asserts that learning involves the "transformation of knowing," and the process of learning can be "characterized as a change in the alignment between experience and competence" (p. 139). These descriptions of learning are key features of the theory of Community of Practice because they highlight the situational or social context in which learning takes place.

The theory of CoP considers "humans [as] . . . social beings, knowledge [as] . . . a matter of competence with respect to valued enterprises, knowing [as] . . . a matter of participation in the pursuit of such enterprises, that is, of active engagement in the world, and meaning [as] . . . our ability to experience the world and our engagement with it as meaningful" (Wenger, 1998, p. 4). As a conceptual framework, CoP provides a way to view learning as increasing participation in a social context that Lave (1991, 1996), Lave and Wenger (1991), and Wenger (1998) refer to as a community of practice and describe as the way its members make meaning and recognize competence in each other. Wenger (1998) summarizes the conceptual framework of CoP thus:

> Being alive as human beings means that we are constantly engaged in the pursuit of enterprises of all kinds, from ensuring our physical survival to seeking the most lofty pleasures. As we define these enterprises and engage in their pursuit together, we interact with each other and with the world and we

> tune our relations with each other and with the world accordingly. In other words, we learn.
>
> Over time, this collective learning results in practices that reflect both the pursuit of our enterprises and the attendant social relations. These practices are thus the property of a kind of community created over time by the sustained pursuit of a shared enterprise. It makes sense, therefore, to call these kinds of communities of practice (p. 45).

Lave (1991, 1996), Lave and Wenger (1991), and Wenger (1998) suggest that learning is the natural outcome of and ought to be the goal of all human endeavors, and that people learn most through meaningful experiences with others rather than by following a contrived curriculum performed outside of a lived context. The experiences that humans have with each other and the world facilitate deepened understandings of themselves, as well as of the world.

Key Concepts of the Theory of CoP. Lave (1991, 1996), Lave and Wenger (1991), and Wenger (1998) identify in their separate studies other features of learning that represented the process as simultaneously engaging the individual and the collective. Lave (1996) explains that foundational work by Martin Packer introduced concepts that developed into a key concept that she and Wenger (1998) refer to as trajectories. Lave (1996) describes Packer's conceptual contributions to the theory as follows:

> 1. Telos: that is, a direction of movement or change of learning (not the same as goal directed activity),

2. Subject-world relation: a general specification of relations between subjects and the social world (not necessarily to be construed as learners and thing to-be-learned),

3. Learning mechanisms: ways by which learning comes about (p. 156).

Like telos, Lave's (1991, 1996) and Lave and Wenger's (1991), and Wenger's (1998) concept of trajectory of participation refers to motion rather than a fixed path; it describes the changes that represent learning. Referring back to traditional enterprises, such as that of tailors, Lave (1991, 1996), Lave and Wenger (1991), and Wenger (1998) describe the trajectory of participation as a process by which the newcomers' increasing participation over time represents and facilitates learning. Wenger's (1998) view of the trajectory of participation does not limit the relationship to master and novice, but expands to include a range of participants engaged in the enterprise.

Wenger (1998) explains that regardless of the enterprise—traditional or contemporary—the earliest moments of interaction among the people in a CoP may be awkward and imprecise. The participants—including master and novice—engage in a process of negotiating their relationship, and the knowledge of the enterprise is therefore transmitted through explicit and tacit means. In the end, it is this negotiated process that constitutes the basis for learning: changing participation and identity transformation in a community of practice (Lave & Wenger 1991).

The concept of the community of practice (Lave 1991, 1996; Lave & Wenger, 1991; and Wenger, 1998; Wenger, McDermott, & Snyder, 2002) describes learning and knowing as an outgrowth of practice in a domain of interest. Wenger (1998) explains that a CoP "is not just an aggregate of people defined by some characteristic"

(p. 74), but a relationship comprising three elements: the domain of knowledge, a community of people, and a shared practice (Wenger et al., 2002). “The domain of knowledge defines a set of issues, a community of people who care about this domain, and the shared practice that they are developing to be effective in their domain” (p. 27). The tacit and explicit means by which people gain knowledge in a CoP can include storytelling, conversations, coaching, and apprenticeship (Lave, 1991, 1996; Lave & Wenger, 1991; Wenger, 1998; Wenger, McDermott, & Snyder, 2002).

Learning is both defined and driven by changing participation and identity transformation in a community of practice, which is what Lave (1991, 1996) and Lave and Wenger (1991) refer to as legitimate peripheral participation. One’s changing participation in a CoP, Wenger et al. (2002) assert, can be described in terms of four levels of participation: full participation as a member of the "Core Group"; partial participation as an “Active” member, whose participation increases and decreases based on the topic under consideration and the relevance it has to the individual's work; "peripheral” participation; and "outsider" status, which entails remaining on the margins.

The Four Components of the Theory of CoP. In order to understand fully how learning and knowing affect participation and construction of identity and vice versa, Lave and Wenger (1991) and Wenger (1998) break the theory down into four basic components and explore the ways in which these basic components of meaning, practice, identity, and community interact with each another.

> Meaning is a way of talking about our (changing) ability—individually and collectively—to experience our life and the world as meaningful. Practice is a

> way of talking about the shared historical and social resources, frameworks, and perspectives that can sustain mutual engagement in action. Community is a way of talking about the social configuration in which our enterprises are defined as worth pursuing and our participation is recognizable as competence. Identity is a way of talking about how learning changes who we are and creates personal histories of becoming in the context of our communities (Wenger, 1998, p. 5)

Meaning. The component of meaning represents more than just "a relation between a sign and a referent" (Wenger, 1998, p. 51). Rather, meaning, in Wenger's term, is a process and denotes how people come to agree upon what something represents. Wenger argues that the process of meaning-making is social. It is simultaneously an individual and a collective experience. Meaning can be thought of as having three features: negotiation, participation, and reification. In this theory, the process of negotiation takes on central importance not only for Wenger's concept of meaning-making but also for the other components of the theory: the concepts of community, identity, and practice. Wenger points out that negotiation conveys "a flavor of continuous interaction, of gradual achievement, and of give-and-take. By living in the world we do not just make meanings up independently of the world, but neither does the world simply impose meaning on us" (Wenger, 1998, pp. 53-54). Through this give-and-take, people work things out and find ways to engage in activities that bring value to their lives. This negotiation affects the things people agree to do, which the CoP framework refers to as practice, and the people they interact with, which the framework calls community, and ultimately the sort of person

that results from these interactions, which the CoP framework refers to as identity. With regard to the CoP concept of meaning-making in a community of practice, Wenger (1998) asserts that meaning comes about through humans interacting in a social context with other humans. There is a historical aspect to meaning-making; the meaning bestowed on something is never set in stone; it is subject to interpretation and reinterpretation, even if the setting and people appear to replicate an earlier encounter; the current situation will likewise be subject to reinterpretation.

The second and third features of the components of meaning are the duality of participation and reification. Wenger (1998) suggests that participation and reification are important because they have a powerful influence on guiding interpretations in a CoP. The CoP conceptions of participation and reification take into account the situational context of relating to others in an enterprise. The following excerpts suggest how Wenger (1998) distinguishes the concepts of participation and reification in the CoP framework from the everyday use of the terms:

> I will use the term participation to describe the social experience of living in the world in terms of membership in social communities and active involvement in social enterprises. Participation in this sense is both personal and social. It is a complex process that combines doing, talking, thinking, feeling, and belonging. It involves our whole person, including our bodies, minds, emotions, and social relations (pp. 55-56).

Wenger goes on to explain that "any community of practice produces abstractions, tools, symbols, stories, terms, and concepts that reify something of that practice in a congealed form . . . [yet] no abstraction, tool, or symbol actually captures in its form

the practices in the context of which it contributes to an experience of meaning" (p. 59). The interrelated aspects of participation and reification often go unnoticed. Wenger (1998) asserts that this is because the interplay of the two features remains largely unproblematic. He emphasizes this point through a discussion of the use of language in face-to-face interactions:

> In face-to-face interactions, however, speech is extremely evanescent; words affect the negotiation of meaning through a process that seems like pure participation. As a consequence, words can take advantage of shared participation among interlocutors to create shortcuts to communication. It is this tight interweaving of reification and participation that makes conversation such a powerful form of communication (p. 62).

Therefore, these features of participation, reification, and negotiation in a community of practice will influence how people associate meaning with their experiences.

Practice and Community. The component of the CoP framework called practice "exists because people are engaged in actions whose meanings they negotiate with one another" (Wenger, 1998, p. 73). "[It] connotes doing, but not just doing in and of itself. It is doing in a historical and social context that gives structure and meaning to what we do. In this sense, practice is always social practice" (Wenger, 1998, p. 47). Consequently it is imperative that any discussion of the CoP concept of practice take into account the role of community. In fact, any attempt to discuss individual components of the theory in discrete sections of a discussion is artificial and limiting because the theory is based on the simultaneous interaction of the

components. Nonetheless, the complexity of the theory warrants careful inspection of its parts.

Wenger (1998) accounts for the interrelation between practice and community by clarifying that practices function as mechanisms for the social cohesion that sustains social configurations of communities of practice. Cohesion occurs when participants are mutually engaged, there is negotiation of a joint enterprise, and the participants develop a shared repertoire. These characteristics of cohesion are the three dimensions of practice as the property of a community (Wenger, 1998).

Mutual Engagement. The concept of mutual engagement rests on the idea that "practice does not exist in the abstract. It exists because people are engaged in actions whose meanings they negotiate with one another . . . Practice resides in a community of people and the relations of mutual engagement by which they can do whatever they do" (Wenger, 1998, p. 73). Wenger continues, "Mutual engagement involves being included in what matters because engagement defines belonging" (p. 74). "Each participant in a CoP finds a unique place and gains a unique identity, which is both further integrated and further defined in the course of engagement in practice" (p. 76).

Joint Enterprise. Wenger (1998) explains that a CoP is kept together if it has three features, referred to above as the three characteristics of cohesion and the dimensions of practice: 1) it is the result of a collective process of negotiation that reflects the full complexity of mutual engagement; 2) it is defined by the participants in the very process of pursuing it; 3) it is not just a stated goal, but creates among

participants relations of mutual accountability that become an integral part of the practice (pp. 77-78).

Wenger (1998) asserts that the aspect of practice that is negotiated relates to the complexities of one's enterprises, which

> [1.] Include the instrumental, the personal, and the interpersonal aspects of our lives . . . the aspect of the component of practice that deals with sharing emerges from the idea that communities of practice are not self-contained entities. They develop in larger contexts—historical, social, cultural, and institutional—with specific resources and constraints (p. 78).
>
> [2.] It is only as negotiated by the community that conditions, resources and demands shape the practice. . . . Because members produce a practice to deal with what they understand to be their enterprise, their practice as it unfolds belongs to their community in a fundamental sense. Negotiating a joint enterprise gives rise to relations of mutual accountability among those involved (p. 80).
>
> [3.] While some aspects of accountability may be reified—rules, policies, standards, goals—those that are not are no less significant. Becoming good at something involves developing specialized sensitivities, an aesthetic sense, and refined perceptions that are brought to bear on making judgments about the qualities of a product or an action (p. 81).

> [4.] Being able to make distinctions between reified standards and competent engagement in practice is an important aspect of becoming an experienced member (p. 82).

Shared Repertoire. Shared repertoire, as the third characteristic of practice, involves the idea that over time, the joint pursuit of an enterprise creates resources for negotiating meaning . . . [The resources] gain their coherence not in and of themselves as specific activities, symbols, or artifacts, but from the fact that they belong to the practice of a community pursuing an enterprise (p. 82).

In the following paragraph, Wenger (1998) explains the complex array of things that can fall under the category of shared repertoire:

> The repertoire of a community of practice includes routines, words, tools, ways of doing things, stories, gestures, symbols, genres, actions, or concepts that the community has produced or adopted in the course of its existence, and which have become a part of it. The repertoire combines both reificative and participative aspects. It includes the discourse by which members create meaningful statements about the world, as well as the styles by which they express their forms of membership and their identities as members (p. 83).

Wenger (1998) explains the interrelatedness of the components of practice and community and elaborates on the ways that this interrelatedness results from the histories of learning that communities of practice share. The following excerpt describes how the process unfolds:

> Over time, such histories create discontinuities between those who have been participating and those who have not. These discontinuities are revealed by the learning involved in crossing them: moving from one community of practice to another can demand quite a transformation. But practice does not create only boundaries. At the same time as boundaries form, communities of practice develop ways of maintaining connections with the rest of the world (p. 103).

Wenger (1998) explains that the CoP concept of boundaries provides a way to describe aspects of practices that decide whom and what to include and what and whom to exclude from practice.

Boundaries may be viewed as characteristics of practices associated with a particular enterprise. Sometimes there are markers such as titles and degrees that identify boundaries, but that is not necessarily the case. People are generally able to recognize membership in the absence of reified markers such as titles or uniforms by observing other characteristics, or boundaries in CoP terms. Wenger (1998) uses the example of social cliques in a playground to illustrate how people notice social markers that define boundaries to practice, even when there are no official markers. Ways of speaking, dressing, and behaving can serve as markers because they convey membership that is detectable both to people inside and to those outside of the cliques. Wenger's point that people who are outside can interpret the boundaries relates to how any practice functions in the world.

That practices function in the world means that communities of practice must be looked at in relation to other social configurations, only some of which may fit Wenger's concept of a community of practice. "Their [CoP] members and their

artifacts are not theirs alone. Their histories are not just internal; they are histories of articulation with the rest of the world" (p. 103). This shared history creates opportunities for interaction. The reification characteristic of a boundary means that some objects, such as a job title, that are specific to one practice may have the same or different meanings in another practice. Nonetheless, the concept of boundary that Wenger (1998) describes explains the shortcuts that people use to convey the range from participation to non-participation that a person may have in relation to a community of practice. The concept helps illuminate how people recognize membership, and it offers a way to understand how people are able to participate in multiple communities of practice at the same time.

Identity. The Community of Practice theory uses the concept of identity to represent the fourth component of the framework. The use of the term goes beyond its conventional reference to one's personal characteristics and presentation. It refers to more than just how we see ourselves or how others see us. Wenger (1998) uses the concept of identity in reference to a way of being in the world. The following paragraph offers a explicates Wenger's (1998) use of the term:

> Identity brings to the fore the issues of nonparticipation as well as participation, and of exclusion as well as inclusion. Our identity includes our ability and our inability to shape the meanings that define our communities and our forms of belonging. . . . Building an identity consists of negotiating the meanings of our experience of membership in social communities. The concept of identity serves as a pivot between the social and the individual, so that each

> can be talked about in terms of the other . . . it is the social, the cultural, the historical with a human face (p. 145).

Wenger (1998) asserts that practices, languages, artifacts, and worldviews are all influenced by and a reflection of social relations. The concept of identity in the CoP framework therefore brings together the personal and the social:

> Even our most private thoughts make use of concepts, images, and perspectives that we understand through our participation in social communities . . . The notions of individual and community are reifications whose self-contained appearance hides their mutual constitution. We cannot become human by ourselves; hence a reified, physiologically based notion of individuality misses the interconnectedness of identity. Conversely, membership does not determine who we are in any simple way, hence generalizations and stereotypes miss the lived complexity of identity (p. 146).

In addition to the interpersonal aspects of identity, Wenger (1989) explores the power dynamics of relationships and the ways that these dynamics facilitate or inhibit access to participation in communities of practice. Wenger (1998) argues that "our identities, even in the context of a specific practice, are not just a matter internal to that practice but also a matter of our position and the position of our communities within broader social structures" (p. 148). The degree to which someone is engaged in practice associated with a particular community of practice will lead to marked changes in the person's identity. Wenger (1998) explains,

> There is a profound connection between identity and practice. Developing a practice requires the formation of a community whose members can engage with one another and thus acknowledge each other as participants. As a consequence, practice entails the negotiation of ways of being a person in that context. This negotiation may be silent; participants may not necessarily talk directly about the issue. But whether or not they address the question directly, they deal with it through the way they engage in action with one another and relate to one another. Inevitably, our practices deal with the profound issue of how to be a human being. In this sense, the formation of a community of practice is also the negotiation of identities (p. 149).

Wenger (1998) summarizes as follows the process by which practice changes identity:

> [Identity] is a layering of events of participation and reification by which our experience and its social interpretation inform each other. As we encounter our effects on the world and develop our relations with others, these layers build upon each other to produce our identity as a very complex interweaving of participative experience and reificative projections. Bringing the two together through the negotiation of meaning, we construct who we are. In the same way that meaning exists in its negotiation, identity exists—not as an object in and of itself—but in the constant work of negotiating the self. It is in this cascading interplay of participation and reification that our experience of life becomes one identity, and indeed of human existence and consciousness (p. 151).

Wenger outlines three dimensions of identity in a community of practice: the mutuality of engagement, which refers to competence in engagement with others in the CoP; accountability to an enterprise, which refers to the way that connections with the enterprise alter the way participants view the world, even during moments when they are not engaged in the practice; and negotiability of a repertoire, which refers to the ability to understand and make use of the repertoire of that practice. Wenger (1998) asserts:

> Membership in a community of practice translates into an identity as a form of competence . . .We experience and manifest our selves by what we recognize and what we don't, what we grasp immediately and what we can't interpret, what we can appropriate and what alienates us, what we can press into service and what we can't use, what we can negotiate and what remains out of reach. In practice, we know who we are by what is familiar, understandable, usable, negotiable, we know who we are not by what is foreign, opaque, unwieldy, unproductive (p. 153).

He argues that identity in practice arises out of the interplay of participation and reification so that identity is not an object but a constant becoming.

In conclusion, the theory of Community of Practice began with Lave's (1991) seminal research on learning in traditional cultures and developed into a robust analytical tool for research on contemporary social phenomena. The power of the theory lies in the reconceptualization of learning: of learners in relation to teachers, and of teaching in relation to instruction. In the theory, learning is regarded as a natural outcome of social interaction and is defined by the ways in which identity

construction is affected and facilitated by participation in enterprise-specific practices. The framework comprises four main components: identity, practice, meaning, and community:

> Meaning is a way of talking about our (changing) ability—individually and collectively—to experience our life and the world as meaningful. Practice is a way of talking about the shared historical and social resources, frameworks, and perspectives that can sustain mutual engagement in action. Community is a way of talking about the social configuration in which our enterprises are defined as worth pursuing and our participation is recognizable as competence. Identity is a way of talking about how learning changes who we are and creates personal histories of becoming in the context of our communities (Wenger, 1998, p. 5)

These interrelated components comprise learning and represent a pattern of motion.

Critical Race Theory (CRT)

In this section, I will review some of the theoretical and practical applications of CRT that relate to the context of black students' participation in the field of environmental sciences. For black students, the institutional and perceived barriers to entering the environmental sciences are exacerbated by the legacy of racism that continues to operate, although undetectable to most non-minority people, in the laws and policies that guide practices in housing, education, and employment. Delgado and Stefancic (2001) describe the origins and features of CRT. It emerged in the mid-1970s from the early scholarship of Derrick Bell and Alan Freeman in Critical Legal Studies, which primarily critiqued the "legal positivist" doctrine and pedagogy espoused by law schools. Adopted by university scholars to explore other societal issues, CRT developed into a theoretical framework that has given rise to further specialized theories—Latino Critical Theory and Queer Critical Theory, to name only two (Delgado & Stefancic, 2001).

> Critical Race Theory has two basic tenets:
>
> First, that racism is ordinary, not aberrational but—"normal science," the usual way society does business, the common, everyday experience of most people of color in this country. Second, most would agree that our system of white-over-color ascendancy serves important purposes, both psychic and material (Chapter 1, Section 7, para. 5).

CRT provides a framework for exploring the role of power in contemporary race relations in the U.S. and the barriers encountered by black students in U.S. educational institutions. It can also specifically help explain some of the psychological and social

barriers that black undergraduates encounter in joining an academic community such as that formed by students pursuing the study of the environmental sciences (Solorzano, 1998). Delgado and Stefancic (2001) argue that the daily messages and insults, called microaggressions—stated or implied—that students receive convey a preference for the white race and undermine students' confidence. CRT recognizes the validity of narrative and storytelling to reveal the ways in which race influences many practices of the legal/judicial and educational systems.

Ladson-Billings (1999) charges that the concept of multicultural education (Banks, 1996) merely pays lip service to diversity of race, ethnicity, and national origin, and fails to address the deep-seated social problems that originate in America's history of racism. CRT, she asserts, offers a more comprehensive framework than multiculturalism for studying the role of race in education because it uncovers the attitudes, beliefs, and behaviors that influence laws and policies, as well as practices and education budgets, rather than simply acknowledging cultural aspects of race. Ladson-Billings (1994) argues that racism is often undetectable to most people because it is "so enmeshed in the fabric of our social order [that] it appears both normal and natural to people in this culture" (pp. 212–213). An application of the framework of CRT to the low participation rates of blacks in the environmental sciences is appropriate because even if laws of segregation that prevented blacks and whites from going to school together no longer exist, the legacy of institutional racism continues to create barriers to blacks' entering some fields.

In the following excerpt, Ladson-Billings (2011) recounts her use of CRT to explore the consequences of the environmental impact of Hurricane Katrina in the lower Ninth Ward of New Orleans, a predominantly black area:

> In late August 2005, the U.S. Gulf Coast was hit by a catastrophic hurricane that the world came to know as "Katrina." The horror of the event and the even more horrific response of the local, state, and federal governments provided me with a way to push a new conceptualization of achievement and school inequity. Instead of talking about an achievement gap, I introduced the concept of the "education debt." The thrust of my argument was not that African-American (and Latino) students needed to "catch up" with White students, but, rather, that a debt had been incurred by the historic, economic, socio-political, and moral inequities that had been allowed to persist since the founding of the nation. It was not African Americans (and other groups of color) who were at fault and needed to run faster, but, rather, it was the collective responsibility of the nation to pay back the groups that had been systematically excluded from the promise of democracy through a quality education (p. 1453).

In the following excerpt, Ladson-Billings and Tate (1995) explain how racism is "endemic and deeply ingrained in American Life":

> If racism were merely isolated, unrelated, individual acts, we would expect to see at least a few examples of educational excellence and equity together in the nation's public schools. Instead, those places where African Americans do experience educational success tend to be outside of the public schools. While some might argue that poor children, regardless of race, do worse in school,

> and that the high proportion of African-American poor contributes to their dismal school performance, we argue that the cause of their poverty in conjunction with the condition of their schools and schooling is institutional and structural racism. Thus, when we speak of racism we refer to Wellman's definition of "culturally sanctioned beliefs which, regardless of the intentions involved, defend the advantages Whites have because of the subordinated positions of racial minorities (p. 55)

Ladson-Billings and Tate (1995) point out that "today, students of color are more segregated than ever before" (p. 55). This statement suggests that the residential college experience provides the first opportunity for many students to live and study with people who do not share their racial and economic background.

Stereotype Threat

The theory of Stereotype Threat (Aronson & Steele, 2005; Steele, 2003) offers an explanation for the academic underachievement of otherwise academically prepared black youth. Stereotype Threat is "the threat of being viewed through the lens of a negative stereotype, or the fear of doing something that would inadvertently confirm that stereotype" (Steele 2003, p.111). Steele (2003) explains that everyone is susceptible to this psychological response and that the response is a result of caring about the issue or domain in question, but a good deal of his research has been devoted to showing how black students respond to the activation of a stereotype threat and how the presence of stereotype threat inhibits high academic performance. The following excerpts from Steele (2003) lay out the logical argument of his theory:

> But virtually all aspects of underperformance—lower standardized test scores, lower college grades, lower graduate rates—persist among students from the African American middle class. This situation forced on us an uncomfortable recognition: that beyond class, something racial is depressing the academic performance of these students (p. 111).
>
> Such, then, is the hypothesized nature of stereotype threat—not an abstract threat, not necessarily a belief or expectation about oneself, but the concrete, real-time threat of being judged and treated poorly in a setting where a negative stereotype about one's group applies (p. 112).

Steele (2003) describes a series of experiments that recognized the existence of a performance-driven response in black students that inhibited high academic performance on a series of verbal tests. Based on the widely known negative

stereotype associated with black Americans' intellectual abilities, Steele (2003) documented that black students scored a full standard deviation below whites when the black students were informed that the test was a measure of intelligence, thereby activating the stereotype response. Black subjects who were told that the test was not a measure of intellect performed on par with their white counterparts of comparable ability level, and this pattern of outcomes was replicated by researchers exploring stereotype threat in other domains. Steele (2003) describes several factors that influence the stimulation of stereotype threat. They include: the emotions of frustration and distrust, acute reactions and chronic adaptations, such as disidentification, and successful remedial efforts such as the establishment of identity safety, which Steele (2003) suggests may be attained through three

> strategies at the level of: 1) pedagogy and relationships between individual teachers and students; 2) institutional and contextual changes; and 3) individual personal responses (p. 125).

According to Steele (2003), "the experience of frustration with the test gives credibility to the limitation alleged in the stereotype. For this reason, frustration can be especially stinging and disruptive for test-takers to whom the stereotype is relevant" (pp. 113–114).

> The success of Black students may depend less on expectations and motivation—things that are thought to drive academic performance—than on trust that stereotypes about their group will not have a limiting effect on their school world (p. 122).

Steele (2003) explains that dispelling the impression that an assessment will be made based on race could reduce stereotype threat, which, he maintains, is as simple as demonstrating that a test is racially fair. The following excerpt describes the phenomenon:

> When strong Black students sit down to take a difficult standardized test, the extra apprehension they feel in comparison with whites is less about their own ability than it is about having to perform in a test and in a situation that may be primed to treat them stereotypically. We discovered the extent of this apprehension when we tried to develop procedures that would make our Black participants see the test as "race fair" . . . We were able to convince them that our test was race-fair only when we implied that the research generating the test had been done by Blacks. When they felt trust, they performed well, regardless of whether we had wakened their self-confidence beforehand. When they didn't feel trust, no amount of bolstering of self-confidence helped (p. 123).

Steele explains some of the psychological responses people have to their encounters with stereotype threat. The following excerpt clearly makes the connection between the psychological response and other behaviors that are negatively associated with high academic achievement and retention in the sciences:

> First, people's reactions to stereotype threat include both acute protective reactions and chronic identity adaptations, and second, these reactions are remarkably nuanced, in the sense of taking many concrete forms . . . The range of reactions—from avoidance, to counter-stereotypic behavior, to

> disengagement, to full disidentification—form a continuum of psychological responses, just now being studied in a rigorous way with controlled experiments. . . . Having a social identity that can elicit devaluation in a setting that one wants to belong to causes conflicting motivations . . . One becomes sensitive to the very things one least wants to see. The resulting ruminative conflict coupled with the threat of devaluation in the setting stand as ongoing pressures against, at the very least, a full engagement in the setting, and at the most, the ability to endure it at all (Steele, 2003, p. 124).
>
> Policies for helping Black students rest in significant part on assumptions about their psychology. Often they are assumed to lack confidence, which spawns a policy of confidence-building. This may be useful for some students. But the psychology of many others, including the best-prepared and most committed students, appears different—underperformance appears to be rooted less in self-doubt than in social mistrust (p. 124).

Steele (2003) explains the role of a remedial strategy he calls identity safety, which allows one to excel in the settings in which one encounters stereotype threat. According to Steele (2003) "despite the many cues in a setting that can evoke a sense of threat, therefore, a remedial strategy has to somehow refute that threat or its relevance to the target . . . To the extent that it is achieved in an academic setting, it should weaken the sequelae of identity vigilance, mistrust, disidentification, and

underperformance. So it follows that education policy relevant to non-Asian minorities might fruitfully shift its focus toward fostering identify safety . . . (p. 125).

Steele (2003) explains that identity safely is not a matter of just "being nice." He provides the following guidance for faculty to help them to deliver critical feedback across the racial divide:

> Tell the students that you are using high standards (this signals that the critique reflects standards rather than race), and that your reading of their essays leads you to believe that they can meet those standards (this signals that you do not view them stereotypically) (p. 126).

Stereotype Threat provides a way to identify certain behaviors that faculty, especially white faculty, can practice to make black students feel that they will not be judged based on a negative stereotype. Some questions about black students' performance in the sciences that remain are: Does a history of legal exclusion and discrimination, coupled with the threat that one may be negatively judged because of one's race, undermine the formation of productive interracial peer and faculty interactions involving black undergraduates pursuing the field of environmental sciences in U.S. colleges and universities? Can CRT and ST provide a way to analyze the stories that the volunteers in this study have been told by family, friends, teachers, et al. about the environmental sciences and related topics? A CRT perspective would explore the role that residential patterns, personal finances, and stereotypes play in preventing black youth from being exposed to the environmental sciences.

CHAPTER 3
METHODOLOGY

Research Design

Informed by the Community of Practice model, this study was designed to explore the following questions: What motivates students to enroll in an introductory course in the environmental sciences or studies? To what degree do various activities and ways of thinking that students encounter in these courses engage them in the environmental sciences? To what extent do the students develop relationships that enhance their interest in and understanding of the material? What internal and/or external obstacles prevent some students from participating in practices and taking advantage of interpersonal relationships associated with the community of practice constituted by people who study environmental sciences?

Data Collection

My interest in questions related to learning in the environmental sciences and the perspectives of undergraduates enrolled at a residential liberal arts college necessitated a naturalistic study. The theory of Community of Practice (Lave, 1991, 1996; Lave & Wenger, 1991; Wenger, 1998), a social theory of learning, provided a lens through which I planned to analyze the participants' experiences and changing perspectives. I reasoned that quantitative and other methods of inquiry would reduce the students' experiences to inputs and outputs. I wanted to focus primarily on the paths taken and the ways the students described their encounters with the discipline, rather than on outcomes, such as declaring a major or finding a career in the environmental sciences, although I regarded those outcomes as important as well. I

wanted to understand whether there were aspects of the social context of learning in the environmental sciences that provided opportunities for, or barriers to, undergraduates, especially black undergraduates. Therefore it was imperative that I design the study to gather the types of insights that would allow me to locate experiences related to Lave's (1991, 1996), Lave and Wenger's (1991), and Wenger's (1998) concepts of *meaning*, *practice*, *community*, and *identity*.

This study's particular focus on understanding experiences with the environmental sciences described by black students made it imperative that I review other key concepts that would help to illuminate issues of race. The concepts of Critical Race Theory (Delgado & Stefancic, 2001; Ladson-Billings, 1994, 1999, 2001; Ladson-Billings & Tate, 1995; Solorzano, 1998) and Stereotype Threat (Steele & Aronson, 1995; Cohen, Steele, & Ross, 1999; and Steele, 1997, 2003, 2010) offered useful perspectives. These concepts suggested ways to examine the implications of messages that discourage black students from participating in the environmental sciences. The naturalistic methodology of the study—which involved observation of some students in the introductory courses during lectures and field trips and transcriptions of interviews with volunteers in which they described their experiences with the environmental sciences—allowed me to contextualize the study in the daily lives of the volunteers. An alternative methodology would have required controlling for the multiple variables that influenced students' experiences, which would have limited my ability to explore how different experiences affected the construction of an identity associated with the environmental sciences, especially if participation in the environmental sciences contradicted the pattern of degree attainment by blacks found

in the national data. Although not true case studies, the interviews and observations I assembled about the students allowed me to draw on insights provided by Critical Race Theory that legitimize narratives and story-telling as forms of data. Such sources are especially valuable in research intended to determine whether institutional barriers exist.

The qualitative interview of the type I chose to conduct is sometimes referred to as an unstructured or nonstandarized interview. Kvale and Brinkmann (2009) point out, however, that unlike ordinary conversations people have in the course of their daily lives, this type of interview for research purposes does have structure and purpose. The researcher guides the interview through careful questioning and listening, while keeping the purpose in mind (Kvale & Brinkmann, 2009).

The knowledge produced by such research depends on the social relationship of interviewer and interviewee, which rests on the interviewer's ability to create a stage where the participants feel free and safe to talk of private events, knowing that what they share is being recorded for later public use (Kvale & Brinkmann, 2009, p. 160).

The fact that I worked at the institution where the interviewees were enrolled imposed some special considerations. Some aspects of this situation were concerns, while others pointed to potential benefits that arose from my association with the institution. Although approval to conduct the study was granted by the institution where the study was conducted, thereby assuring a high level of protection for the interviewees, I took special care to avoid exerting pressure on students to participate in the study, and I took steps to minimize exposing the identity of the institution and the faculty and students who agreed to participate. These concerns were addressed as

follows: 1) I reminded the volunteers during the interviews that they were not required to participate and were free to terminate participation at any time; 2) I committed not disclose keep the name of the institution (henceforth referred to as Hillcrest University); and 3) I assured the faculty and students involved that I would use pseudonyms.

My association with the institution not only raised concerns that were directly addressed; it also provided certain advantages. As an employee of the institution, I had access to information that a researcher with a more distant association might not have had. After almost two decades of employment, I was deeply familiar with the culture of the institution, with its faculty, and with the characteristics of the student body, and was well aware of the general commitment that some faculty in the sciences had to increasing the participation of underrepresented minorities and women in the institution's science programs. This knowledge helped guide the development of the research, informing the interview questions and the follow-up discussions. Additionally, I was familiar with aspects of earlier and current strategies that the institution had employed to retain minorities and women in the sciences, and the degree to which these efforts were changing the demographics of the students choosing to major in the environmental sciences. Having this overall background knowledge was instrumental in drawing my attention to relevant issues that students introduced during the course of the interviews.

My decision to conduct interviews was informed by several facts. First, I was aware that students at the institution were bombarded by surveys. I chose to invite students to participate in interviews partly because of my familiarity with the culture

of the school and my awareness of the likelihood that I would generate a sample adequate in size for a qualitative study.

Another reason for my choosing a qualitative interview methodology that could yield results from a small sample was my uncertainty as to whether I could generate a representative sample of the student body or of a national population. Ideally in quantitative studies, one seeks to assemble a representative sample as a dataset so that the findings may be generalizable across a range of contexts. It was clear to me that I would be unable to make general claims about the findings because the interviews drew on deeply subjective experiences of a select group of students attending a moderate-sized liberal arts college. Nevertheless, I hoped that my findings about the experiences the volunteers shared about their participation in the environmental sciences could help other researchers and institutions in thinking about the experiences of their own students.

The research sample comprised undergraduate volunteers recruited from two sections of each of the two introductory courses. Three of the instructors introduced me at the beginning of the semester, and I used a prepared script (Appendix A) to invite students to participate in the study, which was described as an exploration of students' experiences in an introductory environmental science course (offered in the spring semester) or an introductory environmental studies course (offered in the fall semester). I received a total of 28 volunteers from the four sections, but I was concerned about maintaining a manageable sample size in order to conduct the interviews and analyze the data adequately, so I decided to limit my sample to 15 volunteers. Since I was particularly interested in learning about the experiences that

black students described, I accepted as volunteers the first 15 undergraduates who represented the racial characteristics I was looking for. That resulted in my accepting all the black students who wanted to participate and including several white females. Some of the students who volunteered to participate were enrolled in an introductory environmental science course during the semester in which I conducted their interviews, while others had taken one of the introductory courses in an earlier semester.

In the interviews I attempted to discover the extent to which the students might already be participants in the environmental sciences (as indicated, for example, by their having taken Advanced Placement environmental science in high school, or by their participating in informal or formal enrichment activities associated with the environmental sciences). Other students had begun to learn about the environmental sciences/studies only since arriving at college and began as marginal participants at best. Through open-ended questions I tried to ascertain the discipline-specific activities, or *practices* in CoP terms (Lave, 1991, 1996; Lave & Wenger, 1996; Wenger, 1998) that were associated with their participation in the environmental sciences, and whether they were engaging in a social context through co-curricular activities, study groups, and interactions with faculty that provided opportunities for them to participate in peripheral ways through educational outreach, research, and discussions about environmental issues.

Appendix A contains the script I used to introduce the topic of the research and to invite students to participate. Appendix B contains the questions that I used to guide the semi-structured interviews. The resources needed for this study were minimal, and

I did not provide incentives to anyone who volunteered to participate in the study. I recorded the interviews using a digital audio device and kept my field notes in a small notebook and on my computer.

In addition to interviewing the sample of 15 students who volunteered to participate, I sat in on several meetings of the courses. I recognized that the availability of a second source of information, i.e., observations—like that used by Howard et al. (1996) to explore college students' participation in a sociology course—would help me contextualize the interview data and bring greater clarity to my findings. I also conducted a pilot study. In the spring and fall of 2012, I observed several aspects of three sections of the introduction to environmental science and introduction to environmental studies courses, in preparation for research approval from my dissertation committee and the Institutional Review Boards associated with Rhode Island College and the college where the study was conducted. My field notes from those observations helped me notice differences and similarities between the courses that included variations in the syllabus and in pedagogy. While I was not authorized to conduct any interviews prior to the spring of 2013, this process helped me become better acquainted with the subject matter, professors, and students associated with the environmental sciences/studies at the institution. While awaiting approval to collect data, I also became acquainted with the professor and some of the students who had completed the fall 2011 introductory course in environmental studies. By the time I completed the revisions of my research proposal and received the necessary approvals, I had the 28 volunteers from whom I then selected the participants.

The professors who taught the courses that I studied changed from year to year. Since I had several volunteers who had participated in an earlier iteration of the course that I did not have the opportunity to observe through the pilot study, I met with the instructor of that course to discuss the professor's general approach to the topic and pedagogical style.

In the case of the other participants, my analysis of their experiences takes into account information I acquired from the syllabi and from my observations of students in class. While I was not conducting a true ethnographic study, my observations, which in one case included two field trips, enhanced my familiarity with the course content, the professors, and participants.

Description of the Participants

The interviews involved a group of 15 volunteers, drawn from two years' offerings of the introductory environmental science/studies courses, or two iterations of the introduction to environmental *studies* (designated as A) and two iterations of the introduction to environmental *sciences* (designated as B). Each participant was exposed to the course format and pedagogical style of one of four different professors (referred to as Professors W, X, Y, and Z). With the consent of the volunteers, I often exceeded the limit (10–15 minutes) that I had predetermined to be the duration of each interview, or conducted follow-up interviews with participants whose initial responses suggested that their experiences would provide deeper insight into the research questions. The knowledge gained from what these students told me about their experiences in the courses has implications for understanding the participation of black students in scientific research. It is to be hoped that this understanding can

make a modest contribution to remedying the serious national problem of underrepresentation of racial minorities, especially blacks, in the sciences.

Limitations

The qualitative approach I used has potential weaknesses as well as strengths. The size of the group I selected to interview (n=15) is small compared to the sample for almost any quantitative study. Working with this small number of subjects, however, allowed for a deeper inquiry into the students' journey, or *trajectory* in CoP terms, and into their own interpretation of the opportunities and barriers they saw as affecting their success in environmental sciences, barriers for whose interpretation the concepts provided by CRT and ST proved useful. I contextualized the insights gained from my qualitative study by consulting large federal and institutional data sources.

My pilot study gave me a familiarity with the setting and activities associated with the courses, a familiarity that constitutes a strength of my research: in the interviews I was able to refer to specific activities, such as lectures, projects, and field trips, in which the students had participated, and thus I was able to guide the students more effectively in reflecting on how these experiences had affected their participation in the environmental sciences. The pilot study also gave me confidence that I would have at least three underrepresented minority students in my study, ensuring a 20 percent minority representation, which I in fact surpassed in the study.

My selection of participants in a way that advantaged black volunteers over white volunteers was another limitation of this study. I accepted all the black students who volunteered to participate and interviewed other volunteers until I achieved the predetermined size of 15. I ended up with a group that included students who had

taken the course at different times in the academic year, although they had all had one of the four professors with whose course format I was familiar. The process by which I selected my sample does not permit generalizing the findings statistically for a given population or setting.

The issue of trustworthiness is another limitation of my study. My analysis is largely based on a few students' responses; there is no guarantee that the students accurately assessed and/or reported their performance in the course (Bowman, 2010). Accordingly, the extent to which they are participating in the CoP of environmental sciences cannot be established with precision. Furthermore, the use of recall to describe behavior sometimes proves unreliable. Bowman (2010) describes how measurement error, social desirability, and the halo effect influence the validity of self-reported assessment data supplied by college students about their learning and development, in contrast to data about student gains that are acquired through longitudinal studies. Bowman (2010) identifies a low correspondence between longitudinal and self- reported gains, suggesting that self-reporting is generally unreliable—a phenomenon that may have affected the information I received from students about their own sense of participation in the community of practice. However, as the study developed, I found that I was less interested in the grades students received on examinations and assignments and more interested in their perception that there were practices (such as acquiring friends in the course) associated with the environmental sciences that they found it easy or difficult to achieve.

The institutional and perceived barriers that students, especially black students, in my study describe shed a strong light on the factors that contribute to the low percentage of black people in the environmental sciences. As Delgado & Stefancic (2001) suggest, the subjective narratives and stories that the students in my study provide are legitimate sources of information. In CRT and ST terms, many of the responses black students shared during the interviews testify to ways they felt their individual racialized identity is read in society, and to the ways that they, as students from underrepresented groups, interpreted their experiences (Delgado & Stefancic, 2001; Perry et al., 2003; Steele, 1997, 2010). Because their perceptions mirror those described in CRT and ST, I assumed honesty and sincerity on the part of the students in the study. Moreover, the students' challenges and the practices encountered in the environmental sciences were exactly what I was trying to establish. What matters at this stage is how well they understood and engaged in practices, concepts, and activities that provided opportunities for them as novices to learn about the environmental sciences. Whether they continue on to become environmental scientists will depend on several additional longer-term factors, including their actual performance in the introductory courses, information I have chosen not to explore.

Another limitation of this study may be my other professional roles at the institution may have influenced students to participate, out of curiosity about this other side of me. While a broader ethnographic study, involving my observing students in multiple spaces and activities, would provide greater insight into their participation in the environmental sciences, I was unable to undertake such a study because my duties as an employee limited the amount of time available to me, as well as my ability to

operate without attracting notice. With regard to risks for students who participated in this study, qualitative research of the sort I conducted poses minimal risk to the participants.

Both the department of environmental sciences, like all disciplines, and the institution where I conducted the study, like all schools, have norms and expectations related to the integration of students' academic and co-curricular experiences. Lave (1991, 1996), Lave and Wenger (1991), and Wenger (1998) would assert that the students I interviewed may have been participating in the community of practice of environmental sciences through reified representations such as the syllabus, readings, and lectures, or, according to Lave (1991, 1996), Lave and Wenger (1991), and Wenger (1998), documents, images, and codified procedures. The students were also participating—or not—in communities of practice through social interactions, such as those with peers during and after lectures, or during discussions with peers in residence halls. They may have been observing sustainability efforts being implemented or disregarded by peers, faculty, administrators, and staff or interacting with student organizations dedicated to environmental advocacy, such as the Sierra Club and the college's student environmental groups. Wenger (1998) regards the context in which such experiences take place as the main venue for learning, more significant than readings and lectures. These implicit relations, as Wenger (1998) would put it, include tacit conventions, subtle cues, and unexpressed rules that shape "not only what we do, but also who we are and how we interpret what we do" (p. 4).

In order to explore the ways in which students in the study picked up on elements essential to their sense of participation in the CoP of the environmental

sciences, I designed this study to elicit their subjective interpretations of their experiences in the environmental sciences. I wanted to discover the messages the students were receiving, both through activities and interactions and through reified representations, about the relevance of environmental issues and the significance of their participation in studying environmental science.

CHAPTER 4
FINDINGS PART I: CONTEXT OF THE STUDY

This chapter describes my observations of the students' visible behavior and interactions during course activities such as lectures and field trips, the students' personal accounts, and documents related to the courses, all of which offered a wealth of information on the students' experiences. Especially noteworthy was the large role students' social interactions with peers and certain faculty members in the environmental sciences seemed to play in motivating students' participation in the introductory courses and in the discipline. Of greatest interest to me were the experiences of black undergraduates who took the courses. Together, the black and white students provided insight into some of the short-term and longer-term relationships and career implications of their participation in the COP of the environmental sciences. Black women's narratives about their relationships with faculty, peers, and family were especially striking when the students described defying assumptions about the typical identity of environmental scientists. Overall, black women in the study were more likely to discuss questions of employment and career than their white female counterparts and to express appreciation for the opportunities provided by faculty members who helped them learn about options in the environmental sciences. The opportunities that the black women described as most meaningful to their learning in the CoP of environmental sciences—work in research labs, attendance at professional conferences, and participation in educational/social gatherings with faculty members and their families—suggested avenues for legitimate

peripheral participation in the field. Given my awareness of the intentional efforts by the faculty in the environmental sciences to diversify the field, I would assert that faculty members are well aware, although most may be unfamiliar with the CoP framework, that rather than simply delivering content through lectures, they should demystify the environmental sciences by engaging the students in meaningful work and informing them about professional and other opportunities associated with the field.

Setting of the Study

I chose to study the introductory courses in environmental sciences at a highly selective liberal arts school with a current minority enrollment of approximately 31 percent, including 7.1 percent black or African-American, and a male/female ratio of approximately 48:52 in 2014 (Hillcrest at a Glance, 2014). The school offers advanced degrees in certain fields, including the natural sciences and mathematics. However, it is primarily a liberal arts college dedicated to educating undergraduates. The courses the students in the study were enrolled in form the gateway to the major in the environmental sciences, but also fulfill distribution requirements. The introductory environmental *studies* course is taught by environmental scientists. Thus, although the course explicitly includes considerations from the social sciences, it is thoroughly grounded in science.

Over the past fifty years, the institution has recruited students representing diverse geographical, racial, and financial backgrounds. The institution prides itself on having a low acceptance rate (less than 20 percent of applicants), a strong acceptance rate for U.S. students of color, a high proportion of students who have taken high-

school biology, chemistry, physics, and mathematics through calculus (85 percent), and a high proportion of students ranked in the top percentages of their high-school classes (82 percent) (Hillcrest University Profile, 2013). The proportion of students who attended public versus other types of schools ranges between 49 and 53 percent.

Description of the Participants

The students in the study represented a range of academic interests (from the natural sciences, to arts and humanities and the social sciences), and of prior exposure to the environmental sciences (in high school several had completed Advanced Placement courses and other advanced study in environmental sciences). Their extracurricular interests, and social activities also varied. Because of my particular interest in interviewing black students, the demographics of the volunteers chosen to participate in the study did not represent the racial or gender composition of the introductory environmental-sciences courses at the institution, the racial and ethnic diversity of the student body, or the demographics in the environmental sciences nationally.

The participants can be described according to their academic profiles, race, gender, and geographic origins as follows:

FIGURE 4.1

PROFILE OF THE RESEARCH PARTICIPANTS

Descriptor	Characteristics of the Participants
Graduation year	*13% (2) from Class of 2014, 33% (5) from Class of 2015, 53% (8) from Class of 2016*
Course distribution	73% (11) introduction to environmental sciences, 27% (4) introduction to environmental studies
Course grades	40% (6) received A or A–, 40% (6) received B+/B/B–, 7% (1) received a C, 13% (2) withdrew from the course
Academic year and semester at time of enrollment	27% (4) enrolled in fall of first year, 58% (8) enrolled in spring of first year, 20% (3) enrolled in spring of sophomore year
Grade distribution by iteration of course	Of A/A– earned, 33% in Iteration A-1 course, 17% in Iteration A-2 course, 50% in Iteration B-2 course. Of B+/B/B– earned, 33% in Iteration B-1 course, 33% in Iteration A-2 course, 33% in Iteration B-2 course; the student who received a C and the 2 students in the study who withdrew from the course were in Iteration B-2
Racial composition of the participants	60% (n=9) black, 40% (n=6) white
Distribution by race in iteration of course	Iteration A-1: 2 blk* females, Iteration B-1: 2 blk females, Iteration B-1: 2 blk females, 1 blk male; Iteration B-2: 1 blk female, 1 blk male, 6 white females
Distribution of subjects by gender	87% (n=13) female, 13% (n=2) male
Distribution of females by race	54% (n=7) of females are black; 46% (n=6) of females are white
International students	2 international students, black & female

**Note: blk = black*

Descriptions of the Courses

According to the departmental web site, the environmental sciences department offers courses in the exploration of the natural world on Earth and on other planets. Course topics range from active volcanoes to climate change to eco-conservation. The major is designed to prepare students for graduate school or to

provide a basis for a variety of careers in the private or public sectors. The departmental web site provides extensive information on specific career possibilities in geology, environmental chemistry, ecology, and planetary geology. Hillcrest also offers both a major and a certificate in environmental studies.

The web site states that in addition to the major program, the department provides a wealth of general-education courses. The department offers five introductory courses, including the introduction to environmental studies and the introduction to the environmental sciences, the courses from which my volunteers were drawn.

Because four different faculty members were teaching the two courses, the descriptions varied to reflect differences in topics, focus, and organization. The introduction to environmental *studies*, the course I designate as A, is always offered in the fall, and the introduction to environmental *sciences*, the course I designate as B, is always offered in the spring. Figure 4.2 outlines the features of the two iterations of each course from which the study participants were drawn.

FIGURE 4.2

FEATURES OF INTRODUCTORY COURSES

	Iteration A-1 Prof W (Fall 2011)	**Iteration B-1 Prof Y (Spring 2012)**	**Iteration A-2 Prof X (Fall 2012)**	**Iteration B-2 Prof Z (Spring 2013)**
Maximum enrollment	50 (35 freshmen, 15 sophomores)	60 (35 freshmen, 25 sophomores)	Section 1: 140 (70 freshmen, 70 sophomores) Section 2: 19 (15 freshmen, 4 sophomores)	80 (40 freshmen, 30 sophomores, 5 non-major juniors, 5 non-major seniors)
Course Readings	on-line readings from textbook and journals and the use of discussion board	on-line readings from textbook and journals and the use of discussion board	on-line readings from textbook and journals and the use of discussion board	on-line readings from textbook and journals and the use of discussion board
Assessment	3 exams, 3 short essays, and a final	3 short field-trip reports and/or op-ed-style environmental articles, in-class small-group work, 3 exams, final, 4 hours of environmentally relevant community service	3 exams, 3 short essays, and a final	2 exams and a final, a final research paper or project (may be done in groups), 2–4 problem sets or writing assignments
Additional features		Extended hours 1 day per week to accommodate field trips and small-group activities	2 sections	Lecture/ discussion; 1-3 optional field trips to workplaces or for collecting samples in the field

Observation of the Courses

The courses in which the students in my study were enrolled were designed to introduce students to the basic principles of *the natural world* from an environmental-studies or an environmental-science perspective. Figure 4.2 shows that there were clear distinctions in the ways the four professors set enrollment size and

characteristics, determined the assessment measures, and designed course activities to reach the course objectives.

During one of the two semesters while I was laying the groundwork for approval of my dissertation proposal, I conducted the previously mentioned pilot study of two courses —Iteration A-2 (Prof X) and Iteration B-1 (Prof Y). After securing approval of the proposal, I was able to undertake observations of Iteration B-2 (Prof Z), as well as collect information about the features of Iteration A-1 from the professor who taught it (Prof W). Personal circumstances that arose during the semester when Iteration A-1 was offered prevented me from including the course in my pilot study.

In the following section, I will describe some of the practices that suggest how the students at Hillcrest were participating in the CoP of environmental sciences. My results are influenced by the pilot study, for which I observed at least three meetings of each course. During the pilot stage and later, while I was observing Iteration B-2 after receiving approval of my proposal, I noted such behaviors as how students used their laptops and telephones, conversed with peers, arrived/departed, chose where they sat, and participated in class.

I. Laptops and Telephones. Although it appeared that many students focused their attention on the professor and the projection screen, I noticed that there were several students whose attention seemed to be directed to their laptops or telephones for purposes unrelated to the course. Several volunteers in the study (Raven, Rowan, and Holly) expressed critical opinions of this phenomenon, stressing that they stated that they did not engage in such behavior. My observation of this pattern of using

electronic devices is illustrated in Figure 4.3. In fact, the occurrence was far more prevalent in all 3 courses than I may have recorded in my field notes.

FIGURE 4.3

FIELD NOTES OF STUDENT ACTIVITIES DURING LECTURES—LAPTOPS AND TELEPHONES

Observation of students during lectures	**Courses, # of day of the course, # of day of research observation**
3 students viewing videos during class. White males	Iteration B-1, students' 3rd lecture out of 25, my 1st day of observations
2 watching video. White males. One of them starts to take notes at 1:20	Iteration B-1, students' 4th lecture out of 25, my 2nd day of observations
1 student on Facebook (race/gender not noted)	Iteration B-1, students' 5th lecture out of 25, my 3rd day of observations
Some students using laptops (notice 2 students on Facebook	Interaction A-2, students' 4th lecture out of 25, my 1st day of observations

II. Peer-to-Peer Discourse During Lectures. Figure 4.4 illustrates my observations of conversations taking place in class while the professor was lecturing or trying to engage the students.

FIGURE 4.4

FIELD NOTES OF STUDENT ACTIVITIES DURING LECTURES—PEER-TO-PEER DISCOURSE

Observation of students during lectures	**Courses, # of day of the course, # of day of research observation**
Question asked about computing the pollutants, I heard a student say "*What? What?"* then someone turned to her, said something, and other students joined in the conversation. I think, or I would like to think, that they helped clarify her confusion right away.	Iteration A-2, students' 4th lecture out of 25, my 1st day of observations

Note: This is an illustration of a practice in which a student requests assistance from a peer, rather than formally asking for help.

III. Patterns of Arrival and Departure During Lectures. Some students seemed to regularly arrive late for lecture, while other students arrived on time. Students appeared to feel comfortable leaving the hall during the lecture, perhaps to purchase coffee, go to the restroom, or engage in other activities. Additional research would be required for me to understand the features and patterns of these behaviors.

FIGURE 4.5
FIELD NOTES OF STUDENT BEHAVIOR DURING LECTURES— PATTERNS OF ARRIVAL AND DEPARTURE

Observation of students during lectures	**Courses, # of day of the course, # of day of research observation**
1:46 PM 3 students go outside, I think maybe to the restroom, 2 return at 1:48 PM, another student leaves, 1:53 PM two students return —1 with a coffee drink	Iteration B-1, students' 3rd lecture out of 25, my 1st day of observations
Asian male arrives late	Iteration B-1, students' 4th lecture out of 25, my 2nd day of observations
Student leaves early 1:45 PM BM Student leaves 1:47 PM WF Student leaves 1:48 PM WM A student leaves the room at 1:57 PM I notice fewer people getting up to leave the room than during earlier meetings.	Iteration B-1, students' 5th day of lecture out of 25, my 3rd day of observations)

Note: BM = Black Male, WF = White Female, WM =White Male

IV. Seating Patterns. Students developed habits of sitting in certain parts of the lecture hall, or made conscious decisions about where they would sit. Examples of the types of seating patterns I noticed are listed in Table 4.6. Several volunteers in the study told me where they sat in the lecture hall. Savannah always sat in the front; Holly and Rowan always sat in the back of the lecture hall. Raven commented on where other people sat.

FIGURE 4.6

FIELD NOTES OF STUDENT ACTIVITIES DURING LECTURES—SEATING PATTERNS

Observation of students during lectures	**Courses, # of day of the course, # of day of research observation**
Seating position: more towards the back	Iteration B-1, students' 4th lecture out of 25, my 2nd day of observations
Notice the group of 4 seated in the back of the room. One has on a hockey sweatshirt.	Iteration B-1, students' 4th lecture out of 25, my 2nd day of observations
Left, back clique (appear to be athletes) continues to sit together	Iteration B-1, students' 5th lecture out of 25, my 3rd day of observations

V. Speaking in Class. The introductory courses that students in my study took did not evaluate students on class participation. However, some students asked and answered questions more than others. Although I attended at least 3 meetings of each course over its 3 months of duration, I was unable to gain sufficient insight into the students' discourse patterns (frequency and speech acts). Additional research would be needed to determine how some students use oral participation to learn about the environmental sciences and whether some students feel "shut out" of this communication. I was unable to collect sufficient data about students' communication with the professors in class (asking and answering questions or making comments) or their communication with their peers about the course material. The last entry of the list, noted by *, is an example of the way that students may employ speech as a practice specific to the environmental sciences. In the example below, I received the impression that the students were having difficulty disengaging from their small-group discussion and that the side discussions they were having were indeed focused on the course material. I noticed that other small groups were having similar difficulty while the professor was trying to bring the class back together.

FIGURE 4.7

FIELD NOTES OF STUDENT ACTIVITIES DURING LECTURES—SPEAKING

Observation of Students During Lectures	**Courses, # of day of the course, # of day of research observation**
White male student speaks first	Iteration B-1, students' 4th lecture out of 25, my 2nd day of observations
2 White female students	Iteration A -2, students' 12th lecture out of 25, my 2nd day of observations
Professor conducted a poll. Students' responses converged around the male in back. The professor concluded the student in the back was correct. Answer: Growth rate of finger nails	Iteration B-2, students' 3rd lecture out of 25, my 2nd day of observations
Observations: No questions; no interruptions for clarification, even though it appeared from the level of student response (audible) that there was actually less certainty.	Iteration, B-2, students' 6th lecture out of 25, my 3rd day of observations
* The group to the left does not appear to refocus on the professor after she returns to the front of the room for instruction. They keep talking among themselves. I hear speech from different groups.	Iteration B-1, students' 4th lecture out of 25, my 2nd day of observations

VI. Field Trips. Time and distance constraints prohibited me from attending the optional field trip offered to the students enrolled in Iteration B-2. The field trip was scheduled to take students to an organic dairy farm in another state, a considerable distance from my place of work and residence. However, I did attend the two field trips that were required of students enrolled in Iteration B-1 because both locations were only a short distance from the campus. The first took the class to the regional wastewater treatment plant, and the second to a park located in a ravine within walking distance. The professor did not attend the tour of the wastewater treatment plant. For the trip to the ravine, the class was divided into small groups of about 15 students, and the professor served as guide. I found it difficult to take detailed notes during the field trips, but I was able to record some of my observations.

The Wastewater Treatment Plant. The students were generally respectful of the tour guides, who were plant employees. The professor had given the students a

worksheet with a set of questions to answer, and I gained the impression that they confined themselves to posing questions to the tour guides that would help them answer the questions on the worksheet. A few students seemed to be friends and tended to stay together during the walking tour. They talked and joked with each other, but never to the point where it seemed they were not paying attention to the tour guide or were disruptive.

The Ravine. The ravine tour took place on a particularly pleasant day in April. Consistent with the format of the wastewater treatment tour, the professor gave the students a worksheet to complete. The professor instructed the class to look for dead wood and notice how insects, fungi, and bacteria were decomposing it. Features of the streams, animal tracks, and plants were called to the students' attention. The students on this field trip seemed more engaged than the students who traveled to the wastewater treatment plant. As the professor picked up samples of wood or broke off pieces of branches to examine them under a magnifying glass, the students clustered around to get samples for themselves, which they looked at through the magnifying glasses the professor had distributed for them to share. They inspected the samples and wrote their observations on their worksheets. I did not notice students clustered in friendship groups.

The courses from which I drew my research volunteers had several things in common. First, although two iterations were designated as an introduction to environmental science and two as an introduction to environmental studies, all four were grounded in natural science and all four paid attention to such social-science concerns as public policy and human relationships to the natural environment. Second,

all the courses had large enrollments (between 80 and 150 students) and were conducted primarily in lecture format. Third, these courses were taught by faculty engaged in research in the environmental sciences, three of whom were tenured. The differences between these courses, besides the differing emphasis on the natural or social sciences, derived from the individual ways in which the instructors chose to design their syllabi, their selection of course activities, and the pedagogy they employed.

CHAPTER 5

FINDINGS PART IIA: ANALYSIS OF CLASS OF 2016 COHORT

During my initial review of the interview information provided by students in the study, I noticed and commented on the ideas that stood out, especially with regard to their academic backgrounds, interest in science, and interpersonal ideas and experiences. The students' accounts of their experiences shed light on some of the obstacles and barriers they encountered in their academic and personal pursuits. Many of the patterns I saw in my initial examination of the material related to the influences social context had on students' learning and psycho-social development. I began to feel even more confident that a theory that focused on the social aspects of learning would provide valuable insight into students' experiences and formation of ideas. By primarily employing the theory of Community of Practice (Lave, 1991, 1996; Lave & Wenger, 1991; Wenger, 1998), a theory of social learning, to guide me through more thorough analysis, I was also exploring whether the theory serves as an effective framework for understanding learning in the context of a specific academic field in college.

The analysis is organized by academic class year, starting with the youngest cohort, members of the graduating class of 2016, and proceeding to the class of 2015 and then to the class of 2014. Whenever possible within each cohort, the information is organized according to some of the most noticeable similarities shared by the participants. Although twelve participants revealed enough similarities to allow me to compare them with each other for purposes of analysis, three participants—Jasper,

Star, and Unity—did not fit closely with other members of their cohort and were analyzed separately. Some sections of the transcribed interviews contain comments as to the types of analysis: “Initial Analysis” refers to my comments from the first review of the data; “CoP Analysis” represents analysis through the lens of the theory of Community of Practice (CoP); and "CRT and ST Analysis" represents analysis about the specific role race plays in the students' experiences in the sciences. Using the theory of CoP, insights from CRT, and concepts from ST as the theoretical framework for analysis, I examined transcriptions of the interviews of the 15 voluntary participants, all of whom had enrolled over a 2-year span in one of four iterations of the introductory course in the environmental sciences or the introductory course in environmental studies. Figure 5.1 provides a list of the participants by academic and demographic characteristics of race and gender, exposure in high school to the environmental sciences, the type and date of the introductory course taken in college, the time elapsed between the start of the introductory course and the time of the interview, and declared major. These characteristics will help the reader understand and keep track of the overall profile of the participants.

FIGURE 5.1

PARTICIPANTS BY ACADEMIC YEAR: 2016, 2015, AND 2014

Advanced Env Sci in H.S.	**Race Gender**	**Name & class year**	**Env course(s) taken, iteration of course, yr/sem. A = Envir. Studies, B = Envir. Science**	**Time elapsed between start of intro course and interview**	**Major declared**
N	WF	Harmony 2016	B-2 (Professor Z) taken Frsh Sp 2013	Spring 2013 (same semester) 3/28/13	UD
N	WF	Dawn 2016	B-2 (Professor Z) taken Frsh Sp 2013	Spring 2013 (same semester) 2/27/13	UD, likely a science major
N	WF	Raven 2016	B-2 (Professor Z) taken Frsh Sp 2013 (Withdrew)	Spring 2013 (same semester, after withdrawal) 10/31/13	Govt, Sociol
N	BM	Rowan 2016	B-2 (Professor Z) Frsh Sp 2013 (Withdrew)	Spring 2013 (same semester, after withdrawal) 12/3/13	UD
Y - AP Env	BF	Silver 2016	B-2 (Professor Z) taken Frsh Sp 2013	Spring 2013 (same semester) 2/24/13	UD
Y - AP Env	WF	Violet 2016	B-2 (Professor Z) taken Frsh Sp 2013	Spring 2013 (same semester) 3/3/13	Env Studies
Y - AP Env	WF	April 2016	B-2 (Professor Z) taken Frsh Sp 2013	Spring 2013 (same semester) 2/24/13	Archeol, Classics
N	BM	Jasper 2016	A-2 (Professor X) taken Frsh FL'2012	S13 (1-2 semesters) 3/3/13 & 9/5/13	Env Sci
N	WF	Star 2015	B-2 (Professor Z) taken Soph Spring 2013	Spring 2013 (same semester) 2/24/13	Engl, Govt
Y – O-levels, UK system	BF	Unity 2015	A-1 (Professor W) taken Frsh Fall 2011	S12, F12, S13 (3 semesters) 12/12/13	Govt
N	BF	Holly 2015	B-1 (Professor Y) taken Frsh Spring 2012	F12, S13, F13 (3 semesters) 10/14/13	Env Sci
N	BF	Opal 2015	A-1 (Professor W) taken Frsh Fall 2011	S12, F12, S13 (3 semesters) 4/1/1S	Env Sci
N	BF	Luna 2015	B-1 (Professor Y) taken Frsh Spring 2012	F12, S13, F13 (3 semesters) 9/5/13	Env Sci
N	BF	Crystal 2014	A-2 (Professor X) taken Frsh Fall 2010	S11, F11, S12, F12, F13, F13 (6 semesters later) 10/9/13	Env Sci
N	BF	Savannah 2014	B-1 (Professor Y) taken Soph Spring 2012	F12, S13, F13 (3 semesters) 10/15/13	Amer Studies

Notes:
BF = Black Female, WF = White Female, BM = Black Male, UD = Undeclared major at time of interview
AP = Advanced Placement Exam, Y= Yes, N= No, UD = Undeclared
Distribution by Graduation Year: class of 2014 13% (n=2), class of 2015: 33% (n=5), class of 2016: 53% (n=8)

I organized the participants of the study by academic-year cohorts–class of 2016, n=8, class of 2015, n= 5, and class of 2014, n=2,–and then according to similar characteristics, such as whether the participant had completed advanced-placement study in high school of environmental sciences. In some cases, if the participants introduced issues of race during the interview, it was helpful to explore the role that race might have played in their experiences. In other cases, racial, and gender differences proved to be less critical to the analysis, and the focus was placed on other characteristics shared by the participants.

Using the components of *identity*, *practice*, *meaning*, and *community* associated with the theory of Community of Practice (Lave, 1991,1996; Lave & Wenger, 1991; Wenger, 1998), I explored more deeply what students said about their experiences in the environmental sciences. The following definitions guided my inquiry:

> 1) Meaning: a way of talking about our (changing) ability— individually and collectively—to experience our life and the world as meaningful.
>
> 2) Practice: a way of talking about the shared historical and social resources, frameworks, and perspectives that can sustain mutual engagement in action.
>
> 3) Community: a way of talking about the social configurations in which our enterprises are defined as worth pursuing and our participation is recognized as competence.
>
> 4) Identity: a way of talking about how learning changes who we are and creates personal histories of becoming in the context of our communities (Wenger, 1998, p. 5).

For analysis of participants for whom issues of race might have been significant in their participation in the sciences, I used the CRT (Delgado & Stefancic, 2001; Ladson-Billings, 1994, 1999, 2001; Ladson-Billings & Tate, 1995) themes unearthed in Solorzano's research (1998), which found students of color more likely to experience the following: 1) feeling out of place in the academy because of their race and or gender; 2) feeling that their teachers/professors had lower expectations for them; 3) encountering subtle and not so subtle racist and sexist incidents. Additionally, I used Stereotype Threat (Cohen, Steele, & Ross, 1999; Steele, 1997, 2003, 2010; Steele & Aronson, 1995) as guidance in identifying successful strategies, referred to as "identity safety" (Steele, 2003), that participants and faculty employed to reduce the negative effects of Stereotype Threat.

Of the 8 students in the study representing the class of 2016, only one (Jasper) had enrolled in the introduction to environmental *studies* course offered in the fall. The others all enrolled in the introduction to environmental *science* course. (See Table 8.)

Harmony and Dawn are white females who had not declared majors at the time of the interviews. I explored similarities and differences in the ways they experienced the course. For the other three white females in the class of 2016, similarities other than their race and gender proved salient. I examined the case of Raven, a white female, in conjunction with that of Rowan, a black male, because they had both withdrawn from the course. I grouped Violet and April, white females, with Silver, a black female, because they had all completed Advanced Placement environmental

science in high school. I examined Jasper, a black male, separately because of his early motivation to enroll in the course and other features unique to his story.

Group 1: Harmony and Dawn

Harmony (white female, duration of interview: 9:35 minutes)

After a brief introduction and review of the consent form, I asked Harmony to tell me about her motivation to enroll in the course.

> Renee: Hello, Harmony . . . share with me a little bit of the background experience you had with science, the study of science . . . Then also tell me a little bit about what motivated you to enroll in this introduction to environmental science course. (1)
>
> Harmony: Um, I don't have an extremely strong background in science. I took biology and chemistry and physics in high school . . . but my high school wasn't extremely strong in the sciences. So just kind of like basic knowledge. Then at [Hillcrest] since we don't have to declare a major until sophomore year, I'm not totally sure what I want to major in, so I decided to just take kind of a large sampling of courses, and environmental issues and activism and that kind of thing has always [been] something I'm really interested in . . . like climate change and trying to like stop deforestation. So I just thought it would be interesting . . . also good and informative for me to take a class [and] kind of like study that and some of the causations of it and that kind of thing since it was already an area of interest. (2)

Initial Analysis: Harmony told me that her high-school science background was not strong and that she enrolled in the introduction to environmental science course because she did not know what she wanted to major in and had a prior interest in environmental issues and activism. She told me that she enrolled in a large sampling of courses in her freshman year, which was when she took the introduction to environmental science course. Also, Harmony explained that she wanted to study the causation of such environmental issues as climate change and deforestation.

> Renee: What are some of the high and low points of this course so far? (3)
>
> Harmony: I think learning about things that I already had heard about or knew a little about like the acid rain lecture that he gave a little while ago and the . . . climate warming, that kind of thing, because I've heard a lot about it, but I've never really been totally clear on . . . what causes it or like multiple theories on it and all that kind of stuff, and so it's been interesting to clear that up. I guess maybe . . .there hasn't really been

any super-low point, but at the very beginning a lot of the stuff we were doing was kind of just like overview from stuff I learned before, so it wasn't like super-exciting and new or anything, which isn't really a low point but there hasn't been anything really bad, so that would probably be like the lowest [chuckle], I guess. (4)

Initial Analysis: Consistent with some of Harmony's earlier comments, she mentioned more topics that she liked learning about in the course. Topics included acid rain and climate change. I wanted to find out whether she was participating in activities outside of the course that might be associated with learning in the environmental sciences.

Renee: Generally, how do you spend your time outside of the course? Do you have any friends in the course and if so, do you all do homework together? (5)

Harmony: There're a few people I know in the course. None are really like extremely close friends, but several of them live in my dorm so (6) . . . we'll kind of talk together sometimes. I haven't really studied with anyone. I usually just kind of study on my own. But we've talked about it a lot and one of my closest friends is not in this same course … but she's in other environmental courses so there's kind of a lot of overlap of subjects and she and I talk about it a lot and I'll end up doing homework in her room a lot. So we'll kind of like overlap and talk about it and stuff. (10)

Renee: Very good. So what else do you do when you're not studying? Do you work? (15)

Harmony: Yeah, I work for [information technology services] (16) . . . so that's only a few hours a week and then obviously all the other courses that I have to study for. (18)

Renee: How do you think your peers in this course that you do not know, how do you think that they would describe their experiences in this course? Do you think that you could speculate on your experience in the course versus others'? Anything you've noticed? (21)

Harmony: I don't know, it's a little bit difficult to say because everyone comes from pretty diverse backgrounds, but I would say I went to a high school that wasn't extremely strong in sciences and at the beginning there's still a little bit of overlap with things I kind of already knew, so I'd say for most people that would definitely be the case. (22)

Renee: Is there anything else that you would like to talk about in regard to your experiences with either the material . . . the reading, the assignments . . . the study session that took place before the exam . . . or anything like that? Are you going to do the field trip? (23)

Harmony: I think so. [But] it conflicts with another class I have. (24)
Renee: It's a large chunk of time. (25)
Harmony: It is. (26)
Renee: You have to be dedicated. (27)
Harmony: Yeah, but I might talk to the professor in that class and see if it would be okay to miss that day. It's a smaller class. It's a language class so attendance is pretty important, but I might see if I can. (28)
Renee: What course is that? (29)
Harmony: German. (30)
Renee: Oh, yeah, you don't want to miss that. (31)
Harmony: No. (32)
Renee: Yeah, how's [that] course going for you? (33)
Harmony: It's going well. (34)
Renee: Good. Okay, well, then . . . the topic of the field trip is going to a farm and learning about sustainable dairy farming and kind of organic dairy farming. What are your thoughts about the farming? Do you know about the [campus organic farm] here? (35)
Harmony: A little. Not a lot. That's kind of like an area of interest of mine . . . I'm really interested in . . . I guess you'd say how food companies kind of have a tendency to be corrupt and not always open about their practices and how that plays into the whole American obesity epidemic and all that kind of thing. So I think organic farming and local farming and all that kind of thing is something I'm really interested in, so I thought it would be kind of a good opportunity to get a closer look at all that. (36)
Renee: Good. Very good . . . well, you know we have that local farm . . . and there are student groups that are involved in it, you can always get in touch with me if you're interested. I know some of the students. (37)
Harmony: Yeah. (38)
Renee: But thank you for your time. Would it be okay for me to contact you at another time . . . maybe later on in the semester, which will just be about two weeks? (39)
Harmony: Yeah. (40)
Renee: Or maybe three weeks, and ask you a few more questions? (41)
Harmony: Yeah, absolutely. (42)
Renee: And if you think of anything that you think might relate in some way to your transition, your kind of thinking about the subject, or about the way that the class is run, the way you feel you're engaging in the topic, please let me know and we can talk again. (43)
Harmony: Okay. (44)
Renee: Thank you so much. (45)

Initial Analysis: I had hoped to interview Harmony a second time, but was unable to do so. I would have liked to learn more about her view of and interest in the role of big corporations in America's obesity epidemic.

Initial Analysis: Several things emerged in my analysis of Harmony's transcription: 1) She was motivated to enroll in the course because she had a desire to advance her knowledge of specific environmental issues, although she felt that she had a poor background in science. 2) Harmony enjoyed learning about the specific environmental issues covered in the course, although some topics were repetitive, as she had been exposed to them in high school. 3) Except for discussions with one friend, Harmony had limited participation in the environmental sciences outside of the course.

CoP Analysis: Even though it was early in the interview, I got the impression that Harmony had limited ties to the field of environmental sciences and regarded her participation in the sciences in general as marginal at best. She stated that she did not have a strong background in science. Employing the CoP framework to analyze her comments regarding her prior experiences with the environmental sciences in particular, I noticed several ways in which what Harmony told me about her pursuit of the environmental sciences fit into Lave's (1991, 1996), Lave and Wenger's (1991), and Wenger's (1998) framework. First of all, the concept of *enterprise*, which Wenger (1998) uses to refer to the domain in which people in a community of practice interact, provides a way to talk about the context of studying the environmental sciences. The introductory environmental science course, in particular, can be thought of as one of the activities that people who pursue the environmental sciences are engaged in. The

course could be viewed in CoP terms as the type of discipline-specific activity that Wenger refers to as *practice*.

Application of CoP as a framework for analysis suggests that taking a course is participation in practice and provides opportunities to build relationships and interactions within the field. Moreover, the participation in this and other practices in the environmental sciences could fundamentally change who Harmony becomes as a result of her experiences, the significance she ascribes to what she learns, the associations she makes, and where she thinks she belongs and what she does. Lave (1991, 1996), Lave and Wenger (1991), and Wenger (1998) use the terms *identity, meaning, community,* and *practice* to describe these main concepts in the theory of CoP. Unfortunately, the interview could capture only the first few weeks of Harmony's enrollment in the course and could not provide extensive information about the effect that the entirety of the course would have on her. However, the information she provided began to shed light on the relationships she had with the subject matter, her peers, and her professor, all areas that the theory of CoP presents as key to learning.

Harmony expressed interest in two of the big topics of the environmental sciences—climate change and deforestation—and her enrollment in the course would have allowed her the opportunity to build relationships with other students and faculty also participating in the field. How Harmony chose to engage with the practices and people of the field would determine what Wenger (1998) calls her "trajectory," which, Wenger asserts, "is not a fixed course or a fixed destination . . . not a path that can be foreseen or charted but a continuous motion—one that has a momentum of its own in

addition to a field of influence. It has a coherence through time that connects the past, the present, and the future" (p. 155). The theory of CoP provided a way to explore Harmony's interview through this aspect of her experiences.

CoP Analysis: Wenger (1998) provides a way to explore Harmony's relationship with her peers. Harmony described her classmates as not extremely close friends and told me that several of them lived in her residence hall. The classmates (whom she would see during class and some of whom she also encountered in her residence hall), along with the friend she said was her closest friend (although not enrolled in the same introductory course), were participating in different ways in the environmental sciences. Applying the CoP framework to her experience would suggest that she and her peers were on different individual journeys with respect to the *enterprise*, called *trajectories*. The interactions that Harmony and her peers had with the environmental sciences could be expected to change who these people were. Harmony and others would construct identities built on varying types of participation and non-participation with regard to the environmental sciences, and it would be these changes in identity that would characterize the types and degrees to which they were learning about and through the environmental sciences. These changes in identity would be both the result of and the catalyst for new ways of constructing meaning related to aspects of the environmental sciences; such changes are changes driven by practice, as illustrated in the way Harmony described the role of "talking a lot."

The activity of talking about the content, issues, and course is an important aspect of exploring and learning about the topic. In this respect, talking with peers operates like the CoP component of practice. Practice, described by Wenger (1998) as

"a way of talking about the shared historical and social resources, frameworks, and perspectives that can sustain mutual engagement in action" (p. 5), can be thought of as the activities that forge community and provide opportunities for people to make sense of their participation in a community. The effect of these encounters with people and ideas has the potential to alter a person's views of environmental issues, as well as the person's relationship to the environment. *Meaning* is the CoP concept used to discuss the effect of these encounters, which Wenger (1998) explains as the component that offers "a way of talking about our (changing) ability—individually and collectively—to experience our life and the world as meaningful" (p. 5). Therefore talking about the course, as a practice, was important because it provided an opportunity for Harmony to make sense of the things she encountered, whether related to the environmental science subject matter, assignments, or associated persons—the professor, teaching assistants, classmates, et al.

The details of when and where this talk took place matter little: whether the talk occurred in the context of co-curricular programming in the residence hall, or in informal exchanges with her closest friend about the enterprise while they independently completed their homework in the friend's room. The CoP framework would treat these encounters as significant to learning. "Members produce a practice to deal with what they understand to be their enterprise, their practice as it unfolds belongs to their community in a fundamental sense" (Wenger, 1998, p. 80). That is why "talking a lot" about the enterprise is an important part of studying the environmental sciences. The three key features of a community of practice—mutual engagement, negotiated enterprise, and repertoire of negotiable resources accumulated

over time (Wenger, 1998, pp. 72-85)—are represented in Harmony's comments about her peers.

Dawn (white female, duration of interview: 9:42 minutes)

I rearranged the order in which I posed the interview questions to Dawn. The interview did not flow as easily as it had with the participants interviewed earlier. My sense of unease may have been driven by nervousness on either of our parts, or personalities, or some unknown factor. Dawn provided curt answers to my questions. I may have contributed to this kind of response because I did not pose all the questions in the open-ended format but instead used some questions that could be, and were, answered with yes or no. My first question to Dawn was designed to find out about whether and how she participated in activities related to the environmental sciences outside of the introductory course.

> Renee: Hello, Dawn. Thank you for agreeing to participate . . .Could you reflect on some . . . I know you've only been in the course for a relatively short time, but can you reflect on some of the high points or low points you've had in that course so far? (1)
> Dawn: Um, I guess one of the surprising things is I'm a freshman, so I have not had that many courses, but in the only other big lecture course I've had it was kind of hard to stay awake sometimes. So I guess you could say that most of the time lectures are interesting. (2)

Initial Analysis: I thought it was significant that Dawn responded to my question by focusing on the large-lecture format of the course, so I prompted her for more information.

> Renee: So that's a high point and a low point? (3)
> Dawn: Yeah, well [inaudible]. A low point was, um, possibly the exam, for relatively obvious reasons. It's like the one thing I was struggling a bit . . . little shaky on was, like, the biggest question. (4)
> Renee: Was that the computation? (5)
> Dawn: It was the topic . . .was like the red shift thing for, um, stars which . . .

was like a huge amount of background material, and I wasn't quite clear which of it was important. (6)

Renee: Were you able to go to the homework help? . . . the homework help session that was offered for the assignment or anything else that was offered to prepare for the exam? (7)

Dawn: We had like a question-answering thing after class before the assignment was due the next day and I stayed behind for some of that . . . and I went to some of the, um, the study session for the exam. (8)

Initial Analysis: Following the discussion about the types of activities associated with the environmental science course, I wanted to find out if Dawn was engaged in environmental-science-related activities outside of the course.

Renee: Have you been able to study with any peers, or have you been able to go to any office hours? (9)

Dawn: No office hours, but there's a couple of the people in my dorm that are in the class so . . . (10)

Initial Analysis: Dawn described how she was responding to aspects of the course in terms of the large-lecture format, the homework, and exams. As for interactions with people, I learned that, like Harmony, Dawn had some classmates from the course living in her dorm. I wanted to find out whether Dawn's descriptions of her experiences with the practice of talking about the enterprise were the same or different from the ways Harmony described this aspect of her experiences. After a brief exchange about the specific dorm where Dawn lived, I inquired about her motivation to enroll in the course.

Renee: Tell me a little bit about what motivated you to enroll in the course. (15)

Dawn: I'm thinking of it for my major (16) . . . An environmental major. (20)

Renee: Oh, cool .(21)

Dawn: Um, it's sort of always been an interest of mine. (22)

Renee: Have you taken any environmental courses before coming to college? (23)

Dawn: Not especially environmental . . . biology had a lot of it. (24)

Initial Analysis: Although earlier Dawn mentioned that there were a couple of classmates living in her dorm, I was not getting the sense that she regarded any of them as "friends," in much the same way as Harmony described classmates as not extremely close friends and only one student as her closest friend. I wondered about Dawn's peer group and influences.

> Renee: Can you tell about some of the other activities you're involved in or just how you spend your time outside of lecture? (25)
> Dawn: That specific lecture or class in general? (26)
> Renee: Class in general. (27)
> Dawn: Um, usually in my friend's room. I do a lot of fiction-writing, and I draw usually. (28)

Initial Analysis: I learned about the time that Dawn shared with her friend, hanging out in the friend's room. I was uncertain whether they were engaged in the fiction-writing and drawing together or whether this was a solo activity for Dawn. Either way, I did not have enough information to deduce how this activity might affect her learning in the environmental sciences. I was curious about Dawn's background in science, because the discipline of environmental science is categorized as a natural science at the institution where the study was being conducted.

> Renee: So, coming of age [growing up], what was your relationship with science? (45)
> Dawn: I was always sort of interested in it, particularly ecology, math, and biology, zoology, um, conservation, and again a lot of Discovery Channel . . . Um, I liked biology freshman year in high school. Had really terrible teachers in physics and chem though, so kind of ruined those for me. Like, I can't remember anything from them. I just, like, blocked it out, and then I took AP bio senior year. Did pretty well in that. Then, um, my advisor at [Hillcrest] actually told me not to take any science courses first semester . . . and he kind of forgot to mention that means you can't take any during the second semester. So, yeah, ah, that's also how I ended up in all those literature courses (46)

Initial Analysis: Dawn's interview revealed two things: first, that Dawn's motivation to enroll in the course was based on her interest in the subjects of ecology, math, biology, zoology, and conservation, and her interest in pursuing a major in the environmental sciences; second, that Dawn didn't like the large-lecture format of the course and experienced some difficulty with one part of the exam because she did not understand a key concept in the course that appeared as the biggest question on the exam. Other activities that Dawn participated in included a help session for an assignment and a study session for the exam. Dawn did not attend office hours, so we do not have a sense of her relationship with the professor. Regarding her relationships with peers, I learned that there were a few students from the course who lived in her dorm, but she did not socialize with them. She had a friend with whom she spent a lot of time, and possibly they engaged in fiction writing and drawing together.

CoP Analysis: The limited information I gathered from Dawn made it difficult to determine how the framework of CoP could be useful in exploring her experiences in the enterprise of studying the environmental sciences. However, I was struck by two ideas in her interview. The first related to her friendship and her involvement in fiction-writing and drawing, and the second related to her impressions of her high school science teachers and her freshman-year academic advisor.

Regarding the first piece of information, Wenger (1998) provides a way to explore situations when the interviews seem devoid of the types of activities that one associates with a CoP. Wenger (1998) discusses the importance of viewing *participation* in ways that do not privilege participation over non-participation but regard both as significant opportunities to learn. "Our relations to communities of

practice thus involve both participation and non-participation, and our identities are shaped by combinations of the two" (p. 164). Although I had hoped to locate Dawn's experiences in specific activities clearly connected to the environmental sciences, I learned from Wenger (1998) that equally significant insight might be gained by looking at what did command her attention. Dawn's non-participation in the CoP was evident in her choosing to write fiction and draw instead of joining clubs or taking part in other course- or environmental-science-related group activities. It was also relevant that unlike Harmony, she made no mention of engaging in informal discussions about environmental science outside of class. When I observed Dawn's class, I noticed a low level of student participation in general. There were no small-group activities that encouraged the students to talk to each other. Although Dawn described homework and pre-exam help sessions, which I did not observe, her descriptions did not suggest a highly participatory setting. These factors may have affected her participation. Wenger (1998) asserts that both participation and non-participation influence where people locate themselves in a social landscape, what they care about and neglect, what they attempt to know and understand or choose to ignore, with whom they seek connections and whom they avoid, how they engage and direct their energies, and how they attempt to shape their trajectories.

Regarding the second piece of information, Dawn's account of poor science teachers in high school and a poor academic advisor in college caused me to wonder about the degree to which these interactions affected her learning. As mentioned earlier, I found my interview with Dawn to lack the free-flowing quality of other interviews. I wondered whether the way Dawn felt she had been treated had negatively

affected her learning. Wenger (1998) would count these experiences as part of her history, which should not be ignored when analyzing her participation or non-participation in the community of practice of environmental science. Dawn implied that poor teaching years before she entered college might have limited her learning later on, in college. A further limitation was imposed by her academic advisor's advice, which she regarded as incomplete at best, and which had implications for when she could enroll in specific science courses that must be taken in sequence. Such experiences can block the trajectory of a student who might otherwise choose to major in the natural sciences.

While not conclusive, Dawn's interview suggests how relationships with faculty—formed during a student's first semester—constitute a historical process that is both *influenced* by the types of relationships the student forged with high-school faculty and *influences* the types of relationships the student will form in college. This situation highlights the consequences of assigning undergraduates interested in the study of science and mathematics to advisors who may not support the students' eagerness to study these subjects immediately upon enrolling in college. Dawn asserted that her academic advisor's recommendation that she avoid math and science in the fall of her first year resulted in her taking a lot of humanities courses and perhaps missing the opportunity to interact with faculty and students engaged in practices related to the environmental sciences. Academic advising is supposed to reflect the overall mission of an institution. An inadequate understanding of the mission of the liberal arts college where the study was conducted may have induced Dawn's faculty advisor to encourage students to avoid early specialization and to

explore the breadth of the course offerings. This approach ignored the specific requirements facing students who hoped to pursue the sciences and mathematics and needed to get started on fulfilling disciplinary prerequisites as soon as they arrived on campus. Overall, Dawn's interview points out the important role that academic advisors and faculty can play in helping students connect with practices and communities associated with their academic interests.

Similarities and Differences between Harmony and Dawn:

Initial Analysis: Harmony and Dawn commented on their poor background in the sciences. Harmony did not comment on any specific aspects of the course that were high or low points, but Dawn commented on several aspects of the course. Dawn disliked the large-lecture format and expressed concerns about her performance on the exam she had taken shortly before the interview. Although she had attended a help session and an exam study session, she had not yet gone to the professor's office hours.

As for experiences related to the environmental sciences outside of the course, Harmony had had some interactions with classmates from the course who lived in her dorm, but Dawn did not interact at all with those classmates who lived in her dorm. Harmony and Dawn both described special friendships. Harmony's friendship involved limited discussions about environmental sciences and did not involve collaboration on homework or studying, while Dawn's friendship involved no discussions or activities related to environmental science; the leisure-time activities she mentioned related to the arts and humanities.

CoP Analysis: The CoP framework relies on the interaction of the four components of meaning, identity, community, and practice to advance learning. Harmony and Dawn did not engage with the content or community of the environmental sciences in ways that would put them in contact with the practices, which included engaging in meaningful discourse about environmental subjects, as well as discussions about the course and the faculty. This limited interaction with peers and faculty associated with the discipline do not further productive entry into the discipline.

Group 2: Raven and Rowan

I decided to examine the similarities and differences between Raven, a white female, and Rowan, a black male, because they had told me that they had withdrawn from the course. I wanted to uncover any patterns that might explain their decisions to withdraw from the course and find out whether their withdrawal was related to the ways they engaged, or failed to engage, with the environmental sciences.

Raven (white female, duration of interview: 26:44 minutes)

Although Raven had signed up to participate in the study while she was enrolled in the course, she had withdrawn from the course by the time of the interview. I began the interview by delving into the circumstances related to the withdrawal.

> Renee: Thank you . . . you took the [environmental studies] course when? (1)
> Raven: I took it last semester from, um, January and actually withdrew from the class in April. (2)
> Renee: Right. So you withdrew from the class in April, so you stuck it out for a while. (3)
> Raven: I was there for about I think 8 or 9 of the total 13 weeks. (4)

Initial Analysis: After a brief review of the consent form, I continued my inquiry into the circumstances related to her decision to withdraw from the course.

Renee: What was the motivation to withdraw from the class? (9)

Raven: I kinda [have a] weird science background from high school . . . but, um, [inaudible] environmental science I started to do it . . . but I just felt like the class overall . . . just the structure of the class; I was not a huge fan of lectures and stuff . . . they're kinda disorganized. (10)

Initial Analysis: Early in the interview, Raven introduced two issues that may have influenced her decision to withdraw from the course: a poor background in high school science and features of the course that included organization and the lecture format.

Raven [continuing]: Really like the professor . . . TAs were just kind of flaky. I had two different instances last year when the TAs just didn't show up to the TA sessions, so I just kind of after a while felt like I couldn't get [it] to work . . . I was looking for the help and I'm a huge, you know, person who likes to like self-advocate if I need help, but you know, if you're trying to take this course where you're already struggling and not getting the help, you know, no one's going to really help you out with stuff, then you just kind of feel like you're digging yourself in a hole. (10)

Initial Analysis: Raven's description of her negative experiences with the teaching assistants made me think that she had been spiraling downward. There was an accumulation of incidents that seemed to undermine her confidence that she could excel in the course.

Raven [continuing]: I was doing extremely well in all my other classes, so it wasn't an issue of, ah, I'm not studying correctly or I'm . . . having all these other problems with my study habits. It's just this one single class where my grade was just awful. I just kept feeling like it was getting to the point where I just wasn't learning anything. It wasn't being productive . . . I eventually, you know, used to talk to my parents several times about it. (10)

Initial Analysis: Raven's defense of her poor performance by pointing out her strong performance in other courses was a way for her to claim that her problems in the

course were not her fault. Still, I wanted to be sure that she had utilized all her resources, especially the professor, so I asked her about office hours.

> Renee: So you were having no success with the TAs. Did you go . . . to meet with your professor . . . did you go to office hours? (11)
> Raven: I feel like I'm trying to remember. I feel like I did or tried to schedule something or talk to him after class a couple of times, um . . . no, he was really nice, I just . . . feel like we saw . . . science completely differently and I could not really understand his way . . . You know how . . . different people explain things in different ways and . . . He wasn't really getting through. (12)

IA: Raven had poor interpersonal experiences with the TAs and only limited interaction with the professor of the course. I wondered if these interpersonal relationships were at the root of Raven's poor experiences in the course or whether there were other explanations.

> Raven: I found in high school . . . I did have a math tutor in high school when some teacher didn't explain things in ways that clicked with me, but the tutor did, so I was really big on, okay, maybe the TAs will as students who are kind of close to me and, you know, I think the other problem . . . my kind of overall problem with the class was that I kind of felt like it was more intermediate [inaudible] chem class than like an intro to environmental science class. I just was like, oh, maybe the TAs who are more my age will be able to explain this better. You know, they did go through the class themselves only a couple years ago. You know, maybe he's [the professor] trying to think of it on a much higher level than I am, especially as someone who didn't take AP chem or AP physics or anything; I just took AP bio, so I don't have the background. (14)

Initial Analysis: Raven's description of the importance of an interpersonal connection with the professor and the TAs suggested that there is a specific context in which she knows she flourished and that context is one in which she is able to forge a close relationship with instructors and their assistants. Could a lecture-based course with an enrollment of between 80 and 150 accommodate her preference for a close interpersonal relationship? Still, I wondered whether other factors might explain her poor performance in the course.

Renee: How did you do on AP bio? (15)
Raven: I got a 3. Um, funny story. I was really not very . . .I was like, okay, in my high school science classes but . . . I was a big science-fair nerd in high school. So everyone always laughs at the fact that I withdrew from intro to environmental science and yet won two international science fairs on an environmental science project. (16)
Renee: You're just kind of a tactile learner, is it? Was it the lecture format that wasn't working for you? (17)
Raven: They . . . yeah . . .I think it partially . . . and I think also like, for science at least, in high school I was really was, um, driven off of just teacher relationships. (18)

IA: Given Raven's self-proclaimed need for strong interpersonal relationships, I wondered what academic discipline or profession she might be drawn to.

Renee: What do you think you're going to major in? (19)
Raven: Definitely majoring in government and sociology double, so very social-science-oriented. (20)
Renee: And what are your relationships like with those faculty members (21)
Raven: Um, much stronger . . . I'm taking . . . my second class with one professor and I really like her personally. I'm already hoping to take more classes with her. I just like the professors a lot more . . . since I understand the material already, I feel like if I'm going in to talk to them during office hours and stuff I'm not going in because I don't understand something but more I want to learn more about it. You know, I kinda get the basics but want to go further. Stuff like that. (22)

Initial Analysis: Raven's desire for a close interpersonal relationship with her professors was not being met in the environmental sciences, but she said that she liked the professors in the government and sociology departments much better.

Renee: What was your relationship like with your peers in that course? (23)
Raven: I had a bunch of friends in the class. They all kind of had the same issues I did but seemed to work through it just because a lot of them . . . were taking other math and science courses or were just math or science majors, so they didn't have the same sort of issues I did, but still felt, I think, a lot of the same frustrations with the class but had an easier time because they, I think, had a much stronger math or science background. (24)

Initial Analysis: Raven thought that her classmates who had stronger math and science backgrounds were better able to cope with what she perceived as the

"disorganization" and unreliability of the teaching assistants. I wondered whether her impression that her peers had stronger math and science backgrounds affected her interactions with those classmates inside and outside the class.

> Renee: Did you get the sense that they [your classmates] formed study groups, or were you a part of the study group with them? Did you do homework together? (25)
> Raven: I think a bunch of people did . . . I went to all the study sessions with people. (26)
> Renee: Okay, so your peers . . . kind of felt the same way but were better prepared, you felt, academically and had more of a math/science kind of orientation, so it seems like they did fine? (27)
> Raven: Umhm. (28)

Initial Analysis: After a brief exchange about the specifics of her residence hall, I still thought that I lacked a clear sense of Raven's interactions with her classmates.

> Renee: Any of the people who took the course live in your hall? (41)
> Raven: Ah, yes. (42)
> Renee: Okay, and these are the friends or just other people you know from class? (43)
> Raven: I think one or two, like, good acquaintances of mine lived in the same hall. (44)
> Renee: So did y'all chat about it? (45)
> Raven: Yeah, I mean people talk about classes, um, I'm trying to think . . . like I said . . . it was like a lot of people were frustrated with a lot of the same things but had a lot easier time than I did. (46)

Initial Analysis: Although I still did not understand the degree to which Raven was interacting with her classmates inside and outside of the lectures, I wondered about her efforts to acquaint herself with other members of the environmental science department.

> Renee: I know [that] relationships matter to you . . . so can you imagine ways that you could have had a different relationship . . . Have you ever been up on the [environmental sciences] floor? (47)
> Raven: Yes. I had been before to actually meet with the professor. I think I was up there three times total. Twice to meet with him and then the third time to withdraw from the class . . . I don't know. It was tricky because it was a very large class, so that was the other thing . . . he didn't know

my face. You know I was just one, I think, [of] 80 people in my class. Um, which was sort of a moment of "This is why I chose [Hillcrest]—not to be in classes where . . . literally the professor would have no recollection of my face, or my name." (48)

Renee: So do you think that if it were a smaller section? (49)

Raven: I think if it were small. I think the problem too is just, um, the idea of intro to environmental sciences has a very different connotation for different people and I felt I found at [Hillcrest], now [that] I'm taking my second science class here, that professors kind of even though they'll say, "Oh, it's . . . a class for non-science majors," that's never the case. I'm in astronomy now and there're still moments . . . the professor will kind of reference AP physics. I'm like, I didn't take AP, I didn't even take any physics in high school, like, I don't know what you're talking about or what I should have known, and I felt a lot of that during that class. (50)

Renee: So when you would have those moments . . . those side statements that a professor might make, [how] did it make you feel? Would you characterize that as a barrier? (51)

Raven: Um, I think, I think definitely, felt like, um, just in general a lot of the stuff, or people would say, "Oh yeah, we learned that in AP chem," or, just kind of [inaudible], well, I'm not gonna know that . . . I know it's not cause I'm stupid or dumb, I know it's because I just did not learn it and I don't know. I feel like if the classes were, especially in science here, smaller and . . . there was actually a non-science science class versus people who took some science in high school and have like a . . . good sturdy foundation of science. I think those are two completely different things. (52)

Initial Analysis: Again, Raven commented on the large class size and connected her criticism to her impression that the course was impersonal. She stated that she enrolled at the university with the expectation of small class sizes. Raven also commented that she thought there was inconsistency in the ways people conceptualize introductory courses. She interpreted statements by professors and peers about Advanced Placement courses as subtle messages that maybe she did not belong in the course.

Although I learned that Raven had had limited interactions with faculty and peers associated with the course, I wanted to find out whether Raven had been willing to do anything extra to advance her learning of the environmental sciences while she

was enrolled in the course. I indicated to Raven that I was aware that the professor who taught the iteration of the course in which she was enrolled offered the optional field trip to a dairy farm.

> Renee: Were you still in the class when they had the field trip? (53)
> Raven: Um, I think I was. I did not go. I think I had something else going on that afternoon or that morning or whatever. (54) . . .Yeah, I actually . . . think I had class . . . when the field trip was supposed to be. (58)

Initial Analysis: After a brief discussion of the reasons for her not participating in the field trip, I tried to find out the reasons for which she had enrolled in the course in the first place. I had begun the interview with an inquiry into her motivation to withdraw because that distinguished her and one other student in the study from the other students.

> Renee: So what motivated you to enroll in the course? (65)
> Raven: Honestly, it was straight-up just gen eds. I still have no interest in going into science, but the same time, you know, I was at a point where I was debating whether or not I wanted to do the . . . program [on the role of science in society]. My dad especially has been pushing hard for me to be a scientist, which is just not going to happen, but, you know, from science fair of course my parents have deduced, well, you obviously have some sort of talent in science. So I was sort of like, okay, well, if I'm looking for a science class I imagine the easiest for me, chem, was already out of the question. I just, you know, like I said, barely survived, um, chemistry in junior year of high school . . . biology. I pretty much survived by teacher relationships in high school, so environmental science, I kind of said, okay, I know a lot of environmental science just from working in environmental science on the science-fair project for three years. That will be the easiest course to take. (66)

Initial Analysis: I learned that Raven enrolled in the course in order to fulfill a distribution requirement in the natural sciences. Raven's decision to avoid chemistry or biology based on her experiences with the courses in high school reinforced my impression that she saw her preparation for the sciences as weak, while her parents

were encouraging her to study science. I suspected that Raven's decision to withdraw from the course might have unfolded gradually as she recognized that it was going to require more time and effort than she had anticipated.

> Raven [continuing]: And I also would, if I had to do it all over again, I would have looked at the difference between intro to environmental sciences and intro to environmental studies. I should have taken studies, looking back. I just did not know it even existed, and that's why I'm actually in the [student government]. My huge push was for better peer advising, especially when it comes to scheduling, because as a freshman I had no idea that class existed until a friend said, "Oh, you should have just taken environmental studies," and I said wait, that's a class . . . and it turns out it was way easier . . . way more what I was looking for and more hands-on real-world stuff. (66)

Initial Analysis: Raven's comments about the failure of her advising resources to point her in the direction of the environmental studies instead of the environmental science course raised the important question about ways in which various fields are (or are not) promoted to students and how that information is passed on to students during their first year. I considered the vulnerability of most college freshmen, especially first- semester freshmen, in a context such as a highly selective liberal arts residential institution, and the reasonable concerns that Raven raised about poor advising. As a person who repeatedly described her need for strong interpersonal relationships, Raven would likely rely more on personal advice (from her faculty advisor, peer advisor, and parents) than on information available in the on-line course listings. I was beginning to sense that Raven was not getting the services she needed to be successful. I wanted to understand what was going on in the rest of her life.

> Renee: So tell me about what was going on in the rest of your life. [What] filled your time outside of the class? (69)
> Raven: Um, I was taking four other courses, I was taking over the normal course load. (70)
> Renee: Why? (71)

> Raven: Um, 'cause I actually just like school and . . . I was also down a credit from a separate other issue that happened my first semester freshman year . . . was just straight-up poor advising. I was not advised correctly. Took a class I shouldn't have taken, only to find out that I needed to take two semesters of that course. (72)

Initial Analysis: Raven was again blaming poor academic advising for a credit deficiency she had incurred in her first semester. Earlier she had stated that she wanted to improve the peer advising program at the institution. As Raven described the circumstances involved in her placement in a two-semester foreign language course, I wondered how much of her difficulty with the environmental-science course had had to do with a lack of information about the course rather than with the subject matter itself.

> Raven: I was taking [a] history class . . . [a] government class . . . [a] sociology class and a writing class . . . so it was pretty much all writing social sciences. On top of that I am a member of the [student government] and a very active member. I run a college admissions web site that's turned into [something] mildly successful. I write for a ton of other publications both on and off campus. I joined [the student blog]. That's just the stuff I can think of off the top of my head. I tutor once a week SAT to underserved high-school students. So there was a lot of other stuff going on. (80)

Initial Analysis (IA): Raven acknowledged that there were many demands on her schedule, and it sounded as though she had been overextended. The demands on her time were already taking a toll on Raven's academic record, which now included two course withdrawals. Selective liberal arts institutions like Hillcrest favor students who are highly engaged in co-curricular activities in high school. I suspected that a student like Raven might be so accustomed to the fast pace of activities in high school that she was unable to reduce her involvements once she entered college. If Raven had not previously told me about her beneficial interpersonal relationships with teachers and

her tutor in high school, I might have concluded that she did not value the interpersonal relationships she could form with her college faculty, and therefore did not see the advantages of minimizing co-curricular activities in favor of forging interpersonal relationships with faculty. However, this was clearly not the case. I realized that I did not fully understand this contradiction in Raven's behavior in certain courses (the language course in the first semester of her freshman year and the introduction to environmental science in the second semester). It will be informative if I have the opportunity to interview Raven again in her junior or senior year in college to see the pattern of relations with faculty that she formed.

> Renee: Generally are there any high points or low points that you can think of that occurred during the course? (83)
> Raven: I remember a high point was I got an A-plus on the first exercise, so I was like, okay, I got this, I can do this. First test I bombed, I absolutely failed it. Straight-up F. . . I can count on my hands [the times] I've actually failed something, you know. (84)
> Renee: So was it that the material was not the same as what he covered in lecture? (85)
> Raven: Yeah, I think it was a combination of a lot of things. One, I just felt like yeah, like, a lot of the material . . . the book, I remember we were never on par with the book . . . I would look up topics that he had . . . you know, acid rain . . . I would go to the acid rain . . . It wouldn't be at all what we had to know . . . I would search to try and figure out where he was getting his information. And if you were just going off of basically PowerPoint in class, I felt like they were extremely disorganized . . .there was no real pattern to them . . . it was like a lot of random pictures and things, so I just, I felt like my notes were sort of shaky . . . I take good notes and I paid attention a lot in class. (86)

Initial Analysis: Raven expressed a great deal of frustration about various aspects of the course, including the contents of the PowerPoint slides and inconsistencies between the lectures and the course readings. She felt that she took good notes and paid attention. But she did not describe any steps she had taken to corroborate her impression that she took good notes by conferring with her professor or other students.

She relied on her subjective assessment of her own work. Raven's statement about paying attention in lecture reminded me that during my observation of the course lectures, I had frequently observed students watching videos, writing papers or emails, and engaging in other activities on their computers instead of taking notes and actively listening. I wondered how a student like Raven regarded using the computer during lecture for non-course-related activities.

> Renee: You're not one of them that's on YouTube in the back? (87)
> Raven: No [chuckle]. (88) . . . I was sitting in the middle, I could see about half the class were, like . . . the guys in front of me always watched soccer when they were in that class. (90)
> Renee: What was the deal? I would see soccer, I would see wrestling, I would see all sorts of things. I think there might have been someone who was watching replays of the football game. (91)
> Raven: Yeah. (92)
> Renee: Studying moves, I think. (93)
> Raven: I just remember the first test that I got the straight F on, the guy in front of me who was always watching soccer got a 94 percent, and I was just, . . . how did you [manage that], out of not paying attention, not taking notes? It was the most frustrating part for me. I literally listen the entire lecture and would write down everything he said and still felt like my notes weren't that good, and then, you know, I'd go to the review session and there would just be all this information that I was just like, where are these people learning this information? (94) . . . I went to every single class. Paid attention every single class. Would go home, re-read my notes. Study them and you know, I was putting in a lot more time in this class than any other class that semester. (98)
> Renee: My daughter is taking an [environmental science] course this semester and she's complaining to me that it's requiring a lot of time. She, like you, isn't really fond of the natural sciences. (99)
> Raven: I think that was kind of the low point for me in that . . . At first I was like, okay, I'll bounce back, I can study, I'll, you know . . . was really trying hard, but it just kind of felt like . . . the help wasn't really there. The second test I did better, I didn't fail, but . . . it wouldn't have been enough to bring up my grade . . . I'm not really one who's very, ah, my grades need to be perfect . . . I kind of went through my own grade crisis in high school . . . legitimately, it would have beyond ruined my GPA, to a point where it just would not have been acceptable . . . just to a point where if it was on a transcript I would not have been proud of it and I feel like it would have been this strange outlier in my transcript if I had to somehow explain to an employer or just, you know, if I was

> applying for a scholarship or something and they said, hey, why do you have the, I don't know, the D-plus or something in this class? (100)

Initial Analysis: Raven was understandably concerned about the implications of a poor grade on her transcript, but she did not point out what the low grade might represent in terms of how much she did or did not learn in the course. Although the transcript does not necessarily represent effort or the amount of learning that has taken place for a particular student, Raven was being realistic, given the possible effects of a poor grade on graduate school admission and employment opportunities.

> Raven [continuing]: I talked to [my class dean] several times . . . I have As in all my other classes and then a C-minus/D-plus in this class . . . There's obviously a disconnect . . . I'm taking four other classes on top of that class [and] a lot of other stuff. Still pulling As in those classes. Learning a lot. Feeling like I'm, you know, really fulfilled, and then this one class, just feeling like I'm not. It's a waste of my time . . . My advisor, who I don't really talk to except to get [preregistration] stuff done officially . . . just kind of signed it . . . trusted my judgment. (100)

Initial Analysis: It was clear that Raven was wise in withdrawing from the introduction to environmental science. Although she described feeling fulfilled in her other courses, she saw the environmental science course as a "waste" of her time. So the question remains: Did Raven get into this unfortunate situation with the course all by herself, or were there insufficient resources and inadequate information?

> Renee: Is your advisor in government? (101)
> Raven: She's in art history . . . I've absolutely no idea how I ended up with [an] art history professor, and she was really nice but not able to help me in any capacity other than if I wanted to take an art history class, which I didn't. (102)

Initial Analysis: Early in the interview, Raven had told me about her interest in the fields of government and sociology. Raven said she did not understand the process by which colleges assigned faculty advisors, and she suggested that the academic field of

a faculty advisor should coincide with the student's academic or career interests. Her previous comments about her advisor suggested that she had not forged a close relationship with her. Having had a lengthy and interesting interview with Raven, I wanted to elicit one more piece of information. Had the subject matter of the introduction to environmental science course affected her thinking about environmental issues?

> Renee: So do you think that this course has affected how you like think about the environment? Did it have enough time to make an impact? (117)
> Raven: It was interesting to see [how] global warming itself works, 'cause people would say, oh, there's global warming. But like what does that mean? How do scientists even measure global warming? I thought that was interesting. (118)

Initial Analysis: Raven's comment suggested that she had found some value in the subject matter of the environmental science course and that even though she had not completed the course, she had learned the science behind some of the major environmental issues of our time.

Overall Summary of Analysis of Raven's interview:

My lengthy interview (approximately 27 minutes) with Raven was informative.

1) She had been motivated to enroll in the course to complete distribution requirements and had withdrawn from the course because she was doing poorly on the exams. She said that she had lacked information about the nature of the course prior to her enrollment (a failure she ascribes to her faculty and peer advisors), and she attributed her problems in the course to a lack of support and poor course structure. Raven believed that she had been inadequately prepared in high school science and

managed to succeed by dint of forming effective interpersonal relationships with her science teachers and with a math tutor.

2) Raven liked learning the science behind such environmental issues as global warming, but said that her hard work in the course felt like a "waste" of time. She claimed to have good note-taking skills and study habits, and she was extremely busy with other classes, student government, her Internet business, blog activities, and tutoring in the local low-income community. She struggled with various aspects of the course and suggested that she was disadvantaged by her limited science background and the professor's assumptions about the students' preparation in the sciences.

3) An apparent contradiction in Raven's behavior was the limited interaction she had had with the course instructor and classmates outside of the lectures, despite her strong affinity for interpersonal relationships in academic situations. She dismissed the teaching assistants as ineffective. Similarly, she had not attempted to establish a relationship with her faculty advisor, perceiving that the professor was knowledgeable only about her own field.

CoP Analysis: The teaching-assistant sessions, designed to supplement the course lectures, offered an opportunity for students to pose questions to more advanced students. At Hillcrest, the teaching assistants in the environmental-science course were undergraduates, hardly older than the students enrolled in the course. In Lave and Wenger's terms, the sessions the teaching assistants were hired to facilitate could be viewed as a *practice*. Raven's charge that the teaching assistants twice failed to show up for a session points to a breech of a tacit social contract. Wenger (1998) describes three components of practice: mutual engagement, joint enterprise, and shared

repertoire. The collective negotiated aspects of the practice meant that by not showing up for the session, the teaching assistants denied Raven, her classmates, and even themselves the opportunity to learn. By learning, I do not mean acquisition of information. Rather, I am referring to learning in CoP terms, in which learning consists of the changes in identity that result when a group engages in a practice that negotiates and ascribes significance to a concept.

The concept of CoP allowed me to view Raven's professors and teaching assistants, as well as her math tutor and high-school faculty, as participants in communities of practice with which Raven was trying to be involved. In college, the CoP of the environmental sciences included the practices of which teaching assistants and professors (i.e., the homework sessions and the course) would be a part. Wenger (1998) defines a *community* as "a way of talking about the social configurations in which our enterprises are defined as worth pursuing and our participation is recognizable as competence" (p. 5). Through her experiences with the teaching assistants and faculty, Raven began to think that her participation in the enterprise was not worth pursuing. She described her attempts to get help and her perception that "the help just wasn't there," but she offered no evidence that she had undertaken to make the professor aware of the teaching assistants' unreliability.

When Raven described her positive experience with professors in the government and sociology departments, she provided further evidence to support viewing her experience through the lens of Wenger's (1998) concept of community. Also relevant to her impression of differences between the professors in various departments is the concept of identity that Wenger (1998) describes as "a way of

talking about how learning changes who we are and creates personal histories of becoming in the context of our communities" (p. 5). The process of building an identity, according to Wenger (1998), "consists of negotiating the meanings of our experiences of membership in social communities. The concept of identity serves as a pivot between the social and the individual, so that each can be talked about in terms of the other" (p. 145).

Wenger helped me understand that when Raven praised the faculty in some departments over others, the basis for her preference had less to do with the professors' teaching style than with the degree to which she grasped the subject matter. Raven liked the professors in government and sociology because she could easily engage in topical discussions with them (see Turn 22).

In light of Wenger's (1998) explanation that identity is deeply connected to questions of participation and non-participation, it made sense that the disciplines in which Raven felt most competent were those in which she sought further subsequent involvement through such practices as attending professors' office hours.

Meaning is "a way of talking about our (changing) ability——individually and collectively—to experience our life and the world as meaningful" (Wenger 1998, p. 5). This concept was illustrated in Raven's attributing the differences between her performance in the course and her peers' performance to their relative competence in mathematics and science. As Wenger (1998) explains, "negotiating meaning entails both interpretation and action" (p. 54). That suggests that Raven made sense of her participation in the course in part by assessing how her performance compared to that of her peers. She had a sense that her peers performed better and she attributed their

superior performance to competence rather than effort. Also noteworthy was that Raven stated, in defense of her inadequate performance, that her peers shared her frustrations regarding the course.

Like several other participants in the study, Raven had classmates who lived in her residence hall. I learned earlier in the study to recognize "talking with peers" as a practice in the CoP of the environmental sciences. It relates to the concept of community, being a constituent of the "social configurations in which our enterprises are defined as worth pursuing and our participation is recognizable as competence" (Wenger, 1998, p. 5).

Raven's descriptions of the experience of encountering the professor's assumptions about the students' previous exposure to sciences that she did not take in high school related to the concept of practice. Practice is "a way of talking about the shared historical and social resources, frameworks, and perspectives that can sustain mutual engagement in action" (Wenger, 1998, p. 5). Raven expressed a sense of exclusion in her remarks about the comments. In the excerpt below, Wenger (1998) reviews how practice facilitates learning:

> The concept of practice includes both the explicit and the tacit. It includes the language, tools, documents. . . . . But it also includes all the implicit relations, tacit conventions, subtle cues, untold rules of thumb . . . underlying assumptions, and shared worldviews. Most of these may never be articulated, yet they are unmistakable signs of membership in communities of practice and are crucial to the success of their enterprises (p. 47).

Raven's remarks suggested that she interpreted the references from her professor about the Advanced Placement courses as subtle cues of exclusion.

The faculty and peer advising programs fit the CoP concept of *practice* because they provide a context in which the advisors meet individually with first- and second-year undergraduates (who have not yet declared majors) in order to guide them in their selection of courses and other academic matters. As a practice, these meetings are part of "the shared historical and social resources, frameworks, and perspectives that can sustain mutual engagement in action" (Wenger, 1998, p. 5). The advising system, although not specific to the enterprise of studying the environmental sciences, is important to students' success in college and forms a part of a larger historical and social contract between students and the higher-education institutions, especially the kind of small liberal arts institution where the study was conducted. Raven's comments point out what happens when practice leads to poor outcomes. Raven's experience with academic advising in her first year of college contributed to her constructing an identity that did not include trust. An outcome of Raven's lost trust in the process was that she did not give other participants (faculty or peer advisors) the chance to engage in a collaborative learning experience with her.

Raven's involvement in numerous co-curricular and extracurricular activities suggests that she might have left herself only limited time to engage in activities/practices related to studying the environmental sciences, a field in which she saw herself as less well prepared than others. She immersed herself in activities that reinforced her sense of competence and success, consistent with what the CoP framework refers to as *community*, or "the social configurations in which our

enterprises are defined as worth pursuing and our participation is recognizable as competence" (Wenger, 1998, p. 5).

The concept of meaning provides a way to interpret Raven's response to those classmates who did not seem to be paying attention yet managed to receive a much higher grade on the exam than she did. *Meaning,* according to Wenger (1998) provides a way to talk about changing abilities in a CoP, and Raven felt increasingly less competent in the course. One aspect of meaning that Wenger (1998) describes is reification, or the symbolic representation of participation. In the context of the environmental science course, examination grades constitute a reified version of comprehension of the course material. While one might assume that students who performed well had studied and participated in the course activities, there may be many explanations for their success. From other participants in the study I learned that that, unlike Raven, some students (like April) had previous training in the environmental sciences. Some had taken Advanced Placement environmental science in high school, and others, unlike Raven, had strong backgrounds in science and mathematics. The limited information Raven had about her classmates' profiles caused her to struggle to make sense of the differences between her academic performance and theirs. Earlier Raven commented on her sense that some courses were inaccurately represented as introductory when in fact they unfairly expected students who enrolled to have stronger backgrounds in science. This observation would also connect to the concept of meaning as it relates to the ways that Raven finds contradictions in representation of the course in the catalogue versus the actual background needed for success.

Raven's rationale for withdrawal from the course provides additional support for the concept of *meaning* in this context. When she described her concern about the way the letter grade on her college transcript might be interpreted, she showed awareness of the way the academic transcript functions as a reification of a person's academic abilities and effort, regardless of such features as intelligence, creativity, resilience, and good character.

Rowan: (black male, duration of interview: 17 minutes)

Rowan and I began our conversation after a brief review of the procedures of the interview. He wanted to be sure that whatever he said was confidential. I assured him that it was.

> Renee: So you were enrolled in [the course] in spring of 2013? Intro to environmental science . . . why did you enroll in that course? (5)
> Rowan: Um, I enrolled in it because I was interested in environmental science and, like, its impact on our society today basically, and that was basically the main reason. (6)
> Renee: Now you shared with me that you withdrew. Why did you withdraw? (7)
> Rowan: 'Cause I wasn't getting the grades I thought I deserved in that class, basically. (8)

Initial Analysis: Rowan's interest in environmental issues was his motivation to enroll in the course, and his performance, as measured by grades, motivated him to withdraw.

> Renee: Ok . . . Since you were interested, what were some of the high points? (9)
> Rowan: Of the class itself I didn't have any high point. I didn't really like it. (10)
> Renee: So they were all low points? (11)
> Rowan: Yeah. (12)

Initial Analysis: I was surprised to hear Rowan say that although he was interested in the subject matter, he didn't like any part of the course.

Renee: So did you enter the class with any friends? Any peers? (13)
Rowan: One friend. (14)
Renee: Did you study together? (15)
Rowan: Not really. No. (16)
Renee: So did you have any support in your study of environmental science? (17)
Rowan: No. (18)
Renee: So you were doing this alone? (19)
Rowan: Yeah. (20)
Renee: Did you notice that other people had paired up in groups? (21)
Rowan: Yes. (22)
Renee: Okay, and is your sense of yourself that you're more a lone studier . . . You don't really do groups? (23)
Rowan: I would not necessarily say that . . . I would just say I just feel like I didn't really know that many kids in the class to begin with. (24)

Initial Analysis: Although Rowan had a friend in the class, they did not study together. He noticed that other people were paired up for studying, but he implied that the social atmosphere did not encourage people to make new friends. After a brief discussion about his residence on campus, I directed the interview toward a discussion of his pre-college experiences.

Renee: Tell me a little about your high school and your pre-college awareness of yourself with science. What was your experience with science? Did you think you wanted to do science? (31)
Rowan: I didn't have, like, such an in-depth experience with science, but I took biology and chemistry my freshman and sophomore years of high school. (32)
Renee: Okay, you took biology and chemistry in high school? (33)
Rowan: Umhm. (34)
Renee: And did you do well? (35)
Rowan: I got like a B/B-minus (36)

Initial Analysis: The interview revealed that Rowan did not have a strong high school background in the sciences. I struggled to find out more about him, but it seemed we had fallen into a pattern of short answers. Nonetheless I tried to understand what mattered most to him and how that might affect his involvement in the environmental sciences.

Renee: What other activities where you involved in outside . . . in high school and then again at [Hillcrest]? Were you an athlete? (39)
Rowan: Yeah, I'm on the football team. (40)
Renee: So in high school you played football, middle school, all from the beginning, so that consumed a lot of your time . . . When you were younger, what did you want to be when you grew up? (41)
Rowan: A lawyer. (42)
Renee: Okay, and are you aware of the opportunities to combine your interest in environmental issues and law? Environmental law? (43)
Rowan: But that seems boring though (44) . . . I've never heard of anything in that field (46)

Initial Analysis: Rowan stated that when he growing up he wanted to become a lawyer. When I suggested that he might explore environmental law, his response was that environmental law seemed boring. I was trying to resist assigning Rowan to a stereotype of a male athlete from a privileged economic background. During the interview, I noticed that Rowan was sniffling. He told me that he wasn't feeling well and might have the flu. We continued the interview after a brief discussion about the value of a flu shot.

Renee: But back to the topic. So you were motivated to enroll in the course because you . . . had some kind of interest in environmental science? What was going on in the rest of your life? . . .Were you playing for [Hillcrest] last spring? (59)
Rowan: Well, that was not the season, but I still had practices. (60)
Renee: Ah, so you had practice and you were pledging. (61)
Rowan: Yeah, I was . . . How do you know that? (62)
Renee: I know these things. It's my business to know. (63)
Rowan: How did you know that I pledged in the spring, not the fall? (64)
Renee: I put the dots together. (65)
Rowan: How? (66)
Renee: It would be unwise for you to have pledged as a first-semester freshman. (67)
Rowan: Other people pledged first semester. (68)
Renee: Well, that was not wise, but you were wise, so you waited until spring, yes? (69)
Rowan: Yeah. (70)

Initial Analysis: I learned that football took up a lot of Rowan's time. While enrolled in the environmental science course, he participated in off-season football practices and he pledged a fraternity.

> Renee: So that's what you were doing second semester. So time on task was limited . . . Did you do that project? (71)
> Rowan: I dropped it before the project. (72)

Initial Analysis: I told Rowan about my recollection of an assignment that the professor had issued while I was observing his class and, although he had withdrawn from the course by the time the assignment was given, Rowan seemed to me to be interested in the details of the project-based assignment. So I wanted to know more about his impressions of the format of the assignments, assessments, and lectures associated with the course.

> Renee: How did that course compare to other courses you were taking? (73)
> Rowan: Other science course I've taken or just? (74)
> Renee: Other general courses you've taken at [Hillcrest] in terms of size, and dynamics. (75)
> Rowan: It was one of my larger classes. (76)
> Renee: Do you think that that [class size] took away from the experience for you? Do you do large classes well? (77)
> Rowan: No, I'm more of a intimate class size [fan] 'cause I like to . . . build a, like, relationship with the professor, and I feel that helps me a lot when it comes down to, like, not necessarily grading but enjoying the course in general. I feel like that helps, but other than that, with the course I feel like the teacher—I'm trying to remember . . . Did he do a lot of PowerPoints? (78)
> Renee: All PowerPoints. (79)
> Rowan: Yeah, I don't really like that. (80)
> Renee: And [the electronic course-management system]. (81)
> Rowan: Yeah, PowerPoints . . . I know that's how we're, like, shifting today in our generation, but I feel like it . . . put me to sleep, just like staring at it the whole time instead of like having a discussion. (82)
> Renee: You would have done better in a discussion-based? (83)
> Rowan: Yeah, it's easier for me to pay attention in a discussion-based class. (84)

IA: I learned that Rowan did not like the lecture-based format of the course and the heavy use of PowerPoint presentations. He prefers a smaller class with a discussion format.

> Renee: What do you think if they had field trips? (85)
> Rowan: Yeah, field trips are always fun. It's just like getting out of the class. It's more hands-on. (88)

Initial Analysis: The professor had organized the optional field trip to the dairy farm, but I assumed that if Rowan had already withdrawn from the course before the due date for the project assignment he might not have known about the field trips. After a brief exchange about field trips that did not produce any insights, I focused my attention on getting Rowan's impressions of his classmates in the course.

> Renee: Did you . . . do other things in class besides trying to pay attention to the screen? (93)
> Rowan: Not really. (94)
> Renee: You weren't one of those people who had your computer open? (95)
> Rowan: No, I don't bring a computer. (96)
> Renee: Okay, but did you notice anything about how other people did? (97)
> Rowan: Oh, yeah, you see it a lot. I don't know, like, it's just like the culture of, like, the back of the classroom. You have your laptop open. You're in the class, just doing other things. (98)

Initial Analysis: Previously Rowan had mentioned that the lecture format made it hard for him to pay attention to the lecture. I wanted to know if there were other things competing for his attention during lectures. He stated that he did not bring a computer to class but that he felt there was a subculture in the back of the classroom in which students, although present, were disengaged from the lecture. I wanted to know more about Rowan's interaction with the professor and teaching assistants.

> Renee: Did you go to his office hours? (99)
> Rowan: I went to all the TAs', I'm pretty sure. (100)
> Renee: Okay, the TA sessions, the homework sessions. (101)

Rowan: Yeah. (102)
Renee: Okay, but you did go? (103)
Rowan: I don't think I went to the office hours. (104)
Renee: Do you have a sense of why? Is it something you don't do? (105)
Rowan: No, I go to office hours a lot, I don't know why I didn't. (106)
Renee: You didn't really feel like it would work out? (107)
Rowan: Yeah. (108)

Initial Analysis: Although Rowan stated that he had gone to the homework sessions offered by the teaching assistants, it took several attempts to get him to tell me that he had not gone to meet with the professor during office hours. Toward the end I may have led him into saying that he didn't think office hours would be helpful.

Renee: How do you think your peers in your class were . . . doing, and did you have a sense that other people were thriving in ways that you weren't? (109)
Rowan: Actually my other friend that was in the class, he dropped it with me and, um, this upperclassman who was taking it didn't really like it at all. I forgot his reason for it. I feel like the material that we covered was . . . broad and dense for, like, an introduction class that we were just overwhelmed by it and he [the professor] didn't explain it that well in class. (110)
Renee: Did you feel that you could ask questions in class? (111)
Rowan: Do you remember kids asking questions? (112)
Renee: I don't. I remember maybe two or the same people asking a few questions . . . when he would ask questions. (113)
Rowan: I'm trying to remember how he taught the class, um . . . I feel like it was conducive to asking questions but kids really didn't know what to ask. (114)

Initial Analysis: Rowan told me about two students who, like him, withdrew from the course, and he stated that they shared his negative assessment of the course. I wondered why Rowan (and others) did not ask clarifying questions during lecture, and Rowan suggested that the level of confusion might have been so deep that students did not know what to ask. I wondered if the "culture" that Rowan described as characterizing the back of the classroom was involved. Were students unknowingly inhibiting each other from asking questions as they pretended to understand? As the

interview was coming to a close, I wanted to know if Rowan saw any benefits to his limited experience in the course.

> Renee: Can you recall anything in particular? Anything in the course that was, you know, was a take-away during the time that you were just kind of making it through the class? Was there any topic that was covered that kind of deepened your consciousness about environmental issues or concepts? (115)
> Rowan: Are you saying what theme, like, caught my eye the most? (116)
> Renee: Umhm. (117)
> Rowan: I feel like I never knew, like, the amount of acid rain we had. That was new to me. (118)
> Rowan: Yeah, I think that stuck with me the most. I'm trying to remember from that class. (124)
> Renee: Why do you think that stuck with you? What was it that made it so concrete . . . was it a concept that you'd wondered about before? (125)
> Rowan: Umhm, not really. Probably because I don't know, like, it rains a lot and it's happening probably every single time it rains. It's like, people aren't aware of it and it's kind of a big issue, so that's what stuck with me. Why aren't, like, more people, like, concerned about it when it is a real issue? (126)

Initial Analysis: Rowan described his interest in learning about acid rain and thought that more people should be concerned about it. I was beginning to think that perhaps Rowan had a deeper sense of environmental consciousness than I had previously thought.

> Renee: Do you live an environmentally conscious, um, lifestyle? (127)
> Rowan: Me, myself. What do you mean by that? (128)
> Renee: I mean, like, do you think about water? (129)
> Rowan: Do I recycle? Yeah, I recycle. (130)
> Renee: Good. (131)
> Rowan: Turn off when I brush my teeth (132)
> Renee: Good. (133)
> Rowan: And stuff like that. (134)

Initial Analysis: Perhaps even prior to enrollment in the environmental science course, Rowan had been making good decisions regarding his use of natural resources, as described by his accounts of daily practices of water conservation and recycling.

Renee: Do you have anything that comes to mind that you want to share with me for the sake of this advancing knowledge . . . in the context of studying science or just studying it at [Hillcrest]? (139)
Rowan: I don't get the . . . Do I want to add anything? (140)
Renee: Yeah, like any last bit . . . is there anything that you've been thinking about. . . you've been wondering . . . any critique you have? (141)
Rowan: Of this course at [Hillcrest]? (142)
Renee: Yeah, the course. (143)
Rowan: Does it have to be such a big lecture? I don't get, like, what decides what . . . can be a big lecture course. (144)
Renee: I think it's demand. (145)

Initial Analysis: As we brought the interview to a close, the one thing that Rowan wanted to comment on was the large-lecture format. Discussions about the size of the lecture have emerged in interviews with several students. Students like Rowan who think that they learn best through questions and discussions are less engaged in large lecture-based courses, and the problem of disengagement may be exacerbated as the enrollment in the course increases.

Initial Analysis: Overall Summary of Analysis of Rowan:

During my 17-minute interview with Rowan, I learned: the following:

1) Rowan enrolled in the course because he was interested in environmental science and its impact on society, and he withdrew from the course because he was not getting the grades he thought he "deserved." Rowan's comment about his grades may have been intended to suggest that he was dissatisfied with his performance rather than that the grades he received were an inaccurate representation of his knowledge of the topic. Additional insight into Rowan's experience in the environmental science course was revealed when I asked Rowan about his career goals. When. I suggested the possibility of combining environmental science and law, he viewed the idea as boring—without knowing anything about the specialization to which I had referred.

2) Although earlier in the interview Rowan had stated that he did not like any part of the course, by the end of the interview he mentioned that he liked learning the science behind acid rain and felt that more people should be concerned about this environmental issue.

3) Although Rowan had friends in the course, he studied alone. This fact was interesting because later in the interview Rowan mentioned that two classmates also withdrew, for reasons similar to those he expressed during the interview. Rowan's deep commitment to football and participation in off-season practice and pledging a fraternity while he was enrolled in the environmental science course caused me to wonder about the amount of time and focus he directed toward his studies. Rowan's description of a culture in the back of classrooms in which students do not pay attention to the lectures seemed to suggest a familiarity with that culture, although I was not able to confirm whether he participated in it. Another feature of the course that Rowan helped me notice was the infrequency of questions during lectures. Rowan thought that the lecture was conducive to asking questions but that students might not have known how and where to begin.

CoP Analysis: The theory of CoP uses the concept of practice as "a way of talking about the shared historical and social resources, frameworks, and perspectives that can sustain mutual engagement in action" (Wenger, 1998, p. 5). The course in which Rowan enrolled could be considered a practice. However, Rowan failed to engage in the course as a practice of the CoP of studying the environmental sciences. Several aspects of his participation in this practice suggested the low level of engagement Rowan had with the enterprise of the environmental sciences. First, although he

enrolled in the course with a friend, he stated that they did not study together, and Rowan did not make new friends among his classmates. Second, he was not interested in exploring ways to combine his interest in law and the environmental sciences into a future law career. Third, Rowan explained that he did not like the large-lecture format or the use of PowerPoint slides as lecture aids, but preferred intimate, discussion-based seminars. Fourth, he did not make use of the professor's office hours. This choice was domain-specific because he stated that he did attend other professors' office hours.

Rowan's comments about peers who likewise did not like the course and withdrew from it relate to the CoP concept of *meaning*, "a way of talking about our (changing) ability—individually and collectively—to experience our life and the world as meaningful" (Wenger, 1998, p. 5). Rowan's comments highlight a way in which he assumed, because several other students withdrew, that these students and others would corroborate his conclusion that the course was a problem. This aspect of Rowan's interview also addressed the role of *community*, "the social configurations in which our enterprises are defined as worth pursuing and our participation is recognizable as competence" (p. 5). Students take cues from their peers about what is acceptable and what is not. Rowan's statement suggested that he found his own decision to withdraw from the course reasonable, in part because he was not getting the grades he thought he should, and also because other students shared his poor opinion of the course. In those peers he found people with whom he could identify, something he could not do so readily with those who remained enrolled.

Critical Race Theory (CRT) and Stereotype Threat (ST) Analysis:

A primary interest in this study concerns the underrepresentation of blacks in the field of environmental sciences. I was interested in learning whether and how issues of race influence the patterns of participation by blacks in the field. I thus wanted to explore the interpersonal experiences black undergraduates have while pursuing the environmental sciences in the United States. To avoid leading the participants in the study to the topic of race, I waited for the participants to mention race before exploring the issue in relation to their participation in the environmental sciences. When participants mentioned race, I expanded the discussion.

Rowan, a black male, did not reference race. During the interview, Rowan told me that he lived in the house belonging to his fraternity. I was aware that the fraternity he mentioned is a predominantly white organization and that several of the undergraduate members of the fraternity were also members of the Hillcrest football team. The fact that Rowan's interview did not include comments about race does not negate the relevance of race in his experiences in the environmental sciences. His association with the fraternity and the football team, as social institutions, provides a context for applying Critical Race Theory (Delgado & Stefancic, 2001) to his comments.

The conceptual framework of Critical Race Theory (Delgado & Stefancic, 2001) offers a perspective on Rowan's overall experience in the environmental sciences. CRT provides a way to analyze the socio-political context in which Rowan operated in the lecture hall—where he might have sat in the back of the room (or at least was familiar with the culture of sitting there)—and on campus—where he was a member of a predominantly white fraternity and a member of the college football

team. The use of CRT in analyzing Rowan's interview involves exploring his association with institutions such as the fraternity and the football team as places where Rowan's large physical stature and race were "read," to use a CRT term, in a particular way. Solorzano (1998) offers an economic perspective on the value that the dominant society places on black bodies according to the demands of the labor market. College football can be viewed in economic terms. Delgado and Stefancic (2001) argue that contemporary U.S. society remains a race-conscious setting in which white people are privileged and people of color are subordinated. That means that Rowan's black body may be read by the larger society as threatening in some settings, such as academia, yet is celebrated in the aggressive sport of American football. Another interpretation of Rowan's association with the fraternity and the football team is that his membership in the predominantly white fraternity and his decision to live in the fraternity house suggests that Rowan is immersed in the practices, for better or worse, of the fraternity. Although the pledging process for many of these fraternities is thought to be a secret, members of the administrative staff acquire intelligence about the pledging processes in the interest of insuring the safety of pledges. Rowan expressed surprise and a degree of indignation when he discovered that I knew he was pledging while he was enrolled in the introductory course. He would likely have resisted any suggestion that the demands of the fraternity and the football team, even during off-season, posed an additional barrier for him as a black male athlete expected to perform on the field and seeking social acceptance.

The importance placed on the fraternity and the football team (Division III) speaks to another facet of Rowan's interview for which the concept of Stereotype

Threat (Steele, 2003, 2010) is useful. Stereotype Threat deals with the psychological and emotional response to the fear that one may confirm the stereotypes others attach to one's particular social identity. The manifestation of Stereotype Threat has been demonstrated to cause low performance by otherwise academically well-prepared middle-class black college students (Steele, 2003). Rowan's association with the fraternity can be viewed as the type of adaptive strategy that Steele (2010, 2003) discusses in which blacks engage in *disidentification* from a domain in order to gain acceptance into the dominant society; disidentification can express itself though adoption of the dress, speech, and culture associated with the dominant group. This concept may explain Rowan's strong allegiance to the football team and the fraternity, which help him manage how that society treats him as a black male.

Initial Analysis: Similarities and Differences between Raven and Rowan:

At first glance, the main similarities between Raven and Rowan are their academic year (freshman) and their decision to withdraw from the course. Their differences of gender and race are far more pronounced. Raven stated that she enrolled in the course to fulfill distribution requirements, and Rowan stated that he enrolled because he was interested in environmental sciences. However, they pointed out similar issues during their interviews. They withdrew from the course because they were getting low marks on their exams. Rowan stated that he was getting grades he did not deserve, and Raven was frustrated that the student who watched soccer matches on his laptop instead of paying attention in class had received a strong grade on an exam that she had failed. While Raven described having limited information about the course and blamed poor faculty and peer advising, Rowan had different

complaints. Raven mentioned her father's interest in her pursuing science and noted that she had discussed her decision with her parents before withdrawing. Rowan, on the other hand, did not mention consulting anyone about his course selections or the decision to withdraw.

Both Raven and Rowan described their learning styles and the features of the course format that did not meet their needs. Raven stated that the professor and the teaching assistants were not accessible, her faculty and peer advisors were poorly informed, and she was unable to forge effective interpersonal relationships with them. When I inquired about their use of the professor's office hours, Raven stated that she had met with the professor on three occasions, including once to withdraw from the course, and Rowan informed me that he had never taken advantage of office hours. Both stated that they had attended homework sessions facilitated by teaching assistants.

Both Raven and Rowan commented that they disliked the lecture-based format of the course and the extensive use of PowerPoint. Raven thought the course was disorganized and did not line up with the readings. Rowan stated that although the course was conducive to asking questions, students did not know how to ask them.

Both Raven and Rowan were involved in various extracurricular activities that consumed time and energy. Both claimed to have been attentive during lectures and to have studied alone. Raven and Rowan cited evidence of classmates who were disengaged from the lectures, whether watching videos during lecture (Raven) or sitting in the back of the classroom and engaging in activities unrelated to the course (Rowan).

Group 3: Silver, Violet, and April:

Silver, a black female, and Violet and April, white females, had all taken

Advanced Placement environmental science in high school. The three participants all enrolled in the introduction to environmental science, but unlike Silver and April, who enrolled during their freshman year, Violet registered for the course as a sophomore. At the time of the interview for the study, Silver had not yet declared a major, while April had declared a major in archeology and classics, and Violet had declared a major in environmental studies.

Silver (black female, duration of interview: 12:29 minutes)

After a brief review of the terms of the interview and the consent form, I began with an inquiry into Silver's background in science.

> Renee: To start, I'm interested in knowing a little about your biography as it relates to science in general, but more specifically environmental science. So I'm interested in understanding how you came to decide to enroll in this course. (16)
>
> Silver: I took an AP environmental science class my last year in high school as a senior. . . basically I'd already had an interest in sciences . . . since I was a little girl. However, that really gave me an insight on environmental science that I'd never really looked at, and it made me realize that environmental science [was] way, much more than I thought . . . I ended up, you know, passing the class with a really high A and also I took the AP exam and made a 3 on it as well, so that was a major accomplishment. But it more so showed me that environmental science was, like, a study or a field that I might be interested in . . . as far as career terms. (17)

Initial Analysis: Silver's background in science, especially the Advanced Placement course in environmental science, suggests that she believes she had the interest and preparation to pursue the field.

> Silver [continuing]: So the class, you know, the experience of being in high

> school and then when I saw the class here on the course log, it was like, okay, it shouldn't be that hard. It should basically recap what I learned in high school and basically I'll be learning more about environmental science . . . Luckily I got into the class and I'm enjoying it so far, um, I'm comfortable with the material and possibly I might end up majoring in environmental science. (17)

Silver's preparation in high school gave her a strong sense of confidence about enrolling in the course.

> Renee: Okay, so tell me about what was going on in the . . . rest of your life? (20)
> Silver: Um. Well, currently I'm a part of [a low-income neighborhood after-school program] where we tutor kids . . . I'm a part of a dance group . . . from my last semester experience I try not to put myself in too many programs and activities that will stray me away from my studies because it takes time to study for the subject, especially environmental science . . . I'm not in a lot of things that I would like to be in just because I want to get the material and I want to be able to pass the exams and complete the assignments, so I mean, I'll say I'm in two clubs so far. (21)

Initial Analysis: Silver had set up a schedule for herself that left time for studying the environmental sciences. I concluded that she did not think she would breeze through the college course, even though she had taken AP environmental science in high school. Therefore, I was especially looking forward to learning about her approach to studying environmental science.

> Renee: How do you study the material? How do you study, and do you study solo or with others? (26)
> Silver: Um, first I study solo . . . I re-read the information that I took in class, like the notes I take, [refer] to [the] PowerPoint, and then if I have questions I write them down so that I can go to my professor and email him and also I find myself now forming a group of people who actually live on my hall. (27)
> Renee: What hall do you live on? (28)
> Silver: I live on the writing hall . . . and so two of my . . . I guess, hall mates are actually in the class. (29)

Initial Analysis (IA): Silver described her technique of studying the environmental sciences as a process that starts off as solitary and may move toward discussions with the professor or peers. The process included reviewing notes and course resources and writing down any questions she had in order to review with the professor or hall mates from the class with whom she had formed a study group.

> Renee: Have you managed to go to any office hours? (32)
> Silver: I haven't been to office hours . . . it's been mostly email because I have . . . other things to do, but like as far as . . . information sessions or sessions that he does hold I make a way to get to those so that I can ask him personally . . . so he can answer me. (33)

Initial Analysis: Although Silver was communicating with the professor by email, I wondered whether the electronic medium was able to provide the informal support and encouragement that students sometimes require. I wanted to hear whether she was simply posing questions and getting answers, and how Silver's experiences in the introductory environmental-science course compared to those in other courses.

> Renee: Good. So, um, tell me how this course compares to other courses you've taken in the past or during the semester. So either last semester or this semester of college classes. (40)
> Silver: In comparison to other classes, for one, this is my largest class, so at first I was . . . kind of uneasy about that 'cause I don't feel like, ah, I'm good in large classes as far as feeling like I'm an actual factor in the class. But from it being a large class I feel like I'm able to learn more because there are more people and there're more people asking questions and different questions and some of the questions I actually have, so my questions are being answered. (41)
> Renee: Umhm. (42)

Initial Analysis: The issue of the large enrollment of the course has been a recurrent theme among most of the participants I have analyzed so far. I wonder how much the students are affected by the transition from high school to college, and whether they

had specific expectations about class size when they enrolled in a small liberal arts institution.

> Silver: At the same time I am learning from other people who answer the questions, 'cause they know, they might know, something that I don't know, so they're saying something that's totally different . . . the class has been so far a great experience . . . I kind of like that it is a big class overall and in comparison to, like, I guess, last semester's classes. I like the professor, he is a really nice professor, um, he is very sweet and he makes sure that . . . he's always making sure in some type of way, either it's a funny way or a learning way, but it's like we all grasp the information. (43)

Initial Analysis: I was surprised by Silver's statement about questions and the benefits of a large class in providing increased opportunities to hear other people's questions. Her follow-up statement about the benefits of a large class contradicts her earlier statement about course size, and I did not know what to make of the claim that the professor was "nice" when she interacted with him only as a figure in front of the lecture hall and by email.

> Renee: Very good, so, um, can you think of some high points and some low points? I know we are still in early phases of this class. (44)
> Silver: I guess I'll tackle the low points first. Low points would be . . . the interaction between us and the professor, like, there's certain people, you know, who will answer the questions, but I kind of feel like as a teacher he should . . . start calling on people because then . . . the students feel like they are being a part of the class, as well as also, like, learning the information. (45)

Initial Analysis: Here Silver suggested that she did not like that only some students posed questions and commanded the attention of the professor.

> Silver [continuing]: I mean there's tons of us in the class, so he can't get to everybody, but at the same time he needs to make sure that everybody, I guess, understands and is able to formulate some type of question, like, I know everybody has questions but everybody doesn't ask, so I think that he needs to be more . . . I don't want to say demanding, but more assertive as far as having different people talk . . . I mean, you get tired of hearing the same people ask questions and you feel like they're,

like, the smartest ones in the class, but there're other people, um, and I think that's the only low point I have for the class, because we just started and we don't, um, we don't really, I guess we haven't really learned much about him as a professor. (45)

Initial Analysis (IA): Silver's comments suggest that she did not like an approach that suggested favoritism.

Silver [continuing]: High point would be again to reiterate the fact that everybody needs to understand what he's talking about. He makes sure that before we all leave out of the class, you know, d'yall have this? He asks us a lot . . . he teaches at a nice pace . . . I don't know, he doesn't flip through the slides; even though there are a lot of slides, we still get through the whole presentation and sometimes we're even able to go into a presentation that's gonna be next class. So he's, he has a good pace of teaching, and he's also an interesting professor. He's not boring. He's not dull. He's not old. He's not, you know, too young. He's, you know, right there. (45)

Initial Analysis: Silver describes the high point of the course as the professor's style of teaching, which was not what I expected her to say after her lengthy statement about her frustration with some aspects of the classroom dynamics. I wonder what the professor's next step would be if students responded, "No, we do not understand." Would he keep them after class, tell them to come to office hours, or something else? These are important considerations. To what degree are professors' checks with students just rhetorical questions or solicitation of sincere feedback? And how hard is it to say, especially in a large lecture hall, "No, I don't understand?" Unfortunately, this interview suggests that few students speak up in class.

Renee: So . . . as we bring the interview to a close, is there anything else you want to mention about your experience with this course this semester so far? (48)

Silver: I would say that . . . I like the way he did his exam setup. We just took our first exam and he had us do multiple choice. He had matching. He also had a short answer and he had a kinda, like, essay, but for me to be taking my first college exam it wasn't as bad as I thought it would be. Like I thought it would be, you know, I don't know, blowing out of my

> head, but, like, because he taught me so well and because I was able to retain the information so well, I feel like I was able to execute the exam. (49)

Initial Analysis: Overall Summary of Silver:

I interviewed Silver for approximately 13 minutes. I learned 1) That she had taken AP environmental science in high school and, based on her score on the exam, felt prepared to excel in the college course. 2) Silver raised the issue of the large size of the course but explained that there were benefits to large classes. According to her, the large class size resulted in increased and more varied questions from students, and more people to respond to questions, yet larger classes made participation difficult for some students. Silver shared with me her frustration that only a limited number of students actually spoke up in class. I think that when she described the need for some students to feel that they were a part of the class she was describing her own reticence in the lecture. 3) Although Silver had refrained from overloading her schedule with extracurricular activities that might have taken time away from studying for classes, her reliance on email rather than office visits with her professor suggested a missed opportunity to cultivate a closer tie with the professor.

CoP Analysis: Silver enrolled in the course with prior experience in high school with environmental science. Her confidence was high, and she was considering a major in the discipline. The CoP concept that practice fundamentally changes *identity* provided a useful way to explore some aspects of Silver's interview. The *learning trajectory* is an aspect of identity that Wenger (1998) describes. The concept is based on the premise that "we define who we are by where we have been and where we are going" (Wenger, 1998, p. 149). Of the five types of trajectories that Wenger introduces,

Silver's comments suggest that she was functioning in the category in which "newcomers are joining the community with the prospect of becoming full participants in its practice. Their identities are invested in their future participation, even though their present participation may be peripheral" (p. 154). Wenger (1998) calls this type an *inbound trajectory*. Silver's investment in a future in which she would fully participate in the environmental sciences was demonstrated in the decisions she made. These decisions included careful attention to her schedule so as to avoid overloading it in ways that might interfere with her studies. Additionally, she had a strategy for studying and occasionally met with hall mates from the class to discuss aspects of the course.

Silver's interview also brought up concerns with class size. While other participants mentioned their impressions that the large-lecture format affected their experiences in the course, Silver described the issue differently. I thought the idea of feeling insignificant in the class was worth exploring further, as it could affect her learning trajectory. Wenger's (1998) description of the CoP concept of *community* provided an effective starting point for eliciting the implications of Silver's feelings about her marginal participation in the course. She could not engage in the practice as some of her classmates could. Silver recognized the social aspect of learning, and her comments included important points that illustrated the CoP framework. For example, Silver acknowledged that she learned from the questions asked by her classmates and that learning would be enhanced if the professor called on students and enlisted the participation of the silent majority. Silver's comments related to the concepts of *mutual engagement* and *joint enterprise*, which are two of the three dimensions of

practice as the property of a community that Wenger (1998) outlines. The third dimension, which I was unable to detect in Silver's comments, involves a *shared repertoire*, which results over time as classmates interact in class and develop a set of "shared resources for negotiating meaning" (Wenger, 1998, p. 82). Shared repertoire takes longer to be established, and Silver was still in the early stages of the course when she participated in the study.

Critical Race Theory (CRT) and Stereotype Threat (ST) Analysis:

Like Rowan, a black male, Silver, a black female, did not introduce the topic of race. However, Critical Race Theory (Delgado & Stefancic, 2001) provides a way to explore some of the societal implications of issues that Silver raised about the social context of the course. In particular, the phenomenon of reticence in classroom participation can be viewed through the lens of CRT in the de facto racially segregated elementary and secondary schools in the nation. Silver comes from a major city in the South, and although she was a successful student in high school, she may have studied with only a few white students. At a highly selective private liberal arts institution like Hillcrest, Silver was likely to find herself in only a few courses with other black students, and there were certainly only a few in the introductory environmental science course. Without additional comments, I was unable to identify how, specifically, race affected Silver in the course, but it was likely that the students who asked questions and answered the professor's questions during lecture were white, as I noticed while observing the course during the pilot for this study.

Reluctance to ask and answer questions in lecture can also be viewed as a manifestation of Stereotype Threat (Steele, 1997, 2003, 2010; Steele & Aronson,

1995). Applying the framework to Silver's comments about her refraining from speaking in class provides a perspective on her experience that places her behavior in the category of an adaptive strategy. Perhaps it means something different for white males to refrain from speaking in class than for white females and members of racial minorities; American society tends to view white males as competent and entitled to speak, and white females and persons from racial minorities as less competent and less entitled to speak. The concept of Stereotype Threat (Steele, 1997, 2003, 2010; Steele & Aronson, 1995) suggests the possibility that Silver and others may have calculated the costs/risks of speaking in class and thereby possibly confirming a negative stereotype about themselves as female or as black. The unfortunate reality of such avoidance is that while it minimizes the possibility of confirming a stereotype, it may have a negative effect on engagement and learning.

Violet (white female, duration of interview: 13:07 minutes)

> Renee: What motivated you to enroll in the intro to environmental science course this semester? (7)
>
> Violet: Well, one reason is that there are other classes that require this class. It's a prerequisite for other classes that are, like, more specific and interesting maybe. Also I guess I feel like maybe it will, ah, just . . . help me increase my understanding of life processes and, ah, earth processes . . . and maybe if I can sort of imagine the world in a more, sure, concrete way, then I'll be able to make different decisions about how I interact with the world. Sometimes I feel like now my decisions . . . I'm not really sure about what I'm doing, especially with regard to, like, sustainability . . . If I knew more about the different processes that go into that, I can make decisions with more confidence. (8)

Initial Analysis: I learned that Violet had enrolled in the introductory environmental science course to satisfy a prerequisite for further courses in the field, and that she

wanted to increase her understanding of environmental issues (e.g., sustainability) to improve her life decisions.

> Renee: You're going to major in one of the environmental areas? (9)
> Violet: I think I'm going to do environmental studies. (10)
> Renee: In the fall did you consider enrolling in the environmental studies course? (11)
> Violet: I did . . . I had a lot of classes . . . I had like six or seven classes that I was interested in taking, so that was one of them—but I went to, like, the first day and I could have taken it . . . but it seemed, I don't know, it seemed sort of, like, vaguer. (12)
> Violet: Also I had another class in that same lecture hall and I was like, I don't want to be sitting in here for this whole semester, so like, for a number of reasons. And my schedule is a lot more balanced with the different class instead. (14)
>
> Renee: And so far, being in this course, could you tell me about some of the high points and low points that you've noticed in this particular course? (15)
> Violet: Well, I feel like most of the stuff I sort of have learned before I took the first semester AP in environmental science in high school and it's nice. One high point is kind of like going over that, and clarifying things that I've kind of forgotten . . . for some reason I never really understood like, the wind patterns, before as much as I did after he went over it in this class. That was a high point. Also the stuff about lakes. And I really thought that about, like how the distribution of matter in lakes changes throughout the year. (16)

Initial Analysis: The fact that Violet took advanced-placement environmental science in high school puts her at an advantage over classmates who were encountering the material for the first time in the college course. Violet clearly articulates how the college course helped clarify and remind her about concepts related to the environmental sciences.

> Violet [continuing]: Low points are when I feel like we spend a lot of time on something and it doesn't really make sense to me. Like I don't understand how we can date the age of the earth based on meteors . . . Sometimes there's stuff that we learn and it's clear that in order to really understand it you have to go really really deep into it and obviously we don't have time for that in the class so, like, that's sort of frustrating. (16)

Initial Analysis: The things that Violet didn't like or found frustrating were all related to mastery of the content of the course. She did not comment on the physical location or other aspects of course activities, though earlier she commented on the lecture hall as a consideration in her decision not to enroll in the environmental-studies course in the fall. I recall from observing the course lectures that they took place in two different lecture halls. Both halls had fixed row seats, no windows, and a podium and screen marking the front. I recall that Violet had another course in the same lecture hall that semester. Perhaps it was going to the same location for different courses during the same semester that was the concern rather than the lecture hall itself. Aside from the lectures, I wanted to know if Violet was communicating with the professor.

> Renee: So, when you have those moments of wonder and kind of an incompleteness . . . (17)
> Violet: Yeah. (18)
> Renee: Have you been able to do anything about that? (19)
> Violet: Well. (20)
> Renee: Go to the office hours? (21)
> Violet: Never been to office hours. I've talked to people about it because I have a lot of friends in the class . . . so it's nice. And I, like, can do some research on line. But also I'm like super busy. I have tons of other things to do, so I don't have, like, that much time to really devote to doing my own research. So I don't generally do much about it. (22)

Initial Analysis: Like several students in this study, Violet mentions that her busy schedule prevented her from taking advantage of office hours. She comments that she searched the Internet and implied that she consulted the many friends she had in the class when she experienced difficulties, rather than going to the professor's office hours.

> Renee: What about this idea of doing independent research? A number of students in their junior and senior year or during the summer here at [Hillcrest College] will get the opportunity to do research with a faculty

member. Is that something that you think you might be interested in doing at some point? (23)

Violet: Yeah. It definitely sounds interesting. I haven't, like, really thought about it at all or considered it. (24)

Renee: Have you done any kind of independent research before, like in high school? Did you do any competitions? Anything that exposed you to research? (25)

Violet: Not like that thoroughly . . . I do art, and that's like what I normally do for extra-curricular . . . I don't know, in high school I didn't really like science class that much, and I don't know if I even like hard science that much, just because I can't really relate to all of the, like, diagrams and [inaudible] and things. So even though I would like to think it would be cool to do, like, my own research [inaudible] and I could sort of build it in a way that makes sense to me. I [was] never really inspired that much by any of my science classes ever. I think environmental science is something I can relate to a little more. And it's sort of one of those things that I think its important, or, like, studying science I think it's important to study. But it's not like super-natural for me, so I never was really, like, inspired to do extra work [and] my own projects. It's more like for understanding how other people see the world and how, like, our society has developed. (26)

Initial Analysis: I was surprised by Violet's statement about not really liking science and science class in high school. I had interpreted her comments in the earlier part of the interview as suggesting that she enjoyed science. This part of the interview revealed that she believed that it was something that demanded a great deal of effort on her part and that she planned to use the environmental sciences to explore their relation to society. Violet was interested in the application of the science rather than the academic study of it.

Renee: So I know you mentioned that you have a number of friends in the class. (27)

Violet: Yeah. (28)

Renee: And how do you spend your time outside of class? Do you all talk about the course? Study together? (29)

Violet: We never talk about it that much. Yeah, we like study together and work on the assignments together and it's nice to have other people to talk to about it. (30)

Renee: Do you all live in the same area? (31)

Violet: Yeah, it's actually pretty cool. There're like four girls who live in my

dorm. (32)
Renee: Is it Writers' Hall? (33)
Violet: No, Green-Living Hall. (34)
Renee: Green-Living Hall. Okay. (35)
Violet: Green-Living Hall and then, like, I'm not on Green-Living Hall, but there's two people on Green-Living Hall and then, like, three other people on my floor. (36)

Initial Analysis: I learned that Violet did not live on Green-Living Hall, part of a campus dormitory dedicated to an environmental theme, but that she had several classmates who resided in the same residence hall (on separate "theme" floors). They studied and completed course assignments together, but, according to Violet, they seldom discussed the course. It sounded as though when she met with her classmates in the residence hall to study and complete homework assignments, they were engaged in meaningful interactions related to the course, developing their understanding of the concepts associated with the environmental sciences. Whether she did not recognize these types of interactions as "discussions" about the course was unclear to me.

Renee: That's great. Can you think of anything else that you, um, want to share at this time about just, kind of your general impressions of the course and the discipline of environmental studies. (37)
Violet: Ahhh, not really. (38)
Renee: I'd like to interview you again after spring break, maybe after we get back . . . Just kind of ask you similar questions about your impressions and maybe a few other questions. (39)
Violet: Cool . . . cool (40)
Renee: Thank you! (41)
Violet: This was good. It helped me understand myself. (42)
Renee: Now, I'm very happy to hear that. (43)

Initial Analysis: As I prepared to bring the interview to an end by inviting the participant to tell me if there was more to share, I was pleased by Violet's comment that the process of the interview had been beneficial, helping her to understand herself better. Her statement was a reminder to me as an interviewer that I was engaged in a

social experience with the students who had volunteered to participate in the study. The experience of the interview could challenge and alter the way they viewed their involvement in the environmental sciences. The idea that I had identified the environmental sciences as the context of my study suggested to the participants that there was something special about the field worth exploring. I did not give the participants a great deal of detail as to the purpose of my study because I did not want to influence what they disclosed.

Initial Analysis: Overall Summary of Analysis of Violet (advanced-placement environmental science):

I interviewed Violet for approximately 13 minutes. I learned 1) Violet enrolled in the course to satisfy a prerequisite for more advanced courses (a possible major) and to increase her understanding of environmental issues in order to make more environmentally conscious decisions in her daily life. She had considered enrolling in the introduction to environmental studies offered in the previous semester but decided against it. Her rationale for the decision had to do with the specific lecture hall, the balance of her schedule, and a sense that the fall "studies" course was "vague."

2) Violet, who completed AP environmental science in high school, commented that the college course helped clarify and remind her about concepts related to the environmental sciences. She commented that she did not like science in high school and that her interest in environmental science related to environmental questions in society. Violet stated that the low points in the course were associated with the difficulty of the content. Unlike some of the participants in the study, she did not comment on the lecture-based format, class size, or activities associated with the

course. Violet claimed that her busy schedule prohibited her from attending the professor's office hours. Rather than meet with the professor of the course for assistance, she stated that she searched the Internet if she had unanswered questions. 3) Although early in the interview Violet implied that she consulted her classmates when she experienced difficulties, later in the interview she stated that the classmates seldom discussed the course, although they studied and completed homework together. Violet's comments did not provide insight into her thinking or communicating about the environmental sciences.

CoP Analysis: Like Raven and Silver, Violet met with her classmates who lived in her residence hall to discuss aspects of the course. As I discussed in my analysis of Raven's and Silver's interviews, these gatherings of classmates outside of the lectures for studying can be thought of in terms of the CoP concept of *practice*. The concept is described as a "way of talking about the shared historical and social resources, frameworks, and perspectives that can sustain mutual engagement in action" (Wenger, 1998, p. 5).

April (white female, duration of interview: 10:56 minutes)

April is a member of the class of 2016 who enrolled in the course with an advanced background in the environmental sciences. She completed the advanced-placement course in high school.

> Renee: Tell me a little about your experiences coming into the Course . . . tell me about yourself in relation to science before you came to [Hillcrest]. (5)
>
> April: I took AP Environmental and the IB test as well . . . so I did have a year of environmental kinda coming into this, so I wasn't entirely sure I wanted to take the into class because I wasn't entirely sure how much repetition there would be. But . . . after the first lecture I really liked the professor and it seemed like a more kind of in-depth and intensive

course than I had had in high school, so that was kind of what drew me to it. Um, but environmental has always been the science that interested me the most, so it kind of seemed logical, I suppose. (8)

Renee: Are you thinking at this point that you'll probably major in it? (9)

April: I'm thinking of a certificate. I know I want to major in Archeology . . . but whether or not I double-major in something, or try to get a minor or certificate, I'm not entirely sure, but, um, I do want to keep taking environmental classes even if I don't have sort of an official indication of that. (10)

Renee: In your youth, before discovering the environmental studies courses in your school, did you think about any of the other science areas? Were you drawn to science generally? (11)

April: I wanted to be a paleontologist for a while. But kind of drew away from that. I was always kind of interested in the earth sciences above, like, kinda chemistry or anything like that. I liked bio more than chemistry, but I don't know, I was always more interested in, like, the way that the planet worked. You know, plants and animals and things like that, as opposed to like . . . I guess I wasn't so much interested in the sciences you couldn't really observe or see, you know. (12)

Renee: Wonderful. So now I'd like to ask you to tell me a little bit about your experiences in the class so far. I mean, I know you've had your first exam. (13)

April: Yeah. (14)

Renee: So what are your thoughts at this point? (15)

April: I really am enjoying it more than I thought I would . . . I like it more than the high school class I took. It just goes more like into details about things. I like the way it's structured too cause I tend to learn better from, kind of, lecture and asking questions format, as opposed to kind of other methods, so . . . I liked the way it's structured . . . and the test went well I thought, so fingers crossed. (16)

Renee: So tell me more about learning through lectures and asking questions? Yeah, tell me how you see that playing out in the class. (17)

April: I think that I am able to understand best when first of all . . . you know the professor is explaining, obviously, but also . . . because he has the PowerPoints. There're lots of pictures and, you know, writing out problems and vocab words. That helps me kind of connect what he's saying with what's across the board, and then you know if anyone has any question they can clarify. But I feel like just discussion formats for that kind of class don't necessarily work as well because, I mean, the professor knows a lot more . . . than we do, so it's nice to be able to ask questions when we need to but also ultimately, like, he's doing most of the instructing, you know. (18)

Renee: That's very helpful. Very helpful. (19)

Initial Analysis: April described her participation in several activities associated with the course, including the question/answer aspect of the lecture and the visual experience of the PowerPoint presentation that the professor used. I wanted to know whether April was involved in other activities related to the course and the field of the environmental sciences.

> Renee: So, have you had an opportunity to visit a professor during office hours? (20)
> April: No, I haven't actually, I haven't. (21)
> Renee: So outside of the formal meeting of the lectures, are you having any other interactions with peers in that course? (22)
> April: There're, I think, like, three or four other people on my hall who are in that class. (25) . . . So, like, when we had that one assignment due I think, like, a week before the exam . . . a bunch of us got together, like, in our study room the day before it was due and, like, worked through some problems that we had with, um, the last questions, and we were able to, kind of, like, use each other, I guess, to finish it. (27)
> Renee: How do you fill your time outside of school . . . outside of that Course . . . outside of classes? (30)
> April: I've gotten pretty involved in the classics and archeology departments. I'm in a lot of those classes. This weekend I'm going on a trip to Harvard to see, like, an exhibit about some pyramids in Giza, so that will be really fun. Um, and I'm also on . . . the academic quiz bowl team, which meets once a week so that's a good filler of my time. I spend a lot of it studying. I'm in class hours more than I was last semester so I kind of have to . . . budget some things to make sure I get everything done. (31)

Initial Analysis: April described how she benefited from working with some classmates who lived in her dorm, and I learned that outside of lectures April was deeply involved in activities associated with her study of classics, more involved than in her study of environmental sciences. Earlier in the interview April described her interest in "observable sciences" such as biology as a factor in her decision to enroll in the introductory course and then she described her involvement in the Classics department, so I was curious about the similarities and differences she saw between

her various courses.

Renee: So can you tell me a little bit about how this course compares to the other courses you took last semester and this semester? (34)

April: Last semester I took an introduction to planetary geology class . . . so these are the only two, like, science classes I've taken here so far . . . It was actually really helpful having that class beforehand because some of what we've been learning this semester is relevant to that . . . I'm in mostly like, you know, more classics and history and English-type classes. It's really nice to have that science as, like . . . a break from all of that. I mean it was another motivation in taking a science course . . . you know, not have exactly the same thing to do all the time. (35)

Renee: Can you think of any real high points that you've experienced in this course and kind of low points? (36)

April: Yeah. I think the first, like, official lecture that we had was definitely a high point . . . It just really interested me. Like the way we were talking about kinda the origins of the universe and things like that. That just fascinated me. Low point I guess could be more the calculations, 'cause I've never really had an aptitude for that kind of math stuff. (37)

Renee: For the assignment where you guys had to put the thing? (38)

April: Right. Like, it took me longer than other sections of the assignment did just because I don't know, it doesn't come as naturally to me as some of the other material did, but I don't know . . . he's really clear about it . . . . like giving me instructions, so it was just a matter of kind of sitting down and working through it. (43)

Renee: As we bring this interview to a close, is there anything else that you would like to mention about this kind of early stage, in relation to what you bring brought into the class, the perspectives that you have coming into the class, from what you've experienced so far? (44)

April: Okay, yeah. I think that it was a really good class for where I was in my, like, knowledge of environmental science because since I did have that background I wasn't necessarily going into it all cold. So it was kind of comfortable for me to approach the material because I knew that I had some prior knowledge to fall back on. But it goes into depth about things that he explores that I didn't necessarily get the chance to explore in high school. So it was just, I don't know, for me it's just been a good combination of, like, having something that I'm familiar, I'm comfortable with, a combination with that kind of comfort but, also, you know, I don't feel like I'm just taking the class over again, you know. I really didn't want that to be the case so it's good that on the one hand I'm comfortable with the material but I'm also able to explore it in ways that I hadn't really been able to before. (45)

Renee: Thank you so much, April. (46)

Initial Analysis: Overall summary of analysis of April: April's interview revealed 1) That her enrollment in the course was based on a general interest in the field of environmental sciences, especially in the fields of paleontology and the earth sciences. I also learned that April regarded the environmental science courses (which included the introduction to planetary geology the previous semester) as a break from a concentration of humanities courses in her schedule. 2) April commented on the lecture-based format of the course and the exam, stating that she liked the lecture-based format and thought she learned better in a lecture-and-question than discussion format and stated that she was optimistic that she had done well on the recent exam. April said that she liked the professor's use of PowerPoint and pictures, and writing out problems and vocabulary words. 3) I learned that April interacted with her classmates who lived in her residence hall and that they worked together on at least one assignment. However, April was in general more involved in the classics and archeology programs. She spoke about a field trip she was preparing for and her experiences as a member of the academic quiz-bowl team.

CoP Analysis:

The responses that stood out to me in April's interview were her description of her motivation to enroll in the course and her appreciation for the lecture-based format of the course, as opposed to a discussion seminar, a claim that was inconsistent with the views of most of the other participants in the study. On the first issue, the CoP framework provides a way to explore these expectations of the course through the concept of *trajectory*, which "is not a fixed course or a fixed destination . . . [but] has a momentum of its own in addition to a field of influence" (Wenger, 1998, p. 154).

April's revelation that she planned to pursue archeology, rather than major in the environmental sciences, placed her on a *peripheral trajectory*. Wenger (1998) defines five types of trajectories, each with various expectations for future members in the CoP. The peripheral trajectory refers to the way in which "by choice or by necessity, some trajectories never lead to full participation. Yet they may well provide a kind of access to a community and in practice that becomes significant enough to contribute to one's identity" (Wenger, 1998, p. 154). Therefore, April's enrollment in the course could support an identity she hoped would align with the enterprise of archeology.

Another issue that April described related to the relationship she had with the professor and her peers. Although the relationship lacked the interpersonal dimensions of conversations and time spent together, there was an unspoken rule of interaction that April liked. This phenomenon dealt with aspects of the CoP framework (Lave, 1991,1993; Lave & Wenger, 1991; Wenger, 1998) that involve *community*. *Community* is defined as "a way of talking about the social configurations in which our enterprises are defined as worth pursuing, and our participation is recognizable as competence" (Wenger, 1998, p. 5). This notion also connects to the component of *meaning,* because it relates to April's feeling successful in the course and viewing her participation in the course in positive terms. The focus of April's comments pertained to the regularity and predictability of her participation in the course as a practice. That her professor's teaching style and course structure fit her expectations was important. April did not think that a discussion-based format would work for the type of information that needed to be covered in the course. April described the setting as one in which she learns a certain kind of material best. The relationship she described

between her and the professor situated the professor as the speaker, with occasional opportunities for questions and a wealth of visual aids. That she did not attend the professor's office hours was another way in which April maintained a somewhat distant relationship with her professor.

April described an instance when she met with classmates who lived in her residence hall to complete an assignment. When she met with these classmates for this purpose, they engaged in an activity that the CoP theory (Lave 1991, 1993; Lave & Wenger 1991; Wenger 1998) calls *practice*. *Practice* is "a way of talking about the shared historical and social resources, frameworks, and perspectives that can sustain mutual engagement in action" (Wenger, 1998, p. 5). Since the interview took place at the start of the semester, I do not know the extent to which April and her hall-mates from the class subsequently discussed course-related matters outside of the class. But the Community of Practice framework treats practice as the process through which all the other components—meaning, community, and identity—are driven. Learning takes place in practice, and both meeting with housemates from the course and the course itself can be thought of as practices of the enterprise of studying the environmental sciences. These practices have the three dimensions of mutual engagement, joint enterprise, and shared repertoire, which Wenger (1998) asserts provide the coherence, negotiability, and opportunity to create the resources for negotiating meaning that define practice.

Another aspect of the interview that related to the CoP framework was the way April described her involvement in the classics and archeology programs, in ways that suggest that her involvement extended beyond simple course enrollment. Wenger

(1998) offers the concept of *peripheral trajectories*, which can be used to discuss her participation in these departments. April might be constructing an identity of non-participation in the environmental sciences as she works towards full membership in the fields of classics and archeology. However, her participation in practices related to the environmental sciences can serve as boundary practices that may help her develop an identity of full participation in the other fields, because knowledge about aspects of the environmental sciences will be relevant in her study of classics and archeology.

Initial Analysis: Similarities and Differences between Silver, Violet, and April:

Silver, Violet, and April are three female participants who took advanced-placement environmental science courses in high school, enrolled in the introductory environmental-science course in the college, and characterized their experiences with the course in positive ways. All three participants stated that their schedules were busy and that they had not attended the professor's office hours, although Silver mentioned that she communicated with the professor by email. The participants had joined study groups in their residence halls, and Silver and Violet had a plan of action for steps to take if they encountered difficulties in the course. For Silver, it was to review her notes and the professor's presentation and write down her questions before consulting with the professor or attending a study group. For Violet it was to consult the Internet or discuss with classmates. Their differences included race (Silver is black and Violet and April are white), level of interest in science (Silver stated that she was always interested in science, while Violet stated that she had not liked it in high school, and April expressed a preference for observable science. Lastly, the participants in this group held differing perspectives on aspects of their experiences. Silver saw the large

course as presenting both benefits and shortcomings; Violet had no comments about the size or dynamics of the lecture; and April liked the lecture format of the course.

Jasper (black male, duration of interview: 14:04 minutes)

Although Jasper, a black male, had not enrolled in an environmental-science course in high school, he enrolled in the introductory environmental-studies course offered in the fall of his freshman year.

> Renee: The first thing I'd like to do is ask you to give me a bit of an autobiography of your life with science. (11)
> Jasper: My life with science? Wow. (12)
> Renee: Yes, tell me about how it began. (13)
> Jasper: Ah, specially the study of the environment. (14)
> Renee: But that didn't start at 5. (15)
> Jasper: The environment? (16)
> Renee: So . . . start general and [go] to specific. (17)
> Jasper: So just in general science, ever since I was young, like, really young, I've always wanted to be a scientist. It's weird, it was one of those really romanticized, science-is-awesome things . . . I went through a phase where I wanted to be an archeologist, and then I went through a phase when I wanted to be a chemical engineer, and in high school and stuff and then . . . I was in a program at the Museum of Natural History called the Sands Research Mentoring Program. I was under a mentor . . . my mentor was a paleontologist, and so I did research with him in my junior and senior year of high school. And that was really fun and that was the moment when I was like, yep, definitely gonna do science. And then I came here. (18)

IA: Jasper's expression of a life-long interest in science in which he considered various fields and had a terrific opportunity to form a mentoring relationship with a scientist suggests that he was already set up and on his way for success in the sciences.

> Jasper: I wasn't exactly sure what kind of science I wanted to do per se, but I thought paleontology would be cool, but obviously that's not a major here, so I just took a few science courses. So I took bio and I took intro to environmental studies, and I also took planetary geology, 'cause those seem like interesting things to me. I always enjoyed bio and earth-related/earth sciences. So, yeah, does that answer your question? (18)

IA: Jasper described a process of deliberate exploration of the various areas in science available to him in college.

Renee: Perfect . . . how did it come to be . . . I mean, 'cause you were so open-ended that perhaps you would have [pursued] . . . paleontology, maybe you would have thought . . . anthropology and archeology? (19)
Jasper: Yeah. (20)
Renee: What or who was influencing you? Guiding you? Was it your advisor? Were there other players in this decision-making process? (21)
Jasper: Um, for the intro to environmental studies class I think one of the main reasons I took it was because during the during the . . . (22)
Renee: Open enrollment, something like that? (23)
Jasper: Yeah, but also the orientation period when we, like, went to the cool lectures and stuff. (24)
Renee: Yes. (25)
Jasper: With professors and stuff. [Professor X] had one. (26)
Renee: This was during your freshman year? (27)
Jasper: Umhm, and [Professor X], he had like a really cool lecture about invasive species and how, like, he did this whole thing about how Arogon from Harry Potter was an invasive species and how, like, [inaudible] Lord of the Ring series dealt with invasive species [inaudible], and I thought that was really cool. And he was an excellent lecturer . . . I looked for a class with him and I saw that he taught . . . intro to environmental studies, and I was, like wow, that sounds interesting. I don't think I have a very good background in environmental studies, so I'm just going to go into that and I went to the class. (28)
Renee: So are you a kind of . . . Middle Earth kind of person? . . . I don't know what that genre is called? What is it, fantasy? I guess sci fi? (29)
Jasper: Yeah, sci fi fantasy, definitely. I love sci fi fantasy. (30)
Renee: So that was kind of a hook for you too? (31)
Jasper: Oh yeah, I mean, that was like a cool side thing. (32)

Initial Analysis: The process by which Jasper discovered the course came out of a single positive encounter with a professor. His example points to the impact, positive or negative, that a single professor may have on a student, and the messages of welcome or rejection that the student may detect. While having a common interest is important, though not necessary, references that faculty and student share may be interpreted differently, based on a range of different experiences students bring to the

situation. In contrast to Jasper's appreciation of the professor's reference to the Harry Potter stories, Raven interpreted negatively her professor's references to AP science. In both cases the professor intended to make a conceptual connection, but the outcome was very different. Could this type of conceptual connection help explain why students begin to feel as if a certain course, department, or field may or may not be "a place for them?"

> Renee: And it helps that he plays Led Zeppelin at the beginning of each class. (33)
> Jasper: Yeah . . . I just like [Professor X] as like, as a lecturer. He's really cool. I'm actually taking another one of his classes now, research methods . . . (34)

Initial Analysis: After a lengthy discussion about what intrigued Jasper about the sci-fi fantasy references that the environmental studies professor added to his lectures, our interview continued, and Jasper said that he liked the professor on a personal level in addition to as a lecturer.

> Renee: So tell me about what was going on in the rest of your life and just generally. I'm very interested in contextualizing people's experiences. It's not just about those courses . . . So how are you . . . spending your time outside of the class? (35)
> Jasper: Um, I mean I'm very busy. I do a lot of things, but in the context of environmental studies . . . one of my closest friends . . . took that class with me and now he's in a environmental sustainability class taught by [a visiting professor]. We have a lot of discussions just about life . . . about humans' impact . . . humanity's impact on the environment and whatnot. Its kind of strange sometimes. We get into really philosophical debates and whatnot. But I mean, generally speaking, I'm not in any specific extracurricular that deals with environmental studies per se. 'Cause, like, I use my extracurriculars as a way to do things that I'm not doing in my classes. So I'm doing a lot of music-related things, like, I'm in a play and whatnot. (36)
> Renee: What play are you in? (37)
> Jasper: *A Raisin in the Sun.* (38)

Initial Analysis: The fact that Jasper enrolled in the course in the first semester of his freshman year meant that by the time I interviewed him, he had completed the course and had already developed a close friendship with a classmate from the course. His description of his discussions with the classmate is an important clue to his development in the field of environmental sciences. Jasper explained that his extracurricular activities did not relate to the environmental sciences because he used them to engage in such things as his music and theatre. However, he did spend a lot of time outside of class talking about environmental matters.

> Renee: So tell me how that course compared, to, and how your environment courses in general compare to other courses . . . that you took that year and that you're taking now? (45)
>
> Jasper: It's a very interesting question 'cause it's like intro to environmental studies was probably one of . . . the most enriching classes that I've taken so far. Like just developing as a person I've gained a lot from being in that class. An understanding or getting a better grasp of, like, where I belong, I guess you could say, in the grand scheme of things and what my duty is, like, I guess you could say. (46)

Initial Interview (Initial Analysis): Jasper's experiences with the environmental studies course as a first-semester freshman, coupled with the course he took as a second-semester freshman with the same professor, were transformative on a personal level. In dialogue turns (46)–(52), Jasper revealed the ways that the content of these courses, especially the course on research methods, taken in the spring term, caused him to consider deeper philosophical questions about his moral obligation to the environment. With the assistance of his former classmate from the introductory environmental studies course, Jasper described the ways that discussions with his peer and experiencing an art installation about the environment advanced his learning and development.

Renee: So, is there anything else, I mean, can you tell me, can you reflect on any high points or particular low points in that course, as you reflect back? (53)

Jasper: So one of the low points, I guess you could say, or . . . just the aspects of the class that it was a really huge lecture which I'm not a big fan of huge lectures. I prefer smaller seminar-based education. But one of the low points I guess you could say was . . . . there'd be certain things that we would learn that would put me in a position where I felt that my ideas were compromised, which I guess happens; it put me in an awkward position sometimes. Like I would learn that some of the things that I do or some of the ways that I was thinking were ways that I didn't want to live and I didn't realize that. It was an eye-opening experience, I guess you could say, about a lot of things and that also goes back to my friend. We spoke a lot. (54)

Renee: Can you give me an example? (55)

Jasper: Um. (56)

Renee: [alarm] I think I'm over time. (57)

Jasper: Yeah, of course, I'm in no hurry to go anywhere. So there was a day when we went into class and I hadn't done the reading before 'cause I had other things to do, unfortunately. But we went into the class talking about . . . how food production doesn't correlate typically to the amount of people there are and that food distribution is a really big problem . . . there's a lot of hunger . . . even though at this point in time there should be enough food to feed everyone . . . There were a lot of people actually that had different views about it and I felt like I had this view that like everyone . . . that the way it was at that point in time and the way we were going was fine . . . I said something in class and looking back I can't remember exactly what it was, but I know [my friend] spoke to me after class and got into this argument, and it was very interesting. (58)

Renee: Were you friends before the class? (59)

Jasper: Yeah. (60)

Renee: Okay. (61)

Jasper: Um, we live in the same hall. (62)

Renee: Okay. (63)

Jasper: Um, we met the first day. (64)

Renee: So can you think of anything else that you'd like to mention at this time about your experience in that course, and also just keep in mind that I'd like to interview you again, maybe in a couple of weeks, and ask you a few more questions. (67)

Jasper: Okay. (68)

Initial Analysis: Like several students in the study, Jasper didn't like the large lecture-based format of the course. Earlier in the interview, Jasper mentioned the

benefits of having a friend who shared his interest in the environment and the moral dilemmas that he encountered during his studies. These points were illustrated in his description of the incident involving a debate about global population and food demand. Having a friend along provided the support Jasper needed to challenge and support his previously held ideas about the environment.

Overall Summary of Analysis of Jasper:

1) Jasper had a long-term interest in science, and while in high school he had been mentored by a paleontologist. With no prior course in environmental science, Jasper enrolled in the introductory environmental-studies course in the first semester of his freshman year after attending an orientation lecture by the instructor of that course. Jasper described being intrigued when the professor made references during the lecture to a sci-fi fantasy genre that Jasper valued. 2) Like many students in the study, Jasper stated that he did not like the large-lecture format of the course, but he did not provide additional details on the matter. 3) Jasper forged a close friendship with a classmate from the introductory environmental-studies course, and discussions that ensued from the friendship, as well as Jasper's viewing of an art exhibit, facilitated reflection and dialogue about philosophical and moral environmental issues. Jasper stated that he used his extracurricular time to explore such interests as music and theater.

CoP Analysis: Jasper's attraction to the environmental sciences was facilitated by his interest in sci-fi fantasy and the way that this connection to a pre-existing interest—which can be viewed in terms of the CoP framework as a boundary practice—caused Jasper to positively view Professor X. The CoP theory's conception of *identity*

provides an effective starting point for exploring this phenomenon. Like anyone who becomes a part of a CoP, Jasper and Professor X participate simultaneously in more than one community of practice or a *nexus of multimembership,* in CoP terms:

> We may all belong to many communities of practice: some past, some current; some as full members, some in more peripheral ways. Some may be central to our identities while others are more incidental. Whatever their nature, all these various forms of participation contribute in some way to the production of our identities (Wenger, 1998, p.158).

Jasper's views of Professor X and the relationship to the sci-fi fantasy is a part of the process of *reconciliation* in which people negotiate the differing demands that come out of different practices. Wenger (1998) states that "proceeding with life—with actions and interactions—entails finding ways to make our various forms of membership coexist, whether the process of reconciliation leads to successful resolutions or is a constant struggle" (p. 160). After the introductory course, Jasper enrolled in more courses with the same professor, suggesting that Jasper was motivated to do so because he had had a positive experience in the first course. Besides sci-fi fantasy, Jasper was interested in music and theatre, and spent much of his time outside of class engaged with those types of activities.

Another way in which Jasper's interview fit into the CoP framework was his use of peer-to-peer discussion as an important *practice* in the CoP of studying the environmental sciences. Jasper's account reveals how sharing the ideas he acquired in class with his friend caused him to change some of his views and taught him how to engage in difficult discussions about environmental issues. Jasper mentioned explicitly that the experience of the course helped him develop as a person, gaining an understanding of where he belonged and what his duty was. This recognition

illustrated a fundamental aspect of the CoP framework, in which practice causes changes in identity, and it is that changing identity in a community of practice that constitutes learning. Additional comments from Jasper are contained in the interview with Luna (below). However, his individual interview provided the insight needed to explore his experiences through the lens of CoP. It is worth noting that Jasper did not mention race in his individual interview, but the question of race was introduced by Luna during their group interview. Therefore analysis of Jasper's experience through the lens of CRT and ST will not be covered in this section.

CHAPTER 6

FINDINGS PART IIB: ANALYSIS OF CLASSES OF 2015 AND 2014 COHORTS

The Class of 2015 segment of the study included volunteers who had enrolled in both introductory courses, A and B, and in both iterations of each course.

Star (white female, duration of interview: 14:48 minutes)

Star, a white female, is the member of the class of 2015 who had had the most recent exposure to the course. She took the introduction to environmental science in the spring of 2013. By the time of the interview, she had already declared majors in English and Government.

Renee: Thank you . . . so the first thing I'm interested in is a kind of biography of your experience with science in general, or maybe environmental science specifically, coming into this course (1)

Star: Yeah, I guess I'm more of a humanities person to be honest . . . I did science for all four years in high school . . . mostly just like classes. I guess environmental science has always been the kind that I'm most interested in. Just 'cause it seems really important. And so I've done a bit of research just like on my own time into, like, climate change and things like that. But I won't say that I have that much background knowledge. I took a semester of chemistry freshman year at Hillcrest (2)

Renee: Are you a first year? (3)

Star: I'm a sophomore. (4)

Renee: Okay, good. (5)

Star: But besides that, this is still the only science course I've taken. (6)

Renee: So needless to say, the chances of you declaring environmental science as a major are pretty slim. (7)

Star: Pretty slim, yeah. (8)

Renee: But as a certificate? (9)

Star: Um, probably not. (10)

Renee: Probably not. Okay . . .So, um, you're enrolled in the class just for general interest, and since you've done your own research on climate change to educate yourself, perhaps this will influence whatever you end up doing. (11)

Star: Yeah, I mean, I think it's definitely like something that's important to address [Inaudible] politicians [inaudible]. (12)

Initial Analysis: Star described herself as more of a "humanities person" with four years of high- school science and the initiative and curiosity to research climate change online. A sophomore when she enrolled in the course, Star had already set her mind on her intended major, so I was interested in gaining a clearer sense of her motivation to enroll in the course, and to hear what experiences related to the environmental sciences she was having inside and out of the course.

Renee: Could you tell me a little bit about what else is going on in your life? How you fill your time, outside of class? (13)
Star: I guess it's probably relevant that the government major, which I'm hoping to declare, requires 2 science courses. So . . . I did have to take a science class this semester. I wanted to take environmental science because that's where my interest lies. So it wasn't entirely, like, for my knowledge base. (14)
Renee: A requirement. (15)
Star: I guess I'm hoping to double-major in English and Government, and so I spend most of my time in reading-and-writing-heavy classes and, like, very subjective-type things. So it's kind of refreshing and interesting to be in a class where everything is so concrete. (16)

Initial Analysis: Star expanded on her previous statements about her motivation to enroll in the course by adding that she was trying to fulfill her science requirement for the government major. Nonetheless, she found the subject interesting and a nice break from her less objective courses.

Renee: Where do you live? Like what dorm? (17)
Star: I live in . . . the writing-program hall. So it's way over there. The other side of the [art building]. (18)
Renee: So, do you have a community of folks that you're able to do work with around environmental science or just shared interest? (19)
Star: Just in general, I tend to work by myself. I guess one of my closest friends here is, like, interested in the [societal aspects of science program], so, like, it's best to like [ask him] if I have any questions or about how this . . . relates to real people. (20)

Initial Analysis: Star described her preference for working alone and stated that she directs her questions to a close friend who is pursing a major in a program focused on the interrelationship of society and science.

Renee: Can you tell me a little bit about how this course compares to other courses you've taken in the past and during this semester? I think I know the answer to this. (21)

Star: Yeah, obviously it's a lot bigger than most of my courses. Most of my courses tend to be, like, either small lecture classes, like 20-something people, or, like, discussion classes with, like, 10 to 20 people. So that's different. I also think it's nice to have a break from having to, like, engage all the time because sometimes, I don't know, I don't necessarily have anything to say, I would rather just listen and learn. So it's nice to have a place to do that. It's definitely a different class and, like, studying experience just compared with all the sort of more philosophical and discussion-based courses that I have had. (22)

Renee: What do you think about the . . . approach to teaching environmental science as a lecture as opposed to as a more discussion-based model? (23)

Star: I guess, I mean, part of it, I don't know a whole lot about it, but I would imagine is just the logistics. Obviously a lot of people wanted to take this course. A lot of people need it for their majors or for other majors, as I do. So I know it would be hard [inaudible] to provide a bunch of small discussion classes on this. I think that it could be helpful. I wasn't able to go to the discussion or the question session for the test but . . . I went to one of the, like, help sessions and that definitely gave me a chance to address more if I had any specific questions. (24)

Initial Analysis: Like several students before her, Star commented on the large size of the lecture class, and, like Silver, she identified some benefits to the large lecture. For Star there were times when she just wanted to listen rather than engage in the activities of the class. She pointed out that the class itself and studying the material provided an experience different from the experiences she had had in philosophical and discussion-based courses.

Renee: What did you think of the large assignment and the exam? (25)

Star: I had a little bit of a hard time just because my brain isn't really geared toward science, I think. I'm not super-good at numbers, but I thought the assignment was very manageable, especially with the help

session. Like, I would have had a hard time with that Excel graph thing on my own, but like [inaudible] and it was fine. (26)

Renee: And you did it all on your own? (27)

Star: Well, I went to the ah . . . (28)

Renee: The help session. (29)

Star: Yeah. (30)

Renee: In terms of here in the class . . . (31)

Star: Yeah. (32)

Renee: have you built . . . new relationships with any peers in the class? (33)

Star: I can't say that I have. (34)

Initial Analysis: Previously Star stated she did her work on her own, but later in the interview I learned that she used the help session to complete the Excel assignment. I wondered why she had not included this fact in her earlier comments. Also, Star stated that she had not established any new relationships in the class. I think this is another common phenomenon in this study that may indicate that the course format does not encourage peer collaboration.

Renee: Okay . . . I wanted to know if you could just share with me some highs and lows. (35)

Star: Definitely. Some of the lectures . . . the other day when we were learning about the meteor KT boundary, and the lecture kind of about the beginning of the Atropine period and how, like, it was a question among scientists whether we were in that period or not or on the boundary or what. I thought that was really interesting. (36)

Renee: Were you aware of the meteor that broke over Russia? (37)

Star: Yeah. (38)

Renee: Shortly thereafter? (39)

Star: Yeah, I had seen that on the news and, you know, watched all the videos. (40)

Renee: How did you experience that after having just learned about it? (41)

Star: It was kind of worrisome, 'cause the fact that nobody really knew it was coming I guess, to be honest. I don't know [what] NASA or anybody could do to prepare for anything like that, even if we did know it was coming. But, like, I mean, like, logically I know it's a rare event. I mean, like, . . . astounded by, like, the videos of the Russian drivers just like going about their days as I imagine everybody else did. (42)

Renee: And it did happen after that lecture . . . right? (43)

Star: Yeah. So I think that we had learned about the KT boundary and

[that] it was likely a meteor that . . . killed the dinosaurs. and then after that we went more into depth about it. (44)

Initial Analysis: The fact that the course lecture corresponded with a celestial occurrence provided an opportunity for Star to see the modern-day relevance of the information she was learning in the course. Coincidentally, Star recalls the science related to this incident as one of the high points of the course. Perhaps when students experience the real- world application of the science, they are more likely to remember and attach excitement to the topic, or perhaps Star was simply intrigued by the topic.

Renee: So, can you think of any low points in the course so far? (45)
Star: As I said, the test was a little [inaudible] but that was kind of a crazy week as it was and I didn't get the chance to study as much as I would have liked to. (46)
Renee: So, um. [alarm goes off] (47)
Star: I don't have anywhere to be. (48)
Renee: So do you have anything else as you reflect on your experience so far? Do you have anything else? Other insights that you think you might want to share at this point (49)
Star: I guess just, like, with the [inaudible] I guess like the only downside of the lecture class is that you're talking less to the people around you and . . . the relationship-building part of it is not as much built in for you. (50)
Renee: Have you managed to go to the professor's office hours yet? (51)
Star: I have not. (52)
Renee: Just curious. I'm just checking that, and are you involved in any clubs or anything like that? (53)
Star: I am a writing mentor . . . so I [have], like, four students that I meet weekly with to work on various writing things. I do the choir. I'm [inaudible], and I'm in this mentoring program where I am partnered up with a little girl from [town] and we hang out once a week and like go to the library and stuff. (54)
Renee: Is that [the low-income housing project]? (55)
Star: No, I actually did [that] last year, but this is the [neighborhood development organization] mentoring. (56)
Renee: With [the former executive director]? She's a part of the [that organization]. (57)
Star: Yeah, I think so. (58)
Renee: That's wonderful. That's great. Um, well. Would you be willing to participate in another interview? (59)
Star: Yeah. (60)

Initial Analysis: Star explained that her "crazy week" had prevented her from studying as much as she would have liked for the exam, with the result that she considered the exam a low point. I wondered about competing demands on the students' time and the degree to which those demands caused them to experience the course positively or negatively. Like most of the students in the study, Star did not attend the professor's office hours. Star told me that she was a writing mentor at the campus writing center and a mentor to a little girl in a local neighborhood. Star added that the lecture format of the class was a disadvantage in her eyes because it did not facilitate the formation of new relationships; classmates did not get to talk to each other.

Overall I learned the following about Star: 1) She had enrolled in the course to satisfy a requirement for the government major, and she considered herself to be more oriented toward the humanities than toward science. 2) She did not mind the lecture format and saw it as a break from her more discussion-based and subjective courses. 3) Star had not formed friendships in the course and relied on a friend who was in a multidisciplinary program for assistance when needed. Additionally, she did not attend the professor's office hours.

CoP Analysis: The CoP framework provides limited insight into the information that Star shared with me during the interview. The only aspect of Star's comments that was marginally relevant to features of the CoP was the role of her friend. In mentioning her close friendship with the peer who was studying in the program integrating social sciences and science, she illustrated the presence of the *practice* in which peers talk to each other about aspects of studying in the environmental sciences. Star commented

that she did not attend the professor's office hours and that she directed any questions about her course's subject matter to her friend. Later in the interview, Star commented on absence of *community*, which the Theory of CoP defines as "a way of talking about the social configurations in which our experiences are defined as worth pursuing and our participation is recognizable as competence" (Wenger, 1998, p. 5).

Unity (black female, duration of interview: 14:11 minutes)

Unity is an international student and a black female. She took the introductory environmental-studies course in the fall of her freshman year and later declared a major in government.

> Renee: Thank you . . . I know you took the course. Which one did you take? (1)
> Unity: Environmental studies with [Professor W]. (2)
> Renee: With [Professor W]? (3)
> Unity: Yeah. (4)
> Renee: [Professor W]. And could you tell me in as much detail as possible what stands out for you as you reflect on the course? (5)
> Unity: I won't say it was the content or such but the fact that [Professor W] herself studied geography in college, which was what I intended to study here. I wanted to [design my own major] and environmental studies is linked to geography. But . . . I felt like then having [Professor W] as my teacher, then if I had any questions about . . . the content that was being taught in the class with geography I could easily go to her and she could answer my question. So it was a matter of who was teaching me, because a lot of the stuff we covered I had already done in high school. (6)
> Renee: In what capacity? (7)
> Unity: . . . the [Regional] Advanced Proficiency Exam—so I did Geography, and that covers stuff like everything we do in environmental studies and then more advanced stuff. 'Cause when I came here and they said that my Advanced Proficiency Exam wouldn't count for me to move beyond environmental studies, and so I had to redo it again. So I just thought, "Oh, if I'm going to redo it, I might as well take somebody who's interested in the field that I want to go into." (8)

Initial Analysis: Unity's motivation to enroll in the course was based on her expectation that the professor's expertise in the discipline of geography would provide the educational guidance that would help her to develop an individually designed major. As for Jasper, it was the professor's profile that gave Unity the initial incentive to enroll in the introductory course. Students who are motivated to enroll in the course based on hastily formed assumptions about a professor run the risk of later discovering that the course content and the professor's personality do not meet their expectations. On the other hand, enrolling in a course with the anticipation of a positive experience with a professor can set the stage for rewarding experiences associated with the course. Unity stated that she did not expect to acquire new information, as she had completed an advanced high-school course in the subject. Following up on my impression that Unity did not expect to learn much from the course, I tried to elicit her reactions to various aspects of the course.

> Renee: So what were some of the high points of that course that you took with her? (9)
> Unity: Oh, the assignments. (10)
> Renee: Okay. What was it about the assignments that was good? (11)
> Unity: Some of them included going to public events. So it brought me to [performances in the arts], or we had to do group activities that incorporated, like, dance and, like, different aspects of the humanities in sciences, which was something I hadn't done ever before in high school. And so that for me made the class stand out. (12)
> Renee: What year were you when you took the course? (13)
> Unity: I was a freshman. So that was my first semester here at [Hillcrest] and so I had taken science classes before in high school, but it was the first time that science was approached that way, so that made the class interesting. It wasn't like, oh, I've learned all these things already, it's boring, or, I don't need to study. But I actually found myself where I felt like I needed to be engaged because it was just interesting. (14)
> Renee: So what were some of the low points of the course? (15)
> Unity: Just like going over stuff I already did, it's, like, basic facts about like the Carbon Cycle or the Water Cycle, 'cause those are pretty basic. Like you start doing those in like grade eight, so it's like, why am I

doing this in college, you know. Especially when you spend so much time learning these things to take a huge exam in high school that like should place you out of those basic courses in college, and then you're here and it's like, nope, you should learn this again. But I guess . . . it wasn't that difficult with [Professor W's] approach . . . it was more of ah, yeah, we covered this in class, but in terms of what you're doing outside, you're not going over notes but you are taking like a step beyond. Like you're going to the [arts building] and actually thinking about how issues with the water cycle are affecting, like, the Pacific Island small islands. (16)

Renee: So tell me about what motivated you to take the course . . . to enroll in the course? (17)

Unity: Because I was set on being either one, an environmental science major or doing a [self-designed major] where I'd try to design a geography program with [Professor W] as my advisor. (18)

Initial Analysis: Although Unity spoke positively about the instructor of the intro course, I detected that she had felt compelled to enroll in the course in order to develop an independent major and perhaps also to get to know the professor. However, Unity's statement also suggested that she was hesitant about revisiting material that she had mastered in high school. Her statement about the professor's incorporation of the humanities into environmental studies highlights the two levels of her experiences in the course. On one level, the course was about revisiting topics related to the field. On another level, the content of the course challenged notions of the meaning and pedagogy of science to which she had been accustomed by incorporating the arts and humanities into the study of environmental questions.

Renee: So, tell me also about what was going on in the rest of your life when you were taking this course? What was filling the rest of your time outside of the class? (19)

Unity: Oh, so freshman year I was doing a lot . . . especially because after freshman year going into sophomore year, I felt like I hit a plateau where I just felt . . . I had already done everything at Hillcrest . . . I felt bored. I remember . . . I was doing a senior dance thing . . . I was taking dance classes . . . I would go star-gazing . . . like every event that happened on campus, I'd be there. And then it was just pretty exciting because you coming in and [Hillcrest], this new place, and there's just

so much to explore, so it wasn't just about, okay this is university, I should just focus on classes, but there was, I think I felt the need to go beyond that and see what was out there. So that's a lot in my freshman year. (20)

Renee: Do you think your peers felt that way . . . or were you unusual? (21)

Unity: Yeah, I feel like I was definitely unusual because, like, I remember freshmen year, like, I thought people would just come in, like, we're all freshman and then we'd get to know each other and then, you know, we'd spend four years together and then bonds would build . . . and then I remember first day in [the student center]. I walked in. People had already had their friend groups, so I was, like, okay, I'm just going to sit with somebody. But then going around trying to meet people it was like, oh, who are you? We're already friends [laughter] which was strange. But, like, I didn't take any offense, I just, like, went to my stuff by myself. So, like, you'd see me at [a performance] by myself. Going to the movies by myself. But it's interesting now to see that those groups . . . those tight groups have dissolved and people are much more independent, so that's just interesting. (22)

Initial Analysis: Unity's description of the social experiences she had during her freshman year, while not directly related to the course, is relevant to how she thought about herself relative to her peers. Whether it was a matter of cultural differences between Unity and her predominantly American peers or some other factor, Unity found it difficult to form friendships during her freshman year. So Unity's freshmen experience, although active and engaged, to judge by the variety of activities she described during the interview, lacked peer interaction.

Given Unity's account of having limited peer interactions outside of class, I wondered whether she had found relationships through her other courses.

Renee: So tell me about how . . . the intro course compared to the other courses you were taking during that semester. (23)

Unity: I was taking math. (24)

Renee: What level math? (25)

Unity: It was precalc math, so that was pretty easy . . . I was taking 4.5 Courses, but I don't remember all the classes. I remember I was doing, like, additional stuff, a dance class that gave you extra credit, but I don't remember what my other major course was. All I remember was [an essay-writing course]. I was taking different courses from all across

> [the curriculum], which I felt was really good because, like, it gave me a feel of, you know, the different things that [Hillcrest] has to offer academically . . . I felt so relieved because, like, coming from high school, where everything was so streamlined and for me to just study some history along with some sciences was really hard . . . I had to step outside of the standard curriculum and do that on my own. While here it was just, like, select your classes and go to class and enjoy. (26)

Initial Analysis: Earlier in the interview, Unity had described her appreciation for the integration of the humanities into the study of science. Her comment in this section expands beyond the course and suggests that she recognized the institution's open curriculum as an opportunity to enjoy a broad range of subjects. Also noteworthy is that Unity described enjoying her courses rather trying to get them out of the way. I wanted to understand more about the attitudinal differences among students in the study regarding the courses they took and the activities in which they chose to engage.

> Renee: So you decided not to pursue environmental science? Was there a point at which you got turned off from the field or was there something that you got turned onto? (27)
>
> Unity: Definitely not turned off . . . I realized that I wasn't interested [in] pursing a career in . . . environmental science. I only liked learning about the environment and more specifically geography, and I was more interested in how the natural environment affects our social environment and human behavior . . . I thought I was going to be a major, and the summer after freshman year I was doing research with [inaudible] and I did research for, like, six weeks in the lab and I was, like, nope, I cannot do this with my life. I need to be out and I need to be talking with people and I need to be talking about issues that are going on in the world. And yes, I did understand that my scientific research was, like, affecting, like, issues going on and could solve problems, but for me it just wasn't fulfilling enough. I wanted to be on the front line talking to people . . . feeling like I'm solving the issues, [not] in a lab working around a computer or with some different, you know, specimen or something. (28)

Initial Analysis: It is helpful that I have a range of different academic years represented in this study. In the time that had elapsed between the semester when Unity had enrolled in the course and the date of our interview, she had engaged in a

variety of courses and activities, most notably a laboratory research project that dissuaded her from pursuing geography or environmental science. The impression she had that majoring in environmental science would lead only to working in a lab, made me wonder about the types of discussions she had with the faculty and professionals in the field of environmental sciences. Could it be that the specific ways in which faculty worked as researchers in the environmental sciences offered a limited image of the field to prospective majors? Were the faculty unknowingly discouraging students who did not fit a narrow profile?

> Renee: Is there anything else about your experience in that intro course or just your observation in general about studying science in the U.S. that you want to share? (29)
> Unity: Yeah, I think, I don't know if it's because how [Hillcrest's] academic system is structured, but I feel like the sciences here are much more welcoming and supportive to people in general. (30)
> Renee: Do you think that's all of the natural sciences? (31)
> Unity: Yeah, I think all of the natural sciences and, like, in talking [to] my Peers [from home] who are still doing the sciences, a lot of them don't feel close. (32)
> Renee: Are they doing it in the U.S.? (33)
> Unity: Yes .. my friends here in the U.S. but . . . I give my opinion based on having been a science student [abroad] and then having friends who are pursing the sciences now. Friends who are studying to be doctors or engineers or biochemists. And in terms of, like, looking at the different levels of support that are available here in the U.S. and there [at home], it's much bigger. (34)
> Renee: Here? (35)
> Unity: Yeah, it's much bigger here in the U.S., and especially I feel at [Hillcrest] 'cause I have other friends who are studying at other universities in the U.S. And in terms of how open professors are, that's not a thing [at home]. That's something you do not get. And in terms of work. Doing research with a professor as an undergrad. No, like I remember, I did research with [Professor A] and like I had only taken math and environmental studies and that was it. And he was, like, yeah, you're a freshman, you should come work with me. That would never happen [at home] unless you're pursuing, like, some really advanced degree. (36)

Initial Analysis: Unity's comments about the "supportive" atmosphere of the institution and U.S. institutions of higher education are noteworthy. She highlights an invitation from a professor to work in his lab although she had taken only two courses in mathematics and science. This comment troubles me if the kind gestures lead students to overlook the necessity of rigorous preparation in the subject matter.

> Unity [continuing: And I don't know, it was really interesting, especially when I was doing the [grant-funded science research program] because we got invited to this seminar on minorities in the sciences. And I was really confused, because, like, for me it was, like, what do you mean, minorities in the sciences? Because the way I grew up was that if you're smart everybody forces you to go into the sciences. So for me to say I am a government major, that's me kinda rebelling because people [are] questioning, Oh, what you going to do with a government major? Why you don't be a doctor? Aren't you smart? Why you don't be an engineer? And so it was, it took a while for me to understand the history of that. Then, like, in talking to my other friends who are in the [science research program] at the same time I was in it and talking to them and seeing how they studied science differently [in] high school was interesting. Where I feel like because their high school probably wasn't as rigorous as [mine at home] is when it comes to the sciences—when they come here it's like they're all flustered or they're just so stressed with the sciences. While for me I leave [home], work so hard and I come here and I have open professors who are greeting me with smiles and, like, paradise, like, wow, why you being sweet so nice? You know, so it's like one thing to point out . . . it depends on where you're coming from, I think. (36)
>
> Renee: Thank you very much . . . I appreciate it. (37)

Initial Analysis: At the start of the interview Unity's comments about the difficulty she experienced making friends as a first-semester freshmen caused me to wonder how much this difficulty was related to cultural differences between her and her American peers. At the end of the interview she chose to provide further information about her impressions of studying in the U.S. versus her native country. She described how students who are termed "minorities" in the U.S. sometimes come to college underprepared to take on rigorous study in the sciences. As a black female, her society

provided messages that reinforced her ability (and even responsibility) to dedicate her intelligence to the sciences. Although she explained that she had recently learned about the historical issues that contribute to the under-preparation of U.S. blacks for the sciences, she did not mention that U.S blacks, unlike blacks in her home country, may get the message that they do not have the intellect to do science. Unity's comments point out a host of issues (including preparation and perception of abilities) that continue to erect barriers for members of underrepresented minorities trying to complete bachelor's degrees (not to mention advanced degrees) in the sciences. Overall I learned that Unity: 1) had enrolled in the course because she wanted to study with the professor who was trained in geography. 2) She enjoyed the format of the course, especially the way that the arts and humanities were integrated into the curriculum. 3) Unity found it difficult to establish friendships during her freshman year when she was enrolled in the course. 4) Although she had interacted with the professor, Unity desired a closer relationship.

CoP Analysis:

Like Jasper, Unity was motivated to enroll in the introductory course because of an interest in studying with the professor who would be teaching the course. While Jasper was drawn to his professor because of their common interest in the sci-fi fantasy genre, Unity was drawn to her professor because of their common interest in the field of geography. Various aspects of the CoP framework could be employed to explore Unity's comments about Professor W, but as I stated earlier, in my analysis of Jasper's interview, Wenger's concept of *identity* provides an effective starting point because it allows for a discussion of the role of *multimembership,* which provides

brokers and boundary practices that allow members of one CoP to enter new communities.

Unity commented about responding positively to the course assignments because they facilitated her discovery of a new way of thinking about studying science, different from the way she had been educated in her native country. The new approach to studying science disrupted her prior conception of a strict separation between the disciplines, allowing her to exist at the nexus of multiple enterprises. Changes in Unity's identity were being influenced by interactions with peers who were not from the nation where she grew up, as well as with people associated with the environmental sciences and other disciplines at the institution,.

Toward the end of the interview, Unity described differences between the contexts in which students study science in her home country in comparison to the U.S. Employing the CoP framework, I could see how the *community* in which the faculty at the institution were situated engaged in a practice of recruiting promising undergraduates into their research laboratories, which can be considered a community of practice. Because the institution has only a small number of graduate students, undergraduates provide much needed assistance to faculty research. Participation of undergraduates in faculty research also provides a way for students to engage in experiential learning in ways that will put them in contact with explicit and tacit aspects of the discipline, or *enterprise* in Wenger's (1998) terms. Unity's experience in the laboratory caused her to move away from research because her experience involved solitary research and seemed devoid of opportunities to interact with the public.

CRT and ST Analysis:

Unity's comments included statements about racial stereotypes that she encountered in the U.S. regarding black people's limited participation in science. As an international student who is a black female, Unity said that many of the U.S.-educated black students whom she encountered during her first year of college seemed underprepared for rigorous study of the sciences in college. Wenger's (1998) description of the concept of *meaning* and the framework of Critical Race Theory, which explores institutional structures and practices that privilege white youth over black ones, provides a lens through which to explore what Unity had detected. According to Wenger (1998), people in practice negotiate meaning. Opportunities or lack of opportunities to participate in the practices of a specific enterprise influence which types of students get to participate in those enterprises. Such inequities are explained by Critical Race theorists such as Ladson-Billings and Tate (1994), Solorzano (1998), Delgado and Stefancic (2001), and Solorzano, Ceja, and Yosso (2000). According to Unity, in her home country, "smart students" regardless of race are encouraged to study the sciences and to aspire to such prestigious professions as lawyer, doctor, or engineer. A Critical Race Theory analysis of U.S. society suggests that black youth regularly encounter societal messages that undermine their confidence in pursuing the sciences and mathematics. Solorzano, Ceja, and Yosso (2000) explore the effects of the negative messages that Critical Race theorists refer to as microaggressions. Unity's comments about the encouragement black youth receive in her country highlight the difference in the societal messages that black youth in the U.S. receive. Wenger (1998) says that *community* is "a way of talking about the shared

social configurations in which our enterprises are defined as worth pursuing and our participation is recognizable as competence" (p. 5). Therefore it is apparent that negative or positive associations that exist in the society affect how black students view their participation in the enterprise. If, from their earliest years, young people get the message that the sciences are a possibility for them, they work with confidence to achieve mastery. In the U.S., given the history of racial discrimination, blacks do not receive a similar message. The negative messages are further crystalized by a series of encounters inside classrooms and in the larger society, with the result that U.S. blacks who aspire to excel in the sciences and mathematics cannot help being aware of the negative stereotypes associated with their race. The belief that one may be unfairly judged in an enterprise about which one cares, referred to as Stereotype Threat (Steele, 1997, 2003, 2010), continues to haunt those U.S. blacks who manage to succeed despite the institutional barriers and microaggressions they may have encountered. That Unity was socialized in a different cultural context allowed her to recognize easily the message of inferiority U.S. blacks receive when it comes to pursuing the sciences.

Group 4 - Holly, Opal, Luna

Holly, Opal, and Luna are black females who had taken different courses—the introduction to environmental sciences in the spring of their freshman year for Holly and Luna, and the introduction to environmental studies in the fall of her freshman year for Opal. All three decided to major in the environmental sciences.

Holly (black female, duration of interview: 39:07 minutes)

> Holly: Well, I always knew that my strength was, like, math and science. I went to an exam school in Boston. (1)

Renee: What was the name of your school? (2)
Holly: [specialized school for math and science] . . . But I [had] never taken earth and environmental science. I didn't take the AP course (3)
Renee: Did they offer it the AP in environmental science? (4)
Holly: Yes, they did. (5)
Renee: Did you take a different AP? (6)
Holly: I did . . . I took physics and calculus. (7)
Renee: That's nice. (8)
Holly: I knew my strength was really math, and that's what I was going in Thinking . . . econ or math or something like that, but not . . . environmental science. (9)
Renee: So you've always been interested in and strong in math and science . . . went to a specialized high school . . . really weren't thinking environmental science? (10)
Holly: Yeah. (11)

Initial Analysis: Holly described her background in science and math as strong. This assessment was supported by her enrollment in a specialized high school for those subjects. She had taken advanced-placement courses in physics and calculus, but before college she had never considered exploring the environmental sciences.

Renee: So tell me now… fast forward to the decision to select the environmental sciences as a course that first year. (12)
Holly: I think it had more to do with the fact that [Professor Y] was my advisor and I knew her personally. (13)
Renee: Okay. (14)
Holly: And then so I got to see her behind the scenes of . . . (15)
Renee: Yes? (16)
Holly: of the course and things like that . . . 'cause I also worked for her in her lab. (17)
Renee: So tell me more about that relationship with [Professor Y] . . .so she's your advisor . . .you were paired no doubt because you expressed an interest in science but not necessarily an interest in earth and environmental science? (18)
Holly: Yes. (19)

Initial Analysis: Holly's statement that her decision to pursue the environmental sciences had to do with Professor Y is interesting. Holly disclosed that she and Professor Y had a number of points of contact, which started because of her initial assignment to be Professor Y's advisee. Holly said that being Professor Y's advisee

allowed her to establish a personal relationship with the professor and gave Holly the opportunity to work in the professor's research lab.

> Renee: Tell me about some of the activities, the co-curricular activities you were involved with in high school. (20)
> Holly: In high school . . . I did volleyball, and after school I did . . . poetry the end of my freshman year . . . my summer time, it was dedicated to my AP courses. I had to take summer classes at [a local university] and things like that my senior year but beyond that I definitely was, like, more into, like, track and athletics and the arts and things like that. (21)
> Renee: Were you a sprinter? (22)
> Holly: Long-distance sprinter 200s. Only in [my home town] they have 300s. (23)
> Renee: My son is a runner. (24)
> Holly: Is he a long-distance? (25)
> Renee: He's a freshman. (26)
> Holly: Okay. [laughter] (27)
> Renee: He's coming into his own. He's a long-distance sprinter, but he's running cross country right now . . . he doesn't love it, but he's serious about it. (28)
> Holly: Track is life. (29)
> Renee: He loves sprinting though. (30)
> Holly: I feel like sprinting is like . . . if you work hard, it's a reward, like, to run the relay kind of thing. (31)
> Renee: Do you think that there is any crossover between athletics? (32)
> Holly: I do . . . I think there is a huge crossover between athletics and, like, how well you perform academically. I think . . . it gives you [a] break between working all the time and then going and playing the sport. It just exercises your mind and things like that and I think it builds a balance in your schedule kinda thing. I don't think it's healthy for you to always be sitting down and doing things like that. I think that's really why it helped me succeed through high school because I was always active. I had, like, a tight schedule, like, okay, school, after-school program sports, and then after that I would go to my after-school program and then after that I would go home and finish any homework, so that was the schedule. (33)
> Renee: Sounds like our life. (34)
> Holly: [laughter] (35)

Initial Analysis: Holly's description of her experience with track and benefits of participation in track for her academic performance was interesting. I was especially struck by her statement that it was not healthy to be always sitting down. I imagine

that the skills of managing a tight schedule, which she fine-tuned during her high - school years, continue to serve her well in college.

> Renee: So tell me now about any high or low points. Can we go over five minutes? (36)
> Holly: Yeah, that's fine. (37)
> Renee: K. So tell me about some high or low point that you experienced in the course with [Professor Y] . . .can you think of a high point? (38)
> Holly: Ummm, a high point? (39)
> Renee: Like what did you like about the course? (40)
> Holly: I did like the fact that we went on field trips, because unlike any other class I've ever been in, well, before . . . environmental science, because you know most of the classes, they involve field trips, I'd never been on a field trip and I was like, oh, this is great. I didn't expect this coming to college, I thought it was just gonna be, even maybe drawing outside kind of thing, or just never going off campus and seeing how water is sanitized or anything like that and actually just seeing what we're l earning being applied. So I thought that was nice. A low point— I can't, like, recall a real point. (41)
> Renee: So maybe there weren't any low points. (42)
> Holly: Yeah. (43)
> Renee: Meaning a point at which things you didn't like about the experience and it doesn't even always have to do with the course in particular. Maybe there were aspects . . . of the field. (44)
> Holly: Umhm. (45)
> Renee: The topic . . . interactions you were having? (46)
> Holly: I will say that for an intro course it's hard to, like, get specific into one topic and so with that I was kinda like . . . what to do with all of the information? But I think [Professor Y] did a good job of, like, trying to ground us on some concepts of . . . recycling and just, like, being efficient with everything that you use and things like that. So it's hard to say, okay this is . . . environmental science in one semester kinda thing 'cause, like, even what we touched on is not, like, everything that the whole course is about. I mean everything that the whole major is about. (47)

Initial Analysis: Holly's characterization of the field trips as high points in the course was not surprising, given her prior statement about her preference for an active lifestyle. Her statements caused me to wonder, as the interview continued, whether Holly might turn out to be the stereotypical outdoor environmentalist. As for her

perspective on the low point of the course, it is interesting that Holly pointed out the difficulty she felt in terms of covering all the topics associated with environmental science. But, more importantly, again she credits Professor Y for her ability to cover topics such as recycling and efficiency, big concepts in the field.

> Renee: In just giving those examples, you say, the way you word it, ah, makes me think that there might have been some ways in which your consciousness . . . (48)
> Holly: Of the major. I knew more . . . (49)
> Renee: issues. (50)
> Holly: Oh. [laughter]. (51)
> Renee: You know it was being changed because . . . you're learning the content knowledge. (52)
> Holly: Umhm. (53)
> Renee: About the subject, but when you say being more aware of the water. (54)
> Holly: Yeah. (55)
> Renee: Being more aware, so was there something else happening about your consciousness and your awareness about environmental issues? Was it changing you in any way? (56)
> Holly: I think so . . . I felt like I was becoming more conscious. I just never knew how much plastic . . . bags were used at [the Hillcrest campus store] or like how much effort went into recycling or things like that or, like, now I know pizza boxes can't be recycled because there's food on them and when you recycle them it attracts the rats and makes it harder for them to recycle everything else. It's just, like, becoming more conscious and, like, helping in the slightest way. (57)
> Renee: They need to do a better job of promoting that. (58)
> Holly: Yeah. (59)
> Renee: 'Cause I think people think cardboard . . . (60)
> Holly: Yeah. It's just like food actually hinders the process. (61)

Initial Analysis: Holly's explanations about the ways that Professor Y emphasized the topics of recycling and efficiency caused me to wonder about the ways in which learning about such matters affects one's awareness about how individuals contribute to environmental problems through poor management of waste and energy. I wanted to know if the lessons she learned in class from Professor Y were affecting the way she lived her life, so I introduced the idea of "consciousness" as a way to describe

increased awareness of environmental issues. I think that I may have talked too much, overdone my point, but the examples she gave, of the volume of plastic bags at the campus store and the amount of effort that goes into recycling, provided good illustrations of the point.

> Renee: So what is it like when you go home again and you bring this heightened consciousness of the environment? What's that been like? (62)
> Holly: I mean I've always been the odd ball out with my family, so they think of me as a little odd and I'm just like the hippie . . . the tree-hugger . . . the save-the-world Holly. And I . . . rub off on my brothers a little bit. One of my brothers, he was recycling, and then when I found out about this other stuff I was, like, make sure it has no food in it. If you want to recycle this, you have to rinse it out, and things like that, and now I tell my friends, like, you know, make sure you untwist the caps when you throw the water bottles away so the water can evaporate. I just, like, giving people these little facts, and maybe I'm not explaining [the] whole concept of things but I wanna make sure that . . . they participate in some type of way. (63)
> Renee: So you've found that this awareness has transferred into your lived reality? (64)
> Holly: Yes. (65)
> Renee: It's not just an academic thing for you? (66)
> Holly: No. (67)

Initial Analysis: I learned that although Holly might not have considered a major or career in environmental sciences before entering college, there were aspects of her behavior (i.e., being considered odd, a hippie, a tree-hugger) that spoke to an early appreciation for nature. Additionally, the character traits that are drawn to the environmental sciences remain consistent, regardless of whether she is at school or at home, as indicated by the way she states that her principles have rubbed off on her brothers. This consistency in behavior and attitude made me feel confident that she was already comfortable in settings involving the people and activities associated with environmental issues.

Renee: So you mention the field trips . . . I think you mentioned the water treatment [field trip] (68)
Holly: Umhm. (69)
Renee: What was your experience with the . . . walk through the ravine and all that? (70)
Holly: I'm not gonna lie. I'm not really an outdoors kinda person. The bugs I . . . seem to always [be] attracted to me [laughter]. It's one of those things. I have fragile skin and it's just like I know I'm gonna break out if I touch something wrong, but the ravine I actually liked. I went back there with my friend Aspen and we just walked through because we thought it was a nice place and it was a nice place to just, like, relax. (71)
Renee: So someone who's not the outdoorsy type. Don't really like the bugs. How do you engage with the environment? Is it your plans for this major? (72)
Holly: I don't really know. I feel, like, it's just I feel, like . . . I'll do it as I go kinda thing . . . I really feel like I'm open-minded, so that's why I'm going abroad and I wanna try this out. I know there's some people built for the field and some people not, and I guess this will be, like, my true test and not to say, like, I would never step in the field again, but, you know, I'm going to try. (73)
Renee: The environmental sciences is just such a wide open . . . (74)
Holly: Yeah. (75)
Renee: area right now that you know you can sit up in a lab. Work from your computer and do state-of-the art work. So lots of great opportunities. (76)

Initial Analysis: While discussing the field trips associated with the course, especially the water treatment plant and the ravine, Holly again suggested that she did not regard herself as the outdoors type of person. On the contrary, she pointed out her delicate skin and noted that bugs are attracted to her. Nonetheless she was not deterred. Crediting an open mind, she told me that she was going to try. Following the field trip, Holly returned to the ravine several times with her friend because she thought of it as a relaxing place to be.

Renee [continuing]: So then I think I understand why you enrolled in the course. You said it was because your advisor happened to be a faculty member in that department. (76)
Holly: Umhm. (77)
Renee: No doubt you were placed with her because of your shared interest in

science and math. (78)

Holly: Well, I also took a course with her—the [Science in the Media course]. (79)

Renee: Okay, so that was your first semester freshman year? (80)

Holly: Yes, my [first-year experience course]. And that one I really liked because we got to talk about things that we thought were important relating to science, and we had to, like, simplify it for other people. We would [broadcast] it . . . and . . . it was like, I'm famous, a little bit kinda thing [laughter]. (81)

Renee: I know of that show and it's very interesting, and I've known students who've participated in the past. So this idea of making the science accessible to the average person . . . (82)

Holly: Yeah. (83)

Renee: is somehow important to you? (84)

Holly: Yes. (85)

Initial Analysis: I was reminded again that it was a confluence of events that landed Holly in the introduction to environmental science; those events included her being assigned to Professor Y as an advisee, enrolling in her first-year experience course, and working in Professor Y's lab.

Renee: Very good. So you mentioned you have a friend, or I'm sure you have several friends, and . . . you and your friends, sometimes you do some things. (86)

Holly: Umhm. (87)

Renee: Go to the ravine or whatever. So what else goes on in your life? Like, you're not playing volleyball anymore, are you? (88)

Holly: No. (89)

Renee: Okay. You're . . . not running track? (90)

Holly: Noo [laughter]. (91)

Renee: So what else goes on in your life? What are you doing outside of these classes? What were you doing last year? (92)

Holly: Well I'm the manager of . . . it's an African dance troupe. I'm also on the board of the [cultural journal]—it's an on-line student publication built toward, like, bridging the gap between communities and having a voice for students of color on campus. I'm also a part of the [association for students of African heritage]. I'm a member. I'm sure I've done other things. I mean, I've participated in the woman-of-color [organization] but I'm not, like, on the committee. I'm just a member of that and I feel like I'm just a student who always goes to events that sound fun. So I'm a supporter [laughter]. Yeah, I think that's it. (93)

Initial Analysis: Holly's list of co-curricular activities in college included racial and ethnic group affiliations and an organization for women. I was surprised that none of the affiliations included anything associated with the environmental sciences. Could it be that, like Jasper, Holly reserved the activities outside of her course for interests other than the environmental sciences? I wondered whether her involvement in this way was a good thing. After all, would it not make more sense to immerse oneself in as many activities as possible related to one's academic major and career interest? I could see how Holly benefited from the multiple ways she could interact with Professor Y. Does it work differently in the co-curricular life?

Renee: So where do you live? Where did you live during the year you took this course? (94)
Holly: The year I took the course, that was my freshman year, so I was in the [residence hall]. I was in [residence hall], the best [laughter]. (95)
Renee: And then, so did you say you had friends who were enrolled in that introductory course with you? (96)
Holly: Yes. (97)
Renee: So did they live close by? (98)
Holly: Yes. (99)
Renee: In [residence hall] too? (100)
Holly: They did. (101)
Renee: And did you all study together? (102)
Holly: Yes. Me and my friend . . . , we studied together, and I also had a friend on my hall that was in the class. (103)
Renee: Now was Aspen an [environmental sciences] major? (104)
Holly: No, she's not. She's a psych major. (105)
Renee: Okay, so she still stayed with the sciences? (106)
Holly: Yes. (107)
Renee: Which is good. And your other friend? (108)
Holly: Ashley Ramirez. Yeah she was on my hall and she was taking the class as well. I'm sure a few other people on my hall were taking it, but I just was always leaning on her, like, oh, do you want to study for the exam, or anything like that. (109)
Renee: Aspen or Ashley? (110)
Holly: Ashley(111)
Renee: Ok. So do you know if Ashley ended up majoring in [environmental sciences]? (112)
Holly: Yes, she did. (113)

Renee: She did. Very good. So the two of you did support each other in that respect. (114)
Holly: Umhm. (115)

Initial Analysis: Holly's description of her group of friends, one in psychology and one in environmental sciences, and the ways that she sought out the environmental sciences major for study together suggests that Holly recognized the value of peer study groups and that she was a part of an intimate group with shared interests.

Renee: So how did you spend … the summer after you completed this year of being introduced to [environmental sciences]? (116)
Holly: I actually applied for the [grant-funded student research] program, and I was assisting [Professor Y] with her project, and I was sent to [a university in a neighboring state], and I worked with Amber—I don't know her last name. (117)
Renee: Research? (118)
Holly: Yeah, and I did research for the summer, and then I came back and presented what I found. But it was kind of like we didn't really find anything. (119)
Renee: Were you still working on [those samples]? (120)
Holly: Yes, I was . . trying to extract the [substance] from the [samples], but, um, the chemistry was wrong, so we kind of . . . had to do it over, so I was, like, doing chemistry for the summer. (121)
Renee: Oh, very good. So you enjoy that? (122)
Holly: Yes. (123)
Renee: You enjoy lab work? (124)
Holly: I did, but I feel like I need a balance kinda thing, so, like, being in the field and then also just doing the lab work. (125)
Renee: The lab work. (126)
Holly: Yeah. (127)

Initial Analysis: I learned that through yet another effort on the part of Professor Y, Holly spent the summer after completing the introductory course conducting research at another university. In reference to her preference for lab versus field work, I learned that Holly was seeking balance between doing work in the field and work in a lab.

Renee: So, what are you enrolled in now? (128)
Holly: I'm in intro to GIS, so it's a program mapping class. I'm in drawing 1 and I'm also in intro to biology. (129)
Renee: So you're taking 3 courses? (130)

Holly: Yes, yes. (131)
Renee: You've chosen to lighten the load for a reason? (132)
Holly: Yeah. Last semester I was taking about 5 courses so [laughter]. (133)
Renee: Wow. (134)
Holly: I was, like, I think I need to take it easy. I'm going abroad . . . ecology was . . . a requirement to study abroad, but it wasn't being offered right now and so I took biology. I wanted drawing because I was, like, I go to a liberal arts school I should feel like I do, and intro to GIS because I want to complete something in my major so I'm on track. (135)
Renee: So if you should go to [study-abroad programs], will you be able to take [a] course related to environmental? (136)
Holly: Yes. (137)
Renee: Oh, very good. (138)
Holly: I'm very interested in marine biology, that's why I'm choosing, um, these study-abroad locations near the coast, so because I want to be in the water and things like that. (139)
Renee: So that's your ecology? (140)
Holly: Yeah. (141)
Renee: It's not so much the rock formations. (142)
Holly: No, not really [laughter]. (143)
Renee: The fauna and flora, not interested in that? (144)
Holly: No, not really. (145)
Renee: You wanna be in the water. (146)
Holly: I do. (147)
Renee: So where does that interest—where does that come from? Is [it] your family heritage . . . or where you grew up? (148)
Holly: No, I mean the closest I guess is [city] . . . is it a lake? [laughter] I Mean, we live on a lake. It's landfill. (149)
Renee: Is your family multigenerational American? (150)
Holly: Yes my parents are from [city], and my grandparents are from like other regions. (151)
Renee: Of the U.S.? (152)
Holly: Yes. (153)
Renee: Like my husband. He's multigenerational. His family is from North Carolina and Virginia. (154)
Holly: Okay. (155)

Initial Analysis: I learned that Holly continued to take courses, some of which were unrelated to environmental sciences, which she took because she had the option to do so as part of her liberal arts education. Earlier in the interview I learned that she was preparing to study aboard. Then I learned that she had a strong interest in the marine sciences and hoped to study in a marine-science study-abroad program.

Renee: Tell me about how that course compared with the other course? I think you told me that it was—you like the activities. (156)
Holly: Umhm. (157)
Renee: You like the field trips. (158)
Holly: Yes. (159)
Renee: What else about that course? (160)
Holly: Um. (161)
Renee: How does it compare, positive or negative, to other courses? (162)
Holly: One thing. I was always worried about the exams because I just never knew, like, what she would ask because it was so broad. I know I feel like a lot of people did stress on the exams, and that's probably, like, when we all, like, united. We need to really study. I think that was the one thing that I really focused on, if anything, it was, like, the exams because everything else was more like natural. It's . . . just, like, life. We recycle. We don't recycle. This is how much paper we use, kinda things. (163)

Initial Analysis: I was surprised that Holly pointed to the exams when I asked her to compare the course to other courses. Earlier in the interview she had provided limited feedback on the low points of the course, stating that the greatest challenge was covering the environmental sciences in one course. She regarded the exams as separate from the ways that the information she learned in the course affected recycling. I wondered what to make of this segmentation of components of the course. Nonetheless, other students in the study shared her sentiment about the exams.

Renee: How were you perceived by your peers who were not science majors? (164)
Holly: They just didn't understand it. They were like. Holly . . I don't see you [laughter] "one with the environment" kinda thing. (165)
Renee: As if they're some big-time experts [laughter]. (166)
Holly: It's just like, I just don't understand, like, how you [are] going to be a part of this major and you don't like to be outside and rolling in the leaves, and I'm like, I'm sorry, you know [laugher]. I just don't know, but I'll find my balance kinda thing. (167)

Initial Analysis: Although Holly lacks the active encouragement of her peers in her pursuit of the environmental sciences, she presses on. Nonetheless, she did not describe attempts by her peers to discourage her. Their comments were probably based

on stereotypes as to the kinds of people who are involved in the environmental sciences.

> Renee: So now, how do family respond? I know you say that you have this persona in your family as the odd ball, the tree-hugger, so how are they responding to your life plans? (168)
> Holly: Well, my mother, 'cause I live in [city] and my internships for the past two summers have been in [another city] and she comes and gets me. She's like, if you go any farther I'm not coming to get you [laughter]. When I like try to explain what I'm doing, it's, like, hard. It's just like, aah, I'm doing research kinda thing. But yeah, I think they always knew that . . .I was capable of, like, majoring in something like this. (169)

Initial Analysis: The difficulty that Holly encountered when she described her efforts to explain her academic or research interest related to the challenges that some students encounter when their families are unfamiliar with the academic or professional fields in which they are trying to participate. Luckily, by the evidence that her mother continued to drive a long distance to retrieve her from her summer research location, one can assume that Holly maintained the continued support of her family.

> Renee: So do you think that . . . if your path hadn't crossed [Professor Y's], that you would have still found your way to this? (170)
> Holly: I don't know, I don't know if I can say. That may depend on . . . who else I met from the department, maybe. (171)
> Renee: But it would necessarily have meant that you wouldn't have stumbled across it through other means, you think? You think it had to be someone from the department who would plant the idea in your mind that this is a possibility? (172)
> Holly: Yes, I think so. (173)
> Renee: So have you been back to your high school at all? (174)
> Holly: Have I? I don't think. (175)
> Renee: I think you haven't [laughter]. (176)
> Holly: I mean, maybe to pick up a yearbook. (177)
> Renee: Not to participate in anything. (178)
> Holly: No. (179)
> Renee: So you talked to me about your peers' not really kinda understanding. I wanna talk a little about the interactions you observed among your peers with regard to each other with faculty or with faculty in the

context of the lectures and the activities and the field trips, 'cause you remember I accompanied you all on a couple of them. (180)

Holly: Umhm. (181)

Renee: And it was clear that some people seemed more engaged than others. (182)

Holly: Yes. (183)

Renee: So that's the kind of thing in the class in the lecture. What were some of the things that you were observing? (184)

Holly: I mean, I always sat in the back. (185)

Renee: Why did you sit in the back? (186)

Holly: One, I would come in just when class started, and also, I don't know, I just like to sit in the back. I don't know why. (187)

Renee: What did you think of that room? (188)

Holly: It was . . . distant. It was like, when there was ever an activity for us to like be in groups or something it, was like, ahhhh, yeahhh kinda thing, but I could always see . . . I could never understand this, but I could always see like kids . . on their laptops. And I'm just like, how are you getting all this [laughter] and on your laptop at the same time? And then there are the kids right in the front row writing down everything, and it's just like they're writing down everything and it's just like the dynamics of the classroom kinda thing. (189)

Renee: I saw the same thing. It drove me crazy. (190)

Initial Analysis: I was surprised to learn that Holly always sat in the back of the room because I had the impression that students who sat in the back of the room became invisible. And based on her interview, I got the sense that this was not her goal. Nonetheless she mentioned her dismay at students who were preoccupied with their laptops and her awareness of the students on the other extreme who aimed to write down everything the professor said.

Renee [continuing]: Did you observe anything else about, for instance, community service? Did you participate in the community service activity? (190)

Holly: I actually did it over the summer with [Professor Y]. We went To . . . the [garden by a community arts organization] . . . and I helped her plant some things over there. (191)

Renee: And . . . the op-ed piece? (192)

Holly: I wrote about . . . water definitively, but I can't recall what it was. (193)

Renee: Well, it's marine biology [laughter]; the eco-environmentalist in you

will always gravitate towards the water . . . So is there anything else . . . I've really gotten the scoop on how you came to declare this major. I think it . . . seems as though it's been [Professor Y]. (194)

Holly: It really has. (195)

Initial Analysis: Describing her participation in a community-service program at a local community center, Holly provided yet another illustration of the mentoring she received from Professor Y in pursuing the environmental sciences. Holly described the way she used an assignment from the course to explore a topic related to marine biology.

Renee: There had to be other things going on also that made you a willing participant (196)

Holly: I just seen the department and how, like, happier everyone was and also I met [Professor V], and she was just like, if you ever want to talk to me. (197)

Renee: What is it about [Professor V]? What does she represent to you? (198)

Holly: That I can, like, do it. It's just like one of those things and also [Professor Y] is just like another . . . like, even though she's not a person of color, just like [Professor Y] has like this faith in me that I didn't see. And I was just like, are you sure that you want to send me to go do your research, which I've never done before kinda thing, and she's just like, you know you're great, I can see it. And then she also has the talk about, like, you know, this is what I decided to do, and if you don't ever want it, I understand. I like, invested this all in you, if you ever want to change your major you can, kinda thing. So, like, I don't know, I was just like, she has this faith in me. I know I'm not the best at it, but I like it. It's interesting, I want to be happy, and, you know, successful at the same time, so. (199)

Renee: So [Professor V], you said she matters to you? (200)

Holly: Yeah. (201)

Renee: Because she represents that you can do it? Then you quickly say and [Professor Y], even though she is not a person of color? (202)

Holly: Umhm. (203)

Renee: So the logic of this makes me realize that the fact that . . . [Professor V] identifies as a woman of color? (204)

Holly: Umhm. (205)

Renee: Matters? (206)

Holly: Yeah. (207)

Renee: She represents something to you? (209)

Holly: Yeah. (210)

Renee: That you can do it? (211)

Initial Analysis: Holly described the impression she had that everyone is happy in the environmental studies department. This view is widely stated on campus, and I have wondered as to the degree to which it is an accurate assessment of the department. Holly's comments about Professor V, who is a woman of color, and Professor Y, who is a white woman, suggest that their shared support of her plays a large part on her impression that the department is happy. It seemed that the characteristics of a whole department might be defined, in some students' eyes, by the personal interactions they had with a few members. Additionally, more significant than the happy image of the department, is what Holly said about Professor Y's having a faith in Holly's abilities that she did not have herself. Could it be that professors' sincere belief in students' abilities in the sciences proves far more influential than the students' interest in the subject area when it comes to recruiting and retaining students, especially women and blacks?

> Holly: What are some of your interactions with the white students . . . with the white male faculty or non-women? (212)
> Holly: Yeah. (213)
> Renee: What is that like, since you brought it up, in an indirect way? (214)
> Holly: [laughter] Well, because I was already friends with some of the people, like, student-wise, it's like easy for me, 'cause they're like, ahhh is . . . blahblah. (215)
> Renee: But you . . . were already friends with them first year? (216)
> Holly: Yeah, like, they were already on my hall. (217)
> Renee: You took it first semester or second semester? I forget. (218)
> Holly: Oh, the intro class. I took that second semester. (219)
> Renee: So you had met these people and gotten to know them first semester. (220)
> Holly: Yeah. (221)
> Renee: So you all happened to enter this course together? (222)
> Holly: Yeah. (223)
> Renee: And it was cool, right? (224)
> Holly: I've taken, like, poetry and things like that and it just so happens that

all of us are now majors. I met them in other classes, but, yeah ,I think it's because I met them before that I easily interact with them. But one thing I will say is that my friends, my student-of-color friends, always say that I'm like the exception, that I can get along with everyone kinda thing. (225)

Renee: So [do] you believe that, though? (226)

Holly: Yeah, I mean yeah. (227)

Renee: You move through communities very well. (228)

Holly: Yeah, so that's probably why I can get along with them, but I'm not gonna lie, when I see like, Opal or Luna or even Dan Knight—he's not a student of color . . . I'm like, heyyy, and I'll, like, want to be in their group kinda thing. (229)

Renee: Now who's Dan Knight? I don't know him. (230)

Holly: Dan Knight is a guy. He plays on the football team. (231)

Renee: He's an [environmental sciences] major? (232)

Holly: He is. (233)

Renee: Don? (234)

Holly: Dan, but it's DAN Knight (235)

Renee: And he is an [environmental sciences] major? (236)

Holly: Yes. (237)

Renee: Senior? (238)

Holly: No, he's my year. (239)

Renee: Does he have locks? (240)

Holly: No, he doesn't But he has beautiful hair. [laughter] (241)

Renee: Phenotypically looks like a student of color or does not? (242)

Holly: No, he doesn't. (243)

Renee: He doesn't look like a student of color? But he identifies as a student of color? (244)

Holly: But he goes out with a girl who's, like, half-black, half-white (245)

Renee: Okay, I need to find him. So this is good. So does this idea of having a community of people of color while you're pursuing this matter? (246)

Holly: Yeah . . . It does matter. I always thought that [Professor Y] had, like, married a black husband, and I was, like . . . I have to meet her husband [laughter]. (247)

Initial Analysis: Holly described positive interactions with her white peers and faculty. Some of the white peers whom she met in earlier classes enrolled in the environmental-sciences course she took as a second-semester freshman. Her student-of- color friends credit her ability to get along with her white peers to Holly's aptitude for getting along with everyone. However, I thought that her comment about the importance of peer groups that included students of color who are environmental-

sciences majors was important. Earlier in the interview, I had the impression that Holly had only one friend who was both a person of color and an environmental-sciences major. Then I learned that there was a larger group of students of color in the department, and that she recognized and valued their intersecting social identities.

Renee: Do you know why she does what she does? Why she takes particular interest in making sure that everybody has equal access? (248)
Holly: I just think I think she's very supportive of it 'cause she's tired of Seeing, like, the disparity in the field. (249)
Renee: She's not okay with that. (250)
Holly: Yeah. (251)
Renee: She's not okay. She doesn't think this is natural. (252)
Holly: Umhm. (253)
Renee: She thinks this is like global warming [laughter]. Human hands are all over it, you know. She thinks it's not natural for us to have these patterns of underrepresentation, and she wants to be a part of making sure that everyone has equal access. (254)
Holly: Umhm. (255)
Renee: And I just admire her so much. But there is something unique about environmental sciences that I don't understand. (256)
Holly: Yeah. I don't know what. Its just like a home kinda thing. [laughter] (257)
Renee: I want to know how much of it is the people, the [Professor Vs] the [Professor Ys]. (258)
Holly: Umhm. (259)
Renee: Even the [Professor Xs]. Have you met him? (260)
Holly: I probably have and I just don't know it. (261)
Renee: Okay, he is another faculty member you are going to meet, you're gonna take classes with, and you're gonna probably do something over at the [environmental studies center]. (262)
Holly: Umhm (263)
Renee: I studied his course also, and when I interview students about their decision to stick with the major . . . (264)
Holly: Umhm. (265)
Renee: I've had patterns that have pointed to the professor. (266)
Holly: Yeah. (267)
Renee: So does [it] matter? Do you think that you wanna work in the field or do you think you want to go to grad school and then possibly do the kind of scholarship, teaching, that people like [Professor Y] do? (268)
Holly: I don't know, I definitely want to get my master's if anything. I feel like higher education is important. I don't know about a Ph.D. That's, like, dedication. (269)
Renee: You take it one step at a time. (270)

Holly: Yeah. (271)
Renee: All right, that's okay. So can I call you again if I have some more questions and if you think of things that you'd like to talk to me about? (272)
Holly: Umhm. (273)

CoP Analysis: Holly forged individual and collective relationships during her years of schooling that helped her get to the educational and personal point in her life where she had the preparation and the confidence to pursue the study of the environmental sciences in college. The various resources she sought out and activities that she engaged in along the way could be viewed as *practices*, according to the CoP framework. *Practices* are the "shared historical and social resources, frameworks, and perspectives that can sustain mutual engagement in action" (Wenger, 1998, p. 5). It could be argued that in her earlier life even practices that were specific to other *enterprises*, such as the sport of track and field, helped Holly develop the discipline and perseverance to excel in college. Wenger (1998) views the years of participating in different enterprises as an accumulation of historical membership, and argues that this type of participation, which he calls *multimembership*, provides opportunities for some practices to serve as *brokers* for others, which, through a continued processes of negotiation of *meaning*, change who we are. Another aspect of the CoP framework that was related to this interview was the concept of *community*. *Community* is "a way of talking about the social configurations in which our enterprises are defined as worth pursuing and our participation is recognizable as competence" (Wenger, 1998, p. 5). During the interview, I got a glimpse of the communities that provide access to a myriad of relationships that helped forge Holly's *identity*. One set of relationships that she described involved her family and her high school. Her education at a specialized

high school gave her access to *practices* that prepared her by instilling *explicit* and *tacit* knowledge about studying the sciences. It helped her feel capable and prepared to pursue the sciences. Like Unity in the sciences, Holly received messages from her family and teachers that supported and encouraged her interest in mathematics. Her involvement in track during high school could be viewed as relevant to her preparation for studying the environmental sciences, because, according to her, it taught her how to balance her schedule and keep her mind and body active. When she entered college, her association with Professor Y provided a way to enter the CoP of environmental sciences, first through conversations with Professor Y in her role as advisor, then through experiencing her as a professor, and after that from serving as a member of Professor Y's research laboratory team.

The concept of *community* extended to the way Holly described the significance of Professor Y and Professor V (who is a woman of color) in building her belief that she could achieve her goal, and to her friendships with peers of color who were also pursuing the major. Holly described in particular her initiation of study sessions with one friend. As an undergraduate and major in the department, the friend was also a member of the CoP of studying environmental sciences.

Along with Holly's involvement in various *practices* that encouraged and supported her learning, there were aspects of the environmental sciences with which Holly had some difficulty. For example, although she enjoyed the field trips, she didn't view herself as the outdoors type. She mentioned that although she felt the support of her non-environmental-science friends and her mother, it was clear that they did not understand her pursuits.

Like many participants, Holly was worried about her performance on the exams. In the CoP framework, the exams are a *reification* of her comprehension of the course material, but *reification* is different from *participation*. Therefore, students who actively participated in the course did not necessarily receive the highest grades, and the students who participated less were not necessarily the ones with the lowest grades. Earlier I had learned from Raven that some students assessed whether they were suited for a particular major based on their grades in the courses. Holly did not provide comments about grades that would have helped me determine whether this was her position as well, but I am inclined to believe that it was.

The most vivid illustration of Holly's changing *identity*, and an indication of the growing depth of her learning in the CoP of environmental sciences, was her account of teaching her brothers and friends about recycling procedures. The idea that her behavior remained constant regardless of whether she was at home or school, demonstrated that rather than a short-term performance it was a way of being that she had constructed, which can be viewed in CoP terms as *identity*.

CRT and ST Analysis: During the interview Holly commented that there were other students of color majoring in the environmental sciences and that she enjoyed socializing with them. Her involvement with other students of color extended to her extracurricular activities, which included a number of ethno-cultural organizations. Holly suggested that she had the reputation among other students of color of being capable of making friends outside of her race. According to Holly, her friends saw this quality as unusual. Holly commented that although she enjoyed her time with a diversity of peers in the environmental-science field, whenever she saw

environmental-science peers who identified with the student of color community, she wanted to be with them more than with those who shared only the interest in the field.

Opal (black female, duration of interview: 24:07 minutes)

Opal is an international student from [a former British colony]. She decided to pursue the environmental sciences shortly before arriving on the college campus, but she had encountered the study of environmental sciences only among other topics covered in a broader science course in high school.

Renee: Hello, Opal, thank you for agreeing to participate in this interview. As I mentioned, I'm interested in the ways students learn to become scientists or learn about science in the context of these, you know, introduction to environmental courses here at [Hillcrest] and I understand that you took the course two falls ago. Not last fall but the fall of 2012? (1)

Opal: Yes (2)

Renee: No, 2011. Good, and so you've completed a consent form. You have any questions about it? (3)

Opal: No. (4)

Renee: Okay, and as I mentioned before, I have a dual role at the University but you are under no obligation to participate in this study. (5)

Opal: [Inaudible] (6)

Renee: You have to say it. (7)

Opal: I understand [laughter]. (8)

Renee: So the interview will be about 10 minutes and I'm gonna press "start" now [on my phone timer], and the first question I have has to do with your background in science . . . give me an autobiography of your experience in science. So when did it begin? How did it take shape? (9)

Opal: I was never really a science person; I was more of an arts person growing up. In high school I didn't think I wanted to be in science 'cause I really didn't care about the natural sciences much. But when I was introduced to . . . a combined science course in high school and we did some environmental stuff I thought that was pretty cool. Learning like what was the ozone layer . . . the atmosphere, and things like that. (10)

Renee: What . . . academic year in high school? (11)

Opal: I was in the 10^{th} grade, so we did that 10^{th} to 12^{th} grade and I thought that was pretty awesome, learning about those things, but I didn't understand the background of it. (12)

Initial Analysis: After a brief review of the logistics of the interview, Opal told me about her first formal encounter in high school with the course that included the environmental sciences.

> Opal [continuing]: So when I came to [Hillcrest] it was like everything I learned at school plus Captain Planet episodes as a kid. It was like, oh, okay, this is cool. And then the professors here are very excited so [Professor W], when she was teaching the course she was really excited . . . she looked at everyone in the class as like, a beacon of hope. So she was really excited to teach us . . . give us a bunch of information [and] at the same time be like, okay, guys, this is what you guys have to do, so think about the different social issues, environmental issues going on and think about what scientific solutions there are. (12)
>
> Renee: So do you remember if there were field trips or activities in that course that you felt contributed to the excitement and the interest that you had in this course? (13)
>
> Opal: We did a lot of promoting work with, like, [a student landscaping initiative]. We had a lot of extra-credit activities where we either worked with [the landscaping initiative] or there was this one time the Pacific Islander group came and they were telling us about sea-level rise so we learned about that and had to go to their show about their culture basically, and how it's going to get washed away if the sea level continues rising. So we got involved with that and, like, for the end of the . . . semester instead of doing the final [Professor W] just completely switched it and was like, okay, we're gonna do a presentation where you guys have to choose how you're gonna express how the course has taught you something. So my group did . . . a flash mob in [the student center] and then it became a movie and we sent it to [Professor W] and it was pretty cool. (14)
>
> Renee: Very nice. Do you still have the footage from that? (15)
>
> Opal: I do. (16)
>
> Renee: I'd love to see it. (17)
>
> Opal: I'll send it to you. (18)
>
> Renee: So the theme was environmental awareness? (19)
>
> Opal: It was sea-level rise. (20)

Initial Analysis: Opal described the enthusiasm of Professor W, the topics, the [Hillcrest] landscape group, and the encouragement to engage creatively in the subject area as some of the reasons she was attracted to the major.

Renee: So I understand a little bit . . . early in high school you . . . had convinced yourself that you were more an arts person? (21)
Opal: Right. (22)
Renee: Why? (23)
Opal: In high school . . . science was more lax, and we only did physics, bio, chemistry— the usual things like that. And for us, 'cause I came from an island . . . all that [we] did [were] things based off the British composition of how science was done. We did a lot of lab work. But . . . we didn't have many resources or funds for our science department and all that and the teachers . . . were good, but they weren't great. The science was . . . confusing, so, like, kids in chemistry classes were confused, bio was difficult, um, physics, there were only, like, three kids who did well the entire time. (24)
Renee: So what about before high school? What was your interest level like in science before high school? (25)
Opal: When I was a child I wanted to be a comic writer. (26)
Renee: A comic writer—like comic books? (27)
Opal: Yes, I wanted to write comic books. When I was a kid I would . . . have a folder full of comic books, like strips I used to draw in, like, the 6th grade. (28)
Renee: So you're a visual artist also? You're good at sketching? (29)
Opal: I think so. Like, my mom was an art teacher, so she always would encourage us. When we did doodles and things she would encourage us to build on them. And I had an art teacher who helped me develop like 12 years of my life. So I really thought I was going to be a comic writer. (30)
Renee: A comic writer. Are you thinking that maybe you might kind of still take some courses here in studio design and studio arts? (31)
Opal: I did drawing 1. The problem is, even though I like drawing . . . I just don't like . . . spending so much time on it. Like, have a limited amount of time to do what I want to. (32)
Renee: So it is more your hobby. The thing that you do to relax and to have pure enjoyment. (33)

Initial Analysis: Opal told me about her childhood interest in becoming a comic book writer and her experience in high school science in the former British colony. While comic writing amounted to a hobby, it seemed that her interest in the sciences grew when she arrived at Hillcrest.

Renee [continuing: So, in reflecting [on] the course that you did enroll in . . . the intro to environmental studies course two years ago: What motivated you to enroll in it? Was it the prior experience you had in high school with the intro course? I mean, how did you come to decide

that that was the course, because there's also the one that's offered in the spring? (33)

Opal: When I was at home my parents literally had me sit in front of the computer one day and choose what I wanted to do with my life, for the rest of my life. Just to have an idea. So I was like, oh, environment seems pretty cool but . . . I still wasn't sure I wanted to be in the sciences, so I was a little skeptical. So when I came here, I was, like, studies sounds pretty cool. It deals with social justice. I'm interested in that. Then I came to find out that, you know, social justice is fine but it's not really doing what I want, which is, like, to actually make a difference. So I was, like, science seems to be the thing I want to do more than social justice, 'cause social justice is just talking and I don't care to talk that much. (34)

Renee: Oh, okay, all right. So what were some of the high points of that course that you took? (35)

Opal: Weirdly enough, I think the exams were cool. (36)

Renee: They were high points? (37)

Opal: They were. Like the whole course itself was pretty good, but I found exams to be pretty fun-ish because they required us to read the text, which was awesome. She picked some amazing texts for us to read about, like the ways you can help sustain different foods or like ways to stop the ice caps from melting and different economical ways you can approach environmental change. It was really cool. So, like, with all the knowledge that we learned and then we had to read . . . the exams were, like, so tell us what you think about this and that. And I was like, oh, this is pretty cool. Giving an opinion. Have an idea of what you want? It was pretty cool. (38)

Initial Analysis: Opal stated that prior to her first day in college, her parents compelled her to decide what she would major in, and she took me through the thought process she used to decide what aspects of the field she liked and disliked. The comment that I found most revealing was Opal's claim that she regarded the exams as high points in the course. I doubt that any of the other participants in the study shared her view. Most students who brought up the issue of the exams did so as something they were concerned about or regarded as a low point in the course. Opal's position was that the exams required students to provide opinions in response to assigned readings, something she enjoyed. Earlier in the interview, Opal stated that her

schooling was based on the British system. I think that Opal's comments about the exam, like Unity's overall comments about the course, may have come from recognition of the differences between an American versus a British approach to science instruction.

> Renee: Good, so what were some of the low points of that course? (39)
> Opal: Probably that it was large. Well, it wasn't that it was large . . .I kind [of] really [need to] think about it. Probably that we didn't really address the text as much as we should have inside the class but that was so much information we had to relay. (40)
> Renee: Did you use [the electronic course management system] and some online sources, or did you have a textbook? (41)
> Opal: We did have online sources we had to look into for some classes but it was not like we were pressured to read. There were classes where she'd be like, did you read this? No one would have read it, or she had already prepared slides, so it really wasn't a discussion of what we read. (42)
> Renee: How large was the class, about? The number of students? (43)
> Opal: About 150. (44)
> Renee: Were you in [the large lecture hall]? (45)
> Opal: No. We were in the downstairs one, so it was a group, a great group of us. (46)
> Renee: No windows. That one? (47)
> Opal: Yeah [laughter]. (49)

Initial Analysis: Opal started to say that the class was large and then corrected her claim and instead stated that not addressing all the texts was the low point of the course. In future study, I would like to ask the participants more directly about their impressions of the size of the lecture and whether they thought it affected their participation.

> Opal [continuing]: We had to do . . . like somebody had to do a news report on what they learned about some environmental fact or the world. So that was pretty cool. She tried to make sure that everybody knew each other. (48)
> Renee: Really? How did she do that? (49)
> Opal: Like we had a lot of group activities. That same news article . . . she'll be like, this person has this week . . . this person has this week or some people . . . she'd just address that, oh, Brigit did this this week or

Henry got arrested doing the Wall Street take-over, yeah, we knew about that. (50)

Renee: So did you develop any friendships with any of your peers from that class? Did you study together as a result of her trying to kinda do the social engineering? (51)

Opal: We did. I made friends with this girl Savannah. We're cool now. We did a proposal together for the [student-run environmental projects fund]. A couple of us had gone . . . into the class together, so it was like three girls from the [geographical area outside the U.S.]. It was me, . . . Tabitha, and Unity and she used to get us confused for each other, because the three of us are from different countries in the [geographical area].

Renee: [Countries in the geographical area.] (53)

Opal: So she used to laugh . . . good to see you, Tabitha, and I was like, it's not me [laughter]. (54)

Renee: Oh, gosh, but how did that make you feel the first time it happened? (55)

Opal: The first time it was awkward, the second time I just thought it was Hilarious, so I just let her have it because the two of them work in the department and I don't, so it's funny to me that I'm the only one who is still an environmental major. The two girls, they moved away from it. So I think it was funny that she still confuses me for Tabitha. (56)

Initial Analysis: Opal asserted that Professor W tried to facilitate students' getting to know each other through group activities involving sharing news stories about environmental issues; she also announced students' involvement in different forms of activism, like the Wall Street take-over. I thought it was noteworthy that Opal's closest friendships were with two black women from the same geographical area ouside the U.S.

Renee: So tell me, what was going on in the rest of your life . . . what is going on in the rest of your life? . . .So on campus I know that you're involved in the [student organization]. (57)

Opal: Yeah. (58)

Renee: That much I know because of your presentation at Friday night's program. Last year, fall 2011 . . . what else was going on while you were taking this course? (59)

Renee: Nothing. It was freshman year. Absolutely nothing was going on. I was still trying to, like, find my way around, I guess. I just discovered there was a . . . [student organization]. I was still making friends, and was

getting along with my roommate. We were still working on schedules and stuff. Ahh, home life was good. (60)

Renee: So you're taking this course. It's in the milieu you know . . . the soup of everything kind of going well . . . you're engaged in other courses. You're meeting people. You're at a distance from home. (61)

Opal: Yes, distant from home. (62)

Renee: And that's still working out good for you? (63)

Opal: Yeah, yeah, yeah. (64)

Renee: Now tell me about what was tugging and pushing at you with regard [to] environmental studies? Were there any organizations? Now . . . you say that the professor mentioned the [student landscape initiative] several times. (65)

Opal: Right. (66)

Renee: Right, so there was, like, this desire to recruit you into this organization? What was that like for you? (67)

Opal: It was a little pushy. I'm not going to lie…I honestly didn't want to . . . go digging in dirt because that seemed a little extreme, especially since I didn't understand what they were doing. I still don't really understand what they are doing now in front of [a residence hall] . . . But it was like a lot of the students were coming and they were like, we want to do this, we want to do that, and in my head, I'm not going to lie, I thought I was in class with a bunch of hippies. So . . . I was a little [laughter] afraid, I think. That's another thing that kind of pushed me to the science, because I was, like, I am not really feeling this crowd of people. (68)

Initial Analysis: Opal explained how her observations of the student landscape organization and her confusion about its activities tended to discourage her from pursuing environmental studies, or a social justice-based approach to the environment, pushing her instead toward the science-based approach.

Renee: So, have you thought about some of the ways that you might apply the degree in environmental science and whether or not there might be a range of possible . . . for instance, I hear about this . . . what is it, field school? (69)

Opal: Field camp. (70)

Renee: Field camp . . . have you thought about what that might be like for you? (71)

Opal: Haven't. I'm really trying to do something in Brazil. I want to go to Brazil at some point. (72)

Renee: To the rain forest? (73)

Opal: To the rain forest because they're doing different renewable energy

sources right now, so I wanted to go into Brazil and work there for a while. (74)

Renee: So do you see yourself more applying your degree not so much in researching out there in the field, gathering the samples, but probably more, once the samples are brought in by someone else, you're sitting at your computer doing the analysis and the modeling? (75)

Opal: Probably. I want to say, I want to do both. I want to be able to do my own research and then, like . . . find solutions to different issues . . . I have this dream that when I go back home . . . we have a terrible thing with garbage . . . there's a giant dump next to the food-service place that [inaudible] contaminated. But I basically want to find a way to get rid of that garbage. (76)

Renee: Is recycling something that's done in [your country]? (77)

Opal: No. (78)

Renee: And that's probably what contributes to the large landfill. (79)

Opal: There's a large landfill. (80)

Renee: You could take so much and reuse it, and reduce the amount, so just kind of educating people and putting the infrastructure in place for recycling. (81)

Opal: People don't really understand that either because [my fellow countrymen] are naturally just lazy people, so regardless. (82)

Initial Analysis: It was interesting to learn about Opal's plans to travel and live in Brazil in order to learn about Brazil's successful use of renewable energy and her plans to eventually return to her home country so that she could improve the garbage problem there. However, I did not understand her assertion that her fellow countrymen are naturally lazy. Although Opal is a black female, her comments could be interpreted as arrogant and demeaning. In future study, I would like to explore the personal experiences that lead to the formation of such perspectives. I wondered about the role of race and class in her perception of the residents of her country, as the interview did not provide sufficient insight into this subject.

Renee: No. It's new, because even in urban settings where people are not accustomed and not informed, quite frankly, about what's going on, you know, and are preoccupied with making it to the next day . . . this idea of being concerned about whether my plastic has a 6 or 9 or a 7 is just not up there on our list. Everything that's garbage you put in the garbage, then you put it out. It becomes somebody else's problem. In

fact that is one of the criticisms that the environmentalists get, that [they] seem to be removed from the reality of many low-income, yes, still disproportionately minority communities. That people feel as though something that . . . those . . . with extra money and luxuries can be preoccupied [with]. We can't. We have to be focused on some other things. (83)

Opal: Umhm. (84)

Renee: You know, it's tough. It's tough, but that's something you want to work on. That's a concerted project that is an important thing to do. When you even think about the ways in which our ignorance around garbage disposal contributes to more toxins going into the soil and then reaching the water and then harming people and crops. I mean, the whole throwing batteries away. Just throwing them in the garbage. People don't think about it. They just throw batteries in the garbage. Not a good thing, but the amount of batteries and the things that get leeched out over time. Most people aren't thinking about that . . . electronics. (85)

Opal: Throw them in the marshes. (86)

Renee: Throw them in the marshes and then what happens, so we really have to pay some attention. We're gonna need good minds like yours working on this issue. (87)

Initial Analysis: In retrospect, I regret that I delivered a series of monologues in defense of Opal's fellow countrymen after she made a comment about their being lazy. The purpose of the interview was to collect information, and my actions may have altered the ease with which Opal openly shared her perspectives from that point on.

Renee [continuing]: So, to fill your time outside of that course you pretty much didn't do anything but study. You had some friends? (87)

Opal: Studied . . . friends . . . you know . . . dealt with the culture shock . . . called Mom every weekend . . . you know. That was my focus first year. Trying to do . . . the general course requirement. (88)

Renee: And then second semester . . . you come back the second year and you say, okay, I'm going to take another environmental course? Okay, I'm leaning toward the major. Now you're in your second semester of your second year. Have you declared the major? (89)

Opal: Yes, I have (90)

Renee: Oh, good for you. All right, good, good. And who will be your advisor? (91)

Opal:[Professor U]. (92)

Renee: Good. And you've met him? (93)

Opal: Met him. We've had conversation. (94)

Initial Analysis: Opal described her first year as consisting of studying, making friends, and dealing with culture shock, and her second year as involving the declaration of her major and meeting with her advisor.

Renee: Good . . . you're in good shape . . . tell me how this course compares to the other courses you've taken in the past. That course that you took two years ago and you said that it was more exciting, a more experiential kind of thing. (95)

Opal: It was exciting. That course that was the only non-discussion course I had at the time, too, so it was my favorite. I just had to study. (96)

Renee: You mentioned that you came into the course with three other women, and very interestingly two of the three of you chose not to pursue the major. How do you think they experienced the course? (97)

Opal: One of them . . . she wasn't as interested as she thought she had been 'cause she did it back at home, too, so it was one of those things, she thought she was just going to come and do environment, and she realized that she preferred sociology to that. Another one . . . I don't think it was challenging enough for her. She's now a government major. So the two of them, I think they just didn't like it and it wasn't very organized . . . I mean, it was very organized because she had, like, different, like, [inaudible] stuff, but she was a little, what's the word, wayward. (98)

Renee: Inconsistent sometimes? (99)

Opal: Like when it came to like assignments and stuff, like with exams, she was serious, but with the final and stuff, as year one wound down she was more like . . . let's fight to let people know that the environment needs change. Let's do this. Let's be activists. And I don't think they really felt that whole activist [thing]. (100)

Renee: Is there anything else as you reflect on your experience in environmental science that you think I might find interesting, that you want to talk about? (101)

Opal: So, the studies course is very different than the science . . . well, the study is like a touch on environmental science. You have an idea and it's more like, you know, social problems and what do you do to stop it with, like active change . . . activist movements. Science is more like, you need to study. Know your chemistry. Have some bio in your mind. Physics is important. It's very important. Like, I just took [inaudible] with [Professor Y]. We did modeling for, like, what the work would be like if we didn't have certain variables. You have to . . . know the different composition of the sea . . . the chemical composition of the sea to know how ocean acidification is rising, and geomorphology. I have to study the [local river] basin and all types of streams and how

streams start to shrink and stuff. That was nothing to do with, like, low-income communities in different areas. (102)

Renee: Thank you so much, I appreciate it. (103)

Opal: No problem. (104)

Initial Analysis: Opal's assessment was that the introductory course was exciting, and different from the discussion-based courses she took that semester. It was interesting that my inquiry about the two women from the same geographical region with whom she entered the course led to a revelation that her friends had been discouraged by the disorganization of the course, a characteristic that Opal attributed to the professor's "waywardness." The waywardness, according to Opal did not show up during most of the semester with the exams but toward the end of the semester, when Professor W began to push, more and more, the issue of activism. Opal's disdain for the activism served to further discourage her engagement in environmental studies. I was reminded of the risk involved in professors' choosing to disclose aspects of themselves to their students. In some cases, as with Jasper and Professor X, the professor's interest in sci-fi fantasy and rock music proved attractive, but in the case of Opal, her two friends, and Professor W, the encouragement toward environmental activism may have discouraged them from environmental studies. In her closing comments, Opal explains the difference between the sciences and studies. Her decision to explain the distinction provided a fitting end to the interview.

CoP Analysis: The part of Opal's interview that related to the CoP framework was her commentary on the way Professor W tried to facilitate students' interaction. The professor's technique included making announcements about students in the course who were involved in social-justice activism, and encouraging other students in the class to join environmental-justice actions. This approach can be viewed as a *practice*,

in Wenger's terms. The practice presented models, ways of being in the CoP of studying the environmental sciences, that students new to the field could emulate. The models of engagement that the professor highlighted provided ways for students to participate in the CoP of studying the environmental sciences outside of the formal course structure. On another level, the activities that the professor encouraged provided opportunities for students to forge community.

The CoP framework shows that as a practice, becoming a part of activist groups enables students with similar interests to come together in a *community*. Communities socialize students and help them build relationships. The student landscaping initiative at Hillcrest is led by an organization that Professor W encouraged students to join. Opal said that she did not understand the students who participated in that organization. Her attitude could be seen as, in CoP terms, as an indication that she could not identify with the community they had formed. For example, she reduced their activities to "digging in the dirt." For Opal, the organization did not satisfy the dimensions of community—mutual engagement, a joint enterprise, and a shared repertoire. Rather, Opal viewed the students as "hippies," with a negative connotation. This derogatory reference reveals that Opal did not aspire to be competent in that setting.

Opal's interview also revealed the risk that can arise when professors introduce practices into a course that may not appeal to some students. In Opal's case, she could not relate to Professor W's promoting activism, and it made her decide to pursue the environmental-sciences track, which would be more science-based, as opposed to the social-science-based track on which she had been.

CoP and ST Analysis: Opal's comments did not provide insight into her experiences with race. She is a black female, born and raised in a former British colony. A follow-up study would involve exploring the experiences and perspectives that Opal shares with the other black female in the course who was born and raised in the same region. Perhaps issues of institutional racism and stereotypes might present themselves. The only two references provided by Opal that may relate to issues of race were her comments about Professor W's mixing up the names of the three black women from that region, and Opal's comment about her fellow countrymen's being lazy. Opal and Unity both come from countries where the majority of the population is black; their attitudes toward race thus differ considerably from those of the black participants raised in the U.S. Being mistaken for other black females from the region, which Opal laughed off, could be perceived in the U.S. as a microaggression in CRT terms, revealing the failure to recognize individual identity that members of certain racial and ethnic groups tend to experience.

Luna (black female, duration of interview: 27:16 minutes)

The interview with Luna was unlike the interviews with the other participants in the study because I interviewed Luna jointly with another student, Jasper. Although I had conducted an individual interview with Jasper, I invited him to participate in a follow-up interview. Luna's late arrival intruded on my scheduled interview with Jasper. With limited flexibility in both students' schedules for rescheduling the interviews, I decided to conduct a group interview. I have italicized Jasper's comments to convey my intention to focus attention on Luna's comments during the group interview. I started the recorder after they had had a brief chat to ascertain what they knew about

each other. I learned that they had seen each other around on campus, but Luna, an upper-level student and declared major in environmental sciences, was not aware that Jasper had recently declared a major in the department.

> Renee: So you've attended these meetings related to environmental studies? Meetings or lectures. Is that where you see each other? (1)
> Luna: Yes, since they hold research talks every other week and stuff. (2)
> Renee: Give me some topics that you've seen. (3)
> Luna: Like [environmental studies center] talks. I get less emails about those because I'm signed up for strictly [environmental sciences], so I hear all about planetary geology. [Professor V's] my advisor, so anything about [planet] . . . the moon and everything . . . I get, like, direct contact with. Like when it's philosophy and the environment . . . that's when my old teachers that I took a few classes [with] will email me and I get sprinklings of that. (4)
> Renee: Tell me about those informal opportunities that exist for people who want to do . . . environmental work, whatever version of it you are thinking about . . . so you say that you're on this listserv and you find out about lectures. What else exists in that world? (5)
> Luna: In the environmental-science world? (6)
> Renee: Yeah, or that you've tapped into. (7)
> Luna: Tapped into? (8)
> Renee: Or that you know about but haven't tapped into. (9)
> Luna: The [student landscape initiative]. (10)
> *Jasper: If you've gone to [residence hall] there's, I think that it's called [Hillcrest Gardens] . . . so it's, like, a lot of plants . . . just like a lot of flora . . . there are a lot of crickets there at night. (11)*
> Luna: I think the plan is to put like edible plants there and to [inaudible]. When I took intro to environmental science . . . with [Professor Y], she . . . basically made us go . . . we had to go join something . . . do something and volunteer on campus with anything. So I volunteered with them and, like, they just talked to me about it, so I wish I was really involved with the group on campus more. (12)

Initial Analysis: From Luna, I learned that there is a social network of people (faculty and students) in the environmental sciences. Luna said that she received emails about lectures and events that are held at the environmental studies center. She learned about other events from her advisor, Professor V, who is a member of the environmental sciences department. Luna mentioned the student-run landscaping initiative. Unlike

Opal, Luna expressed a desire to increase her participation in the group. I got the impression that Luna, like Opal, was clear about the activities associated with the organization. As Opal had indicated that she felt that Professor W was pushing her class to be involved in the organization, Luna explained that Professor Y insisted that students in the introductory course *join, do, or volunteer to do something*. The idea that the professors were pushing for participation in environmentally focused organizations suggested that the professors saw value in the groups. In a future study, I would like to explore the role of such student-led organizations in encouraging and supporting student interest in environmental-science-related disciplines.

> Renee: What's preventing you? (13)
> Luna: [A student-led dance troupe]. Though freshman year I took a class; they [the landscape-initiative group] only met at 4:30 [and] that was, like, during [my dance class]. I was already in the class by the time I knew, and then they were already moving along the steps toward the finale, so I just helped at the end. (14)
> Renee: So do you think that you'll get involved in it this year? (15)
> Luna: Yeah. I might, but right now they're in this stage where they are, like, just talking and not really, like, out in the field, and my goal for this year is to do something that's more field work . . . more outside stuff. (16)
> Renee: What's out there? (17)
> Luna: [National housing organization], and see if they have anything that's coming up.
> (18)

Initial Analysis: Luna explained that her dance class conflicted with the landscape initiative's meeting times. As for getting involved with group at the time of the interview, Luna explained that they were currently involved in conceptual work, not engaged in practical environmental activities, and her goal was to gain practical experience related to the environmental sciences.

> Renee: Do you [Jasper] do anything in the field? (19)

Jasper: It's actually kind of funny that you'd say that, because over the summer I had a summer job where I worked as a canvasser. I canvassed for the [national environmental organization], . . . ,which is kind of interesting . . . I like it . . . I mean, I really enjoyed it. I mean, canvassing is really hard and, like, taxing on my body. I did it for several weeks. It was very intense but . . . really rewarding and got into a lot. (20)

Luna: A lot of money? (21)

Jasper: Not really. It wasn't. It wasn't right. I wasn't paid properly for the job that I was doing, 'cause I was also field manager, so I had, like, other people that I had to work with. (22)

Luna: When I started it . . . I just did canvassing in [city]. They were having pipelines . . . and then they wanted us to canvass around the city for it. I signed up; the guy was from [a neighboring college] . . . Everything was set up, and then, like, I had this, like, mini, like, sexual harassment thing that happened and I couldn't do it anymore . . . it was so ridiculous . . . that's why I ended up not doing anything, but I did some volunteer work with this, like, non-profit thing, but I was so mad. (23)

Renee: How did you find out about the [national environmental organization] and those kinds of summer job opportunities? (24)

Jasper: Well, I specifically looked for . . . an active job . . . like a job . . .that's politically active. I feel like that looks good on your resumé, but also because I wanted to get some firsthand experience with fighting against environmental injustice. So I found . . . Grassroots Campaign was the name of the group. They had multiple different campaigns, but the one that I was interested in was the [national environmental organization], and I also did some canvassing through the [legal-rights organization]. It was really intense, though…I canvassed a lot in [a neighboring state] but also [a nearby state]. Mostly in [the neighboring state for the [environmental organization], and people would get really into heated discussions with me about the pros and cons of, like, fracking and other things. . . you just learn a lot while doing it. (25)

Renee: Did you get hostility from people about . . . you know I wanna drive my Range Rover . . . (26)

Jasper: Yes. (27)

Renee: In the city? (28)

Jasper: Definitely. (29)

Renee: I want more and more oil? (30)

Jasper: Yes . . . I remember I was canvassing [in a wealthy part of town] . . . I was canvassing, like, down the street from a fracking firm . . . a firm that fought for them, and I didn't even know that's where they set me up, so I was there and a lot of people would walk by and they kind of just laughed, or somebody would say really rude things. I also got into really serious arguments with people about the pros and cons of long-term and short-term results of destroying the environment and the

short-term, like, gains, like, getting oil . . . it really put everything that I was doing into perspective. But I also did get some really amazing conversations with people who had been fracked . . . their land was fracked, and some horror stories and stuff, and also people who were in the business. They would say things like, Oh well, this is actually really bad, but, like, we really need the money and all these other things . . .it was a good holistic education. (31)

Initial Analysis: Although Luna, like Jasper had secured a job as an environmental-education canvasser, Luna did not end up participating in her program. In a future study, I would like to determine whether gender influences the ways that females and males practice and learn the discipline of environmental sciences. This question was stimulated by Luna's comment that she did not end up participating in the summer canvassing job because of a sexual-harassment incident. Additional questions to be explored include: Are females and males treated the same when they are conducting environmental-education canvassing? Are there ways that people learn how to be effective educational canvassers while maintaining their safety? Does the race of the canvasser affect the effectiveness of the efforts?

Renee: So how did you find out about the opportunity that you did or did not fully take advantage of for the summer? (32)

Luna: Just a Google search when I was [inaudible] trying to find out environmental engineering opportunities . . . environmental law opportunities for those, like, still in the initial phases of figuring out what I wanted to do. All of the engineering things were for juniors, and . . . I'd missed the deadline or something. But, like, when it came to law I was okay, maybe I should . . . find this opportunity now and then take a course when I get back in the fall. (33)

Renee: Good. So you got very excited about the . . . social-justice aspect of this Work . . . talking to people, getting into heated conversations . . . could you talk a little about what else draws you, Luna, to the study of the environmental sciences? (34)

Luna: I guess what drew me in was in high school. It was kinda like my high school was all about sciences, and then everyone was kind of picking their bio or chem path. I could always see the importance of all the subjects, but I liked the fact that the environment basically takes all these subjects at the same time. You use everything that everybody else is learning [and it] is applied in this one area, and especially in an area

> where a lot of people of color are not the ones that are engaged . . . [people of color] are not the ones who are doing the research, and even though we are disproportionately affected by all the things . . . in the wind, the environment, the mold—because we specifically don't have as much money and all that. So I think it just hit me, like, okay, wow, Luna! You wanna do something technical . . . you wanna do something in the field or in the lab where it's just really, you know, engaged in this. So I just tried to put it all together and I wanted to do environmental engineering. (35)

Initial Analysis: Luna explained that she learned about the environmental sciences in high school and felt that it was the best path for her because it combined all her scientific interests and moreover it is an important field for people of color. The role that race plays in issues related to the instruction and practice of the environmental sciences has been brought up several times so far in the interview.

> Renee: Okay, might I ask you [how do you] identify racially? If I were to ask, [would] you be willing to put yourself in a particular racial category? Would you, and what would that be? (36)
> Luna: If I had to, I'd identify myself racially, I'd just say I was black. (37)
> Renee: Black, and what about you? (38)
> Jasper: That's the same thing for me. (39)
> Renee: Black. (40)
> Jasper: Yeah. (41)
> Renee: So that's for the record. (42)
> Jasper: Okay. (43)
> Renee: So . . . Luna, you spoke about one of the driving forces for you for the major was the disproportionate involvement [of people of color] and the effect that environmental injustice has on black people . . . black communities. How do you feel about that, Jasper? What are your thoughts on that? (44)
> Jasper: What do I think about it? I mean, there's only really one proper stance for that. Obviously it's sort of tireless. (45)
> Renee: When did you all become aware of this social injustice? This environmental injustice . . . a course, or did you know this before then? (46)

Initial Analysis: Luna's explanation of the ways that blacks and other minorities tend to encounter environmental and social barriers made me think that the term "social injustice" was a proper term to describe the host of issues she described.

Luna: So with me it wasn't only just the injustice in life . . . how each of us physically, emotionally and everything . . . how we're affected. [It] was more the injustice scholastically, in the sense that when it comes down to it, the college rates of who black people and, you know, Hispanic, all of us, the people who even get to school . . . the numbers are so small. And then when you get to school . . . the highest percentages in psychology or the highest percentages are in business administration and all of these subjects, the majors, that have just low employment. And then . . . we also have high incarceration. To then see that, like, some of the highest paying jobs are always in areas that have to do with the environment . . . an area that, like, we should all care about and yet three percent, two percent, are people of color that are in the area, so that kind of threw me. In all the books that I was reading in some of my environmental-studies courses it was like, okay, black people don't care about the environment. Black people don't do this and just a lot of generalization that made me even uncomfortable in class. That's like, okay, I really need to do this [major] and stick with it. (47)

Initial Analysis: Following my introduction of the term "injustice," Luna began to use the term to describe the situations she wanted to correct. I am not asserting that I coined the term. On the contrary the terms environmental injustice and social injustice were used regularly when I sat in on the lectures of several of the courses. Luna was well informed about social justice, or the ways that environmental issues, combined with other societal barriers, disproportionately affected blacks and other minority groups, but she is determined to succeed in the field.

Renee: Excellent . . . for you [Jasper]? (48)
Jasper: I mean . . . the first time I actually came into contact with environmental injustice in that form was actually in that class. (49)
Renee: That class? (50)
Jasper: Intro to environmental studies class (51)
Renee: With [Professor X] right? (52)
Jasper: [Professor X]. (53)
Luna: Oh, you took him. I almost did. (54)
Jasper: He's also my advisor. (55)
Luna: [inaudible]. (56)
Jasper: The first time I heard about environmental justice was in that class, and actually I did . . . I think I told you already, I did an op-ed, um, piece that was inspired by Majora Carter, who is an African-American

woman . . . I saw her at the [award ceremony for activists] . . . I was, like, that was so amazing. (57)

Renee: I brought you to her, right? (58)

Jasper: Yeah, you did; that was fun. And she did a lot of work in the South Bronx, fighting against environmental injustice and trying to make the area more green because there was a disproportionate amount of, like, dumping and pollution that was going on there . . . she's just been really active in the environmental community, and it was really inspiring. (59)

Renee: Are you [Luna] familiar with the work of Majora Carter? (60)

Luna: Oh yes; I had her on my binder freshman year. (61)

Renee: What does it mean to have this visibly young black woman as a real voice and face of environmental justice, as people who are studying environmental justice . . . does it matter at all? (62)

Luna: To me, even her being a black woman, it's more . . .because of all the issues that I've gone through . . . and some of my friends go through and everything, it's just an example of someone who is doing something so great and so big, so much bigger than all of us . . . As much as . . . some students and some professors push you to be great . . . [Hillcrest] has so many people who push you to do nothing or to not even want to be here. So she's, like, an example of, okay, this can happen. Just keep going even if environmental science is not your major, because she did film. (63)

Renee: Exactly. (64)

Jasper: It's an extremely inspiring story. (65)

Initial Analysis: Jasper's introduction of the topic of the environmental activist Majora Carter, winner of a MacArthur "genius award," caused Luna to comment that she did not think that all members at Hillcrest were equally dedicated to supporting and retaining black and Hispanic students. Her assertion was that Majora Carter helped Luna visualize that she too can be successful.

Renee: So what's the next step for you two? What courses are you in in environmental studies now? (66)

Jasper: Oh, right now? (67)

Renee: Yeah (68)

Jasper: Just this this semester . . . I'm not in any environmental science courses. I'm going to take some next semester. (69)

Renee: Why is that? (70)

Jasper: Because . . . we go to a liberal arts school, and there are classes that aren't in, in, like, my major core groups that I really wanna take. (71)

Renee: What's your major? (72)

Jasper: It's going to be environmental science and biology. I kind of want to minor in music. I'm not sure . . . I tried to get into two classes that were humanities--based and I got them both and they are really hard to get into. Creative non-fiction and cultural psychology. I was like, this is amazing. (73)

Luna: That's really good. (74)

Jasper: So I was like, this is fantastic, and then I'm trying to get into evolution right now, which I think also counts for, actually as an environmental-sciences kind of thing as a requirement, but I'm not exactly sure . . . also I'm taking intro chem, which does go toward environmental sciences, and bio, so yeah. (75)

Renee: Nice. (76)

Luna: Which one? The intro chem regular or . . .(77)

Jasper: No, I'm taking intro chem. (78)

Luna: That's why sometimes it's hard. It just depends on your math. (79)

Jasper: Okay. (80)

Luna: And how much you can remember from high school. (81)

Renee: And what are you taking this semester? (82)

Luna: I'm taking structural geology (83)

Jasper: I wanna take that. (84)

Luna: Field geology, which is the lab. . . taking quantitative methods . . . with [Professor X] and that's like, an environmental studies stats class. I'm taking intro to economics . . . economics theory, something like that, so it's just math-heavy, calculus and econ, the one for majors. But I was thinking about double-majoring with econ. I think of it, I kind of like it, but I'm not sure how. . . and then I'm taking the . . . [essay-writing course] because I want to do something with writing skills. (85)

Renee: Very nice. You all have a fabulous . . . course load. (86)

Initial Analysis: At this point in the interview, Luna and Jasper were engaged in a wonderful discussion about course selection. Their statements suggested excitement about the course content, the professors, and the opportunity to expand beyond their interest in the environmental sciences to the subject of economics for Luna and the subjects of music, psychology, and creative writing for Jasper. A future area of study would involve exploring the role of the liberal arts college setting in encouraging or discouraging students from studying the environmental sciences, and trying to establish whether students' experiences differ from those of students who attend large research universities and technical colleges of various sizes. Luna described a desire to

enhance her writing skills and at the same time was considering majoring in both environmental sciences and economics. The path to the environmental-science degree and perhaps to a career in the environmental sciences appeared to resemble the indirect and sometimes surprising path that water might take as it flows through a brook.

> Renee: Is there anything else that you can think about in your experience so far, trying to get into the major, trying to become more knowledgeable and kind of fully a part of the environmental sciences that you think you would want to share with me today? (86)
> Luna: What, like advice for someone who wants to do [inaudible]? (87)
> Renee: Yeah, what would your advice be? (88)
> Luna: I would say that they if they haven't found any way to get exposed to environmental science on campus or they even . . . were just a tad bit interested in the major . . . I would definitely say, take the sophomore seminar in the spring of your sophomore year, because it probably will convince you to change everything, because that is the best seminar class on this campus. (89)
> Renee: Who teaches it? (90)
> Luna: Um, it's a combination of all the professors. They come together and do it. Everybody else that I hear that have, like, their seminars and different stuff for their majors, it's kind of like something that's hard. Not even hard but something that's like really troublesome or like on their shoulders and makes them even feel like I can't do this . . . but to me it's like this should be the beginning of where you feel like I've found my place, you know, and it should be inviting and it should be a place where, like, you can really get to know everybody that's on that floor, especially in [the main science building], where it could feel so quiet and cold. It was a great experience, and you got to go on different field trips every week. You met every professor in the department. You basically knew their life, their school they went to . . . their kids, their husband or wife. It was just really great, and then you met everybody that's probably gonna major with you in that class. It's good because meeting them, then [in] turn in your senior year, when you're doing the capstone project . . . you got support. (91)
> Renee: So you talk a lot about the social aspect of becoming a part of that community and then getting to know people's families, kinda feeling really comfortable. Could you talk a little about your experience so far with that? The social aspect. Does that matter to you? [directed to Jasper] (92)
> Jasper: I mean . . . yes . . . the people, like the students in the major definitely . . . it's definitely like a group but it's a close-knit group. (93)

Renee: As you talk to your peers who are doing different majors, are they also kind of saying that they're finding similar niches? (94)
Jasper: Not that I have heard. (95)

Initial Analysis: As I attempted to bring the interview to a close, I inquired about any last comments and learned a great deal more about the experiences that the students, like Luna, had in their pursuit of the environmental sciences. It began with Luna's recommendation that students take the sophomore seminar. Among the benefits of the experience, referred to several times, was the opportunity to develop personal relationships with faculty and students (especially those who planned to pursue the major). Luna described how students met the entire department's faculty, their families and children, and about the faculty members' educational background. The activity of field trips was brought up again as feature of studying the environmental sciences that Luna (and several students in the study) felt were opportunities to learn the content and social aspects of being in the discipline. She explained that her peers in other departments did not have similar positive experiences with the required seminar courses in their fields, and Luna attributed the closeness of environmental-science students, as compared to the relations among her peers in other majors, to something in the department.

Renee: There seems to be something unique about . . . is it the discipline or? (96)
Jasper: Because it's small. (97)
Renee: Is it the discipline or is it the department or specific people who are in it here at [Hillcrest], the faculty here? (98)
Luna: I used to say that too, like, it is small, but it really isn't that small . . . I didn't even know that you [to Jasper] you were doing it. You weren't a major yet, that's why, but it's not that. It has to do with something about just the way that the professors are and the way that these classes are, like, taught. Oh, that's just a big thing that [Professor X] did . . . you go to these classes, yes, . . . chem and all these classes are really big, but at the same time you take a TA session . . . no one ever takes

the time out to go and let [us] say what everyone's name is. Ever. Not even my . . . dance class, and I love [the teacher]. Nobody ever . . . makes us all feel like we are all equal. We all have a name. Let's go by each other's name. And be able to talk to each other, you know what I mean? That would've changed everything in my physics class that had thirty people, if everyone knew each other's name. It would have been easy to say, okay, hi, so-and-so . . . can we study together? Can we work together? Instead of having to look at skin color and be like, yo, like. can you. wanna help me out? [inaudible] You know, it shouldn't have to be. [Professor X], instead, he stopped. He said, okay, everybody, let's go around and listen to each other's names, where you came from, this this this and that. We're all laughing, joking. So [Professor T], he's doing structural geology—he did the same exact thing. He was like, okay, everybody, let's talk about why you like rocks. And you had to say a sentence for each person and it was just like, this is why we start to get this, and every time you hear somebody say I'm [environmental sciences], we're just like, okay, good. When you meet somebody, you're like, oh hey [inaudible], but I don't see that with my friends that like bio. (99)

Jasper: Oh yeah, I had a very similar experience in [a soils course], which is like, an [environmental-sciences] class and it's taught by [Professor U] and it was amazing. I also feel like [environmental sciences] is very hands-on. [Environmental sciences] and [environmental studies] are something you not only sit down and learn like econ . . .it's like you learn about numbers and dealing with graphs and all these other great things, but I actually [inaudible] this is very hands-on, like it was a service. (100)

Luna: Community service. (101)

Jasper: A service-learning class as well, so we had to go teach a class in [a nearby city], and so we have groups and stuff, and I really got to know everybody in my group. Even outside of my group . . . then there was the teaching part and a lab part and half of the class did that and half of the class did the other. But then it all overlapped and, I don't know, it was fun . . . I really enjoyed it and I really got to know, like, everybody. (102)

Initial Analysis: Jasper stated that he attributed the positive characteristics of the environmental-science department to its small size, to which Luna expressed disagreement and then provided details about the ways the professors in the department cultivate warm relations. Her illustrations included accounts of specific professors in the department who, regardless of the large size of any course, had the

students introduce themselves to each other so that they could make a personal connection. Luna compared this practice with her experiences in other departments—physics and dance—in which the professor did not initiate a similar activity. According to Luna, the practice of facilitating introductions has a particular importance for students of color because it opens opportunities for students to form racially-mixed study groups.

> Renee: What was your class, your school setting in high school? Was it a large school, a small school, intimate, you know . . . what was it like? Is that the kind of environment that you're most comfortable with, or least? (103)
> Jasper: I'm from a very, very, very, very small high school . . . like, there were 70 people in my graduating class . . . that's one of the reasons I chose [Hillcrest] because it's like, it's not huge . . . I enjoyed my high school. It was cool. I knew everybody. Although it could get kind of boring sometimes [inaudible], I knew everybody. (104)
> Renee: What high school was it again? (105)
> Jasper: It was the [well-known public academy]. Yeah. We're actually number one in [the city].(106)
> Luna: Cool. You went to [that school]? (107)
> Jasper: Yip. (108)
> Luna: That's good. [Specialized high school for science]. (109)
> Jasper: Oh . . . [Inaudible] (110)
> Luna: [inaudible] (111)
> Jasper: Cool. (112)
> Renee: Very nice. Well, I want to thank you for your time. I think I have a good chunk of data here . . . might be inviting you back for a follow-up. Would you be willing to meet with me again? (113)
> Jasper: Okay . . . definitely. (114)
> Renee: All right. Well, thank you very much. (115)

Initial Analysis: Finally, I learned that Luna and Jasper had attended specialized public high schools. They commented that they had had close relations with their high-school peers and faculty. Studying the influence that close peer and faculty relations in high school may have on undergraduates' ability to forge relationships with peers and faculty in college would prove valuable. Perhaps students hoping to

replicate earlier close relations seek out academic departments that seem to encourage such relations, as does the environmental-science department at Hillcrest? The idea that attraction to departments is facilitated on the individual and personal level by the presence of similar interests, i.e., sci-fi fantasy for Jasper or the expressed interest of a faculty member in guiding and supporting a chosen student, and on the departmental level by the familiarity of a department's characteristics, i.e., intimate and personal versus formal and impersonal, may play a much greater role in attracting and retaining students than previously documented. These characteristics, in students, faculty, and settings or communities, appear to be central to recruitment and retention in various majors and careers.

CoP Analysis: Luna is a part of a community, comprising her advisor and other professors, who inform her about ways that she can engage with the CoP of students studying the environmental sciences. Unlike Opal, Luna had a positive view of the student group engaged in the landscaping initiative. She expressed a desire to increase her participation with the group. Professor W, who taught the introductory course to Opal and Professor Y, who taught the introductory course that Luna took, both encouraged students to join environmental social-justice groups. While Opal felt she had nothing in common with the participants in the organization, Luna saw the organization as offering a way to gain practical field experience. For her, participation in the organization would provide additional relationship-building and skill-building opportunities in the environmental sciences. For a student like Luna, such relationships and skills would help create new meanings though insight into ways she could organize her life and improve society.

Luna's interview raised the question of whether females are disadvantaged in their involvement in practices that could enhance learning in the CoP of studying the environmental sciences. Luna mentioned a "sexual harassment situation" that prevented her from doing the canvassing job. Unfortunately, the CoP framework does not prove useful for exploring this significant issue.

Like Holly and Unity, Luna introduced the question of race in the interview. The CoP framework would view these students' racial affiliation as participation in another community of practice. In explaining her decision to pursue the environmental sciences, Luna highlights her *multimembership*, explaining that it was important for her to pursue the environmental sciences because blacks are underrepresented in the field. This understanding is an illustration of meaning. While some people would be discouraged by that information, Luna was undeterred by the knowledge and seemed to want to defy the odds, using the underrepresentation of blacks in the field as a source of motivation. In this respect, her membership in the CoP of black students serves as a broker. Majora Carter represented what the integration of Luna's communities, that of black females and that of environmental scientists, looks like. Carter can be viewed as a full member in the community, although she took an alternative path to her work in the field, as she had not majored in the environmental sciences in college.

Luna's description of the close relationships in the environmental-science department points to the role of community. Her comments invoke the three dimensions of community: mutual engagement, a joint enterprise, and a shared repertoire. Students in the department have several ways to learn and interact. Luna

described the field trips and the convention of introductions that she experienced in several of her courses. She asserts that these activities create the friendly atmosphere in the department. Field trips break down social distance and provide opportunities for students to acquire knowledge through explicit and tacit means. The professors who facilitate student introductions are performing an important task because they help students to become familiar enough with each other to engage in discussions about course material.

CRT and ST Analysis:

Two aspects of Luna's interview that lend themselves to analysis in terms of Critical Race Theory and Stereotype Threat are: 1) the role of in-class introductions facilitated by the course professors and 2) awareness of the negative stereotype associated with people of color in the field of environmental sciences.

Luna suggested that the practice of facilitating introductions had particular importance for students of color because it created opportunities for students to form racially heterogeneous study groups, instead of, as she put it, relying on skin color. The concept of Stereotype Threat refers to a psychological phenomenon in which a black person like Luna may feel vulnerable to underperforming in a domain like studying science, because of concern that she may confirm a negative stereotype associated with her identity. When professors facilitate student introductions, the professors help students to break down social distance and become familiar enough with each other to talk about the course material and diminish the activation of stereotype threat. Luna and her peers are better able to establish racially heterogeneous study groups and engage in discussions that will aid them in learning and developing

expertise in the environmental sciences. Engaging in study groups in turn helps break down perceived racial barriers and challenge negative stereotypes that may otherwise go unchecked.

The CRT framework provides a way to explore how historical housing and school patterns in the U.S. have tended to follow racial and economic lines, with the result that in college many undergraduates, especially white students, find themselves for the first time living and studying with people who do not share their racial background. Luna's comments point out that introductory courses in college give undergraduates from diverse backgrounds important racial experiences. They also reveal the racial implications of the classroom dynamics course professors foster, and how these dynamics affect the ways students from diverse backgrounds and social identities relate to each other.

Luna explained her motivation to pursue the environmental sciences as a combination of her interest in the sciences and her commitment to making a statement for black people. She displayed a clear recognition of the social injustices that affect people of color and conveyed her impression that few people of color hold jobs in lucrative careers related to the environmental sciences. Luna also described the inspiration she received from the accomplishments of Majora Carter, an African-American woman who became an environmental-justice advocate. Carter challenges the negative stereotypes about people of color and the environmental sciences with which Luna was familiar. Luna's comments about Carter's significance address issues of visibility.

Class of 2014 (n= 2)

Crystal (black female, duration of interview: 30:50 minutes)

Crystal, a black female who had enrolled in the introductory environmental-studies course in the first semester of her freshman year, declared a major in environmental sciences. The most senior participant in the study and an environmental-science major, her comments included reflections on her experiences from the introductory course through her advanced participation in research, professional conferences, and other opportunities to study the environmental sciences.

Renee: So Crystal, do you have any concerns, any questions about the consent form? (3)
Crystal: No, I don't. (4)
Renee: Do you mind if we record the interview? (5)
Crystal: That's okay. (6)
Renee: Okay. I've been studying students who've taken the environmental-science introductory courses, either intro to environmental science or intro to environmental studies. (7)
Crystal: Umhm. (8)
Renee: 'Cause I want [to] understand the experience that students have in relation to these courses not only within the literature but in relation to thinking about these courses. (9)
Crystal: Umhm. (10)
Renee: So how is it that you came to enroll in . . .which course did you take, for the record? (11)
Crystal: I took intro to environmental studies with [Professor X]. (12)
Renee: Okay, and how did that go? (13)
Crystal: Not very well. I didn't like the class and I felt like I struggled to get a passing grade. I ended up getting a B-minus in the course. (14)
Renee: Given that you didn't . . .you ended up majoring in environmental science. So given that the course wasn't the draw, what was? (15)
Crystal: It was definitely . . . one of the professors in the earth science department [Professor Y]. (16)
Renee: And how did you connect with [Professor Y]? (17)
Crystal: I connected with her through you. (18)

Initial Analysis: After reviewing the logistics of the interview, Crystal proceeded to inform me that she viewed her experience in the introductory environmental-studies course in negative terms, and she credited Professor Y for giving her the support and

encouragement to pursue the environmental-science major. She told me that she struggled to pass the course, yet she received a B-minus, a grade I didn't agree suggested a near-miss.

> Renee: And when you came to see me . . . if I remember correctly, you were exploring the different options . . . it was early enough in your years here . . . you were still exploring courses, right? (19)
> Crystal: Ummm? Well, I was. I think I just needed another course to fulfill my credit requirements for the semester but I thought I was on the track to do the engineering program . . . (20)
> Renee: And what were some of the things that were motivating you to do engineering when you came in? (21)
> Crystal: I'd always been interested in math and sciences throughout all [of] my schooling up until that point. And I think most of high school I had seriously considered being an engineer, one, because they made a lot of money [chuckle] and two, I just like the things that you could do with engineering. It could be very creative and you could use it in a lot of community service, yeah. (22)
> Renee: Which is important to you? Community service? (23)

Initial Analysis: Crystal explained that she had enrolled at the university with plans to pursue the path to an engineering degree. She told me that engineering had appealed to her because she liked math and science, wanted to make a lot of money, could apply the degree in creative ways, and could be involved in community service.

> Crystal: I think it's important that whatever skill I learned I could apply realistically to helping people. It'll just be better. (24)
> Renee: So with the engineering, were you involved in any kind of precollege Program, or were there engineers in your family. . . in your community? Was it something that was being presented to you in very vivid ways? (25)
> Crystal: Not at all. [chuckle] (26)
> Renee: How did you come to think that engineering was the way you wanted to apply your math/science interests? (27)
> Crystal: I think . . . it came to me when I'd seriously started considering which schools I would apply to and then I sat down with my parents and we realized that I still had to choose what I wanted to study. So . . . I think I read a lot of, like, college literature . . . I looked at majors, and engineering just seemed to combine a lot of the things that I like, mathematics, science, and community service. (28)

Initial Analysis: As I considered the various career options that could provide the items on Crystal's list, I wondered about the people and activities she had encountered before college, and the degree to which these encounters could have led her to the initial plan of going into engineering. I learned that she did not have any family or community role models who were engineers, and that her decision was made while she was engaged in the college search process.

Renee: So then you ended up pursuing environmental science as a major? Can you tell me a little bit about after you met [Professor Y], and you say that she was a deciding factor in your choice of major. What [are] some of the early interactions you had with her? What was it about these interactions that seem to have led you to the major? (29)

Crystal: Well, the first thing she is just a wonderful overall . . . a wonderful person. Very kind . . . very giving, and she genuinely cares about students' learning, and what drew me to continue to pursue earth science after the intro course was just her encouragement. From the first day that I met her she offered me a position in her lab working on one of the projects she had in mind, and I was just really surprised by this. And it made me feel really good, 'cause she didn't know anything about me. I didn't have any earth science background, but she still thought that I was capable of working in her lab on one of her projects. (30)

Renee: So when you worked in her lab, were you given, like, mundane, boring things to do? (31)

Crystal: It was half and half. I think with any, I guess, job the newbie gets some of the grunt work [chuckle], so I was washing a lot of containers for other, I guess, graduate students and upperclassmen for their projects, and then I was also working on my own project. (32)

Renee: Good, so you were paying your dues and you were also gradually getting more responsibilities? (33)

Crystal: Yeah. (34)

Renee: That were important to the project? (35)

Crystal: Yeah. (36)

Renee: Umhm. (37)

Crystal: [inaudible] (38)

Initial Analysis: Crystal identified Professor Y's personal qualities as things that drew her toward the major. In particular, Crystal recalled Professor Y's kind, genuine,

caring demeanor and encouragement, as well as the invitation that Professor Y extended at their initial meeting for Crystal to work in her research lab. Crystal explained how the invitation came as a surprise because they had just met and Crystal had not taken the courses related to Professor Y's field. Crystal, like Holly, responded well to this invitation to work in the lab. I was beginning to see more clearly the significant role that working in the lab played in student recruitment and interest in the environmental sciences. When Crystal explained her initial assignments in the lab, I recognized that her experience was characteristic of an apprentice. While washing containers for graduate students and upperclassmen, Crystal was able to observe the discipline-specific and social activities of more advanced students, which could benefit her in the future.

> Renee: [You] enrolled in the course . . . the intro course, and you moved up through the ranks and you started enrolling in more courses. What are some of the other things that you're involved in in your life? What else is going on in your life? (39)
> Crystal: So, after I got to college? (40)
> Renee: After you got to college . . . what kind of like general things have you been involved in and what were some of the highs and lows of college in general . . . [Hillcrest] specifically? (41)
> Crystal: Okay. So I think extracurriculars have definitely played a big part of my life when I first got to college. (42)
> Renee: Like what did you do? (43)
> Crystal: A few organizations . . . the [association for students from a region outside the U.S.] . . . I joined the . . . dance team . . . I was involved in [the African-American students' association]. I really like the social scene on the weekends, so I went out frequently. I think I just got really excited that I was able to be part of a community and just be part of . . . be one of the people who shape it, 'cause in high school I wasn't able to be part of student groups . . . I was a student athlete. I ran all year round and then I had to focus on my grades . . . but then I got here . . . I became part of these groups . . . people started actually looking at me, giving me responsibilities and commending me when things went right. And so I just felt really appreciated and I really liked participating. (44)

Initial Analysis: Crystal described an active social life that included going out and involvement in a number of extracurricular activities in her first semester of college. Like Holly's, her activities included a number of racial and ethnic organizations, and like Holly, in high school Crystal had been involved in track and had carried a demanding academic load. It was interesting to hear how excited Crystal had been to be a part of a community and how much she had enjoyed the opportunity to shape it and to receive praise for carrying out her responsibilities well.

> Renee: Umhm, very good, so did you work also? (45)
> Crystal: Oh, yeah. [chuckle] (46)
> Renee: A job? (47)
> Crystal: That's an important issue. Yes, yes I did work . . . trying to think. I started off with one job the first semester and that was just working with [the neighborhood arts center] doing tutoring and helping out in the program, and then, I think, over the next year and a half I progressed to working for the [dining service's] catering . . . I also joined [the activities office] staff. I worked for the community-service office, driving vans, and there's probably another job out there that I don't remember [chuckle]. (48)
> Renee: Umhm, so currently, what to your work responsibilities look like? (49)
> Crystal: My official jobs? I still work for [the dining service] and I also work for [student activities office], but now I'm one of the captains and I also work . . . as a residential advisor. (50)

Initial Analysis: In the first semester of her freshman year, Crystal held many jobs, and in her sophomore year, she added residential advisor to the list. Like many students in the study, Crystal maintained a busy schedule. I wondered how she found time for her course work.

> Renee: And on top of it you've participated in a number of conferences, and you've been [a fellow in two grant-funded student-research programs], right? (51)
> Crystal: Yeah. (52)
> Renee: Tell us about that. (53)
> Crystal: So, I became part of [the two programs] at the end of my sophomore year. I'd been doing research with [Professor Y] way before that, and so I didn't feel like it was a big deal that I was required to do

research for these programs and so I joined the programs. I just continued my regular work with [Professor Y]. And [Professor Y] being the person that she is . . . always encouraged me to continue to present my research. Do professional development, and so she suggested many summer programs . . . conferences, all of which I applied to . . . I think every summer I've been at [Hillcrest]. I've done some type of research with [Professor Y], but it was just funded through different programs. (54)

Renee: I know you've gone to field camp . . . where was that? (55)

Crystal: Field camp was in [two states in the Southwest]. (56)

Renee: And what was that like? (57)

Crystal: It was very intense. I decided to go . . . to sign up for it 'cause [Hillcrest] doesn't require it, but after I realized that I wanted to major in geology everyone said that it was kind of a rite of passage to go to field camp, so I went to field camp. (58)

Initial Analysis: I learned that Professor Y had encouraged Crystal to apply for the two research programs, which sponsored additional research and conference experiences. I learned that Crystal had opted to participate in a field camp program, a discipline-specific experiential course. Although it was not required for completion of an environmental-science degree, Crystal heeded advice to participate in this rite of passage.

Renee: You know, until you said it, and this is so off-topic . . . I realize that another connection I have with this subject is that my godfather in Jamaica is a geologist. (59)

Crystal: Really. (60)

Renee: We were very poor, and very few children in my neighborhood . . . finished high school, much less went off to college, and I have . . . a newspaper clipping that my mother always treasured because she just regarded him . . . my brother's friend. (61)

Crystal: Is your godfather? (62)

Renee: Well, my brother is twenty years my senior. (63)

Crystal: Oh, okay [laughter]. (64)

Renee: My brother is twenty years older than me, so his friends, when I was born were young adults. (65)

Crystal: Yeah. (66)

Renee: His name is Norman White . . . he graduated from University of the West Indies in Jamaica with a degree in geology, and he works in water treatment (67)

Crystal: Awesome. (68)

Renee: And … so off topic [laughter]. (73)
Crystal: What was I saying? (74)
Renee: You were talking about field camp. (75)
Crystal: Oh yeah, field camp, and I think even going into it I had some deficiencies. I hadn't taken one of the courses, structural geology, that they had required. But I asked them if I could still get by without it and they said it's possible, but you just have to work hard, and so right off the bat I was kind of put at a disadvantage. I kinda lagged behind compared to the other students 'cause they had taken many more geology-related courses. But we did a lot of work and ended up coming out with a B in the course and I learned a lot and I'm happy, yeah, I got to take it. (76)
Renee: So I also want talk about the discipline of geology in general and this impression that I have of it being a warm and welcoming space. (77)
Crystal: [Chuckle] (78)
Renee: But before I go there I want you to finish telling me about some of the other excursions you've had. So you had field camp . . . you've gone to several conferences. Just name them for me. (79)
Crystal: I've been to two GSC northeast regional conferences. I've been to the national GSA conference twice, once in North Carolina and oh, actually, once in North Carolina, and I'm going to the one at the end of the month in Denver, Colorado. I've been to the NABG conference, which is National Association for Black Geoscientists . . .went last year, I went this year as well. (80)
Renee: And what is that like for you? (81)
Crystal: I was really excited when I found out [laughter] that there were, I guess, a large enough group of black people within the field to actually hold a meeting. (82)
Renee: And it's just the United States or it's international? (83)
Crystal: It's just the United States, but there are a lot of grad students who come to the program . . . I mean to the meetings, and they're international students, but yeah, the conference isn't too big. It's only, I think, when I [went] this year the audience was only about 50 large but there are some really important people and it's a small space . . . everyone is so, so loving and encouraging, and I love it [laughter]. (84)

Initial Analysis: Crystal's statements about her participation in conferences and the National Association for Black Geoscientists in particular helped shed more light on two ideas: first, that the national organizations and their associated conferences are important activities for people pursuing the environmental sciences and second, that the existence of the National Association of Black Geoscientists represented a

community of sorts that Crystal was excited to be a part of. In a field in which black people are underrepresented, the existence of an organization designed to support black geoscientists proclaims to the world that they do exist. I wonder whether and how the activities of the black organization and the predominantly white organization are the same or different. I wonder if there is a way in which undergraduates like Crystal are trained and supported by graduate students and professionals. Crystal's enthusiasm and characterization of the black geoscience members as encouraging and loving suggests that the black and predominantly white organizations both play a role in her development and retention in the major.

Renee: Terrific, so the various conferences related to geoscience . . . field camp. And so for the field camp you say it was hard. What was hard about it? (85)
Crystal: I just, I didn't know as much as the other students. (86)
Renee: So it wasn't the environment, it wasn't . . . the accommodations? (87)
Crystal: No. No no no no. We . . . I like slept on someone's house floor for, like, over a week, and then I slept in a tent for over a week, in total [it] was three weeks. (88)
Renee: Would you say that you've always been a kind of outdoorsy kind of ah, [laughter] . . . you know, accommodating . . . go-with-the flow-kind of person? (89)
Crystal: Well, I am a go-with-the-flow type of person, but I've never . . . my family doesn't do outdoorsy things [chuckle] at all. (90)
Renee: I know. (91)
Crystal: I mean, they claim that we went camping when I was younger, but I could have sworn we were in a cabin and it wasn't that serious, but that was like, when I was ten. Yeah, my childhood up until then had just been athletics, school, and then we'd take family vacations . . . but it's like, we'd stay at a resort or something like that. Yeah. (92)
Renee: So not exactly roughing it (93)
Crystal: Naaaa. (94)
Renee: So what is your relationship with you know . . . [there] is some talk about whether being a certain . . . enjoying a certain type of activity draws people to the field of environmental sciences. (95)
Crystal: [Laughter] (96)
Renee: So being an outdoorsy kind of person . . . you won't see yourself as an outdoorsy kind of person? (97)
Crystal: No, I mean, I see myself as someone who's willing to try different

things. I mean what could be better than having a classroom that's outside and, like, climbing and seeing all these beautiful sceneries, but doing it for a class . . . I think it's a win-win situation. (98)

Initial Analysis: Crystal, like Holly defied the stereotype that only lovers of the outdoors are attracted to careers in the environmental sciences. Crystal and Holly disclosed that they were not that type, but both added something else that allowed them to pursue the field. Holly stated that she was open-minded and willing to try field work. Crystal also said that she was willing to try different things; in addition she expressed an appreciation for beautiful scenery.

Renee: So now when you took [Professor X's] course, I know he didn't do much in the way of field trips (99)
Crystal: No. (100)
Renee: during the intro course. (101)
Crystal: We didn't do any. (102)
Renee: But [Professor Y's] intro course. (103)
Crystal: Yeah. (104)
Renee: She does. (105)
Crystal: She did environmental science . . . I think that's very important to relate what you're learning to real life. (106)
Renee: Right. (107)
Crystal: And have hands-on experience . . . in [Professor X's] class he just Lectured, wrote stuff on the board, and then gave us exams. (108)
Renee: And that didn't work with your learning style? (109)
Crystal: Not at all. (110)
Renee: So as you've been taking the other courses you've had field trips . . . you've had other types of activities . . . what are some of the activities you all did do? (111)
Crystal: Well, every course, every environmental-science course that I've taken after the intro course I've had field trips 'cause there's a lab associated with all the classes. We've gone to various sites around [the state] to look at the geology. For one course we actually took a weekend trip to [another state]. There was, like, no pressure, no assignments associated with it, but we got to hang out with our professor, look at some geologic sights . . . just have a lot of fun. (112)

Initial Analysis: I learned that Professor X's course was conducted in a manner that Crystal felt did not work well for her. She explained that Professor X lectured, wrote

on the board, and gave exams rather than relating the topic to the real world. She told me that every environmental science course she took after Professor X's introduction included a lab or field trip. In previous interviews with Luna and Holly, I had learned that the field trips were also highlights of the courses for them. Crystal told me about one course that included a weekend trip to another state to look at geological formations. Consistent with earlier accounts of faculty-student relationships, Crystal stated that there were no assignments associated with the weekend field trip; rather the trip provided an opportunity for students and faculty to socialize outside of the institution.

> Renee: Do you get the sense that other science disciplines are doing field trips where they can, quote, "hang out with the professors?" (113)
> Crystal: [Laughter] (114)
> Renee: Something unique about the way in which this discipline is training up folks. (115)
> Crystal: Umhm. (116)
> Renee: So . . . are [you] saying you learn better when you go on these field trips and you see the rock formations and so on? (117)
> Crystal: Umhm. (118)
> Renee: So does that mean it is important to have these field trips? (119)
> Crystal: Definitely. (120)
> Renee: And therefore the professors have to have a commitment to having these field trips? (121)
> Crystal: Yes. (122)
> Renee: And they go and they're hanging out and they're just being people. (123)
> Crystal: Yeah . . . and I don't know, I don't know. (124)
> Renee: Do you think that it's just . . . (125)
> Crystal: Earth science? (126)
> Renee: I don't know. (127)
> Crystal: I think the subject inherently draws in people who are generally genuinely interested in the subject . . . it's like for like math majors and engineers you can just like numbers and whatnot, but for [the geology course] you actually have to, I guess I don't want to say, act on it, but I know for geology, like everything isn't black and white . . . it's a lot of weighing different things. And so you have to see it, analyze it, and whatnot, and for earth science, I mean, one of the big things in that is sustainability and being green, and I mean, how do [you] preach it if

you don't practice? And so I think it attracts a lot of people that are . . . I don't want to say good-hearted . . . but [laughter]. (128)

Renee: That makes sense now with the way you started this interview and talking about your attraction to math and science and service . . . that whatever you're gonna do with the math and science it necessarily had to have a service component to it . . . well, I want to thank you, thank you very much, I think I have enough to go on. (129)

Initial Analysis: Crystal expressed her opinion about the personality type that the field attracts. She said that environmental scientists are generally good-hearted people; otherwise there would be inconsistency between their rhetoric of environmental awareness and their personal actions. Another quality she finds among the people who enter the field is an ability to evaluate complexities, rather than to see things in terms of either/or.

Renee continued: I'd love to talk about peers and learn a little bit more about your peers. How you're perceived by your peers and . . . what kind of relationship you had with the other students who were in the intro course. (129)

Crystal: Ummm. (130)

Renee: Did you have any relationships? (131)

Crystal: Nooo. (132)

Renee: None? (133)

Crystal: None. (134)

Renee: So that only furthered the sense of isolation, ugh? (135)

Crystal: Ah definitely . . . the course had about, at least, I wanna say, like, 50 students in it, and on top me being a freshman and having a limited network of people on campus . . . people didn't really interact with me . . . I mean I'm kind of a shy person as well, but people just came in. They sat with their friends . . .they got taught whatever [Professor X] was teaching. They had their study groups. We took the exams. I'm sure they did better than me, but we had no interaction whatsoever. (136)

Renee: So did you have a sense that there were . . . students who had friendships . . . were little cliques in the class? (137)

Crystal: Definitely. (138)

Renee: 'Cause I noticed that when I observed these courses. (139)

Crystal: Um . . . Umhm . . . Umhm. (140)

Renee: That there seem to be seating patterns. Who sits with whom and who. Perhaps that flows into study groups, you think? (141)

Crystal: Oh, I know. I know it flows into study groups. (142)

Renee: So did you have a sense that some people were working together? (143)
Crystal: Oh, I knew that, yeah. (144)
Renee: Okay. (145)
Crystal: Definitely. (146)

Initial Analysis: Earlier Crystal described her poor fit with the teaching style of Professor X's intro course. Her statements about the peer interaction or lack of interaction that she had in the course serve to develop further my impression of her vulnerability in the course. She explained that no one interacted with her and that her peers sat with their friends. I wanted to know more about her experiences, which she regarded as negative, with her peers.

Renee: Tell me more about that. Like, just ways that you felt the peer-to-peer dynamics were flowing over into social interactions. (147)
Crystal: Well, I think in general, on college campuses, if it's possible students will work together to do assignments, and I mean, it eases some of the pressure of one student's mind and, um, it helps you to see, I guess, the bigger picture of stuff. I mean, I don't think there's a problem with collaborative work as long as everyone's actively participating and not just, like, copying off of someone. But it can be very overwhelming to be given a problem and have no clue what to do with it and then your professors says it's due, like, tomorrow. (148)
Renee: So I think that seems to have been a barrier for you. (149)
Crystal: Yeah. (150)
Renee: Whereas others might have had some opportunity, some privileges, because they had these networks that were helping them? (151)
Crystal: Yeah, and I mean, I think it continues to be a barrier even in the upper-level courses I've taken. There have been students who have had pre-established relationships, and I know that they've worked together on assignments for that class and they've done better than I have. (152)

Initial Analysis: Crystal thought that poor peer-to-peer interactions in class could affect her academic success because they influenced the ability to form study groups. Crystal explained the benefits of collaborative work, which she said included relieving pressure on individual minds and making conceptual connections. If Crystal's

assessment is correct, then the cards are stacked against students who do not manage to establish social networks in their courses.

> Renee: So you've given me some insight into . . . the interaction you observed among your peers . . . in the class . . . you've shared with me some sense of the faculty interactions. Could you tell me a little about your peers who were not in environmental science [courses]? You told me how you partied you had many friends, you know, mainly the [heritage community] and in the black community associated with [the African-American association] and the [heritage student association]. (153)
> Crystal: Umhm. (154)
> Renee: How did they see you, given that you were pursuing this major and did you have peers that you looked up to who were in the major? (155)
> Crystal: I definitely I think I only had one peer that I looked up to. (156)
> Renee: Because there was only the one [laughter]? (157)
> Crystal: Yeah [laughter]. (158)
> Renee: Right [laughter]. (159)
> Crystal: That was Rose. That was Rose. (160)
> Renee: Yes. (161)
> Crystal: And even though she was only a year ahead of me, she was a very bright person and very determined, very nice, and she knew her stuff. So she was always encouraging. She also worked in my lab, and so I could talk to her. I was never afraid to go to her and ask her questions about the material . . . I probably would never have gone up to the other peers in my class to ask them about stuff but Rose, like, I feel no judgment. She'd break things down for me and I really appreciated that. (162)
> Renee: Umhm kindness . . . the way on another level your relationship is with [Professor Y] (163)
> Crystal: Oh, yeah. (164)
> Renee: No judgment, and you could just ask her questions? (165)
> Crystal: Yeah. (166)
> Renee: You know, move on from there. (167)
> Crystal: Sometimes there are barriers though, 'cause she is my professor [laughter], so sometimes there's things I know I should have done that I didn't and I can't ask her 'cause then she'll know, but with Rose it's like she's a friend and I could ask whatever. (168)
> Renee: And Rose is currently at [a large state university]. (169)
> Crystal: Being awesome, pursuing nano fossils. (172)

Initial Analysis: After describing the limitations of her peer interactions in the introductory course and the consequences that this experience had for her participation in group study, Crystal told me about an older student (one year ahead) she had

become acquainted with while working in Professor Y's lab, and the productive and sustaining friendship that they had developed. Crystal used many of the same terms she used to describe Professor Y, including "encouraging" and "nice," to describe the student. I noticed that Crystal was being mentored by this student in ways that were similar to the way she was being mentored by Professor Y. I wondered if the friendship with this student, along with other benefits that came from Crystal's participation in Professor Y's lab, could partially explain Crystal's retention in the environmental science major.

As a researcher who was also an administrator, I was privy to information about the situations that Crystal described that helped me recognize other characteristics of the upper-level student mentor that Crystal didn't mention, as well as the implications of the overall racial composition of the department during Crystal's freshman year. For example, I knew that the sophomore student was black and was an international student from a region whose culture that Crystal knew well because her parents were born there. I also knew that the student who became her peer mentor was probably the first black environmental-science major at the institution in some years. Earlier in the interview, Crystal had described the fondness she had for the social scene and her involvement in one of the campus ethnic-heritage associations. I concluded that her involvement in these organizations suggested a strong tie to the regional identity that would have helped facilitate the friendship she developed with her peer mentor.

> Renee: Wonderful . . . wonderful, so, um, is there anything else? (173)
> Crystal: Oh . . . there's a second part to that question. (174)
> Renee: Oh, what was the second part? (175)
> Crystal: You said. how do my peers . . .? (176)

Renee: Yes . . . how do your peers who were not in the major see you? (177)
Crystal: That's very important [laughter]. (178)
Renee: Talk to me. (179)
Crystal: 'Cause I get stuff about that basically every day. (180)
Renee: Umhm. (181)
Crystal: 'Cause there are so few black people in earth science, whenever they see me getting ready to go on field trips, I put on my, like, my hiking pants and my hiking boots, and they're like, oh [laughter]. And it's like, look at you progressing the race and just being, you know, just being different and sticking with it, and so we both know that I'm pursuing something that our people don't necessarily do. (182)
Renee: Well, I admire you. I admire your courage and your quiet determination. It's a quiet determination, which makes it even more powerful. (183)
Crystal: Umhm. (184)
Renee: You know you are showing through demonstration rather than through rhetoric that we can truly do everything, and I'm excited about your future. If you can think of anything else as you reflect on your experience and your walk, 'cause you know that I'm committed to this field. I'm committed to access in this area particularly. It's a personal commitment. I don't even know where all of this comes from, but I feel driven in this area. It's not surprising that my research has found its home in this community of practice. If you think of anything, please let me know. (185)
Crystal: Thank, thank you. (186)

Initial Analysis: Crystal's peer support also came from her friends outside the major. She described ways that she negotiated the different aspects of her life. As she prepared to go on a field trip, she would dress differently from the way she usually did. Her friends must have seen this change in attire as the signal that she was preparing to enter another world, one that they were not a part of, and may not have understood. Yet her friends encouraged her, and she felt that her friends saw her pursuit of the major as "an advancement" of the black race.

Renee: [What do] you think explains your continued commitment to the field? Explain how you kind of find your way around the field obstacles you are encountering or have encountered (187)
Crystal: Ummm. (188)
Renee: What are relevant opportunities and privileges that you feel you've had that made a difference in your success? (189)

Crystal: Umhm. (190)

Renee: Because I want to understand this enough that I can provide some prescriptions to [Hillcrest] and other institutions about what we need . . . I'm looking at the successes. I'm also looking at some . . . I don't want to say failures, but the people who made different decisions. (191)

Crystal: Umhm. (192)

Renee: Who didn't thrive in this field . . . and I want to be in a position to make some recommendations as to what we need to do to support people. (193)

Crystal: As you were saying that . . . two things came to mind. And they're kind of related. To the first, were there some obstacles that I've run into, it's just being able to relate, I don't want to say relate, but not having, I guess, earth science directly, like, in my life . . . not living it, not having family members who are in the sciences . . . some haven't even gotten, like, a college degree. And so having this sense of not belonging and, like, over years I found out about more and more students in the majors who have parents who are geologists or . . . associated with the field in some type of way or I always wondered, like, how do they get the things so like . . . understand stuff so easily. Like, oh, because they've been raised like that and I think that programs like [grant-funded student research programs], and professors like [Professor Y] really help students who aren't as familiar with the subject and I guess having an easier time transitioning into it, becoming more confident in it because they're not used to it, so, yeah. (194)

Renee: Thank you so much I really appreciate this . . . thank you . . . may I call you again if we, if I have more questions for the study? (195)

Crystal: Yes, yes. (196)

Renee: Thank you. (197)

Initial Analysis: I learned that Crystal felt that people who were socialized differently through their earlier introduction to the field had advantages. She listed not living the discipline, not having family members in the sciences, and having few college graduates in her family among the list of her disadvantages. She stated that it contributed to a sense of not belonging over the years, as she would encounter peers whose parents were in the field. She asserted that this advantage explained why some of her peers grasped the material quickly. Lastly, Crystal explained that support programs like the ones she participated in at the institution provide opportunities for

students to gain familiarity with academic life and build confidence as they move through college.

CoP Analysis: Crystal's comments about her struggle to do well in the introductory course relate mainly to the CoP concepts of *meaning* and *community,* and to the concepts of *identity* and *practice* to lesser degrees. According to Wenger (1998), meaning is a way of talking about our (changing) abilities—individual and collective—to experience our lives and the world as meaningful, and community is a way of talking about the social configurations in which our enterprises are defined as worth pursuing, and our participation is recognizable as competence (p. 5). As a first-semester freshman who had recently matriculated at a highly selective liberal arts college, Crystal probably had always lived in an environment where grades on exams represented effort, intelligence, and perhaps a sense of belonging. In college these descriptors may or may be accurate representations of the degree to which a student is participating in the activities of the course. Crystal's grades could be thought of as the *reification* of her academic and intellectual abilities. Wenger (1998) would caution that reification is not the same as participation, and the two are often mistakenly thought of as interchangeable. The degree of effort Crystal invested in the introductory course is unclear, but one cannot assume that the highest performing students in the course achieved their grades because of effort, intelligence, or a sense of commitment. Nonetheless, it is reasonable to deduce that Crystal was unaccustomed to less than top grades, and the grades she received may have challenged her self-image, or, to use the CoP concept, *identity*, a "way of talking about how learning changes who we are and creates personal histories of becoming in the context of our communities" (Wenger,

1998, p. 5). Even at this early stage in the interview, I was beginning to notice that Crystal was describing a situation in which her self-concept was disrupted. Finding Professor Y was a step in the development of her new identity, which unfolded slowly over time. If Crystal defined participation in terms of performance, and her participation was conflated with what she thought her grades said about her, it was unlikely that she would have turned to the course professor for guidance. She credits the introduction to Professor Y as a critical factor in her staying with the environmental sciences. I looked forward to learning more about how she thought Professor Y helped her discover the environmental sciences and helped her recognize that she was competent in the subject. I expected to find experiences that related to the CoP concept of practice, a "way of talking about the shared historical and social resources, frameworks, and perspectives that can sustain mutual engagement in action" (Wenger, 1998, p. 5).

As I dug more deeply into the experiences Crystal had with Professor Y, the CoP framework began to provide greater insight into the experiences Crystal had in the field. It began to become clear that certain activities constituted important aspects of the environmental sciences, or the community of practice of the environmental sciences, and that Professor Y was introducing Crystal to them. Those activities could be thought of as *practices* in CoP terms. One such practice of the CoP of environmental sciences is lab research. Others include field trips, exploring features of the outdoors, sustainability, recycling, and environmental justice. By observing several iterations of the introductory courses and interviewing the participants and course professors, I learned that people associated with the CoP to varying degrees engage in

these practices, individually and collectively. Their participation in these practices provided the opportunities that forged the *community*, or "the social configurations in which [their] enterprises are defined as worth pursuing and [their] participation is recognized as competence" (Wenger, 1998, p. 5). I recalled that Holly, another participant in this study, had commented that Professor Y had also invited her to work in her lab. Moreover, Crystal's comments about washing containers helped me recognize the role of apprentice that Crystal (and likely Holly) experienced in the lab. I was beginning to see how the CoP concept of *meaning*, involving changing ability, was at play. Crystal's (and likely also Holly's) early contributions in the lab, while small in comparison to high-level research, provided so much more. Moreover, Wenger (1998) would argue that by employing the concept of identity, I am now able to talk about issues of *mutuality*, which, he argues, is a feature of participation, and allows us to intersect with each other. Could it be that the introduction of Crystal and Holly, who are black, into a lab that is predominantly white, had a developmental effect on everyone, including the professor? "Participation in social communities shapes our experience, and it shapes those communities; the transformative potential goes both ways" (Wenger, 1998, pp. 56-57). I looked forward to finding out whether the CoP framework could help me to uncover more information about the mutual effects that people had on each other as they engaged in specific practices.

Earlier I learned that one of the discipline-specific activities, or practices, in CoP terms, to which Professor Y introduced Crystal (and Holly) was the research lab. At this point in the interview, I learned about another practice, field camp. Based on Crystal's comments, the field camp experience can be examined as a representation of

her changing identity and a demonstration of competence to her community. For starters, Crystal provided valuable insight into the issues that mattered most to her by stating that she decided to enroll in the field course despite its being optional. In this way, she demonstrated her *identity,* a clear sense that she saw herself as a part of the environmental-science community of practice. She further demonstrated an awareness of that fact by stating that people had told her that field camp was a rite of passage. This could not fit more perfectly with the CoP framework, in which there is a practice described as a marker of membership.

With Professor Y's encouragement, Crystal applied and was accepted into two grant-funded graduate-school-preparation programs that were originally designed to encourage and support students from underrepresented minorities to pursue graduate school. Involvement in these programs then made possible Crystal's attendance at a number of professional conferences related to the environmental sciences. According to Crystal, participation in these professional organizations gave her access to discipline-specific practices such as professional presentations. She spoke at length about the experience of attending the National Association for Black Geoscientists. I think that the professional conferences, especially the NABG, were important in a number of ways for illustrating the connections between practice and identity.

CRT and ST Analysis: Aspects of Crystal's comments that dealt with her peer relationships in college could be explained through the lens of Critical Race Theory and Stereotype Threat. She commented that she had a poor experience in the introductory course with Professor X, stating that no one spoke to her and explaining that she was aware that her classmates were completing homework and studying

together, while she was excluded from those networks. A CRT analysis of her comments points toward the likelihood that Crystal and her white peers were unaccustomed to living and studying with people of other races. The concept of Stereotype Threat is helpful in analyzing the comments Crystal made about her sense of isolation in the introductory course. Although one cannot know for certain why Crystal's classmates made no attempt to include her, the experience clearly undermined her self-confidence. Crystal wondered why some classmates seemed to comprehend the subject more easily than she did, and later learned that those people had had prior opportunities to become acquainted with the field through family members who were in the sciences. With only a few members of her family having graduated from college, she had no such social capital.

Crystal likely experienced the emotional stress of ST in that she was hyper-aware of her race and other social characteristics and concerned that she could be unfairly judged by a negative stereotype. Steele (2010) explains that self-isolation is a common strategy black students use to cope with Stereotype Threat and that the strategy only exacerbates the problem, because it denies black students the opportunity to engage in the dialogue and social interactions that dismantle stereotypes. Steele (2010) also describes how faculty, like the professors Luna encountered, can create identity safety by implementing strategies that encourage personal engagement.

For Crystal, a way of coping with the experiences of the introductory course and her isolation from her classmates was to separate her academic and social lives. Like Holly and Luna, also black students, Crystal developed an active social life that included membership in a number of racial and ethnic organizations. The three black

students eventually became members of the grant-funded student research programs, which provided academic and financial support, and a community of students who shared their racial or socioeconomic background. Crystal commented that her student-of-color friends were important to her, and that although they did not understand her commitment to the environmental sciences, they expressed admiration for the way she was contributing to the progress of their race.

Crystal was also able to establish a sense of belonging within a community of people who were both associated with the environmental sciences and were black. While the National Association of Black Geologists organization offered institutional support and encouragement, the one upper-level black environmental-science major associated with Prof Y's research lab provided friendship and mentoring.

Savannah (black female, duration of interview: 19:40 minutes)

Savannah is a black female who enrolled in the introduction to environmental sciences in the spring of her sophomore year. At the time, she had already declared a major in American Studies.

> Renee: Hi, Savannah . . . tell me a little about your background in science. (1)
> Savannah: Growing up, science was never something I thought I could practically apply to my life. I knew that, you know, it was important and that there're many inventions and that there are some concepts that I needed to know, but I never thought about it as something I would need for my everyday life. Then as I got older and I starting cooking . . . I realized, this is science and you know, I started . . . you know [putting] some dots together, but growing up I definitely didn't. (2)
> Renee: So those dots coming together happened would you say in high school or when you got to [Hillcrest]? (3)
> Savannah: When I got to [Hillcrest]. (4)
> Renee: Okay, so your awareness really gelled in college? (5)
> Savannah: Yes. (6)

Initial Analysis: I was surprised to learn that Savannah did not appreciate the study of science until she began to cook, hence discovering a practical application for the subject. Prior to that she recognized the importance of science but she had limited interest in pursuing it.

Renee: So you enrolled in that intro to environmental studies or science? Which one? (7)
Savannah: Science. (8)
Renee: What motivated you to enroll in that course? (9)
Savannah: I wanted to take a science course, but I didn't want to take anything incredibly hard, so that's why I didn't do chemistry or biology . . . I decided that environmental science was something that was pertinent to my life, especially because of global warming and, you know, the talk of climate change, and I wanted to learn more about it and the science behind it. (10)
Renee: So did it fulfill your desires? (11)
Savannah: It did. It did. I didn't expect to like the class as much as I did and I think it was very much because [Professor Y] is so . . . (12)
Renee: Common theme. (13)
Savannah: [laughter] She's really supportive. She's animated. She knows what she's talking about. And you can just tell that she's passionate about what she does. (14)
Renee: So how does that compare to professors you have in other disciplines? (15)
Savannah: Ummm. (16)
Renee: Or other professors you've had . . . just generally. (17)
Savannah: Most of my professors have been passionate . . . at least the ones that I like. I've had some professors who I feel, like, they just come in and they teach and they leave. But [Professor Y] is definitely one of the professors who you know I can go to her office hours. I can talk to her after class or before class, I can send her an email about even things that are not particularly relating to the course but, you know, maybe I saw a *New York Times* article and I found it interesting and I'll send it to her. I do have other professors like that, especially in American Studies, which is my major. (18)
Renee: So did you go to her office hours? (19)
Savannah: I did. (20)

Initial Analysis: I learned that Savannah enrolled in the course to fulfill the institution's general- education requirement and that she had reasoned that environmental science was the area in science that had the most relevance to her life.

Savannah told me that she enjoyed the course more than she had expected to and attributed this experience to Professor Y, who taught the course. Savannah described Professor Y as supportive, animated, well-informed, and passionate. She explained that unlike some professors who only came in, taught, and left, Professor Y did more. Savannah described a range of ways that she communicated with Professor Y: attending office hours, talking before or after class, and sending email, and stressed that the conversations were not limited to the course but might be about a news article.

> Renee: Yeah . . . about when did you start going to her office hours in the semester? Was it the beginning? Middle? Toward the end? (21)
> Savannah: The beginning. (22)
> Renee: Umhm. (23)
> Savannah: I'm very good about going to office hours. (24)
> Renee: Why do you go to office hours? (25)
> Savannah: Well, first of all, the class was the biggest class I've ever been in. I wanted to make sure she knew who I was and that I knew who she was, other than just her name. So that's very important to me and then also, I guess, later on it was to talk about, like, the paper that we had coming up and the exams, but in the beginning it's more just to get to know each other. (26)
> Renee: So you very quickly got to the interpersonal aspect of this course. (27)
> Savannah: Yes. (28)
> Renee: And this is an approach that you take with everybody? Like kind of trying to understand them on an interpersonal level? (29)
> Savannah: Yes, because I think that if we understand each other on that level then when I come to any trouble I have, whether it's academic or maybe I'm sick, or maybe there's something going on in my family . . . then I'll feel comfortable telling them what's going on in my life. (30)
> Renee: How did it come to be that you became aware of that and . . . what do you think it is? I don't want to put words in your mouth . . . what is it? (31)
> Savannah: I think I got that from high school. (32)
> Renee: What high school did you attend? (33)
> Savannah: [A large urban public high school]. (34)
> Renee: What was it about that community that taught you this? (35)
> Savannah: Well, I was in this huge high school, but within the larger high school I was a part of an honors program, and it was very much stressed that we talk to our counselors and to our, like, teachers . . . to our college advisors, just so that we're all on the same page, like, on a

personal level but also academically. Because a lot of things that happen in your personal life affect your academics. (36)

Renee: Do you think all professors see that? (37)

Savannah: No. (38)

Renee: And when you've encountered those professors who don't see that, how do you negotiate that? (39)

Savannah: I don't really have an approach for that. I kind of just gauge how interested they are in my life and, I mean, usually they are. There's only been like two who haven't been. I'm just like, okay. (40)

Renee: So you just kind of say, okay, well, I gauge the relationship and this is how we're gonna interact. I'm not gonna expect any more from you? (41)

Savannah: Umhm [nodding yes]. (42)

Initial Analysis: Savannah explained that relationship-building with faculty is important and something she pays attention to in all her classes, because she feels that it is important to be more than just a name to her professors. She said that it was easier to discuss papers and exams later on in the semester with professors after she first built a relationship with them. She began to attend office hours at the beginning of the semester in order to establish a relationship with her professors, and learned this practice in high school, where she was part of a small honors program in a huge high school. Savannah had encountered only two professors who did not seem interested in understanding who she was, but most professors had responded well. The idea is that it is better for students to build relationships with faculty in advance of needing to discuss personal matters. I wondered if her approach would be equally effective with all professors and I wondered whether she was applying other strategies she had learned in high school.

Renee: So again, this interpersonal piece being so important . . . so you feel that at the beginning of a class session you need to kind of get to know the people you're working with . . . Do you do that with peers as well? (43)

Savannah: Yes, yes. You mean, like, my friends, or like, people I work with? (44)

Renee: Well, even the people that don't necessarily get to the friendship space . . . You know they're almost [at] the stages of becoming friends. So people who you interacted with in that course. Did you go into that course with friends or did you meet people and then you embarked on some journey to becoming friends? (45)
Savannah: In the course I came in with people I knew. I wouldn't say that I branched out and met new people though. (46)
Renee: You didn't? (47)
Savannah: I didn't. (48)
Renee: [Were] there activities in the course that would have allowed you to meet new people? (49)
Savannah: We had, like, group activities maybe once or twice and we went on an excursion and I spoke to people, but it never really carried over to, like, the next day or the next week . . . like I spoke to them in that moment. (50)
Renee: So in terms of who you studied with . . . did you live with any people who were in that course? (51)
Savannah: No. (52)
Renee: Did you do study groups or homework or problem sets or community service with any of them related to this course? (53)
Savannah: No. If either of us had a question like me or Jordan . . . we like…I'd say, hey, did you understand this or you know something like that. (54)
Renee: If I remember correctly, you and Jordan did sit together. (55)
Savannah: Yeah. (56)
Renee: Often in the front of the room? (57)
Savannah: Umhm. (58)
Renee: Was that your doing or was that her doing? Or did you seem to both have the same tendency to sit in the front of the room? (59)
Savannah: Yeah, the same tendency. (60)
Renee: Why did you sit in the front of the room? (61)
Savannah: [chuckle] I always sit in the front of the room in every class . . . just so that I stay focused . . . so that the professor sees that I'm in class and then when I'm absent it's noticeable. Because I'm usually always in the front, so it's a way of me holding myself accountable even when attendance is not being taken. (62)
Renee: So would you tell me a little bit of some of the high points of that course? (63)

Initial Analysis: Savannah explained that she entered the course with some pre-established friendships and that although she participated in the course-related group activities and excursions, in which she got to talk to other classmates, the interaction

was limited to momentary exchanges. She and her classmates didn't talk to each other outside of the lectures.

Savannah described the way she would study alone and how she would ask her friend from the course to help her whenever she encountered issues. Another strategy that Savannah described involved sitting in the front of the room so that she would remain focused and hold herself accountable for her attendance.

> Savannah: I think the highest point was using my experience in New Orleans to write a paper for the class. I spoke to [Professor Y] about it beforehand. I said, you know for spring break I went to New Orleans, and we heard a lot about what happened with Hurricane Katrina. We asked her if that is in the soil and how it's very toxic and then the BP spill and all of that, so she helped me to make that into a paper that I could turn in for her. (64)
> Renee: Good, so were there any low points? (65)
> Savannah: Her exams were pretty hard. I did pretty well, I think I got a B-plus in the class. So overall I did well . . . but it was definitely a challenge. I was not coasting [chuckle]. (66)
> Renee: Okay . . . would you say that you're an exam kind of person? (67)
> Savannah: No. (68)
> Renee: You express your ideas and your understanding how? (69)
> Savannah: Through writing, like writing a paper and having time to do that. (70)
> Renee: Do you think that might have been one of the factors that maybe repelled you from pursuing the sciences? (71)
> Savannah: Yeah, I'm definitely more into talking and writing, not exams. (72)
> Renee: When did you become aware that you are more a talking and writing person instead of an exam person? (73)
> Savannah: High school. (74)
> Renee: How far did you go in your math and science sequence in high school? (75)
> Savannah: Calc . . . AP calc. (76)
> Renee: How did you do on the AP calc? On the AP exam? (77)
> Savannah: A 3. (78)
> Renee: So you got the credit? (79)
> Savannah: I did. (80)
> Renee: Good, so I always think if you can get that far [in] high-school math you can get a decent very good grade on the AP . . . where does one get this notion that science is not really their thing? (81)
> Savannah: I guess I never thought I was, like, horrible in it, but I knew I was better in other things. (82)

Initial Analysis: Savannah stated that the ability to use community-service experience (in New Orleans during spring break) in a paper was a high point in the course, and the difficulty of the exams was a low point. Savannah thought that she expressed herself best in talking and writing rather than on exams, but I was impressed to learn that she had gone as far as Advanced-Placement calculus in high school and that she had received a 3 on the AP exam, suggesting that she had comprehended the main concepts of the course. Savannah explained that although she never thought she was horrible at math, she thought she was better at other things.

> Renee: Okay, so it was not an either–or. It seems that this is more what I want to do? (83)
> Savannah: But I was talking to Crystal . . . who is an [environmental-science] major, and I was like, you know, I really like this class and if I had taken it freshman year who knows what would have happened. But [when] I took it I was already declaring American studies. (84)
> Renee: So you took it as a sophomore? (85)
> Savannah: Ah, um, second-semester sophomore. (86)
> Renee: So the timing of the course was important . . . would you say that when you first arrived at [Hillcrest] you were more receptive to all that was presented and that as time goes on you've narrowed and you're focused on very specific things . . . Am I confusing? (87)
> Savannah: I think I came saying, I want to be a gov major, and then after a while I started to expand my horizons, which I spoke to my other friends who were doing different things and then I came back into, well, not back to gov but into American studies . . . So I started off narrow, then I expanded, and then I narrowed again. (88)
> Renee: You know, one of the things that I'm going to look at is the influence of the peers on our development, and I hear over and over again that it's almost as though, yes, there's the factor of the professor, but there's a really, really strong factor of the peer group . . . What peer group you absolutely end up in can influence so much . . . what you study . . . Could you tell me a little about your kinda walk with that? (89)
> Savannah: Definitely coming in as a freshman, most of my friends were in the hard sciences, and I would hear about how hard it was for them and then I would say, oh, I'm just gonna stay over here with the social sciences. (90)

Initial Analysis: Savannah said that she had once told Crystal that she might have considered an environmental science major if she had taken the introductory course in her freshman year instead of after declaring a major in American studies in her sophomore year. This suggests that the timing of the course can influence whether someone explores the major. Savannah also commented on her relationships with peers, suggesting that the peer group may have influenced her choice of major. She described the subtle unconscious messages that she should avoid a major in the sciences that she received in her freshman year from her science-focused friends.

Renee: Were your friends first-years mainly? (91)
Savannah: Umhm . . . yeah. (92)
Renee: What were some of their, you know . . . to kind of be . . . real explicit . . . what were some of their identities? Were they Latina, Afro-Latina, black, you know? Were they from urban settings . . . Caribbean? What was the deal with them generally? (93)
Savannah: They were all black, but you know one was African-American, two are from Jamaica. Actually another one was African-American . . . So African-American and Jamaican predominantly. . . heterosexual . . . religious to varying degrees. Mostly from the north but some from the south. (94)
Renee: And they were talking about how hard the science that they were pursuing was? Do you get a sense that they were talking about it as a badge, like what I can do, I'm so wonderful, or was it moaning and groaning and so geez, I just dread it? Did they know that they were turning people off? (95)
Savannah: I don't think they . . . yeah, it was mostly just me who wasn't in the hard sciences. The rest of them were all in, like, physics and bio and chem, and so they were commiserating, but then I was just there, like, oh you know, since I wasn't a part of that hard-science crew. (96)
Renee: Now. I know that your friendship circle has broadened over the years beyond that small group of black, probably mainly women. (97)
Savannah: Yes. (98)
Renee: Female-identified . . . Did they all stay in the sciences, or do you have a sense that they kind of expanded out also? (99)
Savannah: They actually all stayed in the sciences and we're all seniors now. One did tag on African-American studies to her [environmental sciences], so she's a double major. (100)
Renee: Is that Unity? (101)
Savannah: That's Heather. (102)

Renee: Heather. (103)
Savannah: I'm pretty sure. (104)
Renee: Yeah. (105)
Savannah: Or at least at some point. (106)
Renee: So she tacked it on? (107)
Savannah: Umhm, but Crystal, Ebony, Daisy . . . They all stayed in the hard sciences. (108)
Renee: Was Daisy in that intro course? (109)
Savannah: No. (110)
Renee: And Crystal had taken it before and, um, Ebony? (111)
Renee: I don't know Ebony. (112)
Savannah: She's [molecular biology] and chem. (113)
Renee: Okay, I don't know her, but she was in the same course with you or she had taken it before? (114)
Savannah: I don't think she's ever taken [environmental sciences]. (115)
Renee: Okay, so she's just in your peer group. (116)
Savannah: Yes. (117)

Initial Analysis: Savannah told me about her three freshman-year friends who were interested in majoring in science, and explained that they had remained in the sciences over time.

Renee: Okay, so what else was going on in your life during the time you were taking this course? I mean, . . . what other activities were you involved in? . . . Like when you think about that time in your life, what defined your, um, the hours in the day? (118)
Savannah: Ah, um, I was taking another science course[on the biology of women] so that was also a struggle, more so than [environmental science], actually. I had a girlfriend. I was applying to [a grant-funded research program]. (119)
Renee: You were a sophomore when you took this? (120)
Savannah: Um. (121)
Renee: That's right. (122)
Savannah: Ah, um, [the low-income housing project] as a tutor, not a coordinator yet. (123)
Renee: Umhm . . . Are you coordinating now? (124)
Savannah: Yes . . . those are the things that pop out. (125)
Renee: You told [me] how this course compares to other courses, right? How does that course compare in terms of size and so on? (126)
Savannah: Yeah, right, that's the biggest class I've every been in. (127)

Initial Analysis: Savannah listed only a couple of extracurricular activities that she participated in during the semester in which she was enrolled in the course. They

included participating in a tutoring program and applying to a research-based graduate-school- preparation program.

> Renee: Now there were different components to the course. There was the lecture and there were all these activities and field trips and so on. There were small-group activities she did in class. What did you think of those activities and the different components of the course? (128)
> Savannah: I definitely appreciate variety because there are different ways for me to learn and different ways for me to be graded. I like the excursions because they make science real and applicable, and now every time I pass by the water treatment plant I'm like, hey, I went there [laughter]. (129)
> Renee: A lasting impact (130)
> Savannah: Yeah, exactly, and sometimes I still go to the ravine. So the excursions were really great. (131)
> Renee: So when you think about the peers in your course, okay, that year what are some of the things you noticed? Did you notice any kind of ways in which they were interacting? . . . You spent a considerable amount of time with these people . . .did you get to know anybody? Did you feel like you were becoming a part of the community? (132)
> Savannah: Nnn-oh. (133)
> Renee: Did you see each other outside of class sometimes? Did you notice each other? Recognize that you're in the same course together? (134)
> Savannah: I would recognize them, but the amount of times that we actually like said hi to each other was very low. (135)
> Renee: So did you see any of them participating in other activities that seemed to align or contradict the whole environmental framework? (136)
> Savannah: Not particularly. (137)
> Renee: Not particularly. You didn't see anybody throwing their garbage on the floor? (138)
> Savannah: Oh [laughter]. (139)

Initial Analysis: Earlier Savannah stated that she did not forge new friendships with her classmates, which continued to surprise me, given the small-group activities and field trips that I had noticed in Professor Y's course when I sat in. Toward the end of the interview, I inquired one more time about the level of interactions with her classmates from the course. Savannah explained that they would recognize each other but greet each other only a few times. I wondered about the degree to which Savannah or her classmates were responsible for this impersonal behavior. Moreover I wondered

whether there was a social agreement of sorts that defined the interactions between classmates as limited to their interaction in the course.

Renee: I didn't mean it was superficial, but . . . you didn't really feel like the connections that were established within the confines of that course extended outside of that course? . . .Do you see [Professor Y] now? (140)
Savannah: Yeah. (141)
Renee: Okay. (142)
Savannah: I mean, she wrote me a recommendation. (143)
Renee: I'm sure she did,\. (144)
Savannah: She's very nice. (145)
Renee: Yes, but the relationship is kind of, that was good and now its over? (146)
Savannah: Basically, yeah. (147)
Renee: Would you encourage other students to enroll in this course? (148)
Savannah: Yeah, I think the things that I learned . . . I may not be able to recall it, like, in the moment just like off the top of my head but . . . in the situation I could, you know. Someone asks me a question, like how do you identify a sycamore tree, I can say, oh, this one is the sycamore, you know. So things like that, they stick with you. (149)
Renee: Perfect. Is there anything else that is interesting, that you find interesting about your experience in science in general, with this environmental course in particular, that you'd like to share? (150)
Savannah: Ummm. (151)
Renee: Like lasting impressions? (152)
Savannah: I'm definitely happy that I took the course. I'm really happy that I took two science courses because they really help me to see the world in a different way and to see myself in a different way. The little things that I can do that will make a lasting impact on, like, the environment, and also just to challenge myself and to come out of my comfort zone of always writing papers. (153)
Renee: Good. I got my daughter to take an [environmental science] course this semester. (154)
Savannah: Nice. Is she liking it? (155)
Renee: She's actually liking it. I mean, she's not going to major in it, because she says that it's not her thing. (156)
Savannah: Umhm. (157)

Initial Analysis: Savannah informed me that after the course ended she had no contact with Professor Y, although she had learned a great deal from the course. It had forced her out of her comfort zone, and she would recommend the course to others. With

regard to her retention of the information learned, Savannah stated that although she might not be able to recall detailed concepts on the spur of the moment, she thought that she retained the ability to identify aspects of the environmental-science concepts she had studied in the course and recalled the little things she could do to make a positive impact on the environment.

CoP Analysis: Several aspects of Savannah's comments relate to the CoP concepts of community, practice, and identity. Savannah had specific strategies, which can be viewed as *practices* in CoP terms, that helped her be successful in college. 1) She mentioned that she took the course with a close friend. The friend could be viewed as a member of, although possibly also a newcomer to, the CoP of environmental sciences with whom she could study and work out the answers to questions. 2) She stated that she sat in the front of the lecture hall as a way to hold herself accountable. 3) Savannah described the benefits of building relationships with professors before needing their assistance. 4) She attended the professor's office hours. These four practices provided effective ways to create opportunities for social and intellectual engagement as she set out to study the environmental sciences. These practices helped transform the perspective that Savannah had previously held about the role of science in her life, and opened up another area of interest and consciousness. Although Savannah had already declared a different major, she commented during the interview that she enjoyed the course more than she had expected to and might have declared the environmental-science major if she had been introduced to the subject as a freshman. She was developed the practice of forging relationships with teachers during high

school, and it became a boundary practice that she found relevant to seeking membership in the CoP of studying in college.

Savannah said that she enjoyed the course because of Professor Y. Professor Y fostered community for Savannah by making herself available during office hours, talking to students before and after class, and communicating by email. But more than that, Professor Y cultivated a situation in which students could bring aspects of their outside lives into the study of the environmental sciences. For example, Savannah mentioned that she shared a *New York Times* article with Professor Y, and Savannah was able to use experiences from a spring-break trip in a course assignment.

CRT & ST Analysis:

Although Savannah referred to race only when she described her group of friends, CRT and SI still offer useful ways to explore some of the other comments she made about her experiences. Standing out most prominently are Savannah's comments about her conduct as a student. Savannah informed me that prior to college and learning how to cook, she thought of science as not having any practical application to her life. Furthermore, she had never had the opportunity to explore the field of environmental science and had thus missed out on the opportunity to enter that field. As CRT reminds us, occasions to participate in certain practices are influenced by social class and race.

CHAPTER 7
IMPLICATIONS AND CONCLUSION

In the previous chapters of this dissertation, I have stressed the importance of addressing racial disparities when it comes to participation in the environmental sciences, discussed some of the empirical studies, theories, and practices that have tried to illuminate and address the participation of historically underrepresented students, and provided an analysis of the interviews of fifteen research participants. I now turn my attention to a summary of the findings, and to recommendations to which the findings point as ways to improve the experiences of black and other underrepresented college students in introductory science courses in college.

This study was undertaken to explore the sources of inspiration and discouragement that students, especially black undergraduates, can encounter while studying the sciences. I set out to discover how the consequences of discouragement relate to continued stark racial disparities in the number of students who earn degrees in scientific disciplines. A review of the literature on programmatic and pedagogical strategies for teaching science to undergraduates and the theoretical frameworks of Community of Practice (Lave, 1991, 1996; Lave & Wenger, 1991; Wenger, 1998), Critical Race Theory (Delgado and Stefancic, 2001; Ladson-Billings,1999, 1994; Ladson-Billings & Tate, 2006; Solorzano, 1998), and Stereotype Threat (Aronson, Lustina, Good, Keough, Steele & Brown, 1999; Steele, 1997, 2003, 2010; Steele & Aronson, 1995; Spencer, Steele & Quinn, 1999) provided guidance for designing a set of questions that would guide participants in discussing their areas of interest and their experiences at different points in their undergraduate careers. For the students in the

older cohorts, who had completed the introductory courses in earlier semesters, the questions explored the ways in which their participation in those courses had affected their personal, academic, and career perspectives and aspirations. For students in the younger cohorts, who were enrolled in the introductory courses at the time of their interviews, the questions focused on their acquaintance with science prior to college and their experiences during the semester in which they were enrolled in one of the introductory environmental courses. The questions covered six areas: 1) motivation to enroll in the course, 2) background in science, 3) co-curricular involvements, 4) interactions with faculty, 5) course format, and 6) interactions with peers. The responses to these questions revealed a set of effective practices that can result in successful recruitment of black and other historically underrepresented undergraduates into the environmental sciences and their retention. The study also uncovers some of the unfortunate dynamics that result when students and faculty fail to interact in affirming and productive ways. These failures exacerbate the forces that discourage students from pursuing the environmental sciences.

My literature review familiarized me with programmatic and pedagogical efforts that purport to further effective recruiting and support of underrepresented students in the areas of science, technology, engineering, and mathematics (Bingham et al., 2003; Francisco, 2006; Kirsten, 2003; Summers & Hrabowski, 2006; Wechsler et al., 2005; Windham et al., 2004). I reviewed some of the positive effects attributed to experiential learning in research labs and on field trips (Caccao, 2009), as well as the types of outreach, support, mentoring/networking, and leadership-development

that have proven particularly effective in furthering undergraduate interest in the environmental sciences (NSF AC GEO, 2012).

The Community of Practice concept, combined with insights gained from research into the psychological phenomenon of Stereotype Threat, and the legal and sociological concepts of Critical Race Theory, offered an effective framework for analyzing how the student participants in the study experienced the environmental sciences. My application of key aspects of CoP, CRT, and ST to the domain of undergraduate science education in a residential liberal arts college setting early in the second decade of the twenty-first century seeks to shed light on the social aspects of learning in the sciences—and the particular challenges and opportunities that black undergraduates encounter. The chosen theoretical concepts helped guide my study toward a close examination of the interpersonal and situational aspects of learning, aspects that are often mentioned in reports on effective programs but seldom explored in detail or theorized. Most studies and interventions focus on recruitment of young scholars, and on pedagogical and programmatic activities intended to increase the representation of black undergraduates in college science. But these studies and interventions fail to explore the process by which the social context affects student retention in the sciences. At best some studies report the importance of social interactions among the participants in programs and activities, but they seldom investigate the underlying function and interplay of various aspects of social relations, including relationships between the people involved (i.e., students, faculty, and staff) and settings (i.e., physical, social, and historical). Brandt (2007), Hunter, Laursen, and Seymour (2006), and McGinn and Roth (1999) represent the small number of

researchers who are exploring the role that the social context of college plays in the pursuit of degrees in the sciences by undergraduates, especially those from underrepresented groups, such as black students. This study will contribute to the body of research that explores the problem from the perspective of situational learning. The strategy of employing the combined theoretical robustness of the concepts of CoP, CRT, and ST allowed for an exploration of the experiences revealed by participants in the study that ventures into new territory.

Although the findings from this study do not lend themselves to generalization across all institutional types and academic disciplines, the study offers insights into the ways in which discipline-specific practices (such as field trips and work in research laboratories) and non-discipline-specific practices (such as attending professors' office hours and forming study groups) offer opportunities for rich learning and development in other STEM disciplines. The CoP framework showed that engagement in practice enables those involved to alter the meaning of specific features of a discipline. The practices of a discipline further development of new understandings and alter the significance that elements of the discipline have for individuals, promoting changes in personal and collective identities. Interaction with others engaged in similar enterprises can constitute the type of community that supports and encourages continued individual and collective learning and development. Therefore the insights gained from exploring the subjective experiences of the fifteen participants in this study can help us envision the role of similar practices as sites of learning and development for other STEM undergraduates.

Insight about the significant role that practice plays in the recruitment and retention of undergraduates was revealed through the use of the CoP framework and complemented by concepts from CRT and ST. The frameworks of CoP, CRT, and ST independently explore the sociological and situational aspects of human engagement in enterprises that include education like the type pursued at the highly selective liberal arts college where the study was conducted. Additionally, the three frameworks incorporate the perspective that people are affected by things that may be invisible to the conscious mind, as demonstrated by the evolution in one's identity uncovered by the theory of CoP, the relevance of legal and social policies and practices that have historically fostered inequality in housing, education, and employment for blacks pinpointed by CRT, and unconscious biases that send a message of low expectations for blacks in the domain of science learning revealed by the research on ST. Despite their shared conceptual features, each of the three concepts offers a unique perspective that advances the discussion about the ways that undergraduates, especially black undergraduates in the U.S., are encouraged or discouraged from pursuing study of the sciences.

A more in-depth discussion of the value of using these three frameworks to guide the analysis follows. The theory of CoP treats learning as a social phenomenon, characterized by increasing participation in practices associated with a particular enterprise. A central idea of the CoP framework is the interaction of the CoP components of *practice*, *meaning*, *identity*, and *community* in the process of learning. Most interesting is the notion that participation in *practices* associated with a particular enterprise allows for changes in the ways people conceptualize and associate

meaning with aspects of that enterprise, and that changing *meaning* through engagement in *practice* changes the *identity* people have in that enterprise. Additionally, there are aspects of the enterprise that forge a sense of cohesion, which reinforces the bonds of *community* associated with an enterprise. The use of the dynamic interaction of the four components of CoP was complemented by employing CRT, which reveals the mechanisms that have historically disadvantaged black people and privileged white people in the U.S. Central to CRT is the premise that the U.S. is a race-conscious society that does not function as a "meritocracy," a system based on ability. The notion of the meritocracy is often used to explain the so- called achievement gap between black and white youth in U.S. schools and the low rates of employment for blacks in scientific careers. Application of the concept of ST made possible an even more narrow focus on the role of race, going beyond the way race affects educational institutions to look at psychological factors that help explain the experiences black students in the study describe. The empirical studies that inform the concept of ST demonstrate the overwhelming effect on performance of the belief that one may be unfairly judged based on an aspect of one's identity. The activation of a Stereotype Threat stimulus, even when inadvertent, can prevent black youth from fulfilling aspirations to pursue the sciences. Combined, the use of CoP, CRT, and ST makes it possible to recognize aspects of students' experiences that are often ignored in other studies seeking to understand the underrepresentation of blacks and other groups in scientific fields.

The insights gained by analyzing fifteen black and white undergraduates who enrolled in introductory environmental courses at a liberal arts college contribute to

the body of research that scholars and educators can consult to improve the training of teachers and professors, enhance pedagogy, and empower students to manage the social context in which they experience learning in the sciences.

CoP, CRT, and ST provided a framework and a vocabulary for exploring and explaining what students reported about their course-related and co-curricular experiences while studying the introductory environmental sciences, and the ways in which engagement in certain aspects of the discipline affected their learning. The theory of CoP furnished the principal framework and vocabulary for analyzing the interviews with the students in the study.

The theory of CoP proved an effective tool for exploring the social context in which black students study at a highly selective liberal arts college. However, CoP fails to explore issues of power and institutional features that play a large role in people's everyday lives. Therefore the inclusion of CRT and ST, two concepts that examine the role of institutional racism in the lives of subordinated minorities in the context of schooling in the U.S., yielded particularly rich insights. The three concepts led to the identification of those patterns of participation in the environmental sciences that served to encourage and those that discouraged engagement in activities associated with the discipline.

Using the theory of CoP as the primary framework and concepts from Critical Race Theory and Stereotype Threat as secondary frameworks for analysis, I examined the interview transcripts for comments about the students' experiences and perspectives that illuminated activities, perceptions, and aspects of learning about the environmental sciences that proved beneficial or detrimental to their becoming

associated with the field of environmental sciences. I was particularly interested in finding out whether the social context in which undergraduates, especially black students, were studying affected their observations on learning about concepts and issues in the environmental sciences. I wanted to understand how students begin to see themselves as fully participating in the field.

The analysis produced several key findings. The main insight gained from employing the theory of Community of Practice was that learning in the environmental sciences in college involves simultaneously learning the concepts and issues associated with the subject matter and learning about and becoming skilled at using the practices associated with the environmental sciences. In applying the theory of CoP to the context of this study, two domains of knowledge emerged: the domain of knowledge belonging to the field of the environmental sciences and the domain of knowledge of the liberal arts residential college.

Some general comments can be made about the group of participants in the study. Figure 5.1 in Chapter 5 offers profiles of the participants according to academic year and the year/semester in which the introductory courses were taken, highlighting the similarities and differences among the participants. Most of the participants (12 out of the 15) enrolled in the course during their first year, a period of transition from high school to college that necessitates learning how to function in the new setting of a residential institution. Moreover, of the students who took the course as freshmen, all but three had never before taken a course in the environmental sciences. Thus nine of the participants had to simultaneously learn the modes of discourse and social norms associated with the enterprise of environmental sciences while learning those

associated with college life. Their new membership in these communities necessitated learning new terminologies and practices as well as content knowledge. Just as the new-student orientation sessions offered by most colleges do not suffice to acquaint entering students fully with all the buildings, policies, and norms of the school, the syllabi and lectures in the introductory courses do not fully convey the nuanced attitudes and practices pertaining to study of the environmental sciences. This gap and other features of the educational setting influence students' social interactions and thus their opportunities to become involved in the environmental sciences.

Comments from several participants in this study described how participants were being changed by their experiences with the environmental sciences. The following situations illustrate the point:

- One participant became increasingly aware of his responsibility for improving environmental conditions and found himself confronting moral dilemmas;
- One participant was surprised to encounter the seemingly unorthodox approach of mixing science with the humanities in an introductory environmental-studies course;
- One participant became knowledgeable about recycling and sustainability and she felt a need to educate her family and friends about recycling;
- One participant recognized that what she was learning about the environment had implications for a situation in her native country. Her interest in the environment was also influencing decisions she was making about her future;
- One participant's new knowledge about the accomplishments of Majora Carter (African-American environmental justice activist and entrepreneur)

bolstered her confidence that as a black female she could excel in the environmental sciences;

- One participant became confirmed and inspired in her pursuit of the environmental sciences through participation in such practices as research, enrichment programs, and professional organizations and conferences;
- One participant acknowledged that she might have pursued environmental science as a major if she had been introduced to the field as a freshman. This student admitted that before she learned to cook in college, science, despite its importance in modern society, had never held personal relevance for her.

This brief list of changes that participants experienced while studying the environmental sciences provides a glimpse of the effects of constructed identity. However, the nuanced changes that contribute to the overall construction of a changed identity become discernible when one explores the comments participants shared about new practices in which they engaged, and when one examines how these practices created opportunities for them to construct new meanings and, through continuous engagement, forge community. These were experiences revealed during the interviews that made students feel included or excluded. The perspectives shared in this study should provide a set of dos and don'ts for faculty and students dedicated to recruitment and retention in STEM fields.

The analysis of the participants suggests that there were some practices that faculty and students employed that brought students toward the discipline and others that discouraged them. Institutional practices that proved particularly instrumental in encouraging students to enter the discipline included:

- Assignment of students to faculty advisors with sufficient knowledge to inform students interested in science about course offerings and major prerequisites;
- Structuring of courses to engage students actively in their learning.

Budgetary and personnel constraints may explain failures to implement these and other practices. Colleges and universities must identify ways to enhance training for faculty advisors who are not associated with science departments. One participant in the study explained that her advisor failed to tell her that enrolling in only social-science classes in the fall of her freshman year would affect her ability to enroll in science and mathematics courses in the second semester because, unlike the social-science and many humanities courses, the majority of science and math classes are sequential. Liberal arts institutions such as the site of this study must find ways to reduce the size of introductory courses in the sciences. The introductory courses that participants in this study enrolled in ranged from 80 to 150 students. While some participants commented on the negative aspects of being in a large lecture course, several participants explained that the lecture format came with some educational benefits or that they had no preference for a discussion-based format. However, my analysis of the participants in the study confirms Demaree and Li's (2009) findings about the negative effects of large class size on college students' comprehension of science.

Some faculty members have developed effective practices to minimize the negative effects of a large course. Strategies that participants in the study describe include:

- an introduction exercise (time-consuming in large classes but symbolically significant);
- required field trips to local sites;
- small-group exercises (even in lecture halls with fixed seats);
- opportunities for students to work in their research labs (even if the students are not advanced in the discipline)
- encouragement of undergraduates to attend professional conferences and field-camp.

For black and other historically underrepresented students, the practice of a faculty-facilitated introduction has great potential to help students to develop a sense of belonging and form relationships with peers.

A fourth set of findings concerned interpersonal relationships that participants described that facilitated their recruitment into the environmental sciences (Brandt, 2008; Demaree & Li, 2009; Hunter, Laursen, & Seymour, 2006; McGinn & Roth, 1999). Noteworthy were comments about the positive influence of having a professor who expressed belief in the participants' ability to do well in the environmental sciences, even though the participant may have been inexperienced in the field. This practice related to the "buffered" criticism that Cohen, Steele, and Ross (1999) identify as an antidote to Stereotype Threat, and suggested that certain practices of inclusion, for example introductions and invitations to participate in research, counteracted the activation of Stereotype Threat in black students. Reducing the activation of Stereotype Threat in interpersonal relationships enhanced recruitment and retention.

Some undergraduates developed practices that helped them be successful in the large course, including:

- forming study groups with classmates who lived in their dorms; completing homework and projects with classmates;
- discussing course content and environmental issues with classmates or peers not enrolled in the course;
- participating in environmental education efforts (the landscaping initiative and a national environmental organization)
- educating their peers and families about environmental impacts and recycling. Some of the interactions between faculty and students proved less productive, although they held great promise. These types of interactions included the following:
- Most participants stated that they did not attend the professor's office hours; some participants communicated with the professor by email or tried to meet with the professor before or after the lecture.
- Several participants stated that they participated in homework sessions and exam preparation sessions offered by TAs (although one student commented that her TA failed to show up for two review sessions).
- Several participants took part in faculty-sponsored research laboratories.
- Participants described the positive experience of going on field trips with faculty and peers.
- Participants described the benefits of participating in activities involving the arts and humanities.

For many college students, enrollment in an introductory course is the first encounter with disciplines such as the environmental sciences. By exploring the comments and perspectives that students offer on the cusp of entering these fields, much can be learned about practices that lead to learning and participation in the discipline and those that stifle learning, inhibit community formation, and hinder retention. The four components of the theory of Community of Practice—meaning, practice, community, and identity (Lave, 1991, 1996; Lave & Wenger, 1991; Wenger, 1998) were beneficial in providing insight into many of the experiences that the students in this study encountered in the course activities as well as other areas of their lives. As a theoretical framework, CoP proved extraordinarily helpful for exploring some of the issues that participants' comments revealed about how some of them were becoming more interested and involved in the environmental sciences while others did not benefit from similar experiences and perspectives. Furthermore, the central concept of the framework that describes learning as increasing participation in a community of practice provided a model of learning and community-formation among undergraduate students.

The analysis of the black participants in this study yielded particularly useful insights. The findings support Quimbly et al.'s (2007) observation that members of ethnic minorities perceived greater barriers to pursuing a career in environmental science. Yet the views expressed by the black participants in the study causes me to stop short of any claim that the black participants had limited concern about environmental problems and less interest in the environmental sciences than their white counterparts. The study shed light on the experiences of black students and other

students whose social identities are underrepresented in environmental science disciplines. Given the data showing that only 2 percent of Earth, Atmospheric, and Oceanographic bachelor's degree recipients in 2010 were black, it was beneficial to have a 60 percent (n=9) representation of black participants in this study, who enabled me to glean these insights (NSF Table 5-7, 2010). To discover the influence that race may have in patterns of participation by blacks, Critical Race Theory (CRT) helped me to identify systemic racial barriers that explained certain experiences black students in the study described. The transcripts were also analyzed to identify themes suggesting that some students experience the type of destructive performance anxiety referred to as Stereotype Threat (ST), which interestingly proved useful in explaining the experiences of some white as well as some black participants in the study.

The participants in this study represent a range of social identities, and their willingness to talk about their experiences with me, in the interest of advancing knowledge, without any remuneration, is noteworthy. Using a prepared set of questions (see Appendix B), I recorded what students said about their pre-college experiences with science, what motivated them to enroll in an environmental course, their impressions of the course, and what activities occupied their time outside of classes. The students described a range of interests and backgrounds in science, community service, and the specific field of environmental science, as well as other disciplines. I reviewed and analyzed the texts for thematic patterns that gave me insight into the participants' experiences, in particular those that may be viewed as barriers to participation and those that may be viewed as opportunities for participation.

Figures 4.1 and 5.1, located in Chapters 4 and 5, contain an overview of participants in the study. Some of the participants (n= 8) were enrolled in the introduction to environmental science (which I refer to as Iteration B-2, Professor Z) in the spring of 2013 at the time of the interviews. Others had completed the introduction to environmental science (designated as B) or introduction to environmental studies (designated as A) at earlier dates, and their courses were designed and conducted by one of three other professors: Iteration A-1, Professor W (n= 2); Iteration B-1, Professor Y (n=2); Iteration A-2, Professor X (n=3). I attended several lectures associated with Iterations B-1, A-2, and B-2 to observe the course and to learn about the course content and format. I also attended two class field trips associated with Iteration B-1. Figure 4.2, located in Chapter 4, provides an overview of differences and similarities among the four iterations of the courses. Figures 4.3–4.7, also located in Chapter 4, contain information about aspects of the courses that I observed and thought relevant to the study of the students' participation in the environmental sciences.

The fact that the study included students from three different classes (2014, 2015, and 2016) yielded different levels of insight. That almost half the participants in the study (7 out of 15) had already completed one of the introductory courses by the time of the interview provided the opportunity to gain insight into the longer-term effects of the experiences associated with their study of the environmental sciences. The participants who had taken the course in the first semester of their freshman year revealed the impact that their participation in the environmental sciences—through the courses and beyond—had on their knowledge, attitudes, and choices. This level of

insight was not attainable from most of the participants from the class of 2016, a group of six freshmen who had only recently started the course when they participated in the interview, and the one sophomore who had already decided what major she would pursue. Thus the issue of time of enrollment in the course emerged as important in the study.

Although the second-semester freshmen, who had been enrolled in the course for only a couple of weeks at the time of the interview, could not provide much insight into the longer-term effects of experiencing the course and other encounters related to the environmental sciences, their experiences shed light on the influence of a pre-college experience on the pursuit of the environmental sciences in college. For example, several participants explicitly stated that they did not have strong backgrounds in science from high school.

Having had poor preparation in the sciences did not necessarily predict a negative experience with studying the environmental sciences in college. One participant declared a major in environmental studies despite having a weak background in science. It is worth noting that one participant who enrolled in the introductory course in the second semester of her sophomore year and another who enrolled in the course in the first semester of his freshman year both declared majors, in environmental studies and environmental science respectively. This suggests that the timing of enrollment in the course did not necessarily affect their decision to pursue a related major.

In the class of 2016, there were two participants who withdrew from the course. The analysis of their interviews suggests that they experienced great difficulty

participating in practices related to the environmental sciences. These participants commented that they decided to withdraw from the course because they were performing poorly. While one participant described how she tried to establish a network of support involving the professor, the teaching assistants, and classmates with whom she studied and completed homework assignments, the other stated that he did not attend office hours or seek out classmates with whom to study and complete homework.

The interview questions were geared toward attaining insight into the following factors:

Motivation to enroll in the course:

The participants in the study provided a range of reasons for their decision to enroll in the introductory course. Almost half of the participants in the study stated that they enrolled in the introductory courses to learn more about general or specific environmental issues, which included specific topics such as acid rain, climate change, wind patterns, pollutants in bodies of water, recycling, and sustainability. Several participants indicated that they were interested in learning more about environmental issues but that they enrolled in the courses primarily to satisfy requirements for majors unrelated to the environmental sciences or distribution requirements. A third of the participants in the study said that they were certain at the time of enrollment in the course that they would pursue an environmental major. Other reasons for enrolling in the courses included: a desire to study with specific professors; needing a course to have a full academic load; and the impression that the course would be the *easiest* of the science courses.

Background in science:

Four participants explained that they had taken advanced courses in the environmental sciences in high school. These students, along with an additional participant who had not taken an environmental science course, said that they were well prepared in high-school science. Four other participants said that they did not have strong backgrounds in high-school science. About half of the participants in the study said they had always liked science and/or math. Only two participants stated that they had always struggled to comprehend science and math, and only one participant admitted that she did not have a strong interest in science or math, although she had performed well in both. The backgrounds in science that participants described suggest considerable divergence in their preparation and interest. The information participants provided corroborates the findings of Hoisch and Bowie (2010), who describe the wide range of academic backgrounds and personal familiarity with the geosciences that students bring to introductory courses, and those of Gilbert et al. (2012), who document a range of reasons for students' enrolling in the introductory courses. The diversity of background and interest poses a difficult challenge to instructors as they try to determine an appropriate level of rigor and thoroughness for the course.

Co-curricular involvement:

Only three participants said that they were minimally involved in organizations and activities. One participant explained that she did not warm to the environmentally focused student group that she was encouraged to join. Eleven participants said that they were highly involved in extracurricular activities during the semester in which

they enrolled in the introductory courses. With only one participant mentioning her interest in becoming involved in a student organizations associated with the environmental sciences and only two participants describing an interest in engaging in summer employment involving environmental education, the study found that over half the participants in the study were highly involved in one or more co-curricular activities unrelated to the environmental sciences. Most of the students described busy lives that left them little time to engage in discipline-specific discussions and relationship-building with faculty and peers through office visits and study groups.

Interaction with faculty:

Two participants described negative academic-advising experiences with faculty outside the environmental sciences. According to these participants, their advisors confined themselves to signing off on course registration and withdrawal forms. One charged that her advisor had steered her wrong by advising her against enrolling in a science course in her first semester, and the other blamed her advisor for failing to inform her about environmental studies, a more social-science-focused course offered in the fall. These criticisms suggest the importance of preparing both advisor and advisees to engage in meaningful and ongoing dialogue about course choices and academic and career trajectories.

As for relationships with course faculty, two participants expressed a desire to form closer interpersonal relationships with the instructors of their introductory courses. Although three participants described limited relationships with both the instructors and classmates, and one participant painted a negative image of the relationship she had with the professor from the introductory course, two participants

described their relationships with the introductory course's professor in positive terms. Of the participants who had completed the course in prior semesters, five described overall close relationships with faculty in the environmental-sciences department. Most of these five were motivated to study the environmental sciences because of a special non-discipline-specific practice adopted by the introductory course's professor.

The participant who said that his interest in a particular professor preceded his interest in the subject matter searched the course offerings to identify a course taught by that professor, which turned out to be the introduction to environmental studies. Similarly, another participant explained that her decision to enroll in the introduction to environmental science came about after she had spent the first semester of her freshman year as a particular professor's advisee. A third participant stated that she enrolled in the institution with the firm intention of designing an independent major with an emphasis on geography. She chose to enroll in the course being taught by the sole member of the department whose undergraduate training was in geography.

Some students acknowledged that non-discipline-specific practices engaged in by the instructor of the introductory course had deterred them from pursuing the major. With other students, the opposite effect occurred. These reactions suggest that faculty must use care in their use of phrases and references intended to suggest familiarity with the students in a course, and must be cautious about promoting personal convictions. Specific references may help the professor establish a connection with students who identify with the reference, but such references may alienate others who do not identify with or recognize them. Students from

underrepresented groups, who are less likely to share the identity of a faculty member, can be particularly sensitive to exclusionary assumptions.

The format and utilization of faculty office hours by students is another practice that must be enhanced if STEM departments are to be more effective at recruiting and retaining a diverse group of students. Several participants explained that they desired a closer relationship with the introductory course's instructor, but most participants stated that they did not attend the professor's office hours. Only one participant stated that she regularly attended the professor's office hours, but she enrolled in the course as a sophomore, when she had already declared a major in another field. This participant saw taking advantage of office hours as a way to establish relationships with professors before there was a crisis, or to ease the process of discussing grades. This participant did not end up majoring in the environmental sciences in spite of a positive experience in the introductory course. Another participant attended a minimal number of office hours, and four participants commented that they never attended office hours with the introductory course's professor. Three participants had limited contact with their professor. One participant suggested that feeling incompetent in the course content affected her willingness to participate in office hours. This means that as she became more confused, it became less likely that she would attend the professor's office hours. This reaction suggests the activation of a form of Stereotype Threat, causing the student to practice avoidance as a strategy to avoid confirming the threat. This participant stated that she made three visits to the professor's office hours, which included the meeting at which she asked the professor to sign her withdrawal form. One student mentioned that she would ask

the professor questions before or after the lecture, and another student commented that she corresponded with the professor by email. The opportunities to interact with the faculty during office hours were underutilized by most of the participants in the study, but the responses of those black students who did forge relationships with faculty show the advantages for recruitment to and retention in the sciences of students from underrepresented groups. Future inquiry is needed to identify discrepancies in the way that students and faculty view office hours and to determine how the practice of holding them can work better for all concerned.

This study illuminated how that faculty develop their own repertoire of practices to engage and support students. Some of these practices include: invitation to work in research laboratories, offering field trips, and facilitating student introductions in class. Additionally, well-intended efforts that some faculty use to connect with students and share aspects of their personal life sometimes aid and at other times hinder successful recruitment and retention. On the one hand, the study identified three participants who liked certain practices that faculty employ—such as including their personal interests in their lectures and conversations with students—and saw them as important factors in attracting them to the major. Several participants in the study described practices that their faculty introduced that seem to have boosted the student engagement. One participant explained that Professor W tried to get students to know each other through group activities and sharing, and she described the positive effect of the convention of introductions instituted by some of her professors in the environmental-sciences department. She explained that whenever professors took the time to have students go around the room to introduce themselves

to each other, it made it easier for students to meet and form study and homework partnerships. The importance of introductions is suggested by the finding that the majority of participants either failed to mention or clearly stated that they did not forge new friendships in the introductory courses. The absence of specific opportunities to form new friendships did not affect all participants equally. Four students entered the course with friends already in place. One participant formed a closed friendship with a classmate who was also a resident in his dorm. Two others described some interaction with classmates, although one participant stated that her course friendships were not close. However, three other participants' comments suggest that they did not have any interaction with peers in the course. One participant's admission that no one ever spoke to her was particularly indicative of the isolation that some students feel in lecture-based courses.

On the other hand, one participant's comments reveal that faculty efforts to make personal connections with students are not always well received. The participant stated that her professor would regularly preface a topic by saying that students might recall the topic from their AP physics courses in high school. Since the participant had taken the AP only in biology, the reference activated a negative response, causing her to anticipate that she would not understand whatever followed. Although the professor was trying to forge community with students in the course, and perhaps succeeded with students who had taken the AP course in question, to the student who lacked that preparation, and other students like her, the remark carried a message of exclusion.

Course format:

Participants described several aspects of the course format that suggest that these features affected the students' experiences both in class and out. These aspects included the lecture format, class size, seating patterns, the role of teaching assistants, and the methods of assessment. Several participants commented that they disliked the large-lecture format of the introductory courses. The two who withdrew from the introductory course specifically mentioned the lecture format as a problem. Only one participant who disliked the format declared a major in the department. One participant commented that the class size and the lecture format did not matter to her. Two other participants felt it was difficult to ask questions in lecture. Another student observed that only a few asked and answered questions; she suggested that professor should have called on students. She commented that speaking in class was an important aspect of learning and observed that there was an element of unfairness in the way the professor did not call on other students who did not volunteer answers during class. Two participants commented that they preferred to listen and take notes rather than engage in discussions in class; they found the format appropriate for conveying the large amount of specialized information.

Another aspect that I noted while observing class sessions was the seating patterns students created. The lectures were held in halls with fixed seats and folding tablet arms, which imposed certain seating patterns. I noticed that pairs and groups of students tended to sit in the same location at every class meeting. Two participants commented about these seating patterns during their interviews. One participant identified the culture of sitting in the back of the room, where, according to him, one

could go unnoticed. Another participant emphasized that she always sat in the front of a classroom or lecture hall, a strategy that helped the professor get to know her and kept her honest about showing up for class.

The role of teaching apprentices (called TAs) received divergent reviews. The TAs associated with the introductory courses were undergraduate students who had taken the courses earlier and were hired to assist current students. Three participants stated that they attended the pre-exam help sessions offered by the TAs. Most participants mentioned only briefly, if at all, their experiences with the TAs. One participant gave a negative assessment of her experience with the TAs, going so far as to state that the TAs were not helpful and twice failed to show up for scheduled sessions. This student interpreted the TAs' behavior as evidence that the course was disorganized.

Several participants commented on the examinations associated with the courses. Three participants praised the format; one participant stated that she struggled with a part of the examination; another participant explained her worries about the exams; and a third found the exams hard. Other comments about the course included: one participant's comments about liking the pedagogical approach and the assignments; two participant's critical remarks about the professor's use of PowerPoint; and two participants' favorable responses to the professor's use of PowerPoint slides. Two other participants evaluated their own performances in the course by comparing them with their peers' performances. These participants thought their peers had criticisms of the course similar to their own.

The impressions that the physical setting in which the course took place affected the kinds of relationships participants in the study forged with faculty, TAs, and peers deserves further interrogation. Instructional settings that do not promote peer interaction or dialogue between faculty and students undermine the kinds of experiences that foster interpersonal relationships. With between 85 and 150 students in various sections of the introductory courses associated with this study, participants were unlikely to engage in meaningful course-related dialogue and activities related to the environmental sciences. If the opportunity to engage in dialogue and activities with TAs, peers with advanced knowledge of the discipline who were charged to assist current students, was impaired by actual or apparent negligence on the part of the TAs, this experience only exacerbated a problematic situation for students less confident of their knowledge, experience, and abilities.

The lecture-based format of the introductory courses proved to be objectionable to several participants in the study. The smallest class was 50 students, the largest 140. Several participants remarked on the negative effect of being in a large lecture course. A few students noted that they had no objection to the lecture format or liked it for the opportunity it afforded them to absorb content and benefit from the professor's expertise. The literature on lecture-based formats provided some insight into the challenges associated with these courses. Demaree and Li (2009) found that social learning strategies like peer-to-peer discussions of course topics in an introductory calculus-based physics course at a liberal arts college enhanced student learning. Likewise, in a study of two environmental-science courses, Lord (1999) found that students who had taken a lecture-based course were less likely to participate

in campus and regional environmental efforts. The study saw improvements in student performance on the exams as a result of small-group activities in which the students worked together on thought-provoking scenarios and critical-thinking exercises or constructed concept maps on the information of the day.

Research from Demaree and Lee (2009) and Lord (1999) supports my own observations of several lectures. I recorded notes on several iterations of the introductory courses in which participants in this study were enrolled. I noticed that the lecture setting constrained the level of interaction students had with each other and with the professor. That students' attention to the lecture suffered was evident from observations of students using their computers and cell phones for purposes most likely not related to the lecture. Some students could be seen viewing sports and other videos, or visiting social networks like Facebook. In the large rooms in which the lectures took place, the professors usually remained at the front of the room, thereby unable to see the students' screens. Contrary to the students' belief, the professors probably recognized which students were not paying attention.

The large lecture hall seemed to contribute to a lax atmosphere. I noticed that some students regularly arrived late, and others would leave the room and return later, sometimes with a cup of coffee or some other beverage. While observing seating patterns, I noticed groups of students who sat far in the back, as well as some who tended to sit at the front. Some clusters of students chatted with each other before and sometimes during the lecture, suggesting that they knew each other. Only a few students posed questions and answered those posed by the professor. These patterns of visible non-participation are less likely to occur in small discussion-based or

seminar courses. For participants in the study who signed up for the course with friends, there was little incentive to forge new friendships with classmates. Two participants confirmed this presumption. Two other participants, who did not have friends in the course, revealed that they never got to know their classmates, while two others described opportunities in the residence halls to meet with classmates to complete coursework and study. Four participants charged that the lecture format prevented them from establishing new friendships among their classmates.

Interactions with peers:

Several participants responded to questions about relationships with peers in ways that suggested that they often found themselves working in isolation, with at best occasional interactions with a limited number of classmates or a peer not enrolled in the course. Half the participants stated, however, that they gathered with one or more housemates who were also in the course to discuss the material and or attend review sessions. A few described how the course facilitated the formation of new friendships with classmates. Four participants stated explicitly that they did not make new friends in the course.

The benefits of peer support were illustrated in comments from four participants whose observations revealed how questions of race affected their experiences. Race clearly played a role in the types of relationships these students were able to establish with peers, especially peers associated with the environmental sciences.

Insight into the experiences of black undergraduates in STEM:

The format of a course, whether large and lecture-based or small and discussion-based, determines the ease by which students and faculty can get to know each other. Familiarity with each other makes it easier for students to study and work together. Likewise familiarity with faculty acquired in a research laboratory and on field trips has been shown to have a positive impact on student success, especially for retaining students from historically underrepresented backgrounds in the sciences. Brant (2008) uses the Community of Practice, which focuses on learners rather than on pedagogy, to explain how that a female Navajo science major learned about her field through working in a molecular biology lab. The process of learning, called legitimate peripheral participation (Lave, 1991) was evident in the responses provided by several participants in my study who experienced the benefits of working in real-life settings alongside professional scientists. Three participants mentioned the surprise and pride they felt when faculty invited them to join their research labs early in their college careers. The experience of doing research in a lab helped one participant discover her preference for the social sciences over research on specimens in a lab setting. Another participant had the good fortune to be assigned to Prof Y as a first-year advisee, which placed her in line to be invited into Prof Y's research lab. Another participant commented that a poor experience in the introductory course with Professor X caused her to doubt her future in the environmental sciences. Another participant explained that Professor Y's demonstrating confidence and encouragement by inviting her into her lab motivated her to pursue the major in spite of the poor experience in the introductory course. Along with their testimony to the positive

influence of working in the lab, three participants described the value of participating in field trips associated with the introductory courses and the environmental-science major. These experiences placed them in the context of functioning like actual environmental scientists and participating in the lab as members of the lab community; they found they could make meaningful contributions to the projects. The CoP framework illuminates the way in which participating in meaningful activities, or practices, in CoP terms, creates opportunities for concepts encountered in practice to take on new meanings. Through mutual engagement, these new meanings allow for the construction of new identities around the enterprise of focus, and ultimately, through sharing, forge communities.

Hunter, Laursen, and Seymour (2006) also documented the phenomenon of legitimate peripheral participation in a community of practice in research laboratories at four liberal arts colleges and identified gains in thinking and working like a scientist; becoming a scientist; personal-professional gains; clarification, confirmation, and refinement of career/education paths; enhanced career/graduate school preparation and gains in skills. Studies show the positive effects of engaging in real-world activities and hands-on fieldwork associated with the environmental sciences provide many benefits that cannot be taught in the isolated setting of a college classroom or lecture hall. It is imperative that students participate in the discipline in order to build on the connections, personal and cognitive, that must be made in order to construct new discipline-specific identities for themselves that honor all that they are, past, present, and who they hope to become. For the black students in the study, who national statistics indicate are least likely to pursue, let along attain,

degrees in the environmental sciences, opportunities to gain hands-on experiences in research laboratories and field study, as well as discuss and work with faculty and peers, were demonstrated to result in positive outcomes.

Analysis of the black participants in this study illuminated the challenges and opportunities that black students experience during their pursuit of the sciences. One participant commented on such challenges as the absence of role models with college degrees, let alone degrees in science fields. Two participants talked about the challenges of pursuing the environmental sciences in light of the limited understanding that family and friends brought to their activities in the field. One participant described her awareness of the negative stereotypes that black people in the U.S. often encountered, especially in terms of their participation in the sciences. The particular way that the history of racism in the U.S. continues to erect barriers to the participation of blacks in the sciences was revealed by one of the participants. As a black female born and raised in a country whose population is predominantly black, this participant explained that in her country smart people, regardless of race, are expected to pursue science, so she was confused when she learned from her black American peers that disparity exists between blacks and whites in their participation in the sciences. The insights provided by CRT and ST offered the key to the continued significance of race in determining the extent to which black undergraduates raised in the U.S. have a future in science.

Consistent with the explanations of Lave & Wenger (1991), the black students who seemed to manifest the greatest sense of belonging were those who described multiple forms of participation in the environmental sciences. These forms included

close relations with the faculty in the department, peer-group interaction outside of class, and an eagerness to take extra courses/training, participate in field trips, join organizations, and educate others about environmental issues. These activities, which the CoP model refers to as "practices," contributed to the high level of participation and the increasing construction of an identity connected to the environmental sciences. This study confirms Lave and Wenger's (1991) statement about the central role that engagement in practice plays in the development of an identity associated with a given CoP: "The form that the legitimacy of participation takes is a defining characteristic of ways of belonging, and is therefore not only a crucial condition for learning, but a constitutive element of its content" (p. 35). Ways of belonging in the environmental sciences and college were being learned through the various experiences students were having with each other and their professors. They were also being taught through the experiences students where having with their family and peers not associated with the field. Students who visit campus can receive only a trivial impression of what it means to experience four years at the college. Likewise, people who do not engage in field trips, informal conversations with professors, environmental-justice organizations, and other practices that engage environmental issues may overlook important opportunities to gain knowledge and skills that are being conveyed in social interaction. Although the students in this study varied in their levels of interest and experience in the environmental fields, they are all familiar with one of the introductory courses. Their experiences with the environmental sciences inside and outside of the courses provided the basis for a conversation about what motivated them to enroll in the course and whether the course and other experiences influenced their interest in the

issues and discipline of the field. This study reveals that social patterns based on race affected the level of awareness of, preparation for, and participation in the environmental sciences that these undergraduates, especially the U.S. blacks, brought to with their studies. The research suggests that a combination of approaches that includes the subject matter, as well as relationships with faculty, teaching assistants, advisors, peers, and family, promises to create increased opportunities and support to expand membership in the CoP of the environmental sciences to represent the racial and gender diversity of the U.S. population.

Some participants in the study offered descriptions of their involvement in the environmental sciences that suggested they were engaged differently in the enterprise from the rest, whose participation was limited almost entirely to the course lectures and assignments. Interestingly, most of the black participants provided details that indicated they were learning about the discipline of environmental sciences by engaging in a range of different practices, including educational canvassing and working in professors' research laboratories. The experiences with faculty that participants described influenced their association with the environmental sciences in general and their association with the department of environmental sciences in particular. The Community of Practice Model is a fruitful framework for making sense of these students' experiences.

APPENDIX A
INTRODUCTION SCRIPT E&ES COURSE

Hello everyone,

I am a student enrolled in the University of Rhode Island/Rhode Island College PhD Program in Education and I am interested in studying student activities and experiences in an introduction to science course.

I would like to distribute copies of a consent form that I would like to ask you to return to me indicating your approval to be a part of a pilot study this semester. Taking part in the study is totally optional and will not affect your grade in this course in any way. The consent form basically asks you to consent to be available to take part in individual interviews. I may contact you this semester or in subsequent semesters (after the course is over) while you are enrolled at [Hillcrest University]. I may contact you for one interview or several. You may limit the number of interviews you are willing to do and you may discontinue participation in the interviews at any time by sending an email to me.

Being involved in this research will involve minimal risks to you. Although you may not receive direct benefits for being in the study at this time, you may contribute to research and scholarship about college student academic development and performance.

Again, you are not required to be a part of this study. Should you choose to take part in the study, I will do everything possible to protect your identity and privacy.

I will distribute the forms now. If you consent to participate, please complete the form. Regardless of your decision to participate, please fold the form (blank or

completed) in half and place it in the designated box I have here [show box]. I am available to answer any questions.

Thank you.

APPENDIX B
INTERVIEW GUIDE

Thank you for your willingness to participate in this interview. The interview will take about 10 minutes.

Do you mind if we record the interview?

Do you have any questions before we begin?

I have been studying the behavior of people as they move from a stage of lesser competence to higher competence in a variety of contexts. Right now, I am interested in exploring learning in the context of science education. So, please tell me about being a student in the [insert name of course].

Could you describe in as much detail as possible what stands out for you as you reflect on the course:

High points

Low points

I would like to understand your experiences with the [insert name of course]

Tell me about what motivated you to enroll in the course

Tell me about what is/was going on in the rest of your life. What fills/filled your time outside of class?

Tell me how this course compares/compared to other courses you have taken in the past or during this semester.

It is my understanding that there are several components of this course; tell me what they are and what you think about each of them.

High points/Low points

Tell me about your peers.

How do you think your peers would describe their experiences in the course?

Could you tell me about the interaction you observed among your peers, faculty, and others in the context of the lectures, small group activities, field trips, exams, and community service?

Ending the interview:

Is there anything else that you found interesting about your experience with your introduction to [the environmental science/studies] course?

APPENDIX C

CONSENT DOCUMENT

Hillcrest University
Rhode Island College

STUDYING SCIENCE: STUDENTS GAINING ACCESS TO THE COMMUNITY OF PRACTICE OF ENVIRONMENTAL STUDIES

You are being asked to be in a research study about the ways that college students participate in the activities and experiences of an introduction to environmental studies course. You are being invited to participate in the study because you are either currently enrolled or you previously enrolled in one of the gateway courses for the [environmental sciences department]. Please read this form and ask any questions that you may have before deciding whether to be in the study.

Renee Johnson-Thornton, an employee at [Hillcrest University] and a graduate student in the University of Rhode Island/Rhode Island College PhD Program, is conducting this study.

Background Information
The purpose of this research is to collect interview data about students' statements about their background in science and their participation in various components of a gateway course for the [environmental sciences department at Hillcrest University].

Procedures
If you choose to be in this research, the researcher may include an analysis of your statements about your participation in the course as part of an overall analysis of studying science in the domain of environmental science and you may be invited to be a part of one or more interviews (lasting 10 minutes per interview) about your experiences with various components of the [environmental science] gateway course you are or have previously taken. You may be contacted for interviews after this course has ended.

Alternative Treatments
This study does not involve the introduction of a treatment to address a particular issue. The researcher is conducting an exploratory, naturalistic study.

Risks of Being in the Study
The risks of being in this research are minimal, meaning that they are about the same as what you would experience in your normal daily activities.

_____ Initial here to indicate that you have read and understand this page

Benefits to You
There are no direct benefits to you to be in this study.

Voluntary Participation
The decision to be in this study is completely voluntary. No professor, administrator, teaching assistant, or anyone at [Hillcrest] or elsewhere is requiring you to take part in this study. You may choose not to take part in this research and it will have no effect on your grades or enrollment, at [Hillcrest University]. Also, you may change your mind about being in the study at any time with no negative consequences. After submitting this signed consent, if you decide to discontinue participation in future interviews, please send an email to me at renee.johnsonthornton@gmail.com and I will not contact you for future interviews.

Confidentiality
The records of this research will be kept private. In any sort of report that might be published, the researcher will not include any information that will make it possible to identify you. Research records will be kept in a secured file, and access will be limited to the researcher. If there are problems with the study, the research records may be viewed by [Hillcrest University] or Rhode Island College Review Board responsible for protecting human participants and other government agencies that protect human participants in research. All data will be kept for a minimum of three years, after which it will be destroyed.

Contacts and Questions
The student researcher conducting this study is Renee Johnson-Thornton. You may ask any questions you have now. If you have any questions later, you may contact Renee at 860-227-0399, renee.johnsonthornton@gmail.com.

If you think you were treated unfairly or would like to talk to someone other than the researcher about your rights or safety as a research participant, please contact Dr. XX, Chair of the [Hillcrest University] Institutional Review Board at XXX@XXX.edu or by phone at XXX-XXX-XXXX, or by writing to Dr. XX, Chair IRB; [Hillcrest University], X, XX XXXXX. You may choose to also notify the IRB at Rhode Island College where the researcher is a student by contacting Dr. Christine Marco, Chair of the Rhode Island College Institutional Review Board at IRB@ric.edu, or by phone at 401-456-8598, or by writing to Dr. Christine Marco, Chair IRB; c/o Department of Psychology, Horace Mann Hall 311; Rhode Island College; 600 Mount Pleasant Avenue; Providence, RI 02908.

You will be given a copy of this form for your records.

_____ Initial here to indicate that you have read and understand this page

I have read and understand the information above, and I agree to be a part of the study *"STUDYING SCIENCE: STUDENTS GAINING ACCESS TO THE COMMUNITY OF PRACTICE OF ENVIRONMENTAL STUDIES."* I understand that my being a part of this study is voluntary and can be withdrawn at any time with no negative consequences. I have received answers to the questions I asked, or I will contact the researcher with any future questions that arise. I am at least 18 years of age.

I ___agree ___ do not agree to be available to be interviewed.

I ___agree ___ do not agree to have my interview audio recorded.

My preferred form of contact to schedule an interview is:

Email: _____ Phone: _____

Print Name of Participant:_____

Signature of Participant: _____ Date: _____

_____ Initial here to indicate that you have read and understand this page

APPENDIX D

DURATION OF INTERVIEWS

Duration of Interview (Total 04:43:36)

Name	Duration of Interview
Jasper and Luna	00:27:16
Harmony	00:09:35
Silver	00:12:29
Unity	00:14:11
Crystal	00:30:50
Rowan	00:17:00
Savannah	00:19:40
Violet	00:13:07
Raven	00:26:44
Opal	00:24:07
Holly	00:39:07
Dawn	00:09:42
Jasper	00:14:04
Star	00:14:48
April	00:10:56

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