Stem cells are specialized cells that are found in multicellular organisms. They have the unique capability of being able to divide and differentiate into a variety of different kinds of specialized cells. This unique ability allows stem cells to play many roles, one being to contribute as an internal repair system. The ability to divide without limit allows them to help replenish certain cell types and tissues. Since the 1980’s when stem cells were first isolated, scientists have been working to understand their behavior and properties in hopes of altering care of individuals with hematologic, oncologic, dermatologic, ophthalmologic, and orthopedic conditions. In recent years, there has been a tremendous increase in our understanding of stem cell biology. Recent studies have shown that adult stem cells can be isolated from a wide variety of tissues, including bone marrow, peripheral blood, muscle, and adipose tissue. The potential clinical applications lead to an extended interest in the use of stem cells in many medical disciplines. The most important role stem cells play in medicine is stem cell therapy: this is when cells that have been lost, destroyed, or altered are replaced. Advances in stem cell research have occurred sporadically since their discovery, however, positive outcomes and benefits are becoming more common with our improved understanding of their properties. Serious ethical concerns have been raised regarding stem cell research. Such concerns for example include and are not limited to issues about disruption of embryos to recover usable stem cell lines. This project reviewed the timeline of development for stem cell research with in depth detail of the significant milestones reached in the development of this important area of biological research.

### Key Events

- **1908**: Russian histologist Alexander Maximow introduced a theory of hematopoiesis
- **1950**: First ever bone marrow transplant performed
- **1963**: James Edgar Till and Ernest McCulloch illustrate the existence of self-renewing cells in mouse bone marrow.
- **1997**: Cloning of Dolly the sheep
- **1998**: Human embryonic stem cells derived
- **2006**: Discovery of iPSCs
- **2010**: The first embryonic stem cell trial in the world

### Example Applications

**Retinal Disease**
- Intraocular injection of retinal cells derived from human ES cells.
- Studies on mice: cells migrated into the appropriate retinal layers and expressed markers of differentiated rod and cone photoreceptor cell
- In 2012, the first report of the safety and tolerability of human ES cell use for the treatment of two patients with retinal disease appeared (one patient with dry age-related macular degeneration, one patient with Stargardt’s macular dystrophy).

**Cardiac Disease**
- Several studies have demonstrated that transplantation of human ES-derived cardiomyocytes improves contractile function of the infarcted mouse heart.
- Intramyocardial bone marrow cell injection was studied in 50 patients with chronic angina
- After a three-month follow-up, active therapy was associated with a statistically significant, but modest, improvement in myocardial perfusion compared with placebo.