Medical Research and Advancement

- Stem cells are the basic building block of the human body, capable of dividing for lengthy periods of time. Stem cells are unspecialized cells that develop into specialized cells needed by the body. Normal body cells are only capable of reproducing themselves, where as stem cells are pluripotent. Pluripotent cells divide and become any one of the 220 different cells found in the human body or they may just divide and make additional stems cells ready to divide and specialize.

Types of stem cells

- Embryonic stem cells -- include stem cells found inside an embryo, inside a fetus or from umbilical cord blood. Harvested embryonic stem cells can give rise to just about any cell in the human body.

Types of stem cells

- Adult stem cells (also known as somatic stem cells) -- found in infants, children and adults. They exist in already developed tissues and organs such as the kidney, heart and brain. They are thought to live in a specific area of each tissue, where they may remain dormant for years, dividing and creating new cells only when they are activated by tissue injury, disease or anything else that makes the body need more cells. They range from cells that are able to form many different kinds of tissues to specialized cells that form just some of the cells of a particular organ. Basic subgroups include:
  - Mesenchymal stem cells -- form fat cells, cartilage, bone, tendon, ligaments, muscle , skin and even nerve cells
  - Hematopoietic stem cells -- give rise to blood cells only (red, white and platelets cells)
  - Neural stem cells -- form only cells in the nervous system

Types of stem cells

- Induced pluripotent stem cells (iPSC) -- Adult cells that have been genetically reprogrammed into a stem cell-like state.

- Isolating and harvesting of stem cells -- There are several ways adult stem cells can be isolated, most of which are being actively explored by our researchers.

From the body itself

- Adult stem cells can be isolated from the body and vary, depending on the tissue. Blood stem cells, for example, can be taken from a donor's bone marrow, from the umbilical cord of a new born, or from a person's circulating blood. Mesenchymal stem cells, which can make varies types of connective tissue can be isolated from bone marrow. Neural stem cells (which form the brain's three major cell types) have been isolated from the brain and spinal cord.
- After isolating the adult stem cells, they need to be grown to large enough numbers to be utilized for treatment.

From amniotic fluid

- Amniotic fluid, which surrounds the fetus in the womb, contains fetal cells including mesenchymal stem cells. Many pregnant women elect to have amniotic fluid drawn to test for chromosome defects, the procedure known as amniocentesis. Researchers are working on the idea of isolating mesenchymal stem cells and using them to grow new tissues for babies who have birth defects detected while they are still in the womb. Since the tissue would be a perfect match to the child's it would not be rejected by the child's immune system and could be implanted either in utero or after the baby is born.

From embryonic stem cells

- Because embryonic stem cells are able to create all types of cells and tissues, scientists hope to use them to generate many different kinds of adult stem cells.

Induced pluripotent cells (iPS cells)

- Scientists have discovered ways to take an ordinary cell, such as a skin cell, and “reprogram” it by introducing several genes that convert it into a pluripotent cell. This cell is called induced pluripotent cell. Scientist are very excited about iPS cells because they come from a patient’s own cells, they are genetically matched to that patient, eliminating tissue matching and rejection problems that currently hinder successful cell and tissue transplantation. Scientist also see the iPS cells as a valuable research tool to understand how different diseases develop.

Ethics vs. Science

- Laboratories around the world are busy testing different chemical and mechanical factors that might stimulate embryonic stem cells or iPS cells into forming a particular kind of adult stem cell. Adult stem cells made in this fashion would potentially match the patient genetically, eliminating both the problem of tissue rejection and the need for toxic therapies to suppress the immune system. Because iPS cells are derived from skin or other body cells, some people feel that genetic reprogramming is more ethical than harvesting embryonic stem cells which are taken from embryos or eggs. However, this process must be carefully controlled and tested for safety before it's used to create treatments. In animal studies, some of the genes and the viruses used to introduce them have been observed to cause cancer. More research is also needed to make the process of creating iPS cells more efficient.

Ethics vs. Science

- Opponents of stem cell research consider the use of any embryo to be totally unacceptable and many disagree with the growing of human tissue as very risky business that could lead man kind down a very narrow road of selectivity.
- Proponents of stem cell research argue that it may be they very answer to many chronic and debilitating diseases that currently plague man kind and researchers should have the ability to see where the discoveries take us.