



# Stem Cell and Cloning - 01

## Types of Stem Cell

- **Totipotent Stem Cell:** These can be converted into any type of cell.
- **Pluripotent Stem Cell:** These stem cells convert into the majority of cells of the body.
- **Multipotent Stem Cell:** These can be converted into a good number of cells.
- **Oligopotent Stem Cell:** Can be converted into a few cells.
- **Unipotent Stem Cell:** These stem cells are converted into single cells.

## Order of Stem Cells

- **Capacity:** It decreases from Totipotent stem cell to Unipotent stem cell.
- **Specialization:** It increases from Totipotent to Unipotent stem cell.

## Classification based on Stem Cell Formation at different stage of Human Life:

- **Embryonic Stem Cell:** These stem cells are found in the embryonic stage inside the mother's womb. E.g., Totipotent and Pluripotent
- **Adult Stem Cell:** These stem cells are found in the adult human body. E.g., Multipotent, Oligopotent and Unipotent stem cells.

## Totipotent Stem Cells

- These stem cells can divide into any type of cells in the body.
- These are present in the early embryonic stage (1 week old).
- Totipotent stem cells are banned globally due to ethical and legal issues.
- For medical research, Totipotent stem cell can be obtained from embryo developed in lab by IVF (In Vitro Fertilization)

## Pluripotent Stem Cell

- These cells are formed by division of Totipotent stem cells.
- It can give rise to the majority of cells and tissue in the body by division.
- Medically, this is the most important stem cell which can be used in stem cell therapy and treatment. Normally, stem cells are used for the same person from whom the stem cell has been retrieved. But in many cases, the stem cell of a baby can also be used in blood relations that are its parents and siblings after matching the blood group and HLA (Human Leukocyte Antigen).

**Retrieval of Pluripotent Stem Cell:** These cells can be retrieved from the human body at different stages.

- **Later embryonic stage (After 1 week):** It is banned because it ends up destroying the womb.
- **From miscarriage (within 12 weeks):** It is meant for research purpose.
- **From umbilical cord blood of baby:**
  - These stem cells are used in stem cell therapy and treatment.
  - These can be stored for the next 2 decades.



- The stem cell of umbilical cord blood is preserved in liquid nitrogen at -196 degree Celsius. This is known as cryopreservation.
- This service of cryopreservation is commercially available in India by various companies, such companies are known as stem cell banks.

## Stem Cell Therapy

Stem cell therapy, promotes the repair response of diseased, dysfunctional, or injured tissue using stem cells or their derivatives. It is also known as regenerative medicine. We can simply say that medical use of stem cells for the treatment of disease is Stem Cell Therapy.

### Applications

- **In treating Blood Related Diseases:**
  - **Blood Cancer:** It is defined as the uncontrolled division of blood cells.
  - **Anemia:** Decrease in hemoglobin content in blood leads to anemia.
  - **Thalasemia:** If RBC and blood formation stops then it is known as Thalasemia.
- **Damaged Tissue:** Stem cells can help in the healing of damaged tissue due to wound or burn.
- **Blindness:** With the help of a stem cell, Retina and Cornea (Parts of eye) can be reconstructed to treat blindness.
- **Diabetes:** With the help of a stem cell, Type-1 diabetes can be treated. This is a condition of total lack of insulin.
- **Development of New Organs:** New organs can be developed by stem cells for organ transplant. This is yet at concept level not yet achieved.
- Stem cells can be used in the treatment of a spinal injury, liver disease, bone and cartilage diseases.
- It can be useful in the treatment of baldness and tooth generation.

## Induced Pluripotent Stem Cell (IPS Cell):

- In 2007, Shinya Yamanaka from Japan developed a technology by which a normal cell of the body can be converted into Pluripotent stem cell.
- 'Induced' signifies that they are made in the lab by taking normal adult cells, like skin or blood cells, and reprogramming them to become stem cells.
- For this achievement, he was given the Nobel Prize of Medicine in 2012.

### Stem Cell Research in India:

- In 2002, research in stem cells was started when Dr Venugopal (AIIMS Delhi) used stem cell micro injection for the treatment of heart disease.
- In 2002, the first embryonic stem cell bank was established for research purposes in AIIMS Delhi.
- In 2005, Center of Excellence for Stem Cell Research was established in CCMB (Center for Cell and Molecular Biology) Hyderabad.
- In 2007, the Government of India rolled out a new Stem Cell Policy.
- In 2014, DBT and ICMR provided a new guideline to regularize and control stem cell treatment and stem cell experiment. According to the guidelines, only blood related treatment and tissue healing treatment by stem cell will be considered as stem cell treatment while rest other efforts will be considered as experiment.
- At present, stem cell banking and stem cell therapy is becoming popular in India and many research centers are involved in stem cell research.



### **Additional Information:**

- In India, stem cell banking and stem cell therapy is under the control of the Department of Biotechnology (they look after the biotechnology aspects), and Indian Council of Medical Research (they look after the medical science aspect).
- These organizations give guidelines related to stem cells.