STEM CELLS:

- **The ancestral cells, which can divide and give rise to progeny that undergo differentiation, are called stem cells**. Zygote is **totipotent** cell. It can give rise to the whole organism. Pleuripotent cells a rise from to tipotent cells. They give rise to most but not all types of cells. Embryonic inner cell mass (embryonic stem cells) of blastocyst contains **pleuripotent** cells.
- **Multipotent** cells are differentiated from pleuripotent cells. Multipotent cells can give rise to only a limited number of cell types.
- **Unipotent** cells are differentiated from the multipotent cells. Each unipotent cell gives rise to a single modified cell type.
- **Haemopoietic stem cells (HSCs)** are pluripotent, and multipotent cells. These are also the self renewing cells. When a cell divides one of the daughter cells remains as stem cell.
- The other cell derived from it divides in to daughter cells that differentiate in to different cells of circulating fluids and the cells of immune system.
- These HSCs produce two **secondary stem cells** (common **progenitors**) namely **myeloid stem cell** and **lymphoid stem cell**. These are non-renewing cells.
- Each secondary stem cell further gives rise to the **committed progenitor**. These cells are also non-renewing cells. Myeloid stem cell gives rise to committed progenitors like **erythroid progenitor**, **megakaryocyte**,**basophil progenitor, eosinophil progenitor, granulocyte – monocyte progenitor**.
- It also gives rise to the **dendritic cell** directly. Lymphoid progenitor gives rise to **T-cell progenitor** and **B-cell progenitor**. It also gives rise to **natural killer cell** and **dendritic cell** directly.
- **1. Cells formed from the myeloid stem cell:** In the erythroid lineage the erythrocyte is formed through different stages like proerythroblast, erythroblast and reticulocyte. Megakaryocyte forms into platelets. Basophil progenitor and eosinophil progenitor form the basophil and eosinophil respectively. Granulocyte-monocyte progenitor forms the cells neutrophil and monocyte.
- **2. Cells formed from the lymphoid stem cell:** T-cell progenitor differentiates into T-lymphocyte in thymus. T-cell may be either T-helper cell or T-cytotoxic cell. Immunocompetent T-cytotoxic cell becomes the functional cytotoxic T-lymphocyte (CTL) in the secondary lymphoid organs.
- B-cell progenitor differentiates in the bone marrow into B-lymphocyte, which is a immunocompetent cell. This immunocompetent cell transforms into a functional cell in secondary lymphoidorgans.These functionalcell divides into plasma cells and memory cells.
- Plasma cells secrete antibodies in the tissues. Memory cells are long lived cell and they readily stimulate than the lymphocytes.
- Some stem cells remain in the epithelium of skin and gastro intestinal tract to replenish the lost cells of apical layers. Skeletal muscle tissue contains the stem cells called **satellite cells** to replace the damaged striated muscle cells.
- Smooth muscles contain the **pericytes** to replace the damaged smooth muscle cells. However satellite cells and pericytes do not divide rapidly to replace the damaged cells.

Application of stem cell research:

- Transplantation of HSCs to the patients, who require them, is an important application. Human Embryonic stem cells (ES cells) are first isolated by Thomson. They are used to replace deceased, or damaged cells in the brain and in treating cell based diseases like Parkinson disease.