

Cell differentiation and Specialisation

1- Cell Differentiation

➤ **Definition:**

Differentiation is the process by which cell changes to become a specialised for its job.

➤ **Example:**

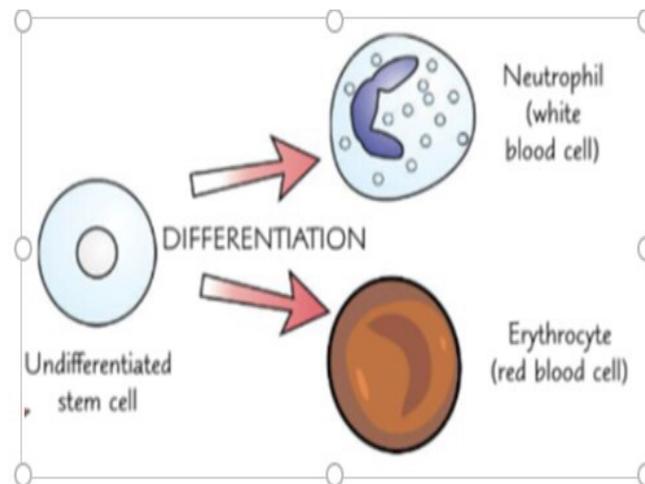
Stem cells are differentiated into different types of cell carrying specific Function

◆ osteocytes —→ Bone cell

◆ neurons —→ Brain cell

➤ Cell that **differentiated into mature animals** is mainly used in repairing and replacing cell e.g skin cells

➤ Cell that are undifferentiated—→ called **stem cells**.

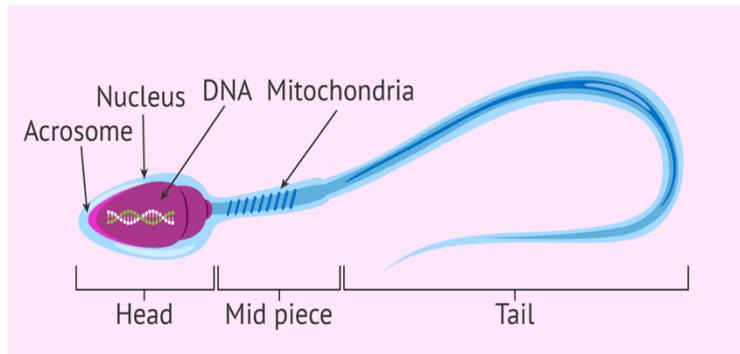


I. Sperm cell are specialised for Reproduction

- **Structure:** long tail and streamlined head which help to swim to egg
Has a lot of mitochondria to provide energy

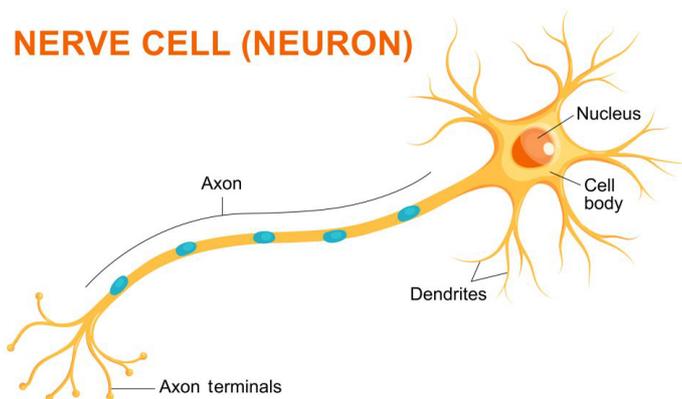
Also carries enzyme to digest through egg cell membrane.

- **Function:** to get male DNA to Female DNA.



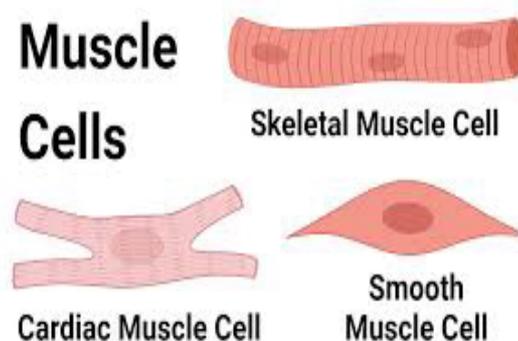
II. Nerve cell are specialised for Rapid signalling:

- **Structure:** They are long, and branched connection at the end to connect other nerve cells.
- **Function:** Carry electric signals from one body parts to other.



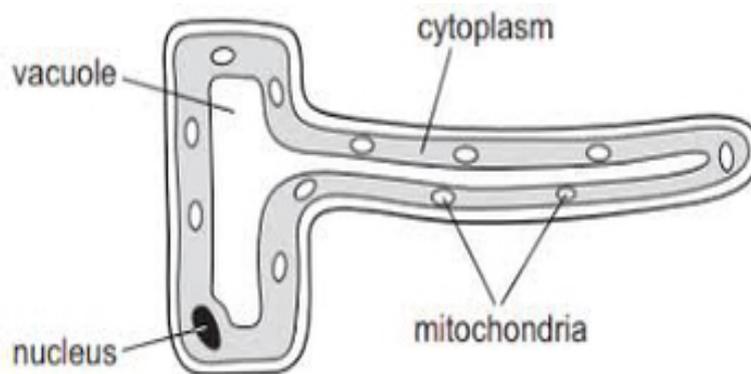
III. Muscle cell are Specialised for contraction:

- **Structure:** they are long and contain lots of mitochondria to generate energy when needed
- **Function:** is to contract quickly.



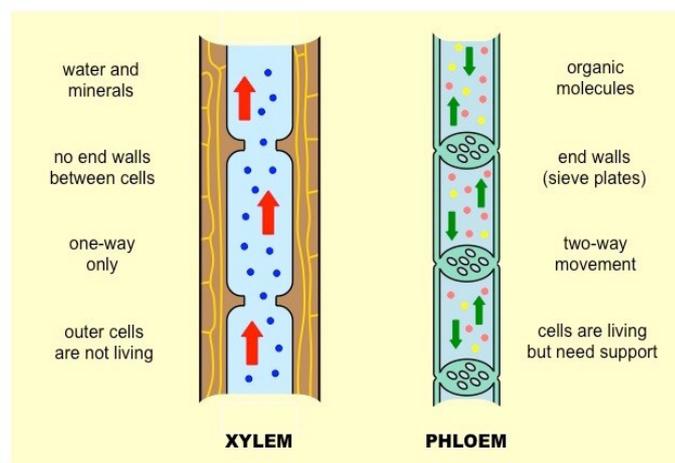
IV. Root cell are specialised for absorbing water and minerals:

- **Structure:** are present on surface of plant root that grow into long hairs.
- **Function:** these hair are stick to the soil and absorb water and mineral from the soil.



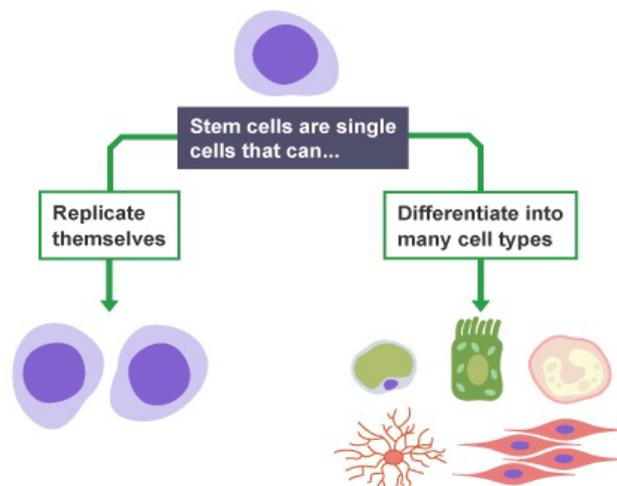
V. Phloem and Xylem are specialised for transporting substances.

- **Structure:** Both are tube like structure. Xylem cells are hollow in the centre and phloem cell have sub cellular structure
- **Function:** Both are used for transporting substances like water and phloem.



Stem cells

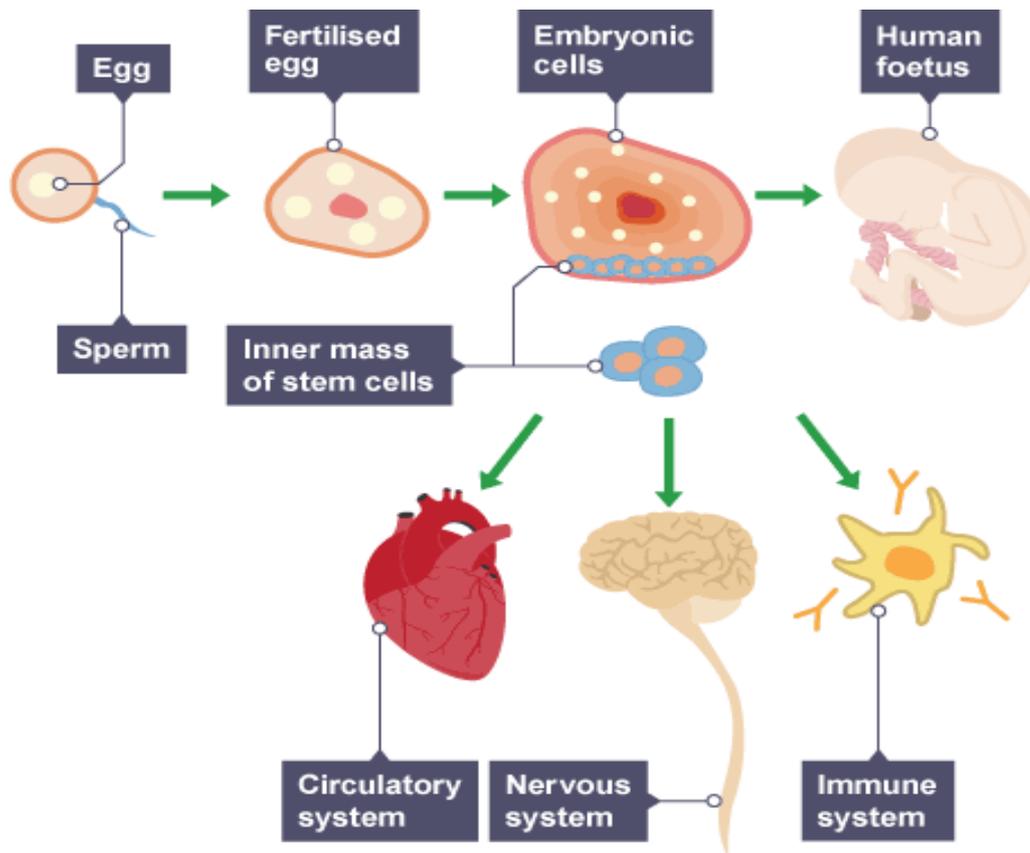
- ▶ Stem cells undergo 2 types of process
 - 1- Replication
 - 2- Differentiation
- ▶ Undifferentiated cell produces a lot of undifferentiated cells by the process of **Replication**.
- ▶ stem cells **differentiate** into different types of cells e.g. oocytes differentiate into bone cells
- ▶ stem cells from embryo or bone marrow can be grown in the lab to produce clones (identical copies of parent), and differentiate them to use in medicine and research.



Stem cells in humans

- ▶ Stem cells are cells that have not undergone differentiation. A cell which has not yet become specialised is called undifferentiated.
- ▶ An embryo develops from a fertilised egg. All of the cells in an embryo start off identical and undifferentiated. These cells are called embryonic stem cells and can become specialised to form any type of cell.
- ▶ They do this by switching genes on and off.
- ▶ For example, if one of the embryonic stem cells formed a muscle cell, it would switch on the genes to turn it into a muscle cell and switch off the genes that would cause it to become a different type of cell.
- ▶ The embryonic stem cells receive signals from other cells so that they turn the correct genes on and off. A whole new organism with skin, eyes, heart, liver and all of the organs it needs, will develop from the embryonic stem cells. This allows

the organism to have all the tissues it needs with the correct functions to be able to survive.



► Some stem cells remain in the bodies of adults. Adult stem cells are found in limited numbers at certain locations in the body, including the:

1. Brain
2. Eyes
3. Blood
4. Heart
5. Liver
6. Bone marrow
7. Skin
8. Muscle

► Adult stem cells are unspecialised but can become specialised much later than embryonic stem cells. They can differentiate into related cell types only.

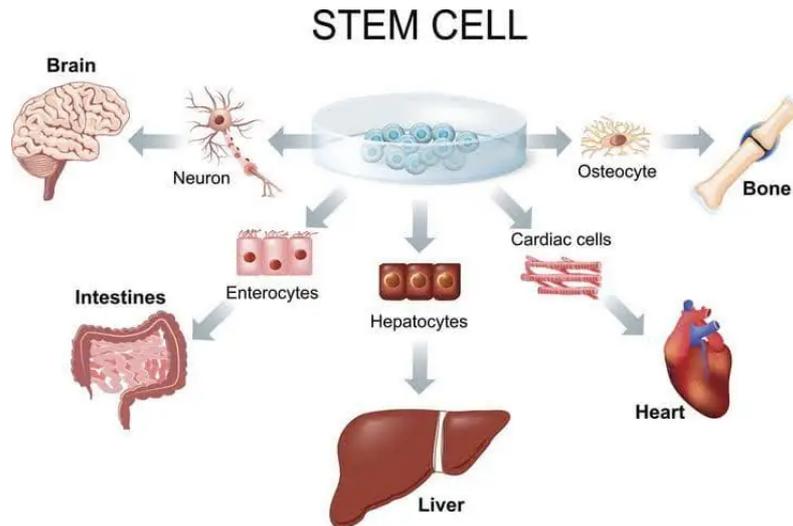
► For instance, adult stem cells in the bone marrow can differentiate into blood cells and cells of the immune system, but not other cell types.

► **Stem cell may be able to cure disease**

- a. Medicine already uses Adult stem cell to cure disease

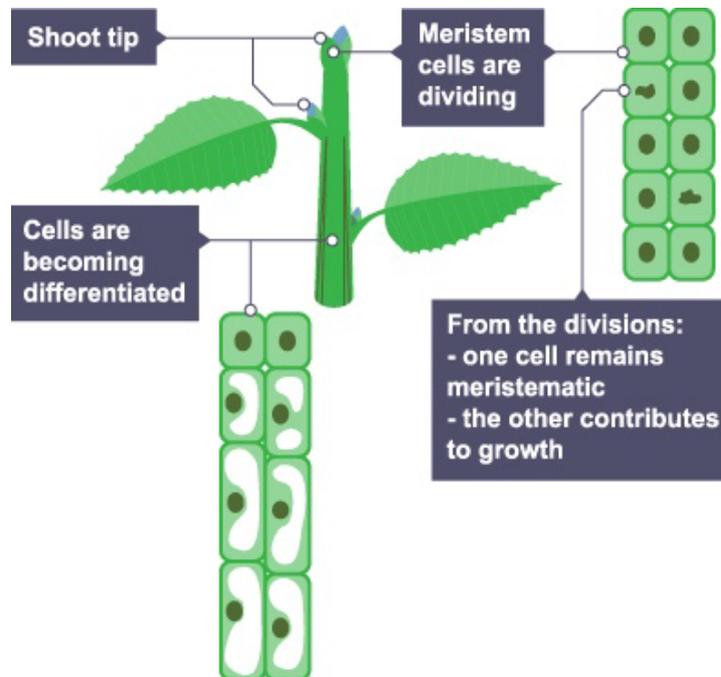
b. stem cell transferred from bone marrow of healthy person can replace faulty red blood cells in the patients.

c. Embryonic stem cells can be used to replace faulty cells with the healthy cell e.g **insulin producing cells** for diabetes patient and **nerve cell** for paralysed patient and many more



Stem cells in plants

- Cell division in plants occurs in regions called meristems.
- Cells of the meristem divide by mitosis and produce unspecialised cells. These cells can differentiate to produce all types of plant cells at any time during the life of the plant.
- The main meristems are close to the tip of the shoot, and the tip of the root.
- In a growing shoot, new cells are being produced continuously near the tip. As the cells become older, further away from the tip, they become differentiated - they enlarge and develop vacuoles.



Stem cell can produce identical plants

- Stem cell are found in Meristem cell in plant
- Meristem cell are used in
 - a) to make clones
 - b) to grow more plants
 - c) to grow more plants with desired feature.

Ethical opinions for and against the use of stem cells for both treatment and research:

For	Against
Stem cell research can be used to treat many diseases, including diabetes and nerve paralysis. Therefore more lives are saved in the long-run	There is destruction of embryos produced from fertilisation. Some believe that life starts after fertilisation, so it is essentially killing. There are moral issues, and religion can come into play.
Stem cell research can be used in research, to aid discovery of treatments for diseases such as cancers.	If the sample of stem cells is contaminated by a virus, they could be transmitted to the patient. This could have negative implications on the health of the patient.
Stem cell research may occur illegally if it was banned, so it is better for the government to legalise it and regulate it heavily.	The current restrictions may not be followed inside labs.

Type of stem cell	Advantages	Disadvantages
Adult stem cell	<ul style="list-style-type: none"> The body will accept the cells so there will be no rejection issues. No moral or ethical issues involving the destruction of embryos. 	<ul style="list-style-type: none"> Complicated and the technology is still being developed.
Embryonic stem cell	<ul style="list-style-type: none"> Source of cells readily available from <i>in vitro</i> fertility (IVF) treatment. 	<ul style="list-style-type: none"> Some people believe that destroying embryos means the destruction of potential human life.

