



Stem cells

🕒 Created	@July 14, 2025 11:13 AM
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Describe the difference in potency of Totipotent and pluripotent

- Totipotent stem cells can differentiate into all cell types including extra-embryonic tissues while pluripotent stem cells has the potential to differentiate into almost any cell types except extra embryonic tissue
 - DO NOT WRITE PLACENTA as it is a subset of the extra embryonic tissues
- **Totipotent** stem cells can **organise into an entire organism** but **pluripotent** stem cells **lack self-organising ability to form an entire organism**

Describe the normal functions of blood stem cells in a living organism

- Undergo self renewal to maintain its population of cells/ provide continuous supply of blood stem cells
- Can differentiate into blood cells to replace worn out/damaged cells
- Blood stem cells include myeloid and lymphoid stem cells
 - Lymphoid stem cells can differentiate into lymphocytes such as B cells and T cells
 - Myeloid stem cells can differentiate into red blood cells, neutrophils, eosinophils, basophil, monocytes, platelets

▼ Mistakes

- Do not provide functions of specialised blood cells

Ethical issues of ipc

- Procedure Of harvesting ES cells destroy the embryo which has the potential to develop into a full-sized organism/ akin to taking a human life
- Intentional creation of embryos with the intention of using them for research and destroying them in that process is considered active killing and violates respect for nascent human life;
- Harvesting of oocytes R! embryos is invasive/painful retrieval from the women / / Medical risk of oocyte reducing the number and possibly the quality of remaining oocyte for future reproductive purposes
- Increasing risk of exploitation of women for commercial benefits;
- Informed consent of donors of surplus ES cell lines from frozen embryos from IVF may not be obtained / donors may not fully understand the implications of the donation/confidentiality of the donor may not be protected;/Patient may not fully understand the moral issue arising from the use of stem cell for their consent;
- ES cells from donor may exhibit unknown long term effects that range from incompatibility to tumor formation in recipient and recipient may not fully understand the implications;
- Technologies used to produce stable stem cell lines can be licensed and patented by the biotechnology companies, only the rich has access to and can afford the stem cell therapies that come with high costs;
- Creation of ES cells using nonhuman oocytes may give rise to chimeras that appear part human and part animal / have characteristics of both humans and animals;
- The implantation of human stem cell into animals during experimentation may cause development of human part on animals';

Defining features of stem cells

- Able to undergo self-renewal by mitotic cell division
- Unspecialised/not terminally differentiated

- Able to undergo differentiation/ able to produce specialised cells

Describe the features and normal functions of stem cells in human

- Embryonic stem cells
 - Pluripotent
 - Found in inner cell mass of blastocyst
 - Can differentiate into different types of cells that develop from the 3 germ layers from which all the cells of the body arise
- Myeloid stem cells
 - are undifferentiated and unspecialised cells
 - Multi potent, able to differentiate into specialised cells
 - Capable of self-renewal by mitotic cell division to ensure a constant pool of stem cells for growth and development
 - Their ability to differentiate into specialised cells helps to replace cells lost due to cell death and injury
 - Able to differentiate to give various blood cells and except lymphocytes such as red blood cells, neutrophils, eosinophils, basophils, mast cells, macrophages, dendritic cells and platelets
- Lymphoid stem cells
 - Multi potent
 - Capable of self renewal by mitotic cell division
 - Able to differentiate to give lymphocytes such as B cells T cells and natural killer cells

Compare myeloid and lymphoid stem cells

	Myeloid	Lymphoid
Range of cell types that it can	Differentiate to give a larger range of cell types like all blood	Differentiate to give a smaller range of cell types like

	Myeloid	Lymphoid
differentiate into	cells except lymphocytes	lymphocytes
Examples of specialised cells differentiated from stem cells	Red blood cells, neutrophils, eosinophils, basophils, mast cells, macrophages, dendritic cells and platelets	B cells and natural killer cells
Type of immune response	Innate immunity	Adaptive immunity
Circulated	Form RBC that are circulated in blood	Form lymphocytes that are circulated in the lymph

Both are blood stem cells derived from haematopoietic stem cells in the bone marrow

Both are multi potent and can differentiate to a limited range of cells under their lineage

Advantages of asymmetrical division

- allows stem cells to produce one daughter stem cell that is identical to the parental stem cell ensuring a constant pool of stem cells
- And one progenitor cell that is only capable of differentiating into related specialised cell type, increasing population of specialised cells in a specific tissue

How ESCs are extracted

- Extract egg cells from female and sperm cells from male
- Fuse or fertilise the egg cell with sperm cell outside of the body or in culture
- Extract out the inner cell mass of blastocysts

Describe how iPSCs overcome some ethical issues associated with medical use of stem cells in human

- No need to destroy embryos for extraction or pluripotent stem cells and hence not regarded as killing a life due to some views that embryos are viable living

organism

- Avoid issues or donor consent
 - Derived directly from patients adult cells and hence not regarded as foreign tissues that may lead to tissue rejection or immune response and no need for immunosuppressed drugs
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Explain how introduction of synthetic mRNA can produce iPSCs/ why are transcription factors needed for production of iPSCs

- Translation of synthetic mRNA will produce proteins which are needed to switch off certain genes in specialised adult cells allowing them to de-differentiate. And switch on expression of certain specific stem cell genes allowing adult somatic cells to achieve pluripotency
- Proteins such as transcription factors like repressors and activators bind to silencer and enhancer respectively
- Needed to alter gene expression patterns of cells such that it is similar to that of embryonic stem cells resulting in production of iPSCs