

This is the **Higher Separate** version — includes all Higher Tier content (marked ★) and all Separate Science content.

Stem cells are undifferentiated cells that can divide and develop into specialised cell types. They have important roles in growth, repair and medical research.

- A stem cell is an undifferentiated cell that can divide (by mitosis) and differentiate into specialised cell types.
- Embryonic stem cells: found in early embryos — can differentiate into ANY cell type (totipotent). Used in research and potentially in medicine.
- Adult stem cells: found in specific tissues (e.g. bone marrow). More limited — can only produce certain cell types (e.g. blood cells).
- Therapeutic cloning: a cloned embryo is made with the same DNA as the patient → embryonic stem cells are extracted → used to grow replacement tissue. Avoids immune rejection.
- Uses of stem cells: treating leukaemia (bone marrow transplant), potentially treating Parkinson's, diabetes, spinal cord injuries.
- Ethical concerns: obtaining embryonic stem cells requires destroying a human embryo — raises questions about when life begins.
- Plant meristem cells at root tips and shoot tips are equivalent to stem cells — can differentiate into any plant cell type. Used to clone plants rapidly.
- ★ **HT iPSCs (induced pluripotent stem cells):** adult cells reprogrammed to behave like embryonic stem cells — avoids the ethical issue of destroying embryos.

### Key Terms

<b>Stem cell</b>	Undifferentiated cell that can divide and differentiate into specialised cell types
<b>Differentiation</b>	Process by which a stem cell becomes a specific specialised cell type
<b>Totipotent</b>	Able to differentiate into any cell type in the body (embryonic stem cells)
<b>Therapeutic cloning</b>	Creating a cloned embryo to obtain embryonic stem cells with matching DNA to a patient
<b>Meristem</b>	Region of actively dividing, undifferentiated cells in plants (root and shoot tips)

■ **Exam Tip:** When evaluating stem cells, always give BOTH benefits (can treat serious diseases, replace damaged tissue) AND ethical concerns (embryo destroyed, religious objections, risk of tumour formation). A balanced answer gains more marks.