



# Edexcel GCSE Biology



Your notes

## Stem Cells

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Your notes

## Animal Stem Cells

# Animal Stem Cells

- A **stem cell** is an **undifferentiated cell** that is capable of dividing to produce many more cells of the same type
- Stem cells can **give rise to other cell types** by the process of **differentiation**
- In animals there are several different types of stem cell
  - **Embryonic stem cells** are important as they help to form **all** of the different tissues and organs needed during development to form a whole new individual
    - Cells in the very early embryo can differentiate to become any other type of body cell
  - **Adult stem cells**, however, are much more limited and can only differentiate to produce a few different cell types.
    - Adult stem cells are predominantly used to **replace cells** lost through damage or to produce new cells for **growth** – although the bone marrow has to continually make new blood cells throughout life

### Animal Stem Cells Table



Your notes

Stem Cell	Function	Potential of cell	What can be produced from them
<b>Embryonic stem cell</b>	On the inside layer of an embryo	Undifferentiated / unspecialised	All the different types of specialised cells found in the body
<b>Adult stem cell</b>	Bone marrow	Limited ability to differentiate / partially specialised	Mainly cells of the blood (red blood cells, cells of the immune system)
	Skin	Limited ability to differentiate / partially specialised	Cells found in the different layers of the skin, hair follicles
	Other organs such as the liver and brain	Limited ability to differentiate / partially specialised	Cells found in these organs
	Umbilical cord blood	Limited ability to differentiate / partially specialised	Cells of the blood (red blood cells, white blood cells), muscle and nerve tissue

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## Plant Stem Cells



Your notes

# Plant Stem Cells

- In plants, stem cells are found in the root and shoot tips, in the **meristem tissue**
- **Meristem cells** are unspecialised cells that can differentiate into the cells needed by the plant in regions where **growth** is occurring
  - For example, meristem cells in the roots can differentiate into root hair cells as well as other cells required in this part of the plant
- Plant stem cells retain the ability to differentiate into any type of plant cell **throughout the life of the plant**
- It is possible to use plant stem cells to **clone plants** with desired characteristics
  - e.g. resistance to certain diseases



Your notes

## Stem Cells In Medicine

# Stem Cells in Medicine

## Using Adult Stem Cells in Medicine

- Adult stem cells can be cultured in the lab and made to differentiate into specialised cells (predominantly cells of the blood) but into **fewer cell types** than is possible with embryonic stem cells
- Stem cells are already used to **treat some diseases** (e.g. leukaemia) but there is huge potential for stem cells to be used to cure many more diseases in the future (e.g. diabetes and paralysis)

## Using Embryonic Stem Cells in Medicine

- Modern scientific techniques mean that is possible to grow human embryos in the lab and to extract **embryonic stem cells** from them
- These embryonic stem cells can then be stimulated to differentiate into **most** types of specialised cell
  - As a result, they are potentially very effective in treatment of certain diseases or to **repair damaged organs** by growing new tissue from stem cells

### Stem Cell Treatment Table



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Disease	Problem	How stems cells could be used to treat it	Source of stem cells
Diabetes (Type I)	Inability on the pancreas to produce insulin to control blood sugar levels	Stem cells could be differentiated into insulin-producing pancreatic cells which are transplanted into the patient's body	Stem cell donors or therapeutic cloning
Paralysis	Damage to nerve cells in the brain or spinal cord, preventing signals from the brain reaching muscles in parts of the body (such as the arms or legs) resulting in loss of movement.	Stem cells could be differentiated into nerve cells (neurones) which are transplanted into the damaged region of the nervous system.	Stem cell donors or therapeutic cloning

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## Evaluating the use of stem cells in medicine

- There are many benefits and risks associated with using stem cells in medicine, as well as considerable ethical and social concerns

### Evaluating Stem Cells in Medicine Table



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Benefits of using stem cells	Risks / issues of using stem cells	Social issues	Ethical issues
<p>Great potential to treat a wide-variety of diseases from diabetes and paralysis.</p> <p>Organs developed from a patient's own stem cells reduces the risk of organ rejection and the need to wait for an organ donation.</p> <p>Adult stem cells are already used successfully in a variety of treatments acting as proof of benefits.</p>	<p>Stem cells cultured in the lab could become infected with a virus which could be transmitted to the patient.</p> <p>There is a risk of cultured stem cells accumulating mutations that can lead to them developing into cancer cells.</p> <p>Low numbers of stem cell donors.</p>	<p>It is possible for embryonic stem cells to be collected before birth (from amniotic fluid) or after birth (umbilical cord blood) and stored by a clinic – but this can be expensive and isn't an option for everyone.</p> <p>A lack of peer-reviewed clinical evidence of the success of stem cell treatments.</p> <p>Educating the public sufficiently about what stem cells can and cannot be used for.</p>	<p>Stem cells may be sourced from unused embryos produced in IVF treatment – is it right to use them? Who gives permission?</p> <p>Is it right to create embryos through therapeutic cloning and then destroy them? Who owns the embryo?</p> <p>Should an embryo be treated as a person with human rights? Or as a commodity?</p>

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