

WJEC Wales Biology GCSE

Topic 2.2: Cell division and stem cells

Notes



Cell division

Chromosomes

A **chromosome** is a **linear DNA molecule** tightly coiled around **proteins**. It carries genetic information in the form of **genes**. Chromosomes are found in **pairs** (one from each parent) in all body cells. Human body cells contain **23 pairs** of chromosomes (46 chromosomes in total). Chromosome pairs are not identical as they may contain different **alleles** (versions of a gene).

Sex chromosomes are a pair of chromosomes that determine sex. Males have an X and a Y chromosome. Females have two X chromosomes.

Mitosis

Mitosis is the **division** of a cell to produce **two genetically identical** daughter cells with a **full** set of chromosomes (46 chromosomes). This is important as it allows the organism to **grow**, **replace** old cells and **repair** damaged tissues.

Meiosis

Meiosis is a type of **cell division** that creates **four genetically different** daughter cells known as **gametes**. Meiosis involves **two divisions** and produces cells with **half** the number of chromosomes (23 chromosomes). It is important in creating **genetic variation** and ensuring that the resultant zygote has a **full set** of chromosomes.

Comparison

Mitosis	Meiosis
Occurs in non-reproductive cells	Occurs only in reproductive cells
Produces two daughter cells	Produces four daughter cells
Daughter cells genetically identical	Daughter cells genetically different
Daughter cells have 46 chromosomes	Daughter cells have 23 chromosomes
Important for the growth , repair and replacement of damaged cells	Important for the formation of gametes during sexual reproduction



Uncontrolled cell division

Cancer is a **non-communicable** disease in which **uncontrolled mitosis** (due to damaged DNA) leads to the formation of a **primary tumour**. Tumour cells break off and spread to other tissues forming **secondary tumours**.

Cell differentiation

Cell **differentiation** produces **specialised** cells with **specific functions**. Some genes are switched on or off, determining cell type. Once a cell differentiates, it **cannot** divide to make an unspecialised cell, nor a cell which has a different specialised function.

Stem cells

Stem cells are **unspecialised** cells capable of **differentiating** into a range of different cell types. In humans, stem cells can be found in **early embryos** or in **tissues** such as the **bone marrow**.

- **Embryonic stem cells** - unspecialised and capable of differentiating into **any** cell type, enable the **growth** and **development** of tissues in embryos.
- **Adult stem cells** - can differentiate into a **limited** range of cell types, enable the **replacement** of dead or damaged cells.

In plants, stem cells are found in **meristematic tissue** in the root and shoot tips. They are capable of differentiating into **any** cell type throughout the life of a plant.

There are both **advantages** and **disadvantages** of using stem cell technology in medicine:

Advantages	Disadvantages
<ul style="list-style-type: none"> • Used to treat damage or disease e.g. type 1 diabetes, heart disease • Used to treat diseases that would otherwise be untreatable • Not rejected by the body • Do not have to be matched to the patient's tissue type • Can be used to grow organs for transplants 	<ul style="list-style-type: none"> • May become contaminated during preparation and when transplanted transmit infections to the patient • Difficult to find suitable stem cell donors • No guarantee that treatment will work • Transplanted stem cells could cause tumours • Long term risks are unknown • Potential side effects



There are also **ethical issues** surrounding the use of stem cells, In particular, **embryonic stem cells**. **Embryos** used to provide these stem cells are usually **destroyed** which is controversial on **ethical** grounds. For example, At what stage should the embryo be treated as a person?

