Your notes

GCSE Biology: revision notes

Cell division, mitosis and stem cells

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Start here: why cells divide

- You started life as one cell. To grow, and to repair damage like a cut, your body makes new cells by copying the ones it has.
- Each new cell needs a full copy of the instructions (the DNA), so the DNA is copied first and then the cell splits in two. This is **mitosis**.
- The two new cells are genetically identical to the cell they came from. Meiosis, which makes sex cells, is different: you meet it in reproduction.

Chromosomes

- The nucleus of a cell contains **chromosomes**, made of DNA. Each **chromosome** carries a large number of **genes**.
- In body cells **chromosomes** are found in pairs. Human body cells have 23 pairs (46 **chromosomes**).
- Gametes (sex cells) have only one **chromosome** from each pair: 23 in humans.

The cell cycle

- Cells divide in a series of stages called the **cell cycle**.
- First the cell grows: it makes more sub-cellular structures, such as ribosomes and mitochondria, and copies its DNA to form two copies of each **chromosome**.
- In **mitosis**, one set of **chromosomes** is pulled to each end of the cell and the nucleus divides.

- Finally the cytoplasm and cell membrane divide to form two identical daughter cells.
- **Mitosis** is needed for growth, for repairing damage and in asexual reproduction.

Cell differentiation

- **Differentiation** is when a cell changes to become specialised for its job.
- Most animal cells differentiate at an early stage and then mainly divide only for repair and replacement.
- Many plant cells keep the ability to differentiate throughout life.

Stem cells

- A **stem cell** is an undifferentiated cell that can divide to make more **stem cells** and can differentiate into other types of cell.
- **Embryonic stem cells** can become any type of human cell.
- **Adult stem cells**, such as those in bone marrow, can form many types of cell, including blood cells.
- **Meristem** tissue at the tips of plant roots and shoots can differentiate into any type of plant cell, throughout the plant's life.

Using stem cells

- **Stem cells** might one day treat conditions such as diabetes and paralysis.
- In **therapeutic cloning**, an embryo is made with the same **genes** as the patient, so its **stem cells** would not be rejected by the patient's body.
- Concerns: some people have ethical or religious objections to using embryos, and **stem cells** grown in a lab could carry viral infections.
- **Meristems** are used to clone plants quickly and cheaply, for example to save rare species or to produce large numbers of crop plants with useful features such as disease resistance.

Growth (Edexcel)

- Animals grow by cell division (**mitosis**) and **differentiation**. Plants grow by cell division, cell elongation (cells take in water and get longer) and **differentiation**.
- Doctors use percentile charts to check a child's growth (mass, length or head size) against other children of the same age.
- A baby on the 75th percentile for mass is heavier than 75% of babies of the same age. Moving a long way across the percentile lines can be a sign of a problem.
- Cancer is the result of changes in cells that lead to uncontrolled cell division.

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Exam tip

- Learn the order of the **cell cycle**: DNA and sub-cellular parts are copied, **chromosomes** are pulled to each end, then the cytoplasm and membrane divide.
- Use the words 'genetically identical' for **mitosis**: it's usually a mark on its own.

Common mistakes

- Confusing **mitosis** (two identical cells, for growth and repair) with meiosis (four different gametes).
- Saying **adult stem cells** can become any type of cell. Embryonic ones can; adult ones only form certain types.

Worked examples

A cell divides by mitosis every 24 hours. Starting with one cell, how many cells are there after 3 days?

Work out how many cell cycles there are: 3 days is 72 hours. **72 ÷ 24 = 3 cycles**

Each cycle doubles the number of cells. **1 → 2 → 4 → 8**

Answer: 8 cells (that is 2^3)

Key terms

Chromosome	A long, coiled molecule of DNA that carries many genes.
Gene	A small section of DNA that codes for a particular protein.
Cell cycle	The series of stages in which a cell grows, copies its DNA and divides into two.
Mitosis	The stage of the cell cycle in which the nucleus divides to form two genetically identical nuclei.
Differentiation	The process by which a cell becomes specialised for a particular job.
Stem cell	An undifferentiated cell that can divide to make more cells like itself and differentiate into other types of cell.
Embryonic stem cell	A stem cell from an early embryo that can become any type of human cell.
Adult stem cell	A stem cell in adult tissue, such as bone marrow, that can form a limited range of cell types.
Meristem	Plant tissue at the tips of roots and shoots that can differentiate into any type of plant cell.
Therapeutic cloning	Making an embryo with the same genes as a patient so its stem cells can be used without rejection.

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Quick questions

Cover the answers and test yourself: remembering is what makes it stick.

1. How many chromosomes are in a normal human body cell?
2. What happens to the DNA before a cell divides by mitosis?
3. How do the two cells made by mitosis compare with the original cell?
4. Which of these is NOT a use of mitosis?
5. What is a stem cell?
6. Where are adult stem cells found in the body?
7. Where is meristem tissue found in a plant?
8. Why would stem cells from therapeutic cloning not be rejected by a patient?

Answers

1. 46
2. It is copied
3. They are genetically identical to it
4. Making gametes
5. An undifferentiated cell that can become other types of cell
6. Bone marrow
7. At the tips of roots and shoots
8. They have the same genes as the patient

What to do next

Practise 14 questions on this topic

Try 7 exam questions, with mark schemes

Read the lesson, one step at a time

Free revision for GCSE and KS3 at lycolearn.co.uk. Some notes are for one exam board only, and say so in brackets.

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