

Growth, differentiation and stem cells

Revision notes · How animals and plants grow, why cells differentiate, using percentile charts, and the types and medical uses of stem cells.

For Edexcel GCSE Biology 1BI0 and Combined Science 1SC0. **Triple only** is not in Combined Science. **Higher tier** is only on the Higher paper.

Growth, differentiation and stem cells Spec 2.5-2.9

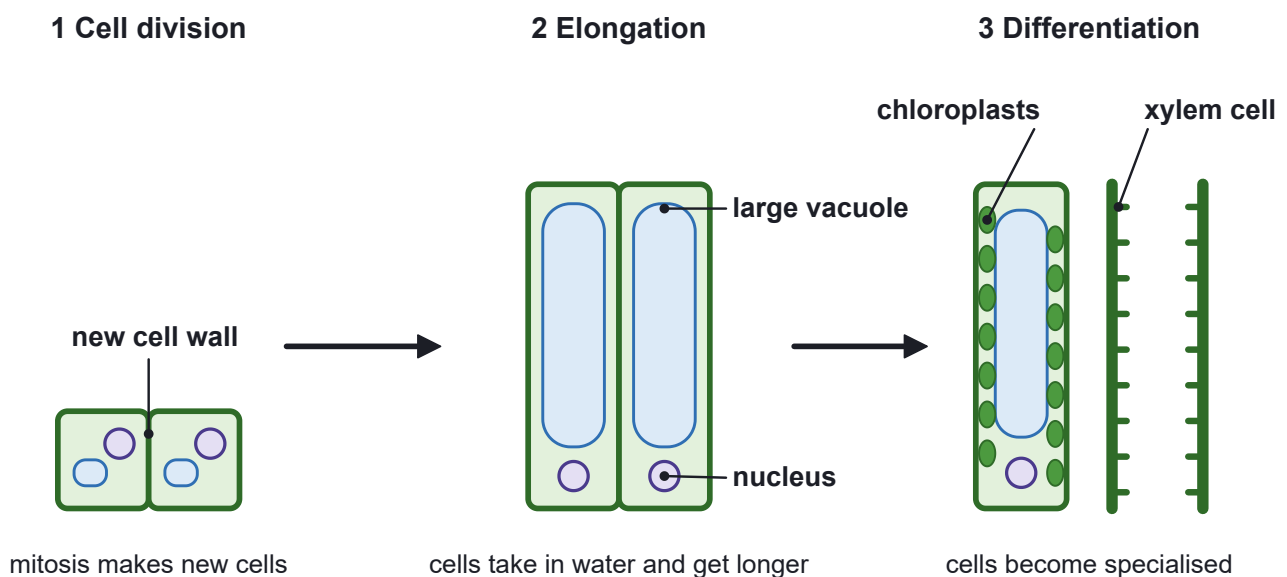
Growth in animals and plants Spec 2.5

Growth is an increase in the size or mass of an organism. It involves different processes in animals and plants.

Growth in animals and plants		
	Animals	Plants
Cell division	Yes, by mitosis	Yes, by mitosis
Differentiation	Yes	Yes
Elongation	No	Yes: cells get longer

In animals, growth happens by **cell division** and **differentiation**. New cells are made by mitosis and then become specialised for particular jobs.

In plants, growth happens by **cell division**, **elongation** and **differentiation**. Cells made by mitosis then get longer (elongate), mostly by taking in water so that the cell expands. After elongating, they differentiate. Elongation is what makes plants grow taller and roots grow longer.



Plants grow by **cell division**, then **elongation**, then **differentiation**.

Exam tip: If a question asks how plants grow, name all three processes. Animals do not grow by elongation.

Cell differentiation Spec 2.6

Differentiation is the process by which a cell becomes specialised for a particular job. The cell gains the sub-cellular structures it needs to carry out its function. For example, a nerve cell has a long axon, and a root hair cell has a long projection that gives a large surface area.

Differentiation is important in the development of specialised cells because a multicellular organism needs many different cell types doing different jobs. Specialised cells form tissues, which make up organs. Each type of cell can carry out its job efficiently.

Exam tip: Link structure to function. 'The cell has become specialised' earns less than saying what structure it gained and what job that structure helps with.

Percentile charts Spec 2.7

A **percentile chart** is used to monitor the growth of a baby or child. It shows curves for the measurements of a large number of children of the same age and sex, such as mass. A child's measurement is plotted on the chart.

- The **50th percentile** line means 50% of children have a lower value and 50% have a higher value.
- A child on the **25th percentile** has a value higher than 25% of children and lower than 75% of children.
- Plotting a child's measurements over time shows whether they follow a curve or move across to a different one. A large change may need to be investigated.

The chart is a graph. Use it to turn a number into a percentile, or the reverse.

$$\text{percentage change} = (\text{change in mass} \div \text{original mass}) \times 100$$

Percentage gain in mass

A baby has a mass of 3.2 kg at birth and 4.0 kg at 8 weeks. Calculate the percentage gain in mass.

1. change in mass = $4.0 - 3.2 = 0.8$ kg
2. percentage gain = $0.8 \div 3.2 \times 100$

Answer: 25%

Maths skill: For percentage loss, use the same equation with the decrease in mass. Always divide by the original mass, not the final mass.

Maths skill: Use an estimate to check your answer is sensible. Round 3.2 to 3: $0.8 \div 3$ is about 0.27, so the answer should be a little under 27%.

Stem cells and meristems Spec 2.8

A **stem cell** is an undifferentiated cell. It can divide to make more cells and can differentiate to become specialised cells.

Types of stem cell	
Type	Function
Embryonic stem cells	Found in early embryos. They can differentiate into any type of cell, so they produce all the specialised cells as the embryo develops.
Stem cells in animals (adult stem cells)	Found in some tissues, such as bone marrow. They can differentiate into only a limited range of cell types. They replace cells that are damaged or worn out, for example bone marrow makes new blood cells.
Meristems in plants	Found at the tips of roots and shoots. The cells divide and can differentiate into any type of plant cell, so the plant can keep growing throughout its life.

Exam tip: Be precise: embryonic stem cells can become any type of cell, but adult stem cells can only become some types.

Stem cells in medicine Spec 2.9

Stem cells may be able to replace damaged or diseased cells. Some potential uses are treating conditions such as diabetes and paralysis, and replacing damaged tissue.

Benefits and risks of using stem cells	
Benefits	Risks
Could treat conditions that are currently hard to treat, such as diabetes or paralysis.	Stem cells can divide out of control and form a tumour.
Could replace damaged cells with new healthy cells.	Viruses in donated stem cells could be passed to the patient and cause disease.
Could be used to grow replacement tissues.	The patient's immune system may reject cells from another person.
	Some people object to using embryos for ethical or religious reasons.

Exam tip: In a 'discuss' question, include at least one benefit and one risk, and finish by weighing them up.

Quick check

1. Which process in plant growth does not happen in animals?
2. What does the 50th percentile mean?
3. What is a stem cell?
4. What is the function of a meristem?
5. Give one risk of using stem cells in medicine.

Quick check answers

Growth, differentiation and stem cells

1. Elongation (cells getting longer).
2. 50% of children have a lower value and 50% have a higher value.
3. An undifferentiated cell that can divide and can differentiate into specialised cells.
4. Its cells divide and can differentiate into any type of plant cell, so the plant can keep growing throughout its life.
5. Any one of: tumour formation, viral infection from donor cells, immune rejection, ethical or religious objections.