

**Target**  
Get back on track

GRADE

**5**

AQA GCSE (9–1)

**Combined Science:  
Trilogy**

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# 3 Cell division

This unit will help you to recognise when cells divide by mitosis and when they divide by meiosis. It will also help you to understand the importance of cell division in the cell cycle.

In the exam you will be asked to tackle questions such as the one below.

## Exam-style question

1 Mitosis and meiosis are types of cell division.

1.1 Complete the table to show which of the features are produced by mitosis and which are produced by meiosis.

Feature	Mitosis or meiosis?
Production of egg cells	
A lizard growing a new tail	
Production of pollen in a flower	
Cells replaced on the skin to heal a cut	

(4 marks)


1.2 Identify the organs that produce gametes (sex cells) in a man and in a woman.

A man .....

A woman ..... (2 marks)

1.3 Describe two differences between mitosis and meiosis.

..... (2 marks)

You will already have done some work on mitosis and meiosis. Before starting the **skills boosts**, rate your confidence in each area. Colour in  the bars.

1

How can I identify the stages in the cell cycle?



2

How can I describe situations where mitosis is occurring?



3

How can I explain the importance of meiosis?



The topic of cell division covers the cell cycle, mitosis and meiosis.

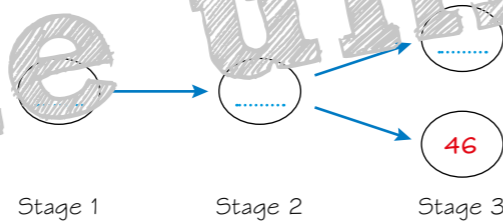
Cells divide in a series of stages called the **cell cycle**. First, a cell grows larger and makes more sub-cellular structures like mitochondria (for energy production) and ribosomes (for making proteins). The cell then makes copies of its chromosomes. One copy moves to each end of the cell, and the nucleus divides. The cell then divides into two new cells. Two cells are produced from one during **mitosis**.

1 Number these statements (1-3) in the order in which they occur in the cell cycle.

Stage	Correct order
The cell increases in size and increases the number of sub-cellular structures such as ribosomes and mitochondria. DNA replicates to form two copies of each chromosome.	
The cytoplasm and cell membrane divide to form two identical, daughter cells.	
A set of chromosomes moves to each end of the cell and the nucleus divides.	

Human body cells have 46 chromosomes. The nucleus of a cell copies the chromosomes to double that number during **interphase**. The cell then moves a copy to each end of the cell during **mitosis**. The cell then divides during **cytokinesis**, making two new cells each with 46 chromosomes.

2 Complete the numbers inside the cells to show what happens to the number of chromosomes during mitosis.



3 Describe what is happening inside the cell between stages 1 and 2.

.....

.....

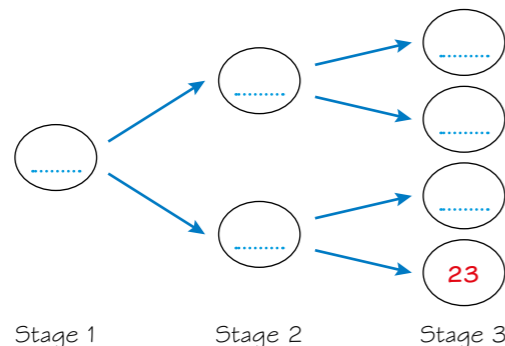
b Describe what is happening inside the cell between stages 2 and 3.

.....

.....

**Meiosis** is a different type of cell division where four cells are made from one cell. In females, meiosis takes place in the ovaries, where it produces eggs. In males, meiosis takes place in the testes, where it produces sperm. The four cells that are made from the original parent cell each have a different half set of chromosomes.

4 Complete the numbers inside the cells to show what happens to the number of chromosomes during meiosis.



First meiosis makes two cells, each with a full set of chromosomes.

These divide again to make four cells, each with a half set of chromosomes.

# 1 How can I identify the stages in the cell cycle?

Actively dividing cells go through a series of stages called the cell cycle. The first stage is **interphase**, where the cell makes new components and a copy of each chromosome. Then, during **mitosis**, the chromosomes move apart and the nucleus divides. The cell cycle ends with **cytokinesis** (cell division). The two new cells that are produced are genetically identical and are called **daughter cells**.

1 a Match the overall stages of the cell cycle with the more detailed descriptions.

Interphase

One set of chromosomes is pulled to each end of the cell, and the nucleus divides.

Mitosis

The cell membrane and cytoplasm divide to form two new cells.

Cytokinesis

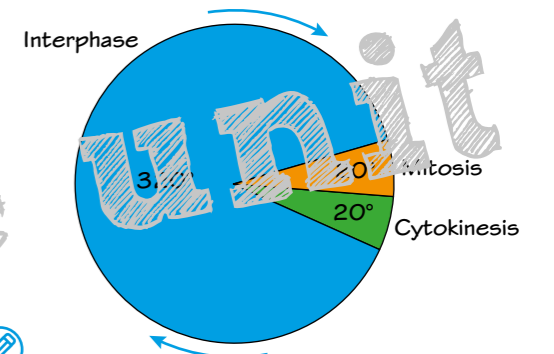
The cell increases in size and produces more ribosomes and mitochondria. The cell also makes a complete copy of the DNA.

b The cell cycle in a tomato plant tip cell lasts 6 hours.

i Convert 6 hours to minutes.

ii Work out the number of minutes represented by a 1° angle on the pie chart.

iii Use the information in the pie chart to complete the table and calculate the time taken for each stage of the cell cycle.



	Angle (°)	Time in minutes	Time in hours and minutes
Interphase			
Mitosis			
Cytokinesis			

How many cells will there be after 6 h?

2 Tomato plants have 10 chromosomes in a normal cell.

a How many chromosomes are there in a cell 5 h 20 min after the start of the cell cycle?

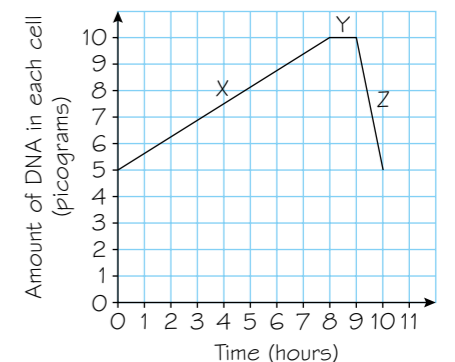
Look at where the cell cycle will be after 5 h 20 min.

b How many chromosomes are there in a cell 6 h after the start of the cell cycle?

3 Look at this graph. It shows the stages of the cell cycle for a different organism over a 10 hour cycle.

a Which letter represents the genetic material doubling during interphase?

b Which letter represents the genetic material moving apart and the nucleus dividing during mitosis?



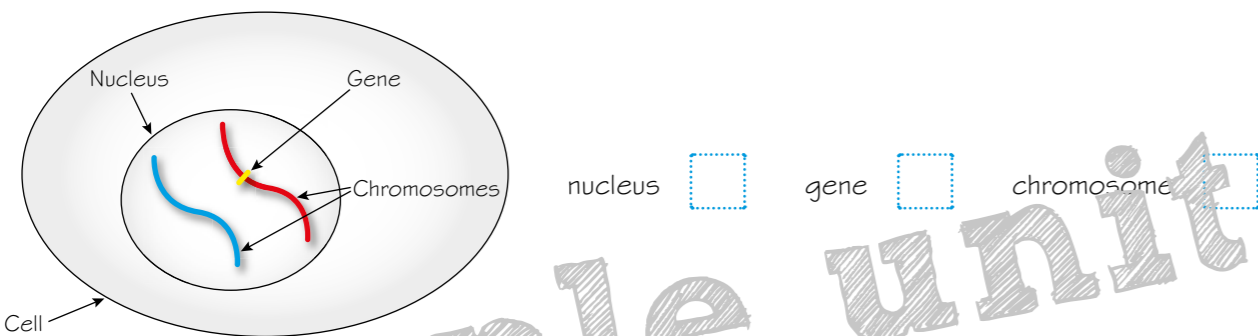
## 2 How can I describe situations where mitosis is occurring?

Mitosis is used for increasing the number of cells during growth, when replacing damaged cells and for asexual reproduction. Mitosis produces genetically identical cells. This means that all cells in the body have exactly the same set of chromosomes.

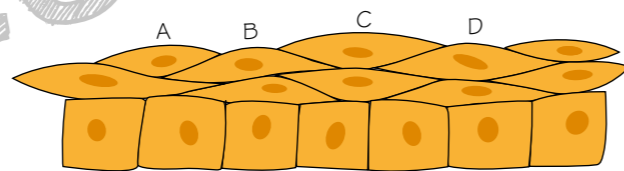
Asexual reproduction leads to offspring produced from only one parent. All the offspring are identical and are known as clones.

Genes are sections of DNA found on chromosomes. Humans have 46 chromosomes in the nucleus of normal body cells. The nucleus controls the chemical reactions inside the cell.

- 1 Look at the diagram and number the parts of the cell in order of size with 1 as the smallest and 3 as the largest.



- 2 Human skin cells A, B, C and D in the diagram have just been produced to replace some damaged cells.



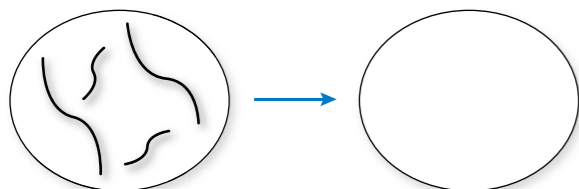
- a Name the type of cell division that has produced these new cells.

- b What happens to the genetic material before the cell divides?

- c How many chromosomes will be in cell A?

- d Why is it important that skin cells can divide?

- 3 The diagram shows a nucleus just before the nucleus begins to divide during mitosis. Complete the second diagram to show what the nucleus of a cell produced by this mitosis looks like.



**Remember** Mitosis produces identical cells. This means that the cells will have an identical number of chromosomes.

You could use this to help you remember what mitosis does.

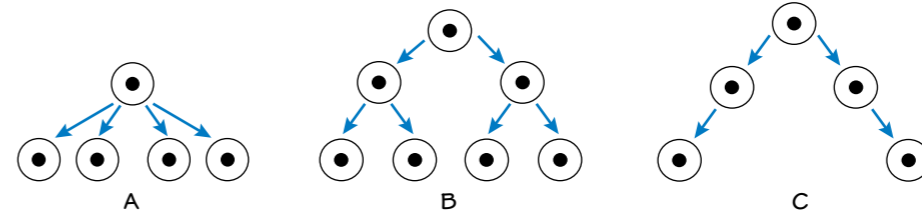
Makes	Makes
I	Identical
Toes	T
O	Offspring
Skin	S
I	I
S	S

## 3 How can I explain the importance of meiosis?

Meiosis is the type of cell division that makes sperm cells and eggs. Meiosis involves two divisions. First, two cells are made with full sets of chromosomes. These two cells then divide to make four **non-identical** cells which can be used in sexual reproduction. Each **gamete** contains half of the chromosomes needed to make a full set. They join together during fertilisation to form a **zygote**.

**Gamete** A sex cell such as egg or sperm. Gametes are formed by meiosis.

- 1 Which diagram represents cell division by meiosis? Circle one letter.



You could use this to help you remember what meiosis does.

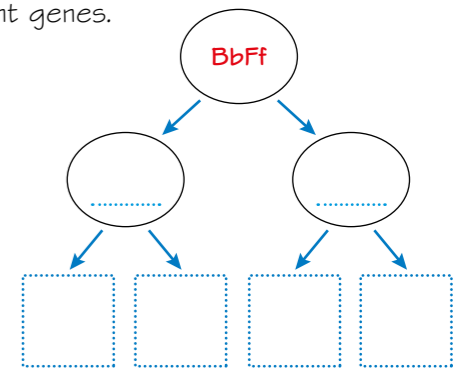
Makes  
Eggs  
I  
O  
Sperm  
I  
S

- 2 Name an organ where meiosis takes place.

**Alleles** are different versions of the same gene. For example, one chromosome could carry the allele for blue eyes and the other chromosome could carry the allele for brown eyes.

- 3 In this diagram the top cell contains two alleles for two different genes. B is the gene for brown eyes and b the gene for blue eyes. F is the gene for brown hair and f is the gene for blond hair.

Write the letters in the boxes to make four different combinations of alleles from these two genes, just like during meiosis.



The **diploid** number in human cells is **46** chromosomes. The **haploid** number is **23**. Most body cells contain 46 chromosomes, but eggs or sperm cells only contain 23 chromosomes.

**Diploid** comes from the Greek for 'double' and **haploid** means 'half'.

- 4 Circle the correct keywords in this passage.

Meiosis **doubles** / **halves** / **triples** the number of chromosomes and leads to **identical** / **non-identical** / **cloned** cells.

In meiosis the cell divides twice. The first division produces two cells with the same number of chromosomes as in the original full set in the parent cell (called the **triploid** / **diploid** / **haploid** number). The second division divides those two cells and reduces the number of chromosomes to half the number in the original parent cell. The four cells now have the **triploid** / **diploid** / **haploid** number of chromosomes. This reduction is essential for **sexual** / **asexual** reproduction and **increases** / **maintains** / **decreases** genetic variety.

# Sample response

Your understanding of mitosis, meiosis and the cell cycle will often be tested in the context of living things. Read this question carefully, use your knowledge and consider your response.

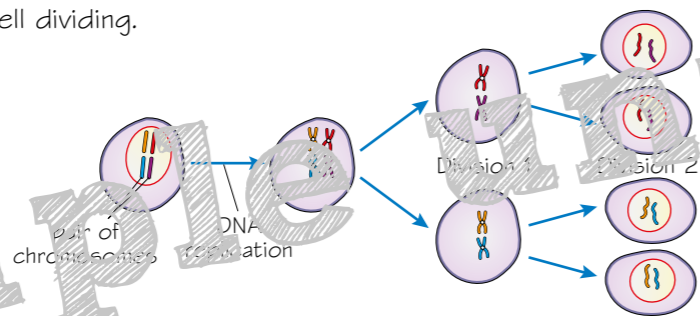
Look at this exam-style question and the answers given by a student.

## Exam-style question

1.1 Mitosis and meiosis are types of cell division. Complete the table below to show whether mitosis or meiosis is being described. Place **one** tick in each row.

Example of cell division	Mitosis	Meiosis
Gametes made in the testes	✓	✓
Growth of an embryo		
A yeast cell budding to produce offspring	✓	
Non identical cells are produced		✓

1.2 The diagram shows a cell dividing.



(4 marks)

Identify the type of cell division shown. Give three reasons for your decision.

*Meiosis because the cell divides twice to produce four cells.*

(3 marks)

1.3 Growth involves mitosis. Explain why growth does not involve meiosis.

*Meiosis produces cells that are not identical. The cells produced do not have the same genes and therefore they are not the same. The original cell has*

*46 chromosomes but the cells produced by meiosis have only 23 chromosomes, and the chromosomes are all different.*

(3 marks)

1 Give two reasons why this student did not get all four marks for 1.1.

.....

.....

2 How could the student have achieved more marks for 1.2?

.....

.....

3 The student scored 2 marks for 1.3. What extra response could have achieved the third mark for 1.3?

.....

# Your turn!

Now use what you have learned to answer this question.

Remember to read the question thoroughly, looking for clues.

Make good use of your knowledge. Read each feature carefully, use the additional guidance below and apply your knowledge from other areas of biology.

## Exam-style question

1 Mitosis and meiosis are types of cell division.

1.1 Complete the table to show which of the features are produced by mitosis and which are produced by meiosis.

Feature	Mitosis or meiosis?
Production of egg cells	.....
A lizard growing a new tail	.....
Production of pollen in a flower	.....
Cells replaced on the skin to heal a cut	.....

(4 marks)

- Eggs need to contain only half the genetic information; this is the haploid number.
- Some animals can grow new body parts identical to the original one.
- Pollen in plants is similar to sperm in animals.
- Lots of new cells are made on both sides of a cut until they meet in the middle.

1.2 Identify the organs that produce gametes (sex cells) in a man and in a woman.

Think about which organs make sperm and eggs.

A man .....

A woman ..... (2 marks)

1.3 Describe two differences between mitosis and meiosis.

What type of cells are made? Where are they made?  
How many are made? What are the cells used for?

.....

.....


.....

.....

(2 marks)

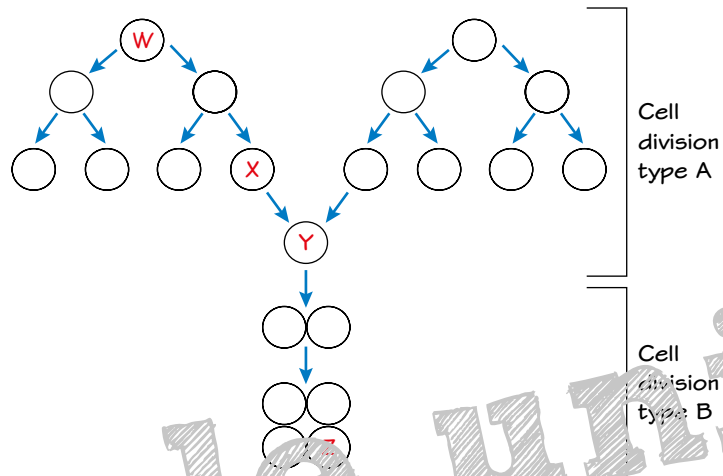
# Need more practice?

You need to be able to recognise where mitosis and meiosis are occurring in a given situation. Often, you will be tested on your understanding of both types of cell division in the same question.

Have a go at this exam-style question. 

## Exam-style question

- 1 The diagram shows two types of cell division.



- 1.1 Give the name for the type of cell division labelled type A in the diagram.

(1 mark)

- 1.2 Give the name for the type of cell division labelled type B in the diagram.

(1 mark)

- 1.3 What is the name given to cell Y?

(1 mark)

Cell W contains 8 picograms of DNA. (1 picogram =  $10^{-12}$  grams)


- 1.4 How many picograms of DNA are there in cell X?

(1 mark)

## Boost your grade

To improve your grade, make sure you can:

- understand the overall stages of the cell cycle
- recognise and describe mitosis occurring in different situations
- explain that meiosis halves the number of chromosomes but fertilisation restores a full set.

How confident do you feel about each of these **skills**? Colour in  the bars.

1

How can I identify the stages in the cell cycle?



2

How can I describe situations where mitosis is occurring?



3

How can I explain the importance of meiosis?

