The Cell Cycle

A Level

Part A Phases of the cell cycle

The cell cycle is the series of processes that dividing cells go through. The cell cycle can be broadly divided into two processes: interphase and [ ] (which is usually followed by cytokinesis). Gametocytes (cells that produce gametes) can go through a different cell cycle consisting, of interphase and [ ] (which involves two rounds of cytokinesis).

Interphase is made up of three phases: growth 1 (G_1) phase, [ ] phase, and growth 2 (G_2) phase.

A cell may exit the cell cycle i.e. it may stop dividing (either temporarily or permanently). A cell in this state is said to be in the [ ] phase. Most nerve cells and muscle cells are in this phase permanently, and so new cells of these types must be produced by separate nerve stem cells/muscle stem cells.

Items:

mitosis **meiosis** **synthesis (S)** **quiescence (G_0)**

Part B Interphase

Match the phases of interphase to the descriptions.

Phase	Description
	cell grows in size, synthesises proteins and organelles, and prepares for synthesis (S) phase
	all of the DNA in the nucleus undergoes DNA replication, and the centrosome duplicates to form two centrosomes
	cell checks replicated DNA for errors, grows in size, synthesises proteins and organelles, and prepares for mitosis

Items:

telophase **metaphase** **growth 1 (G_1)** **prophase** **anaphase** **growth 2 (G_2)** **synthesis (S)**

Part C Mitosis and cytokinesis

Match the phases to the descriptions.

Phase	Description
	chromosomes condense, the nuclear membrane breaks down, and the two centrosomes move to opposite sides of the cell
	spindle fibres move the chromosomes to line up along a plane in the middle of the cell
	sister chromatids are pulled apart to opposite ends of the cell as the spindle fibres shorten
	nuclear membranes form around the separated sister chromatids (now called chromosomes) which decondense
	the cell splits into two new daughter cells

Items:

synthesis **growth 2 (G_2)** **cytokinesis** **anaphase** **prophase** **growth 1 (G_1)** **metaphase** **telophase**

Part D Mitosis without cytokinesis

If a cell undergoes several cell cycles without cytokinesis, what will be the result?

- multiple cells, each containing one nucleus
- multiple cells, each containing many nuclei
- multiple cells, one of which containing one nucleus, and the rest not containing a nucleus
- one large cell containing one nucleus
- one large cell containing multiple nuclei

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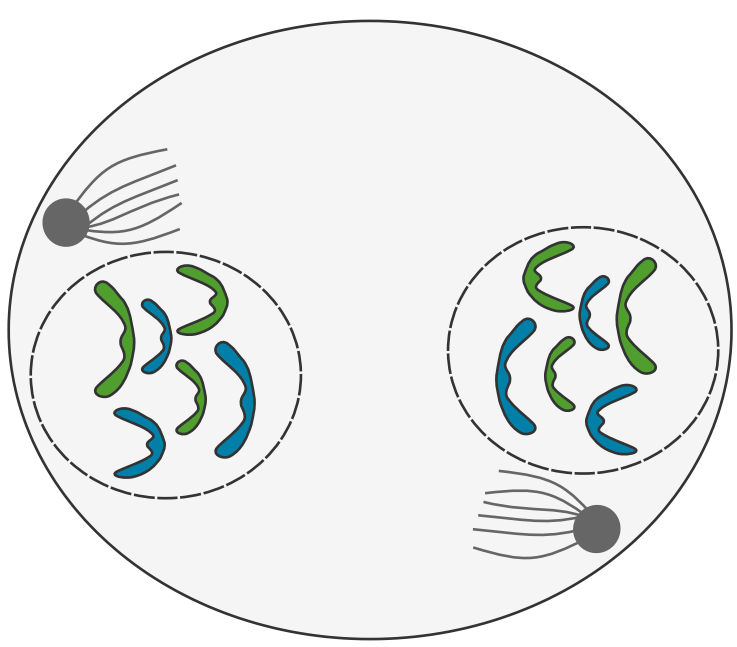
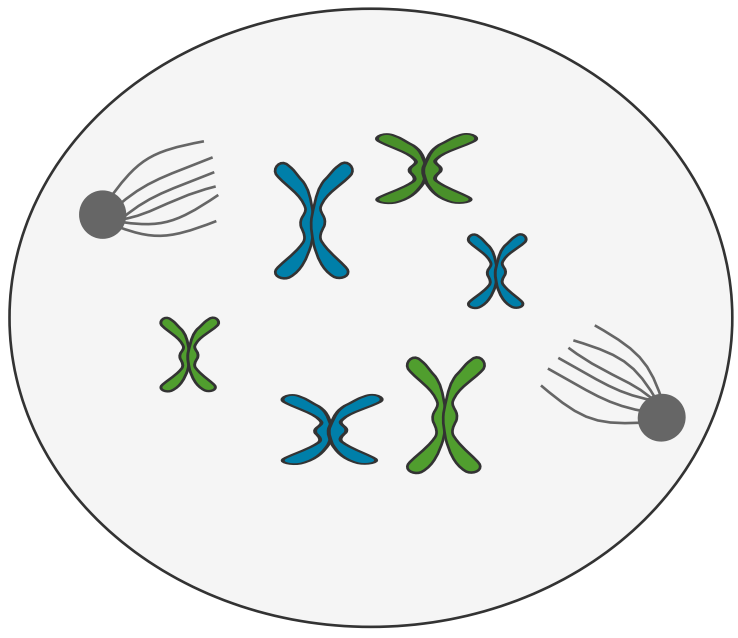
Stages of Mitosis

A Level

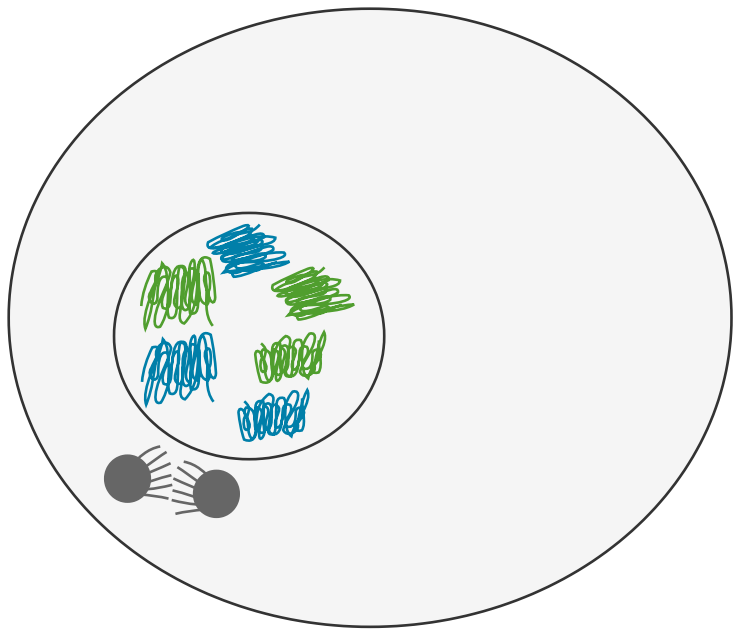
The images below represent different stages of the cell cycle.



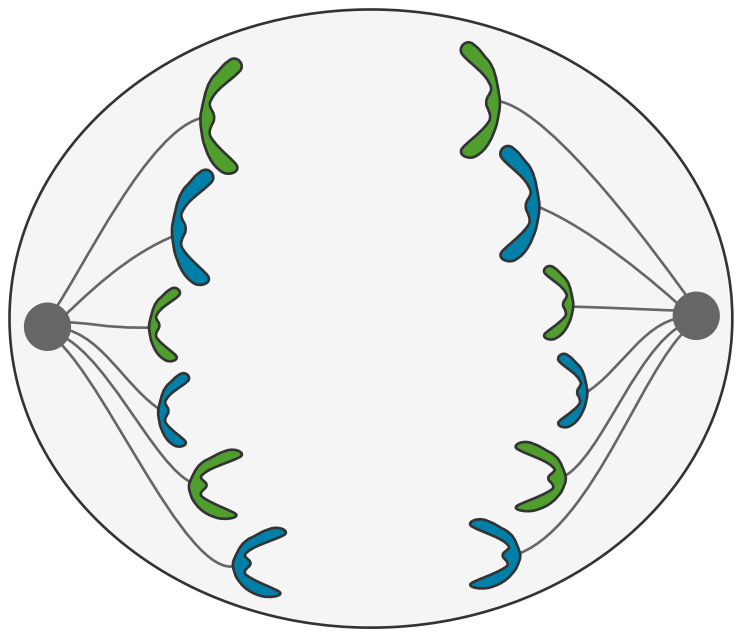
A



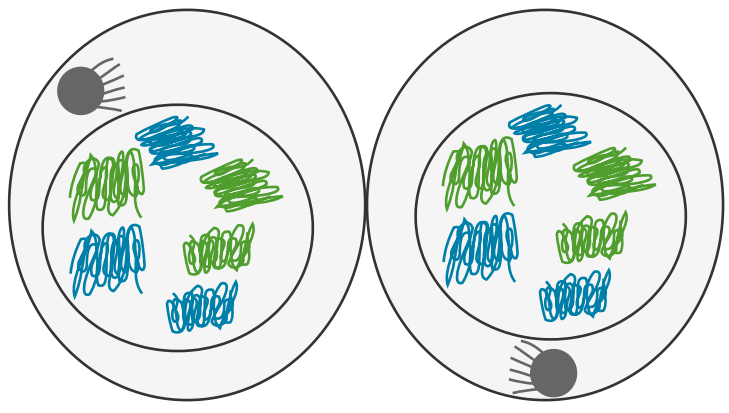
B



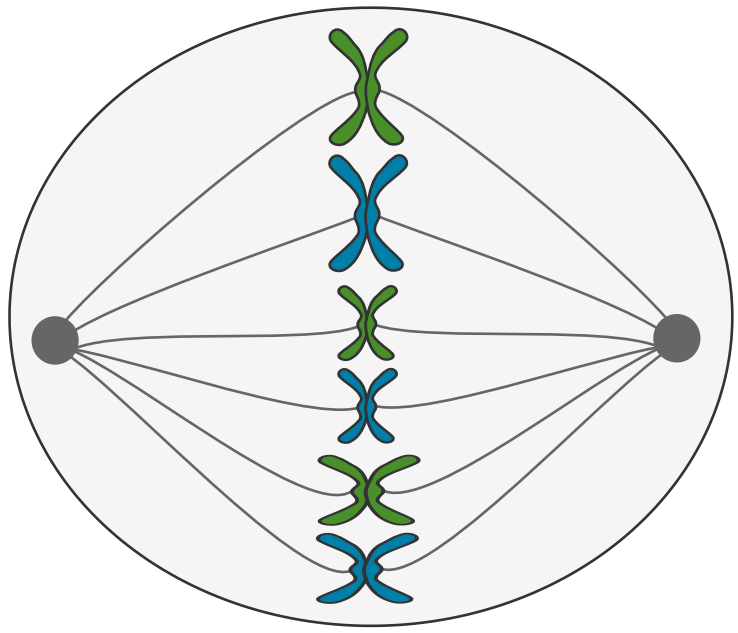
C



D



E



F

Put the stages above in the correct order, and match the name to each stage.

Order	Stage
C	interphase
E	cytokinesis

Items:

A **B** **D** **F** **anaphase** **metaphase** **prophase** **telophase**

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Gameboard:

STEM SMART Biology Week 11 - Mitosis

Miscellaneous Mitosis

A Level

P P P

Part A Functions of mitosis

Which of the following are functions of mitosis? Select all that apply.

- [ ] cell growth
- [ ] tissue growth
- [ ] cell repair
- [ ] replace old, damaged, and dead cells
- [ ] production of haploid gametes from diploid cells
- [ ] asexual reproduction

Part B Cytokinesis

Cytokinesis is the separation of the cytoplasm to form two daughter cells. It is not technically part of mitosis, but almost always happens after [ ] (the final stage of mitosis).

In animals cells, the cytoskeleton in the middle of the cell contracts to pull the cell membrane in, producing a [ ], until the two sides fuse and the cells pinch off from each other.

In plant cells, the [ ] prevents the cell from changing shape in this way. Instead, [ ] assemble in the middle of the cell and fuse with each other and with the cell membrane on either side. This forms a new membrane which divides the cell into two. New cell wall then forms around this membrane.

Items:

prophase **cleavage furrow** **capsule** **cell wall** **chloroplasts** **telophase** **vesicles**

Part C Mitosis vs binary fission

[ ] cells divide by a different form of cell division called binary fission. This process is different from mitosis in that there are no [ ] to pull the two copies of the genome to opposite ends of the cell. Instead, after the single [ ] chromosome has undergone DNA replication, one copy attaches to the cell membrane at one of end of the cell, and the other copy attaches to the cell membrane at the opposite end. The cell elongates and begins to form a new cell wall in the middle, and eventually splits into two daughter cells. In [ ] cells, chloroplasts and mitochondria replicate by a similar mechanism.

Items:

circular **linear** **eukaryotic** **Bacterial** **spindle fibres** **ribosomes**

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Gameboard:
STEM SMART Biology Week 11 - Mitosis

Cell Cycle Regulation

A Level

The cell cycle is regulated by several genes. Some of these genes encode proteins that promote cell division. These are sometimes called [ ]. Other genes encode proteins that stop cell division. These are sometimes called [ ]. The proteins encoded by both types of genes usually act at specific points during the cell cycle, called checkpoints.

At the [ ], the cell checks it has enough materials and nutrients to replicate its DNA, and does not have damaged DNA. p53 is a protein that prevents cells with damaged DNA from entering S phase. At the [ ], the cell checks it has replicated its DNA correctly before entering mitosis. At the [ ] checkpoint, the cell checks the chromosomes have aligned correctly before the spindle fibres pull sister chromatids apart.

Mutations in any of the genes involved in cell cycle regulation may result in uncontrolled cell division, whereby cells "ignore" the checkpoints and keep dividing. This can lead to the onset of cancer.

Items:

metaphase **G_2/M checkpoint** **G_1/S checkpoint** **tumour suppressor genes** **proto-oncogenes**

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Gameboard:

STEM SMART Biology Week 11 - Mitosis

Cell Cycle Mass Changes

A Level

C C C

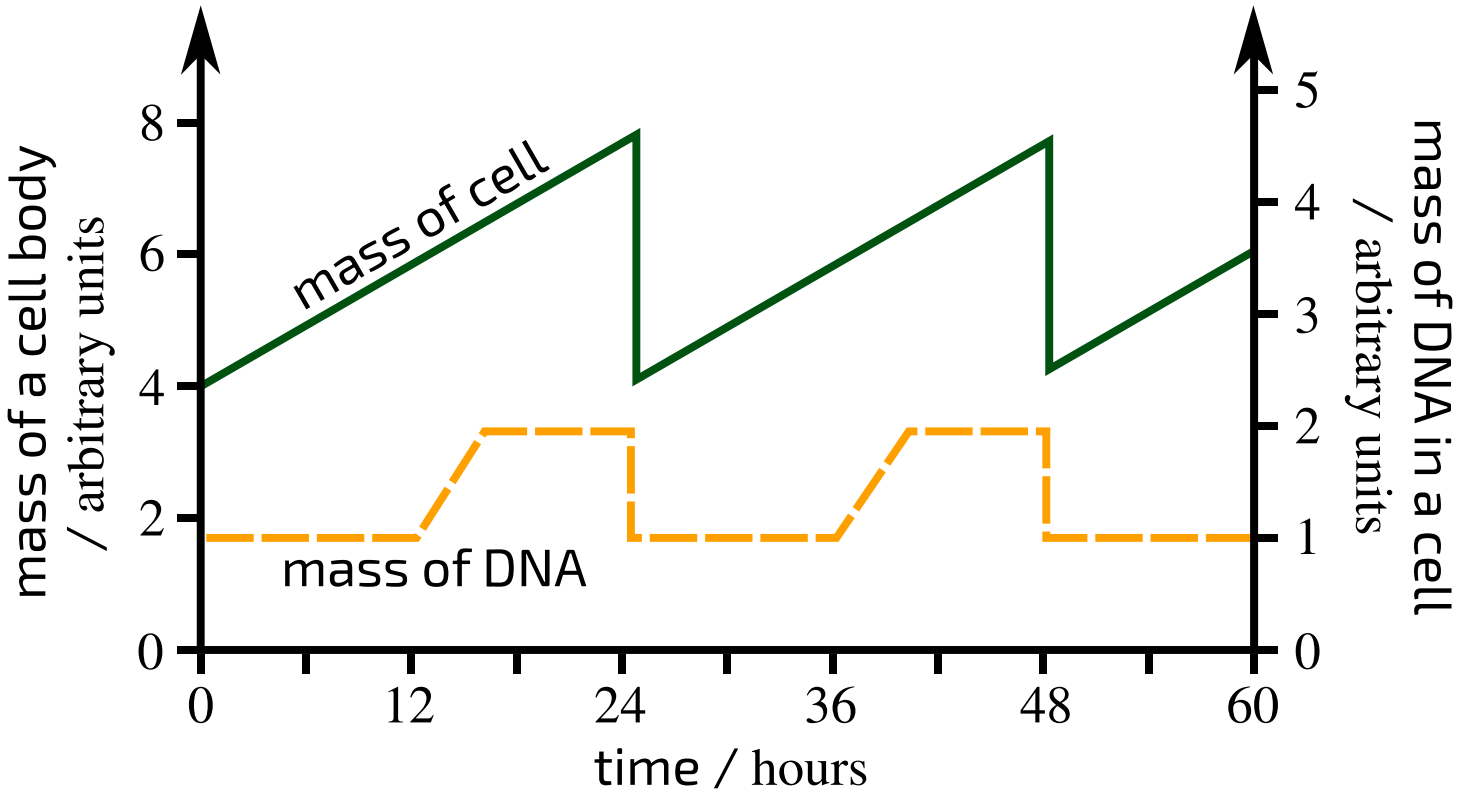

Figure 1: The changes in mass of a healthy human body cell and in the mass of the DNA of that cell over time.

Part A How many cell divisions?

How many cell divisions are shown in Figure 1?

Part B Cytokinesis

When is cytokinesis taking place in Figure 1? Select all that apply.

- [ ] At 12 hours
- [ ] Between 12 and 16 hours
- [ ] At 24 hours
- [ ] At 36 hours
- [ ] Between 36 and 40 hours
- [ ] At 48 hours

Part C Synthesis

When is synthesis (S) phase taking place in Figure 1? Select all that apply.

- [ ] Between 0 and 12 hours
- [ ] Between 12 and 16 hours
- [ ] At 24 hours
- [ ] Between 24 and 36 hours
- [ ] Between 36 and 40 hours
- [ ] At 48 hours

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Gameboard:

STEM SMART Biology Week 11 - Mitosis

Cell Division and Cell Numbers

A Level

C C C

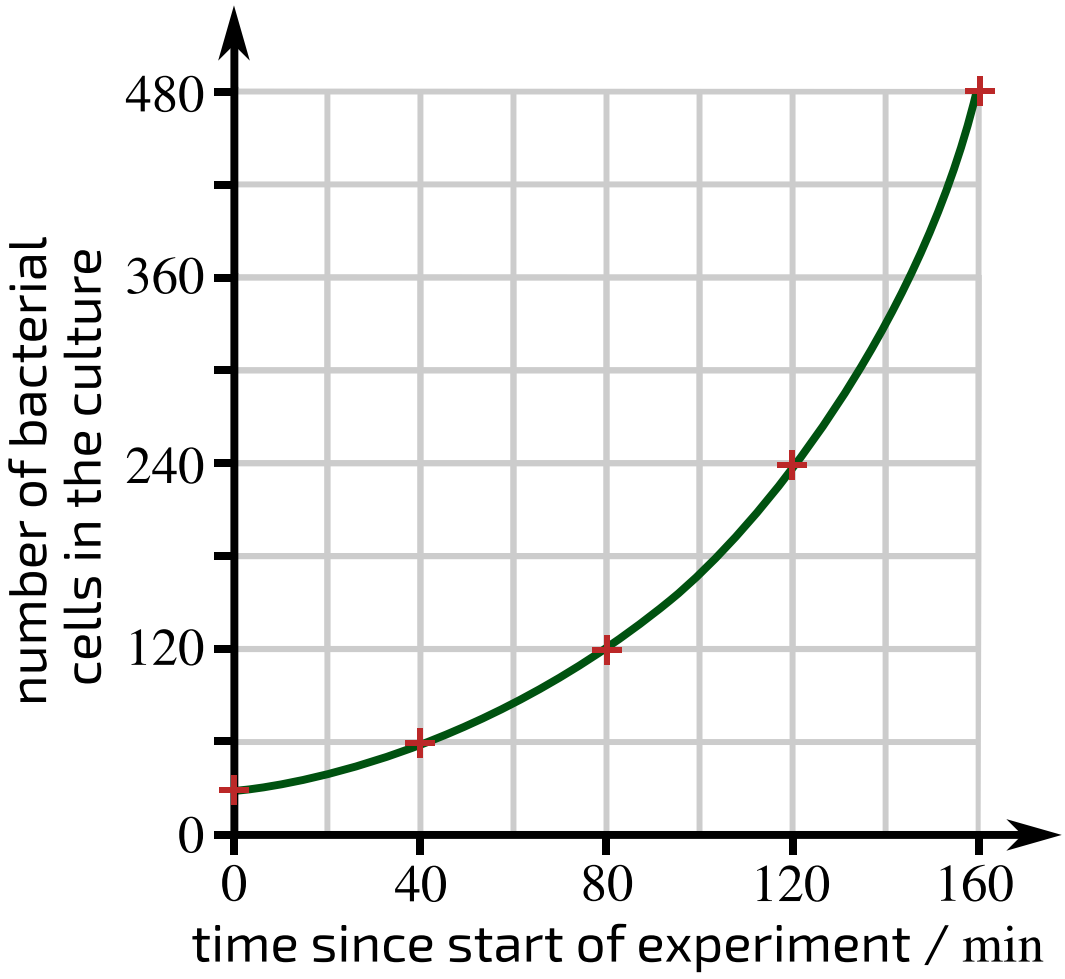

Figure 1: Bacterial cells were grown in a laboratory experiment and the number of cells was recorded at regular intervals. The bacteria in this experiment reproduced asexually using a form of cell division. The number of cells at the start of the experiment was 30.

Part A Percentage increase

What is the percentage increase in cell number during the first 40 minutes in Figure 1?

Part B Predicting cell numbers

Assuming the rate of growth in Figure 1 continues on the same curve, how many cells will there be after 4 hours?

Part C Calculate a

The growth curve in Figure 1 is of the form $y = ak^x$, where y is the number of bacterial cells in the culture, x is the time since the start of the experiment, and k and a are constants.

Find the value of a.

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