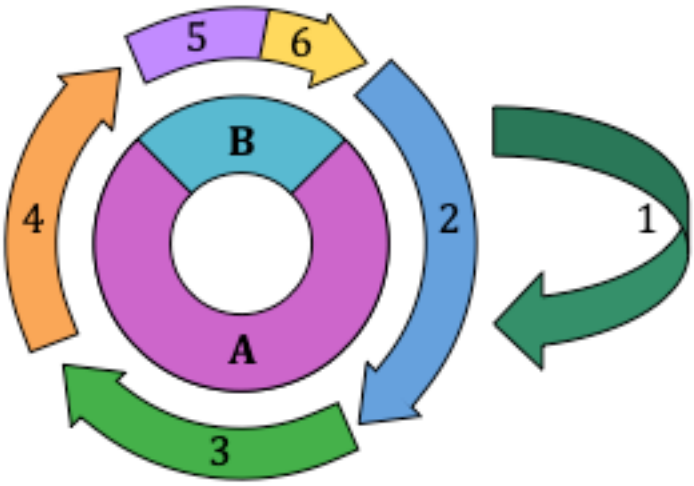
1.6 Cell Division

Cell Cycle

Identify the various stages of the cell cycle



A. Interphase

B. M phase

1. G0 phase (quiescent / resting)

2. G1 phase (growth / preparation)

3. S phase (DNA replication)

4. G2 (growth / proof-reading)

5. Mitosis (nuclear division

6. Cytokinesis (cytoplasmic division)

List the different events that occur during interphase

D DNA replication (S phase)

O Organelle duplication

C Cell growth

T Transcription / translation

O Obtain nutrients

R Respiration (cellular)

Differentiate between the three gap phases

G1: Cell grows and prepares for DNA replication (S phase)

G2: Cell finishes growing and prepares for cell division (M phase)

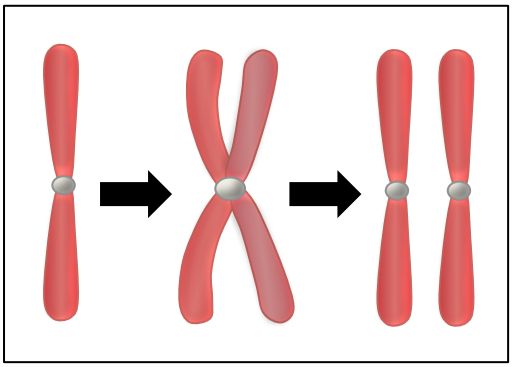
G0: A non-dividing, resting phase for fully differentiated cells (e.g. neurons)

Define mitosis

The division of a nucleus to produce two genetically identical daughter nuclei (diploid → diploid)

Mitosis occurs in human body cells and results in cloned copies

Outline, with a diagram, the changes in DNA organisation during interphase and mitosis

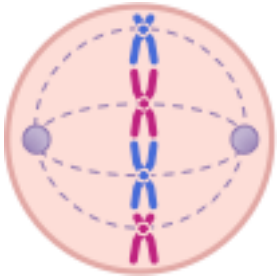
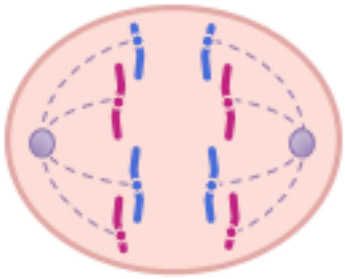
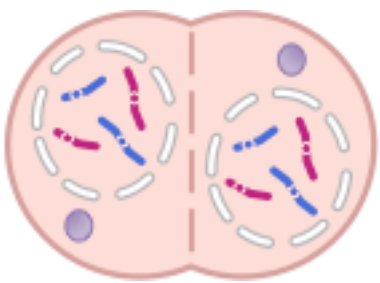


DNA is usually loosely packed within the nucleus as chromatin

During mitosis, the DNA supercoils and chromatin condenses to form visible chromosomes

Because DNA is replicated in the S phase, each chromosome is made of identical sister chromatids

Describe the stages of mitosis

Stage	Diagram	Description
Prophase		• Chromosomes condense (DNA supercoils) • Nuclear membrane dissolves • Paired centrosomes move to opposite poles of the cell and start producing spindle fibres
Metaphase		• Spindle fibres connect to centromeres of chromosomes • Contraction of spindle fibres cause chromosomes to align along the middle of the cell (equatorial plane)
Anaphase		• Spindle fibres continue to contract and this results in the separation of the identical sister chromatids • Each chromatid is now referred to as a chromosome • The identical chromosomes move to opposite poles
Telophase		• Chromosomes decondense • Nuclear membranes reform around the two separate sets of identical chromosomes • Cytokinesis occurs concurrently to split the cell in two

Compare the process of cytokinesis in animal cells and plant cells

Animals: Microtubule filaments form a ring around the cell centre which then contracts (cleavage furrow)

Separation is centripedal because it starts at the outside and then moves in

Plants: Vesicles form in a row at the centre of the cell (equatorial plane) which fuse to form an end plate

Separation is centrifugal because it starts in the centre and then moves out

List four processes that involve mitosis

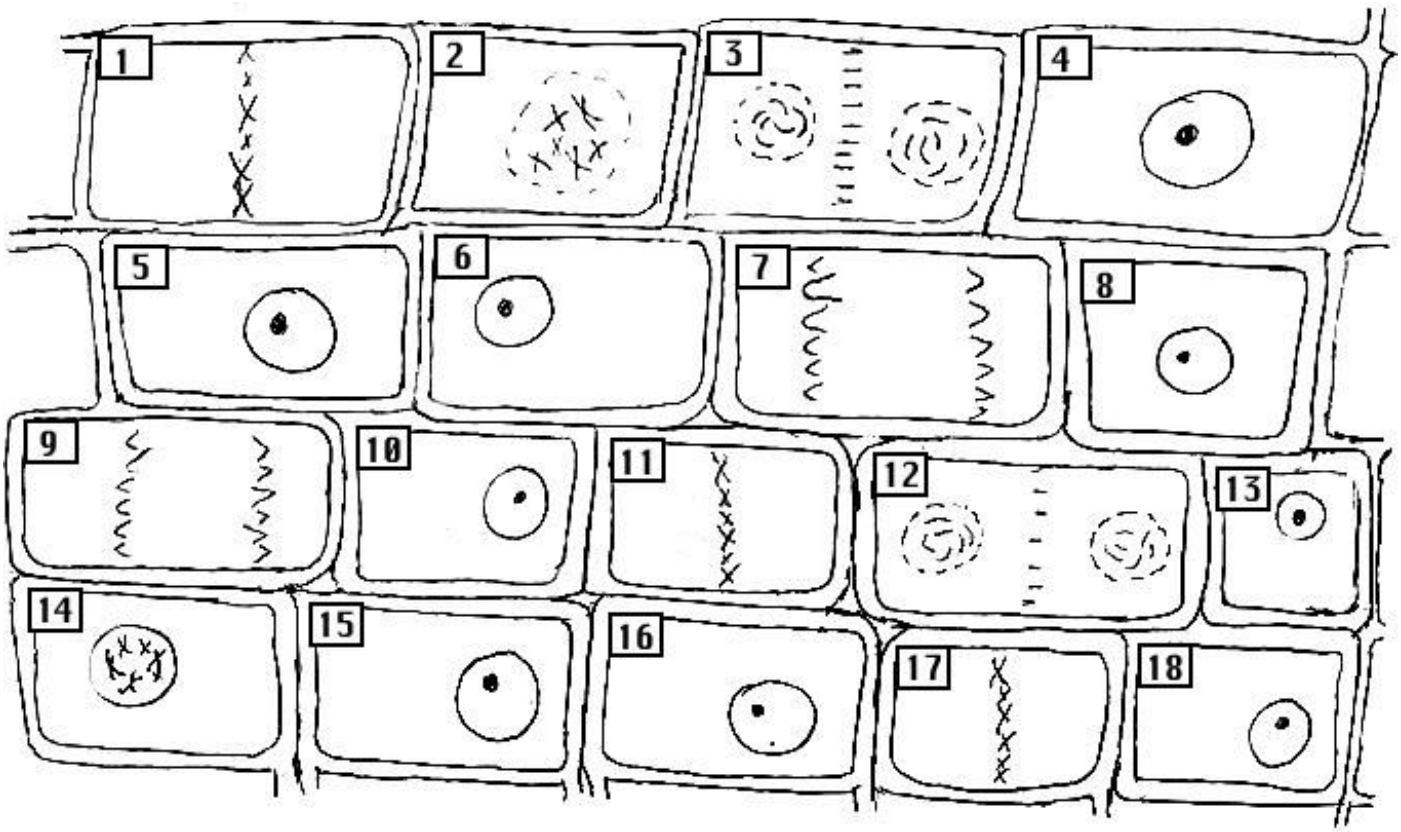
T Tissue repair

O Organismal growth

A Asexual reproduction (e.g. vegetative propagation)

D Development of an embryo

Identify the stages of mitosis and calculate the mitotic index



Interphase: 4, 5, 6, 8, 10, 13, 15, 16, 18

Anaphase: 7, 9

Prophase: 2, 14

Telophase: 3, 12

Metaphase: 1, 11, 17

Mitotic Index: 9 ÷ 18 = 0.5

Cell Cycle Regulation

Outline the role of cyclins in the control of the cell cycle

Cyclins are a family of regulatory proteins that control progression of the cell cycle

Cyclins bind cyclin dependent kinases (CDKs) and form an activated complex

This complex phosphorylates proteins involved in specific cell cycle events

After the event has occurred, the cyclin is degraded and CDK rendered inactive

Compare apoptosis and necrosis as mechanisms of cell death

Apoptosis	Necrosis
Programmed cell death (i.e. cell 'suicide')	Uncontrolled cell death (i.e. cell 'homicide')
Involves cellular signals and mitochondrial proteins	Premature death of cell due to injury or trauma
Membrane bulges (blebs) and contents are then repackaged for recycling by other cells	Membrane destabilises, leading to cell lysis
	Released cell contents trigger inflammation

Define cancer

Cancer is uncontrolled cell proliferation

Distinguish between primary and secondary tumours

Tumours are the growths caused by cancer and may be benign (stays local) or malignant (spreads)

A benign tumour that remains in its original location is called a primary tumour

A tumour that has spread (metastasised) is called a secondary tumour

Outline the role of mutagens and oncogenes in the development of cancer

A mutagen is an agent that causes a change in the genetic material of an organism

- E.g. Chemicals in cigarettes may cause cancer (carcinogens)

An oncogene is a gene that has the potential to cause cancer

- Proto-oncogenes code for proteins that promote cell growth and proliferation
- Tumor suppressor genes code for proteins that repress cell cycle progression