



## Cell biology

### Eukaryotes and prokaryotes

- Nucleus – B; Cytoplasm – C.
  - Any *two* from: This cell has a nucleus, or prokaryotic cells do not have a nucleus; This cell has does not have a cell wall, or prokaryotic cells have a cell wall; This cell does not contain plasmids, or prokaryotic cells can contain plasmids; 'Prokaryotes can have flagella' is allowed.
  - $0.1 \times 1000 = 100 \mu\text{m}$
  - 0.6mm

### Animal and plant cells

- Absorbs sunlight for photosynthesis – Chloroplasts; Provides strength to the cell – Cellulose cell wall; Filled with cell sap to keep the plant turgid – Permanent vacuole.
- A – cellulose cell wall; B – chloroplast; C – nucleus.
  - Cells near the top of a leaf have more chloroplasts to absorb more sunlight; for photosynthesis.

### Cell specialisation and differentiation

- Many mitochondria
  - Any *two* from: Xylem cells; Phloem cells; Muscle cells.
  - To move mucus; out of the lungs OR To move an ovum; along the fallopian tube/oviduct.
- A cell that is undifferentiated and can become any type of cell.
  - Embryo
  - Take stem cells and grow them in a laboratory; Expose cells to chemicals/hormones to make them differentiate into a type of specialised cell; Grow the specialised cells on a Petri dish so that they form tissues; Use the tissues to form the new organ.

### Microscopy

- The cells are not plant cells; There are no visible cellulose cell walls, permanent vacuole or chloroplasts.
  - Magnification =  $\frac{5\text{ cm}}{0.5\mu\text{m}} = \frac{50000\mu\text{m}}{0.5\mu\text{m}}$   
=  $\times 100\,000$
- Higher magnification/resolution; Able to see sub-cellular structures clearly/in detail.
- Size of image = magnification  $\times$  size of real object;  
=  $200 \times 10$ ;  
=  $2000 \mu\text{m}$  or 2mm.

### Culturing microorganisms

- Binary fission
  - Sterilise an agar plate; Spread bacteria over the surface of an agar plate using a sterile inoculating loop; Tape down the lid of the Petri dish and store the Petri dish upside down; Grow the bacteria at  $25^\circ\text{C}$ .
  - Cross-sectional area =  $3.142 \times 2.5^2$   
=  $3.142 \times 6.25$   
=  $19.64 \text{ mm}^2$
  - Number of divisions = 24  
Number of bacteria =  $10 \times 2^{24}$   
=  $167\,772\,160$   
or  $1.7 \times 10^8$

### Using a light microscope

- Move the lowest magnification objective lens over the specimen; Move the stage by moving the coarse focus, until the cells are in focus; Move the objective lens to a higher magnification, and focus using the fine focus.
  - To see the cells/tissues more clearly; different stains can be used to identify tissues/organelles.
  - $\times 400$

	Number of cells after 12 hours			
	1	2	3	Mean
With mitotic inhibitor	12	10	11	11
Without mitotic inhibitor	108	110	106	108

- Any *two* from: Type of cells; Starting number of cells; Temperature; Volume of nutrient broth/culture medium.
  - Use different concentrations of mitotic inhibitor.

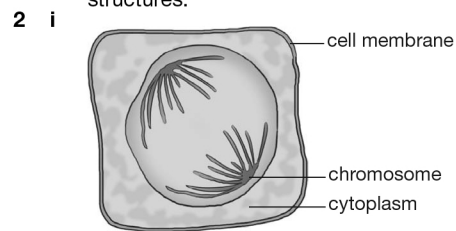
### Investigating the effect of antiseptics or antibiotics

- B
  - To prevent unwanted microorganisms from growing on the agar plate.
  - The clear area shows that no bacteria are growing there; Antiseptic D is inhibiting the growth of the bacteria.
  - Cross-sectional area =  $3.142 \times 4^2$   
=  $3.142 \times 16$   
=  $50.27 \text{ mm}^2$

### Mitosis and the cell cycle

- G2 phase – Chromosomes are checked; S phase – Chromosomes are replicated; M phase – The cell divides into two daughter cells; Cytokinesis – Physical process of cell division.

- So that when the cell divides during mitosis; each daughter cell has the correct number of sub-cellular structures.



- The replicated chromosomes are separating; to the opposite sides of the cell.

3 26 (lb)

### Stem cells

- B
- Any *two* from: Replacing/repair of cells; Growth; Used in medical research/treatments; Meristem used in plant cloning.
- Meristem tissue; found in the shoots, roots and flowering parts of the plant.
- Stem cells can be used to make organs for transplants, so there is no waiting time for organ donors; However, there is an ethical objection to using embryos, as they could potentially grow into humans/animals; Using stem cells in medical treatments means that the body will not reject the cells; but there is a risk of transfer of viral infection from putting stem cells into the body.

### Diffusion

- Diffusion is the spreading out of the particles of any substance in solution, or particles of a gas; resulting in a net movement from an area of higher concentration to an area of lower concentration.
  - Any *one* from: In the lungs for exchange of oxygen/carbon dioxide; In the small intestines for the movement of the products of digestion.
- $24:8 = 3:1$ ;  
 $96:64 = 3:2$   
=  $1.5:1$ ;  
Organism B has the smallest surface area to volume ratio.
  - They cannot get all the substances they need by diffusion alone; They need to increase the rate of diffusion; by increasing the surface area/providing a short diffusion pathway.
- Extract solution from outside the Visking tubing; at regular intervals/named time interval; test for the presence of glucose. Factors – surface area, concentration gradient and diffusion thickness.

### Osmosis

- Osmosis is the diffusion of water from a dilute solution to a concentrated