

# KS4 Combined Science

## Cell Biology

### Home Learning

## Triple Booklet 2



Rastrick  
High School & Sixth Form

Name: \_\_\_\_\_

Class: \_\_\_\_\_

Teacher: \_\_\_\_\_

#### 4.1 Cell Biology

Cells are the basic unit of all forms of life.

In this section we explore how structural differences between types of cells

enables them to perform specific functions within the organism. These differences in cells are controlled by genes in the nucleus. For an organism to grow, cells must divide by mitosis producing two new identical cells.

If cells are isolated at an early stage of growth before they have become too specialised, they can retain their ability to grow into a range of different types of cells. This phenomenon has led to the development of stem cell technology. This is a new branch of medicine that allows doctors to repair damaged organs by growing new tissue from stem cells..

Lesson 9 – Stop the clock

Lesson 10 – Chromosomes

Lesson 11 – Mitosis and the Cell Cycle

Lesson 12 – Diffusion

Lesson 13 – Adaptations for diffusion and Active Transport

Lesson 14 & 15 – **Required Practical 3: Osmosis**

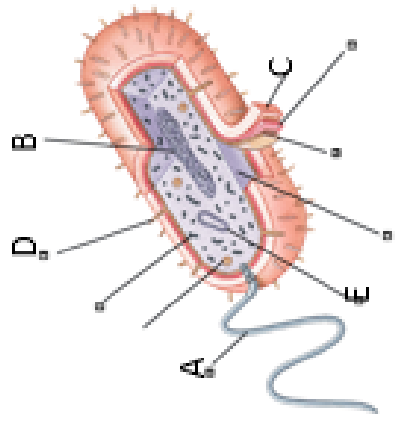
Lesson 16 – Revision

Lesson 17 - Test

# Lesson 9 – Stop the clock

What type of cell is shown below? .....

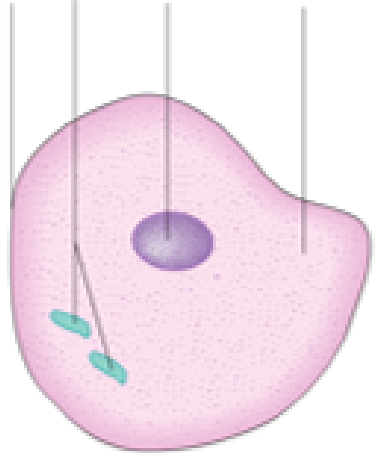
Name the structures A-E:  
 A  
 B  
 C  
 D  
 E



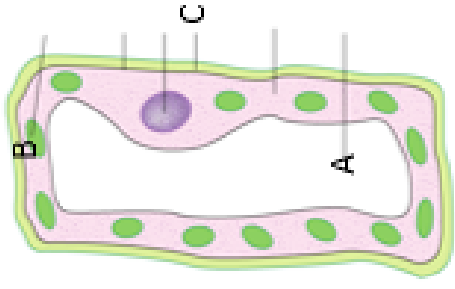
B and E contain the same molecule. What is it? .....

How is this type of cell different from a eukaryotic cell? .....

1. Label the structures of the animal cell.
2. State the function of each of the structures



1. Label the structures of the plant cell



What is the function of:

- A
- B
- C

## Specialised cells

Name 5 different specialised cells:

- A
- B
- C
- D
- E

Pick one of the cells you have named. Draw a picture of it. State the cell's function and how it is adapted for that function.

## Magnification

Name 2 different types of microscope:

- 1.
- 2.

How are they different? .....

An algal cell was observed at a magnification of x400. The image size was 2 mm. Calculate the actual size. Show workings out.



## 4.1.2.1 Chromosomes

Content	Key opportunities for skills development
<p>The nucleus of a cell contains chromosomes made of DNA molecules. Each chromosome carries a large number of genes.</p> <p>In body cells the chromosomes are normally found in pairs.</p>	<p>WS 1.2</p> <p>Use models and analogies to develop explanations of how cells divide.</p>

### In & On:

Unscramble these parts of a cell and then arrange them in order of size (smallest to largest):

**RESOCMOHOM**

**EENG**

**LELC**

**USNLCUE**



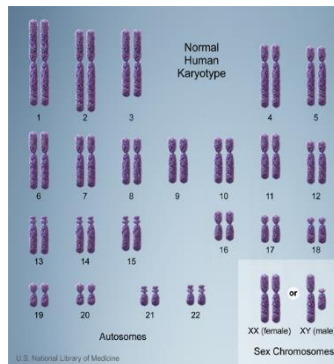
Key Word	Definition
	The part of the cell which contains genetic information (chromosomes).
	Long, thin, thread-like structures found in the nucleus of a cell made from a molecule of DNA. Chromosomes carry the genes.
	Deoxyribonucleic Acid, the chemical that makes up chromosomes. DNA carries genetic info.
	Chemicals in living things that are polymers made by joining together amino acids.
	A section of DNA giving the instructions for a cell about how to make one kind of protein.
	Image of chromosome pairs arranged in descending size.

**Quick fire questions:**

1. Which organelle in the cell contains the genetic information?
2. What are chromosomes?
3. What are the sections of chromosomes called?
4. How many chromosomes do humans have in a skin cell?

/4

### Human Karyotype – in a diploid cell.....



- **46 chromosomes**
- **23 pairs of chromosomes** – one from each parent.
- Chromosomes are made up of **lots of genes**.

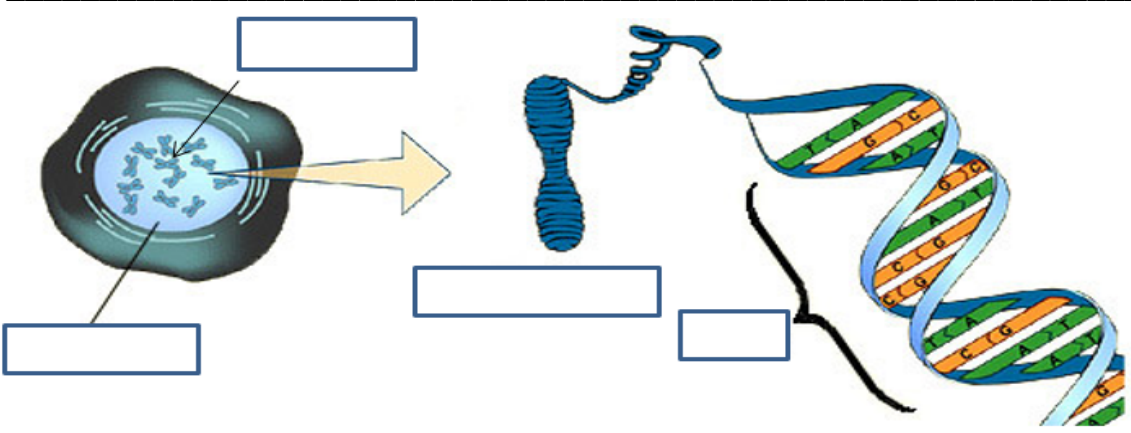
Each Gene codes for a different protein (characteristic)

- You inherit **2 copies** of every gene
- Copies of same gene are called **ALLELES**

**GAMETES** are \_\_\_\_\_ (sperm and egg)

They are \_\_\_\_\_ cells as they only contain \_\_\_\_\_ chromosomes in the nucleus

Why do gametes need to be haploid not diploid?



**Use the words below to label the boxes**

- Chromosome
- nucleus
- DNA
- Gene

**Complete the following paragraph:**

Humans have ..... strips of DNA in every cell apart from ..... cells.

These strips of DNA are called ..... The chromosomes are arranged in ....., one from each .....

Each chromosome is divided into sections. These sections are called ..... Each gene codes for a particular .....

chromosomes	characteristic	sex	pairs	46
	genes	parent		

Look at the list of things found inside cells.

- amino acid
- bases
- chromosomes
- DNA
- genes
- protein

Feedback & Assessment

Finish the following sentences.

Choose the best words from the list.

Inside cells, there are coded instructions called .....

The instructions are made of a chemical called .....

The instructions are carried inside the nucleus on structures called .....

# Karyotype diagnoses

<u>Karyotype A</u>	<u>Karyotype B</u>
<u>Karyotype C</u>	<u>Karyotype D</u>

Use these words to complete this passage; you may use some of these words **more than once**:

gene    protein    DNA    microscope    genetic code    chromosomes    double-  
helix    sexual    amino acid    bases    nucleus    cell    pairs    division

## Genetic Material

If you look at a ..... through a powerful ..... you can see a circular organelle called the ..... . When a cell is about to, or is undergoing cell ....., you can see tiny thread like structures called ..... . A typical human cell contains 23 ..... of ..... . They exist in ..... because they are inherited from two parents during ..... reproduction.

When a chromosome is unravelled it is composed of a long molecule of ..... . This molecule consists of two parallel strands, twisted and joined together to form a ..... shape. Between these two strands is a series of chemical ..... ; there are four of them represented by the letters A, C, G and T, and the order of these ..... forms the ..... . A sequence of three of these ..... codes for one ..... . Therefore, a long sequence of these ..... codes for a sequence of .....s, which will be joined together to form a ..... during a process called ..... synthesis . A section of DNA which codes for a protein is called a ..... . Therefore, one .....codes for one .....

## Edward's Syndrome

- Small head, jaw and mouth
- Clenched hands, malformed fingers and absent thumbs
- Webbed feet
- Heart, kidney, brain, digestive and genital malformations
- Delayed growth and development
- Infections of the lungs and urinary tract



**B**

## Turner's Syndrome

- Short Stature
- Broad Chest
- Low ears and hair line
- Webbed neck
- Infertility
- Heart Disease
- Hypothyroidism
- Diabetes
- Vision Problems
- Hearing Issues

**A**



## Klinefelter's Syndrome

- Most common sex chromosome abnormality in males
- Hypogonadism
- Reduced Fertility
- Feminine Traits
- Enlarged breast tissue



**C**

## Down Syndrome

- Decreased or poor muscle tone
- Short neck
- Small head, ears and mouth
- Upward slanting eyes
- Wide short hands
- Cognitive impairment (particularly with thinking and learning)

**D**

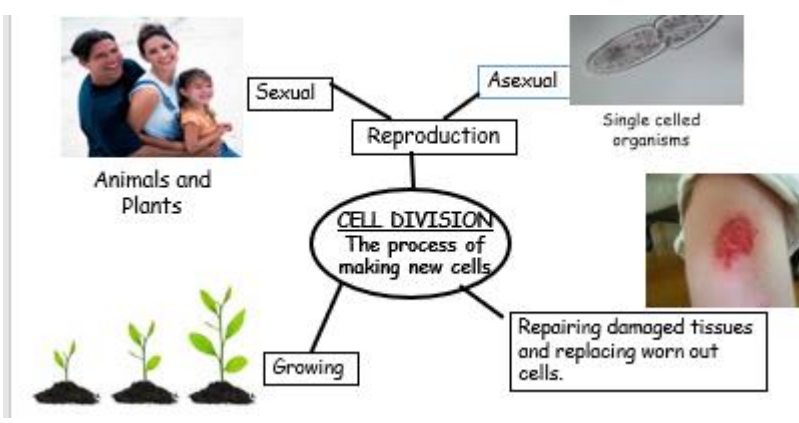


# Lesson 9 – Mitosis and the Cell Cycle

Why do we need new cells and how do we get them?

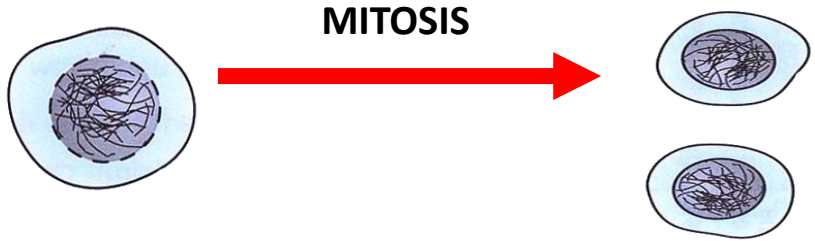
**In & On** - Heads and Tails. Match the statement on the left to that on the right.

Chromosome	The building blocks of a protein chain.
DNA	A section of a chromosome which codes for one protein.
Homologous pair	A strand of DNA.
Gene	Made by the cell usually as an enzyme.
Amino Acid	The chemical which codes for life.
Protein	2 identical chromosomes - one from each parent.



## Mitosis

- Cell division is needed to replace cells in our body, or increase the number of cells when we are growing
- New body cells are produced by a type of cell division called MITOSIS
- One DIPLOID body is cell is copied to produce 2 IDENTICAL NEW DIPLOID CELLS



## Stages of Mitosis

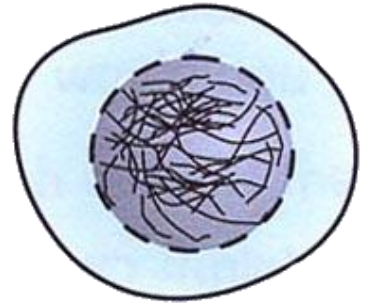
Stage	Description	Diagram
Interphase		
1		
2		
3		
4		
5		



## Interphase

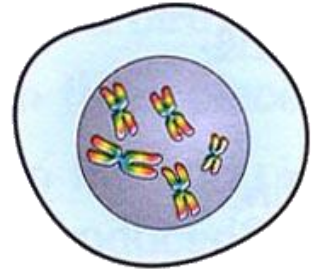
This is a normal body cell.  
Cells spend most of their life in interphase.

When it is not dividing the DNA is spread out into longer and thinner chromosomes, making it difficult to see individual strands.



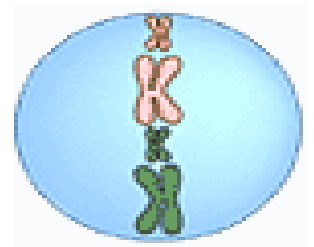
### Stage 1

- The chromosomes get shorter and more tightly coiled
- Each chromosome copies itself (DNA replication) with the two copies held together in the centre producing an X shape.



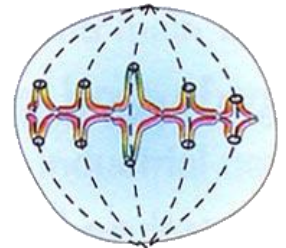
### Stage 2

- Copied chromosomes line up in the centre of the cell



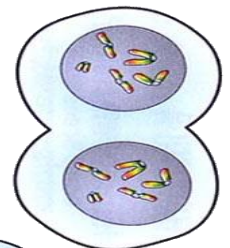
### Stage 3

- Original and copied chromosomes move to opposite ends of the cell



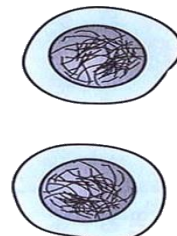
### Stage 4

The cytoplasm starts to divide and a new cell membrane forms around the two new cells as it does so.



### Stage 5 - Cell division

- New nuclei form in each of the two new cells



## 4.1.2.2 Mitosis and the cell cycle

### Content

Cells divide in a series of stages called the cell cycle. Students should be able to describe the stages of the cell cycle, including mitosis.

During the cell cycle the genetic material is doubled and then divided into two identical cells.

Before a cell can divide it needs to grow and increase the number of sub-cellular structures such as ribosomes and mitochondria. The DNA replicates to form two copies of each chromosome.

In mitosis one set of chromosomes is pulled to each end of the cell and the nucleus divides.

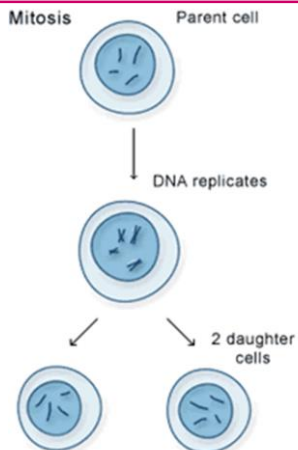
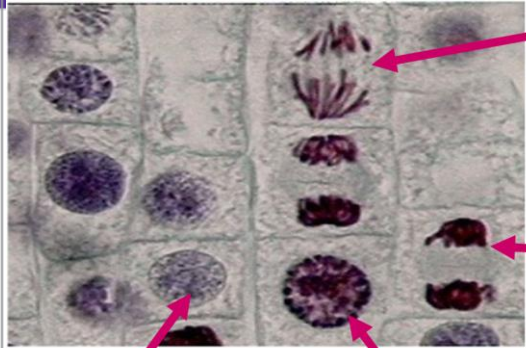
Finally the cytoplasm and cell membranes divide to form two identical cells.

Students need to understand the three overall stages of the cell cycle but do not need to know the different phases of the mitosis stage.

Cell division by mitosis is important in the growth and development of multicellular organisms.

Students should be able to recognise and describe situations in given contexts where mitosis is occurring.

Cells undergoing mitosis – explain what is happening at each arrow



1. What is mitosis?
2. Why is mitosis important?
3. What would happen if mitosis didn't take place?
4. Suggest one advantage and one disadvantage of asexual reproduction.
5. What cells in the body reproduce by mitosis?
6. Which cells in the body do you think are **not** made by mitosis?
7. How many parents does a cell that reproduces by sexual reproduction have?
8. How many parents does a cell that reproduces by asexual reproduction have?
9. Can you give an example of what happens when mitosis goes wrong?

Question & Enquiry

Challenge

Feedback & Assessment



Q1. (a) The diagram shows a normal body cell which has six chromosomes.



(i) Complete the diagram below to show **one** cell produced from this cell by *mitosis*.



(3)

Q2. (a) How many pairs of chromosomes are there in a body cell of a human baby?

.....

(b) Place the following in order of size, **starting with the smallest**, by writing numbers 1 – 4 in the boxes underneath the words.

chromosome

nucleus

gene

cell





(1)

(c) For a baby to grow, its cells must develop in a number of ways.

Explain how each of the following is part of the growth process of a baby.

(i) Cell enlargement

.....

(1)

(ii) The process of cell division by mitosis

.....

.....

.....

(3)

(d) Why is cell specialisation (differentiation) important for the development and growth of a healthy baby from a fertilised egg?

.....

.....

(2)

(Total 8 marks)

# Lesson 12 – Diffusion

## 4.1.3.1 Diffusion

**Content**

Substances may move into and out of cells across the cell membranes via 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.

Some of the substances transported in and out of cells by diffusion are oxygen and carbon dioxide in gas exchange, and of the waste product urea from cells into the blood plasma for excretion in the kidney.

Students should be able to explain how different factors affect the rate of diffusion.

Factors which affect the rate of diffusion are:

- the difference in concentrations (concentration gradient)
- the temperature
- the surface area of the membrane.

**Key opportunities for skills development**

WS 1.2  
Recognise, draw and interpret diagrams that model diffusion.

WS 1.5  
Use of isotonic drinks and high energy drinks in sport.

owl	
vome	
ghhi	
lecl	
smosois	
lelomcue	
dagtrien	
sufifidon	
tranciontenoc	

### Definition of diffusion:

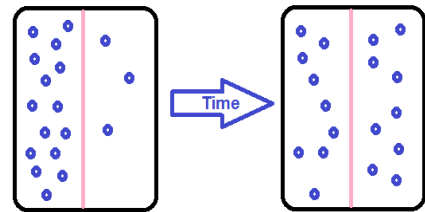
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### Diffusion in Biology:

### Practical – Factors affecting the **rate** of diffusion

**Aim:** To investigate the affect of concentration on the rate of diffusion

Concentration of Hydrochloric acid (M)	Diameter of phenolphthalein diffused out (cm)
0.1	
0.2	
0.4	

Work in pairs.

1. Pour 25ml of 0.1 M, 0.2M and 0.4M Hydrochloric acid into separate beakers.
2. Pick up 3 of the 3 x 2cm agar cubes which have been pre-cut and put 1 cube into each of the 3 Hydrochloric acid solutions.
3. Note the time. Let them soak for 10 minutes with periodic gentle stirring and turning.
4. After 10 minutes, use a spoon or tongs to remove the blocks and blot dry with a paper towel.
5. Cut each cube in half and measure the distance of phenolphthalein solution that has diffused out of the agar.

**Conclusion:** \_\_\_\_\_

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### Factors affecting the rate of diffusion:

Temperature	Concentration	Surface Area
As the temperature increases the rate of diffusion _____	As the concentration gradient increases, the rate of diffusion _____	As surface area increases, the rate of diffusion will _____



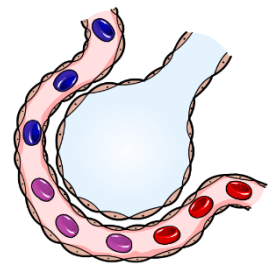
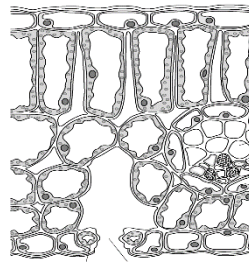
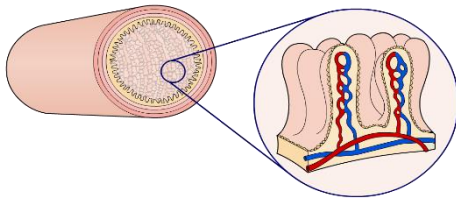
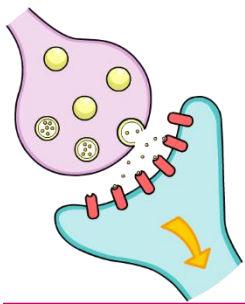


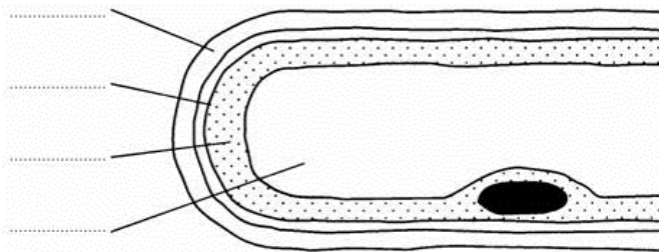
Diagram of:  
Found in:  
Diffusion of:

Diagram of:  
Found in:  
Diffusion of:

Diagram of:  
Found in:  
Diffusion of:

Diagram of:  
Found in:  
Diffusion of:

The drawing shows part of a root hair cell.

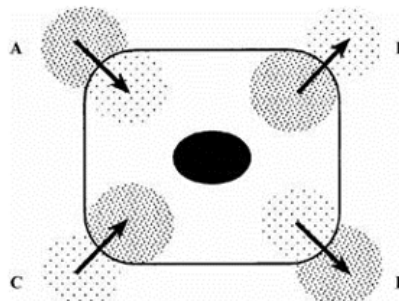


(a) Use words from the list to label the parts of the root hair cell.

cell membrane    cell wall    cytoplasm    nucleus    vacuole

(4)

(b) The diagram shows four ways in which molecules may move into and out of a cell. The dots show the concentration of molecules.



The cell is respiring aerobically. Which arrow, **A**, **B**, **C** or **D** represents:

(i) movement of oxygen molecules; .....

(ii) movement of carbon dioxide molecules? .....

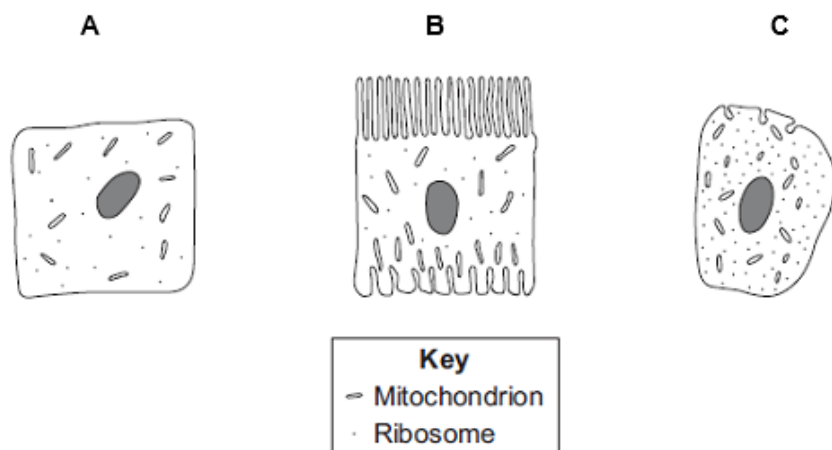
(2)

(c) Name the process by which these gases move into and out of the cell.

.....

(1)  
(Total 7 marks)

**Q3.** Diagrams **A**, **B** and **C** show cells from different parts of the human body, all drawn to the same scale.



Feedback & Assessment

Challenge

- (a) Which cell, **A**, **B** or **C**, appears to be best adapted to increase diffusion into or out of the cell?

Give **one** reason for your choice.

.....  
.....

(1)

- (b) (i) Cell **C** is found in the salivary glands.  
Name the enzyme produced by the salivary glands.

.....

(1)

- (ii) Use information from the diagram to explain how cell **C** is adapted for producing this enzyme.

.....  
.....  
.....  
.....

(2)  
(Total 4 marks)



# Lesson 13 – Adaptations for Diffusion and Active transport

Students should be able to calculate and compare surface area to volume ratios.

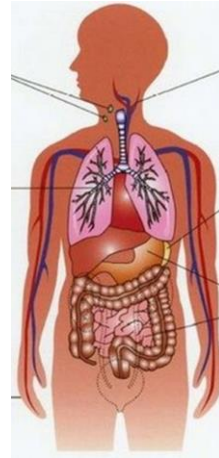
Students should be able to explain the need for exchange surfaces and a transport system in multicellular organisms in terms of surface area to volume ratio.

Students should be able to explain how the small intestine and lungs in mammals, gills in fish, and the roots and leaves in plants, are adapted for exchanging materials.

In multicellular organisms, surfaces and organ systems are specialised for exchanging materials. This is to allow sufficient molecules to be transported into and out of cells for the organism's needs. The effectiveness of an exchange surface is increased by:

- having a large surface area
- a membrane that is thin, to provide a short diffusion path
- (in animals) having an efficient blood supply
- (in animals, for gaseous exchange) being ventilated.

Where does diffusion occur in the human body?



Literacy & Numeracy

### Calculating Surface Area and Volume

Shape	Height (cm)	Width (cm)	Depth (cm)	Surface area (cm <sup>2</sup> )	Volume (cm <sup>3</sup> )	Surface Area : Vol ratio
	5	10	5			
	5	5	5			
	6	12	6			
	15	5	5			
	7	21	6			

For each shape, calculate the surface area and the volume and record in the table.

In the final column, work out the ratio of surface area to the volume e.g. 1:1 or 3:1

The rate of diffusion is \_\_\_\_\_ when the surface area to volume ratio is increased.

This is because the larger the surface area, the more particles can diffuse at any one time.

Complex organisms have evolved specialised exchange surfaces where diffusion takes place e.g. the alveoli in the lungs and the villi in the small intestine.

These structures have a greatly increased surface area to volume ratio, to speed up the rate of exchange.

Extra notes Extra Notes

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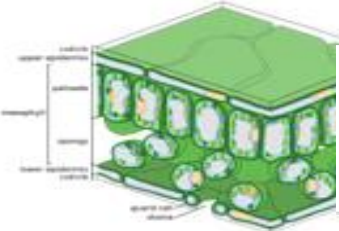

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Explain how the following are adapted for exchanging materials by diffusion:

Example	Explanation
<p><b>Small Intestine</b></p>  	
<p><b>Inside the lungs</b></p>  	
<p><b>Gills of a Fish</b></p>  	
<p><b>Roots</b></p>  	
<p><b>Inside the leaf</b></p>  	

Adaptations for faster diffusion in animals are:

- Very \_\_\_\_\_ walls (one cell thick) for a shorter diffusion path
- \_\_\_\_\_ surface area so more particles can diffuse at the same time
- Moist surface so gases can dissolve
- Good \_\_\_\_\_ supply to maintain the concentration gradient

Q1.

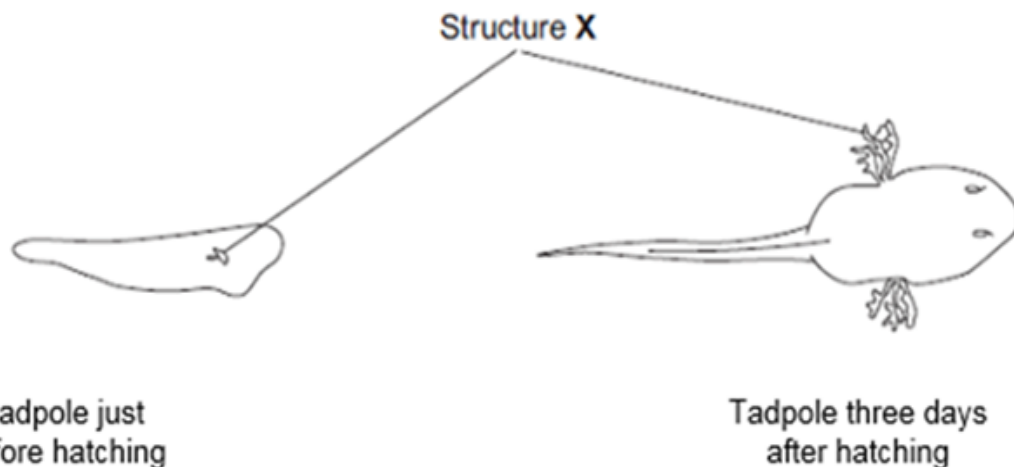
The young stages of frogs are called tadpoles. The tadpoles live in fresh water.

The drawings show a tadpole just before hatching and three days after hatching.

Structure X helps in the exchange of substances between the tadpole and the water.

Question & Enquiry

Feedback & Assessment



- (a) Name **one** substance, other than food, that the tadpole needs to exchange with the water in order to grow.

(1)

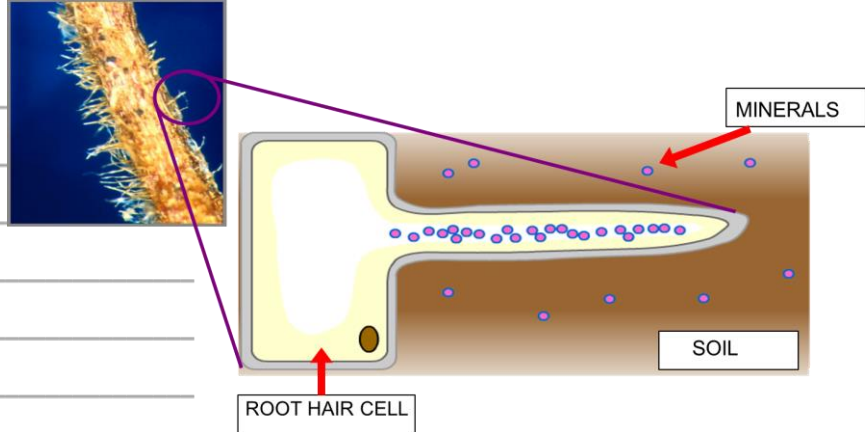
- (b) Suggest how the changes in the tadpole shown in the drawings help it to survive as it grows larger.

You should **not** refer to movement in your answer.  
To gain full marks you should refer to structure **X**.

(4)

(Total 5 marks)

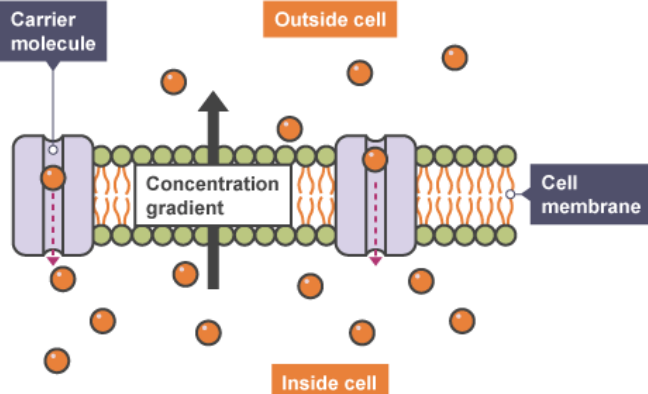
# Active Transport



**Active Transport:** is the movement of dissolved substances e.g. \_\_\_\_\_ and \_\_\_\_\_, from an area of \_\_\_\_\_ concentration to an area of \_\_\_\_\_ concentration, **against a concentration gradient.** This requires \_\_\_\_\_ from respiration.

### 4.1.3.3 Active transport

Content	Key opportunities for skills development
Active transport moves substances from a more dilute solution to a more concentrated solution (against a concentration gradient). This requires energy from respiration.	There are links with this content to <a href="#">Cell specialisation.</a>
Active transport allows mineral ions to be absorbed into plant root hairs from very dilute solutions in the soil. Plants require ions for healthy growth.	
It also allows sugar molecules to be absorbed from lower concentrations in the gut into the blood which has a higher sugar concentration. Sugar molecules are used for cell respiration.	
Students should be able to:	
<ul style="list-style-type: none"> <li>describe how substances are transported into and out of cells by diffusion, osmosis and active transport</li> <li>explain the differences between the three processes.</li> </ul>	



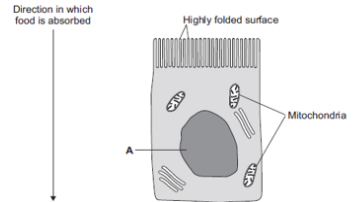
## How are plant roots adapted to absorb water and mineral ions?

Adaptation	Function
Branches and root hair cells	
Lots of mitochondria in root hair cells	

Examples of active transport include:

- uptake of **glucose** by epithelial cells in the **villi** of the small intestine
- uptake of ions from soil water by root hair cells in plants

Q1. The image below shows an epithelial cell from the lining of the small intestine.



- (a) (i) In the image above, the part of the cell labelled A contains chromosomes. What is the name of part A?
- ..... (1)
- (ii) How are most soluble food molecules absorbed into the epithelial cells of the small intestine?
- Draw a ring around the correct answer.
- diffusion      osmosis      respiration**
- ..... (1)

- (c) Epithelial cells also carry out active transport.
- (i) Name **one** food molecule absorbed into epithelial cells by active transport.
- ..... (1)
- (ii) Why is it necessary to absorb some food molecules by active transport?
- ..... (1)
- (ii) Suggest why epithelial cells have many mitochondria.
- ..... (2)

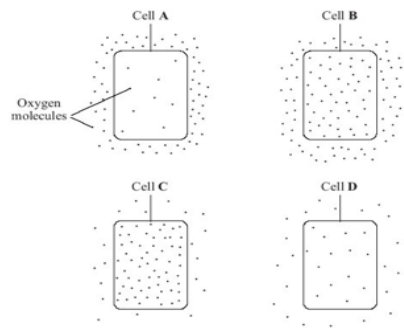
- (d) Some plants also carry out active transport.
- Give **one** substance that plants absorb by active transport.
- ..... (1)
- (Total 8 marks)**

- (b) Suggest how the highly folded cell surface helps the epithelial cell to absorb soluble food.
- ..... (1)

# Lesson 14 – Osmosis

Content	Key opportunities for skills development
Water may move across cell membranes via osmosis. Osmosis is the diffusion of water from a dilute solution to a concentrated solution through a partially permeable membrane.	WS 1.2 Recognise, draw and interpret diagrams that model osmosis.
Students should be able to: <ul style="list-style-type: none"> <li>use simple compound measures of rate of water uptake</li> <li>use percentages</li> <li>calculate percentage gain and loss of mass of plant tissue.</li> </ul>	MS 1a, 1c
Students should be able to plot, draw and interpret appropriate graphs.	MS 4a, 4b, 4c, 4d

(a) The diagrams show cells containing and surrounded by oxygen molecules. Oxygen can move into cells or out of cells.



Into which cell, A, B, C or D, will oxygen move the fastest?

(b) Draw a ring around the correct word to complete each sentence.

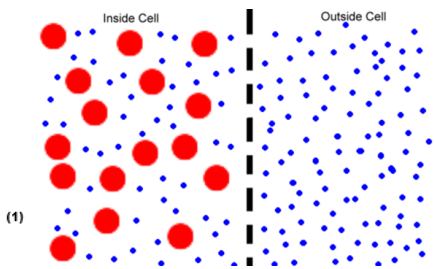
(i) Oxygen is taken into cells by the process of diffusion  
osmosis  
respiration

(ii) Cells need oxygen for breathing  
photosynthesis  
respiration

(iii) The parts of cells that use up the most oxygen are the membranes  
mitochondria  
nuclei

(iv) Some cells produce oxygen in the process of diffusion  
photosynthesis  
respiration

Osmosis is the movement of \_\_\_\_\_ from a \_\_\_\_\_ to \_\_\_\_\_ concentration of water across a \_\_\_\_\_ membrane.



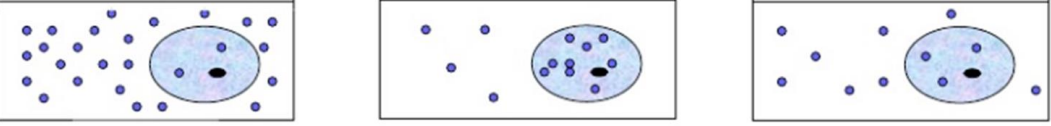
Draw an arrow to show the net movement of water molecules.

(1) **Hypertonic:**  
\_\_\_\_\_  
\_\_\_\_\_  
(1) **Hypotonic:**  
\_\_\_\_\_  
\_\_\_\_\_  
**Isotonic:**  
\_\_\_\_\_  
\_\_\_\_\_

**TURGID CELL:**  
water enters by osmosis, vacuole swells and pushes against cell wall

**FLACCID CELL:**  
water lost from cell, vacuole shrinks, cell loses shape

Draw an arrow to show the net movement of water by osmosis. Under each diagram explain the movement of water.





# Lesson 14 – Osmosis Required Practical

**Required practical activity 3:** investigate the effect of a range of concentrations of salt or sugar solutions on the mass of plant tissue.

## Investigating osmosis in potato tissue

Osmosis is the movement of water through a selectively permeable membrane from an area of high concentration of water to an area of lower concentration of water.

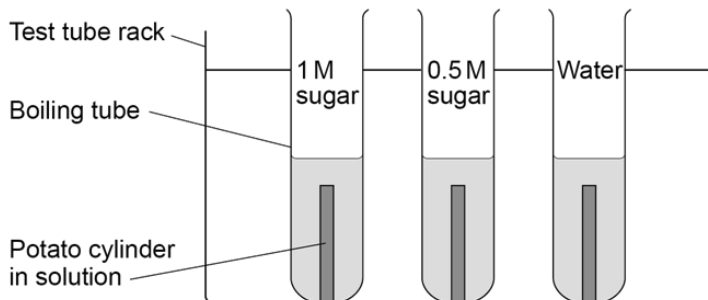
Plant tissues, such as potato, can be used to investigate osmosis.

In this experiment potatoes are cut into equal sized cylinders. The changes in length and mass after leaving them overnight in sugar solution and distilled water can then be accurately compared.

### Method

You are provided with the following:

- a potato
- a scalpel
- 1 M sugar solution
- distilled water
- a cork borer
- a 10 cm<sup>3</sup> measuring cylinder
- three boiling tubes
- paper towels
- a white tile
- 0.5 M sugar solution
- a top-pan balance.
- a ruler
- labels
- a test tube rack



1. Using a cork borer, cut three potato cylinders of the same diameter.
2. Trim the cylinders so that they are all the same length (about 3 cm).
3. Accurately measure and record the length and mass of each potato cylinder.
4. Measure out 10 cm<sup>3</sup> of the 1 M sugar solution and place into the first boiling tube (labelled 1 M sugar).
5. Measure out 10 cm<sup>3</sup> of 0.5 M sugar solution and place into the second boiling tube (labelled 0.5 M sugar).
6. Measure out 10 cm<sup>3</sup> of the distilled water into the third boiling tube (labelled water).
7. Add one potato cylinder to each tube (make sure you know which one is which in terms of the length and mass).
8. Leave the potato cylinders in the boiling tubes overnight in the test tube rack.
9. Remove the cylinders from the boiling tubes and carefully blot them dry with the paper towel.
10. Re-measure the length and mass of each cylinder (make sure you know which is which).
11. Record your lengths and masses in a table such as the one below.

Relationships

Challenge

Literacy & Numeracy



	1 M sugar solution	0.5 M sugar solution	Distilled wa
Initial length in mm			
Final length in mm			
<b>Change in length in mm</b>			
Initial mass in g			
Final mass in g			
<b>Change in mass in g</b>			

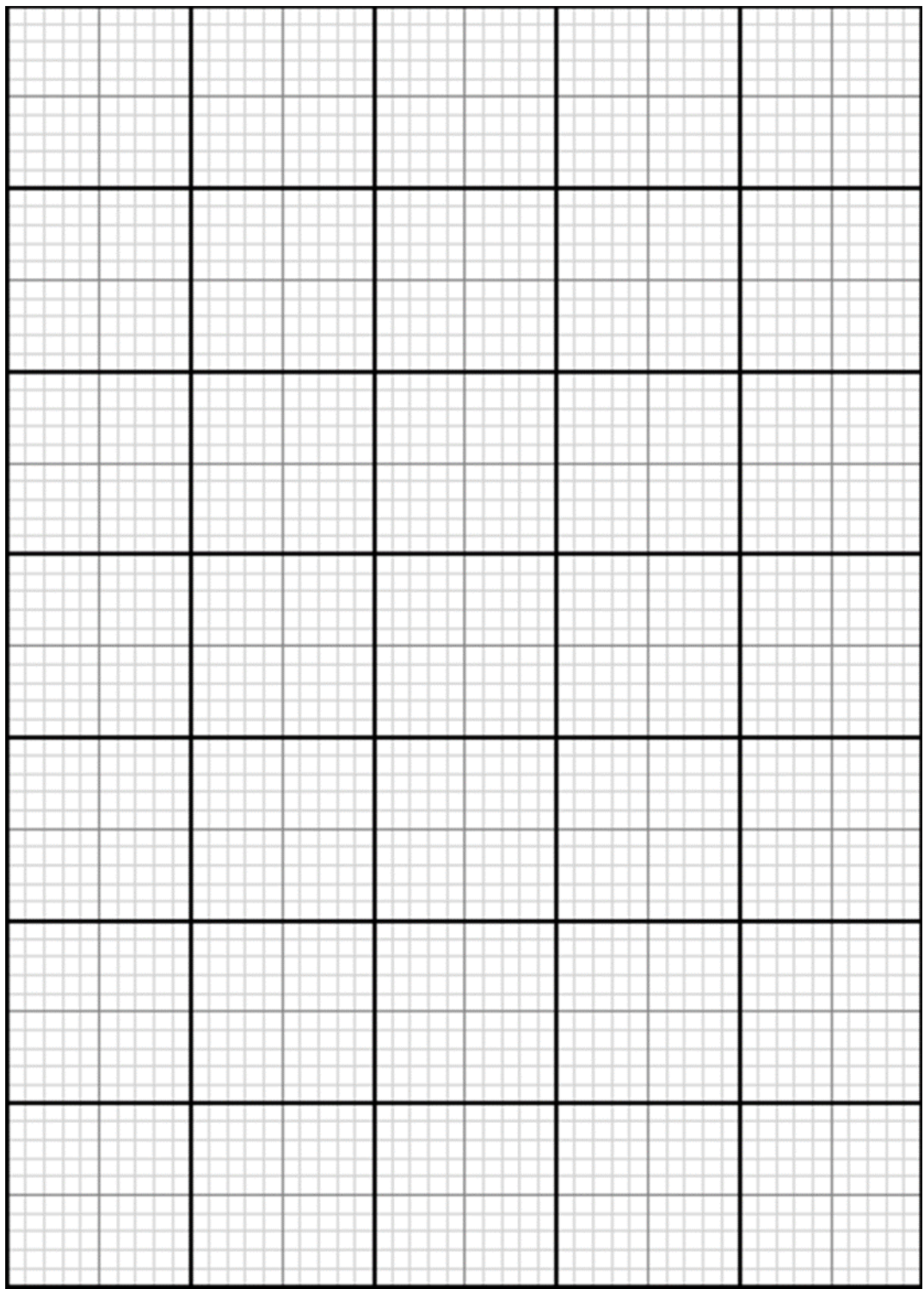
From the change in mass, work out the % change in mass for each potato.

(change in mass ÷ mass at start x 100)

**Why do we use the % change in mass instead of just 'change in mass'?**

Concentration of solution (M)	% change in mass
0.0	16.2
0.5	10.3
1.0	3.2

12. Plot a graph with '% change in mass in g' on the y-axis against 'Concentration of sugar solution' on the x-axis.





**Q1.** Cells, tissues and organs are adapted to take in different substances and get rid of different substances.

The table shows the concentration of four ions outside cells and inside cells.

Ion	Concentration outside cells in mmol per dm <sup>3</sup>	Concentration inside cells in mmol per dm <sup>3</sup>
Sodium	140	9
Potassium	7	138
Calcium	2	27
Chloride	118	3

(a) Use information from the table above to complete the following sentences.

Sodium ions will move into cells by the process of \_\_\_\_\_.

Potassium ions will move into cells by the process of \_\_\_\_\_.

(i) The bag in drink **A** got heavier after 20 minutes.

Explain why.

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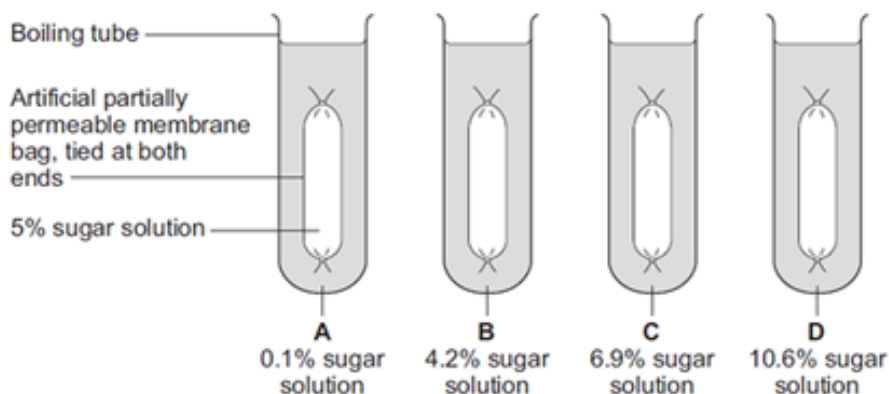
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- (b) Some students investigated the effect of the different concentrations of sugar in four drinks, A, B, C and D, on the movement of water across a partially permeable membrane.

The students:

- made four bags from artificial partially permeable membrane
- put equal volumes of 5% sugar solution in each bag
- weighed each bag containing the sugar solution
- placed one bag in each of the drinks, A, B, C and D
- after 20 minutes removed the bags containing the sugar solution and weighed them again.

The diagram below shows how they set up the investigation.



- (ii) In which drink, A, B, C or D, would you expect the bag to show the smallest change in mass?

Tick (✓) one box.

A       B       C       D

(1)

- (iii) Explain why you think the bag you chose in part (b)(ii) would show the smallest change.

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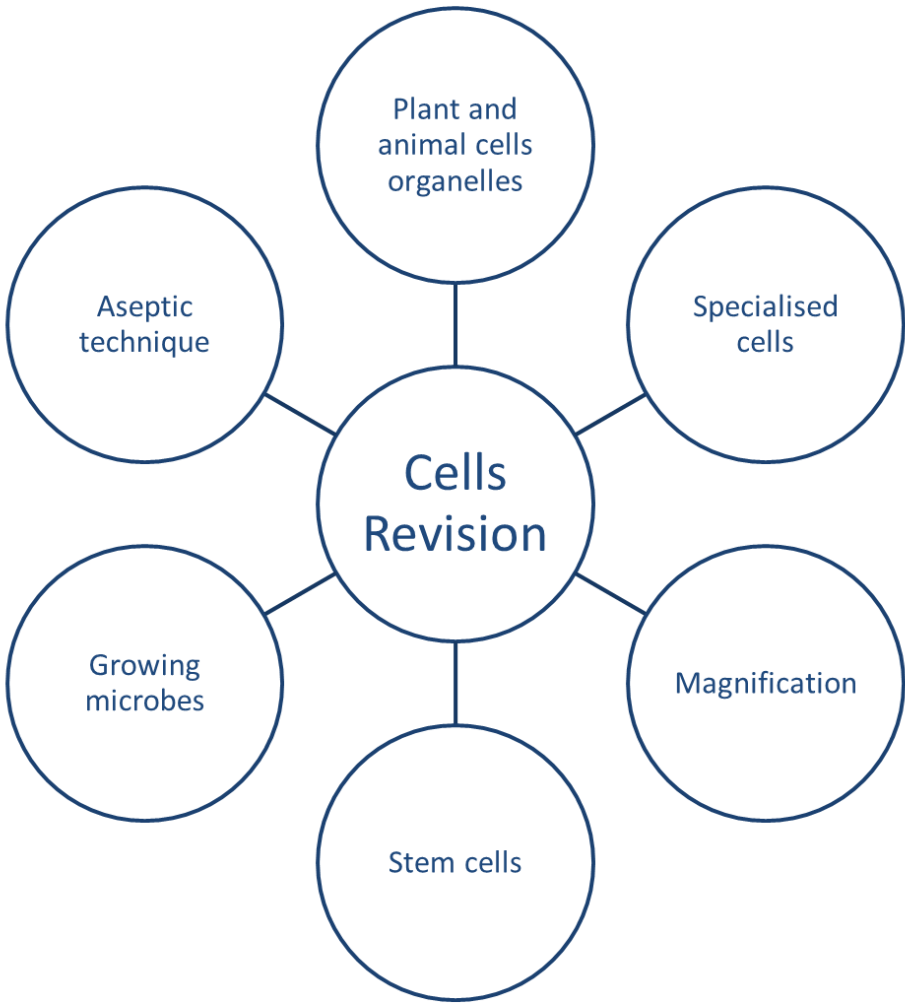
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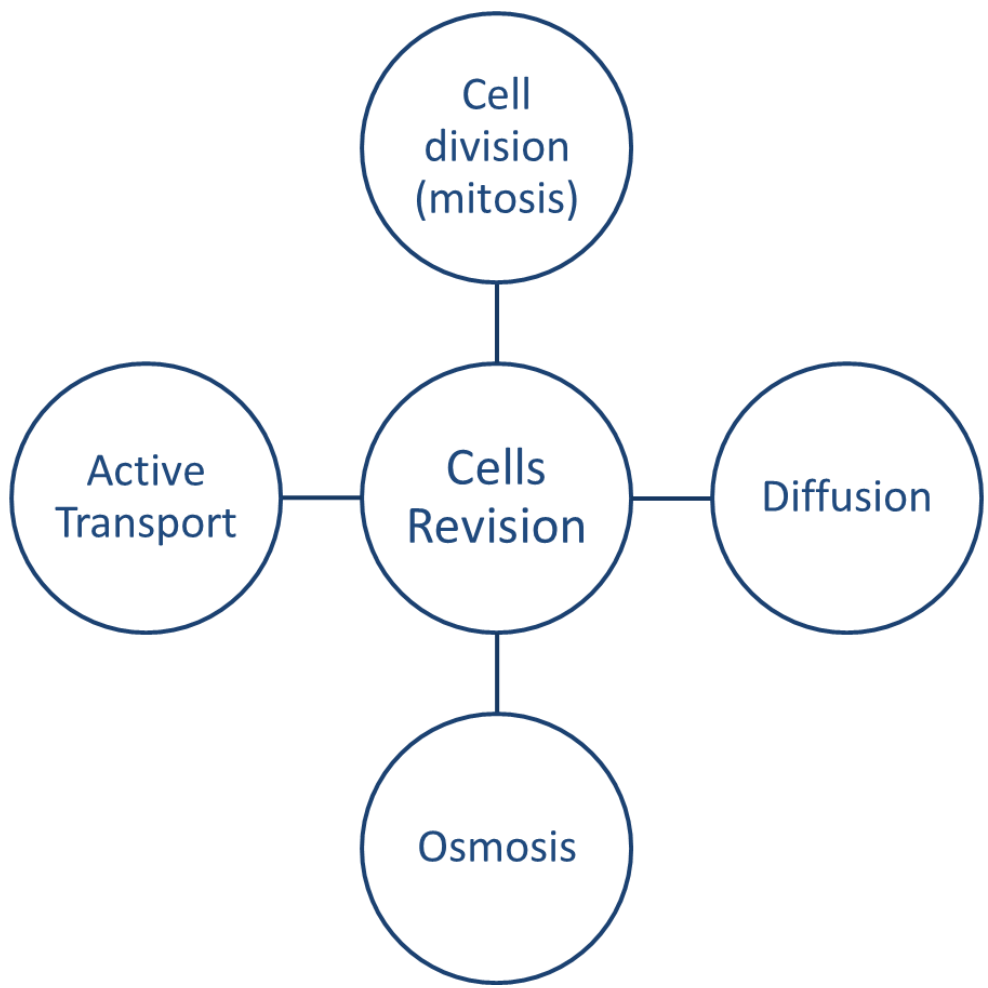
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(2)

(Total 8 marks)





**a** Draw and label a typical plant cell.

Which organelle is:  
• the site of anaerobic respiration?  
• the site of protein synthesis?  
• the site of photosynthesis?

**b** How many chromosomes does:  
• a human skin cell contain?  
• a human gamete contain?



**c** Sperm cells are specialised cells. Explain how the acrosome helps the sperm cell to carry out its function.



**d** Draw and label the parts of a typical bacterial cell.

**e** Why do cells undergo mitosis?  
  
What happens to the cell during:  
• interphase?

• mitosis?

**f** What are 'embryonic' stem cells?  
  
Name 2 medical conditions that could be treated with embryonic stem cells in the future.  
1. \_\_\_\_\_  
2. \_\_\_\_\_

Describe how to prepare an uncontaminated culture of bacteria using the aseptic technique.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

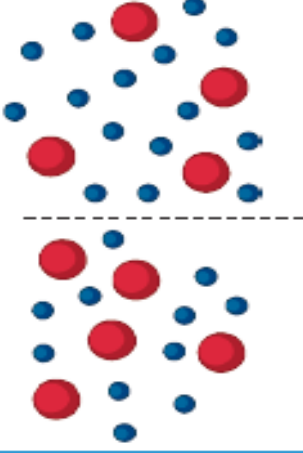
**h** Diffusion is:  
The movement of water particles from a high water concentration to a lower water concentration across a partially permeable membrane.  
The spreading out of the particles of any gas, or liquid from an area of high concentration to an area of lower concentration.  
The movement of particles from a low concentration to a higher concentration.

**l** Name 3 substances that are transported into or out of animal cells by diffusion:  
1. \_\_\_\_\_  
2. \_\_\_\_\_  
3. \_\_\_\_\_

Light microscopes have objective lenses.  
What is the purpose of the objective lens?

**m** Name the tubes that transport water up the stem of a plant.  
\_\_\_\_\_

**n** On the diagram below, draw an arrow to show the direction of the net movement of water molecules.  
  
List 5 important keywords from this unit.  
1. \_\_\_\_\_  
2. \_\_\_\_\_  
3. \_\_\_\_\_  
4. \_\_\_\_\_  
5. \_\_\_\_\_



water molecules ■ sugar molecules ■

**k** Describe an advantage of using therapeutic cloning to treat disease.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**o** What is osmosis?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

My main areas for improvement in this unit are:  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**a** Draw and label a typical animal cell.

- Which organelle is:
- the site of aerobic respiration?
  - controls the movement of substances in and out of the cell?
  - contains the genetic information?

**b** An elephant sperm cell contains 28 chromosomes. How many chromosomes would be in an elephant:

- liver cell?
- ovum?

**c** Root hair cells are specialised cells. Describe how the root hair cell is adapted to carry out its function.



**d** A bacterium can divide once every 20 minutes. A piece of chicken was contaminated with 5 bacteria; how many bacteria will there be on the chicken after 3 hours?

**e** Describe how active transport is used by:

- plants
- animals

**f** Describe 3 ways that exchange surfaces are adapted to their function.

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

**g** Describe 2 ways in which active transport is different to diffusion.

1. \_\_\_\_\_
2. \_\_\_\_\_

**h** Where in the body are adult stem cells found and how do they differ from embryonic stem cells?

**i** The unit 'centimetres' is written as 'cm'. What do each of the following units represent?

- mm: \_\_\_\_\_  
µm: \_\_\_\_\_  
nm: \_\_\_\_\_  
pm: \_\_\_\_\_

**j** Plants can be cloned from meristem cells. Give two advantages of cloning plants.

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_

**k** List 5 important keywords from this topic.

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_

**l** Electron microscopes have better resolution than light microscopes. What does 'resolution' mean?

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_

**m** State 2 factors that affect the rate of diffusion.

1. \_\_\_\_\_
2. \_\_\_\_\_

**n** Write each of the following numbers in standard form.

- 2500; \_\_\_\_\_  
0.003; \_\_\_\_\_  
4 200 000; \_\_\_\_\_  
0.00000006; \_\_\_\_\_

**o** Which has a bigger 'surface area to volume' ratio, an elephant or a mouse?

**p** What is the equation for calculating the magnification of an image?

**q** Why do some people object to embryonic stem cell research?

**r** How do prokaryotic cells differ from eukaryotic cells?

**s** My main areas for improvement in this unit are:

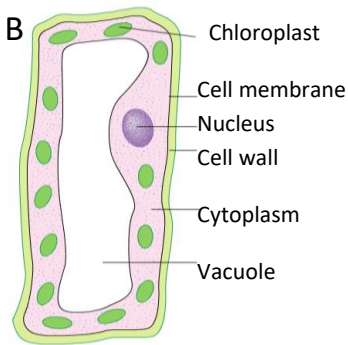
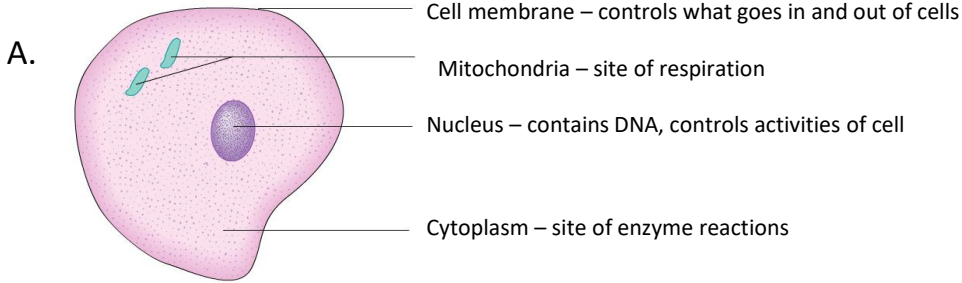






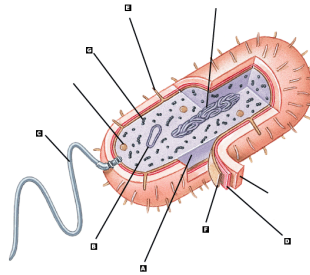
# Answers

# Answers



A = vacuole – contains sap, keeps cell turgid  
 B = chloroplast – site of photosynthesis  
 C = cell wall – supports the cell

Type of cell = bacteria



A = flagella  
 B = DNA  
 C = cell wall  
 D = pilli  
 E = plasmid

B and E both contain DNA. E is a plasmid which is a circular piece of DNA.

Bacteria are prokaryotic cells and their DNA is not contained in a nucleus. Eukaryotic cells have their DNA in a nucleus.

## Specialised cells

### Any 5 cells from:

Sperm  
 Egg  
 Red blood cell  
 White blood cell  
 Nerve cell  
 Root hair cell  
 Muscle cell  
 Epithelial cell

## Magnification

1. Light microscope
2. Electron microscope

Light microscope use light to see the sample, electron microscope uses electrons.

Electron microscopes have a higher resolution compared to light microscopes.

## Calculation

Convert image size to micrometres  
 $2 \times 1000 = 2000$

Actual size = image/magnification  
 $2000/400 = 5$

# Lesson 10 Answers

- *Gene*
- *Chromosome*
- *Nucleus*
- *Cell*

Key Word	Definition
<b>NUCLEUS</b>	The part of the cell which contains genetic information (chromosomes).
<b>CHROMOSOMES</b>	Long, thin, thread-like structures found in the nucleus of a cell made from a molecule of DNA. Chromosomes carry the genes.
<b>DNA</b>	Deoxyribonucleic Acid, the chemical that makes up chromosomes. DNA carries genetic info.
<b>PROTEINS</b>	Chemicals in living things that are polymers made by joining together amino acids.
<b>GENE</b>	A section of DNA giving the instructions for a cell about how to make one kind of protein.
<b>KARYOTYPE</b>	Image of chromosome pairs arranged in descending size.

**GENES**

**CHROMOSOME**

**NUCLEUS**

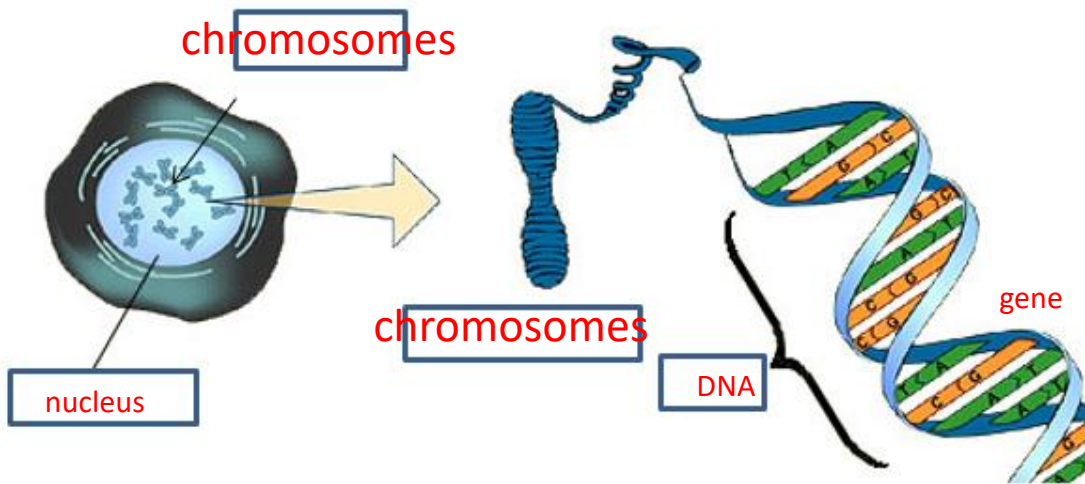
**KARYOTYPE**

**PROTEIN**

**DNA**

# Quick fire Questions

1. Nucleus
2. Long coiled molecules of DNA
3. Genes
4. 46 (23 pairs)



Use the words below to label the boxes

Chromosome      nucleus      DNA      Gene

## Complete the following paragraph:

Humans have .....46..... strips of DNA in every cell apart from .....chromosomes..... cells.

These strips of DNA are called .....parent..... The chromosomes are arranged in .....pairs....., one from each .....sex.....

Each chromosome is divided into sections. These sections are called .....genes..... Each gene codes for a particular .....characteristic.....

chromosomes

characteristic

sex

pairs

46

genes

parent

Look at the list of things found inside cells.

- amino acid
- bases
- chromosomes
- DNA
- genes
- protein

Finish the following sentences.

Choose the best words from the list.

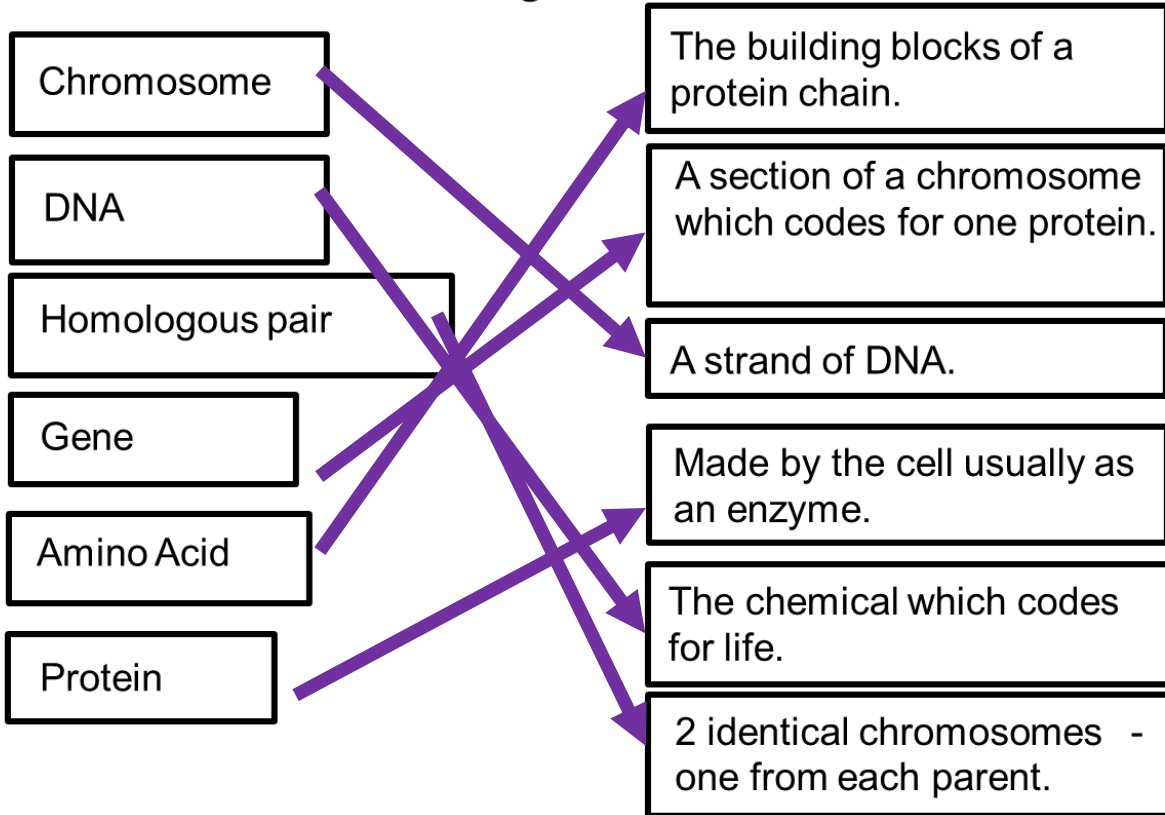
Inside cells, there are coded instructions called ..... **genes** .....  
The instructions are made of a chemical called ..... **DNA** .....  
The instructions are carried inside the nucleus on structures called ..... **chromosomes** ..... [3]

If you look at a **cell** through a powerful **microscope** you can see a circular organelle called the **nucleus**. When a cell is about to, or is undergoing cell **division**, you can see tiny thread like structures called **chromosomes**. A typical human cell contains 23 **pairs** of **chromosomes**. They exist in **pairs** because they are inherited from two parents during **sexual** reproduction.

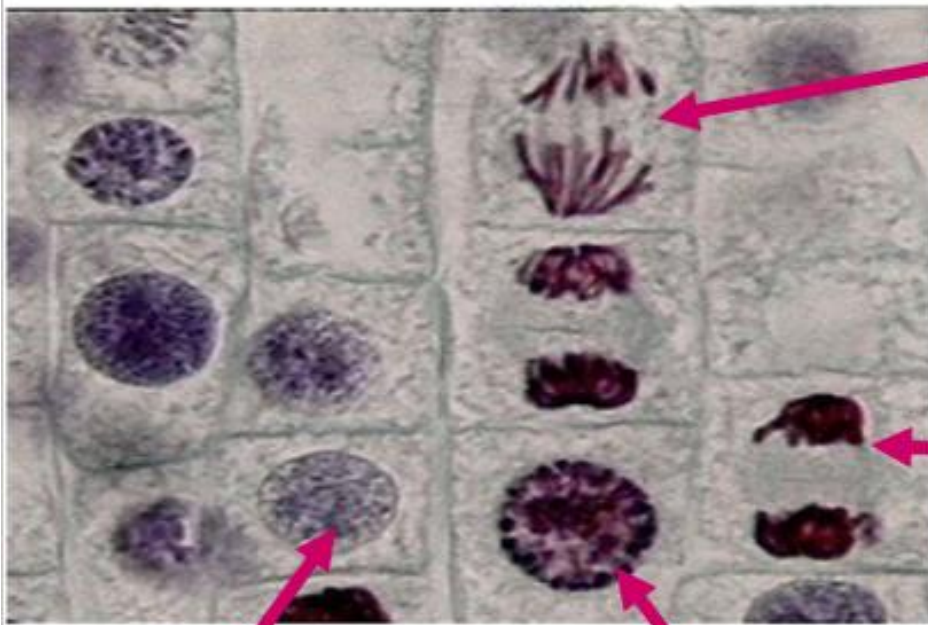
When a chromosome is unravelled it is composed of a long molecule of **DNA**. This molecule consists of two parallel strands, twisted and joined together to form a **Double-helix** shape. Between these two strands is a series of chemical **bases**; there are four of them represented by the letters A, C, G and T, and the order of these **bases** forms the **Genetic code**. A sequence of three of these **bases** codes for one **Amino acid**. Therefore, a long sequence of these **bases** codes for a sequence of **Amino acids**, which will be joined together to form a **protein** during a process called **protein** synthesis. A section of DNA which codes for a protein is called a **gene**. Therefore, one **gene** codes for one **protein**.

# Lesson 11: Answers

**In & On** - Heads and Tails. Match the statement on the left to that on the right.



1. What is mitosis?
2. Why is mitosis important?
3. What would happen if mitosis didn't take place?
4. Suggest one advantage and one disadvantage of asexual reproduction.
5. What cells in the body reproduce by mitosis?
6. Which cells in the body do you think are **not** made by mitosis?
7. How many parents does a cell that reproduces by sexual reproduction have?
8. How many parents does a cell that reproduces by asexual reproduction have?
9. Can you give an example of what happens when mitosis goes wrong?



Stage 3

Stage 4

Interphase

Stage 1

Q1. (a) The diagram shows a normal body cell which has six chromosomes.



(i) Complete the diagram below to show **one** cell produced from this cell by *mitosis*.



- 6 chromosomes
- same 3 homologous pairs
- nuclear membrane drawn

(3)

Q2. (a) How many pairs of chromosomes are there in a body cell of a human baby?

**23**

(b) Place the following in order of size, **starting with the smallest**, by writing numbers 1 – 4 in the boxes underneath the words.

chromosome

nucleus

gene

cell

**2**

**3**

**1**

**4**

(1)

(c) For a baby to grow, its cells must develop in a number of ways.

Explain how each of the following is part of the growth process of a baby.

(i) Cell enlargement

**(cells which are bigger) take up more space**

**(cells) have to get bigger or mature to divide**

(1)

(ii) The process of cell division by mitosis

• **chromosomes duplicate or make exact copies of self**

• **nuclei divide (accept chromosomes separate)**

• **identical (daughter) cells formed**

**accept for example, skin cells make more skin cells or cells are clones**

(3)

(d) Why is cell specialisation (differentiation) important for the development and growth of a healthy baby from a fertilised egg?

**Differentiation mark:**

- **babies need or are made of different types of cells or cells that have different functions**  
**accept different cells are needed for different organs**

**Division or specialisation mark:**

- **as fertilised egg starts to divide each cell specialises to form a part of the body**  
**accept specialised cells make different parts of the body**

(2)  
(Total 8 marks)

**Growth mark:**

- **specialised cells undergo mitosis to grow further cells**  
**accept cells divide or reproduce to form identical cells**



# Lesson 12 - Answers

Unscramble these words:

- owl                      low
- vome                      move
- ghhi                      high
- lecl                      cell
- smosois                      osmosis
- lelomcue                      molecule
- dagtrien                      gradient
- sufifidon                      diffusion
- tranciontenoc                      concentration

Temperature	Concentration	Surface Area
As the temperature increases the rate of diffusion <b>increases</b>	As the concentration gradient increases, the rate of diffusion <b>increases</b>	As surface area increases, the rate of diffusion will <b>increases</b>
At higher temperatures particles have more energy so move faster	Diffusion is faster when the difference in concentration is greater	There is more accessible surface for particles to move through

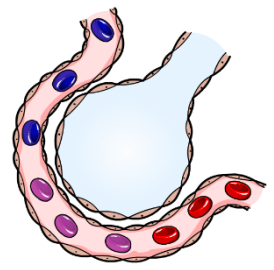
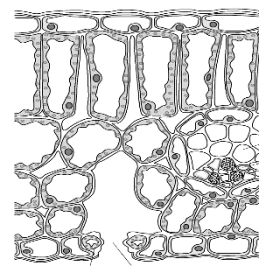
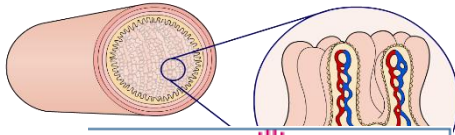
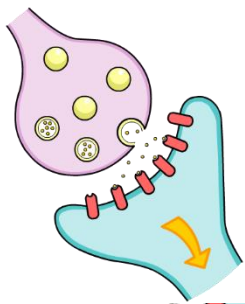


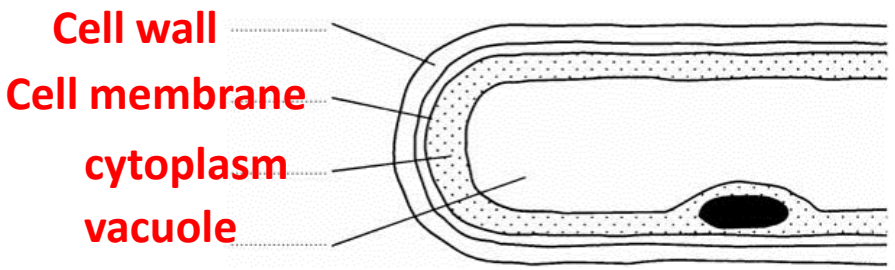
Diagram of: **villi**  
 Found in: **Small intestine**  
 Diffusion of: **Glucose, amino acids, fatty acids**

Diagram of: **synapse**  
 Found in: **Gap between neurones**  
 Diffusion of: **Chemicals (neurotransmitters)**

Diagram of: **Palisade and mesophyll tissue**  
 Found in: **leaves**  
 Diffusion of: **Carbon dioxide and oxygen**

Diagram of: **alveolus**  
 Found in: **lungs**  
 Diffusion of: **Carbon dioxide and oxygen**

The drawing shows part of a root hair cell.

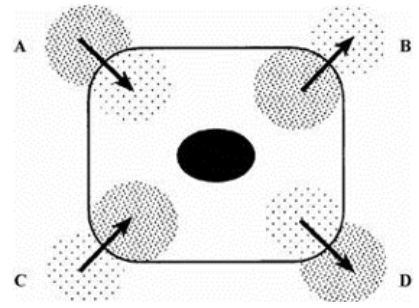


(a) Use words from the list to label the parts of the root hair cell.

- cell membrane    cell wall    cytoplasm    nucleus    vacuole

(4)

(b) The diagram shows four ways in which molecules may move into and out of a cell. The dots show the concentration of molecules.



The cell is respiring aerobically. Which arrow, **A**, **B**, **C** or **D** represents:

- (i) movement of oxygen molecules;    **A** .....
- (ii) movement of carbon dioxide molecules?    **B** .....

(2)

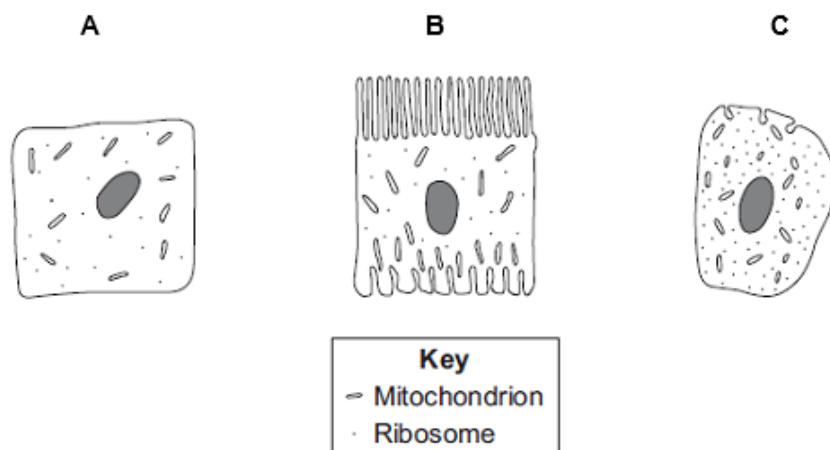
(c) Name the process by which these gases move into and out of the cell.

.....**Diffusion**.....

(1)

(Total 7 marks)

Q3. Diagrams **A**, **B** and **C** show cells from different parts of the human body, all drawn to the same scale.



Feedback & Assessment

Challenge

- (a) Which cell, **A**, **B** or **C**, appears to be best adapted to increase diffusion into or out of the cell?

**B**

Give **one** reason for your choice.

.....  
**Increased surface area**  
.....

(1)

- (b) (i) Cell **C** is found in the salivary glands.

Name the enzyme produced by the salivary glands.

.....  
**Amylase**  
.....

(1)

- (ii) Use information from the diagram to explain how cell **C** is adapted for producing this enzyme.

.....  
**Cell C has lots of mitochondria and ribosomes for protein synthesis.**  
.....  
.....

(2)  
(Total 4 marks)

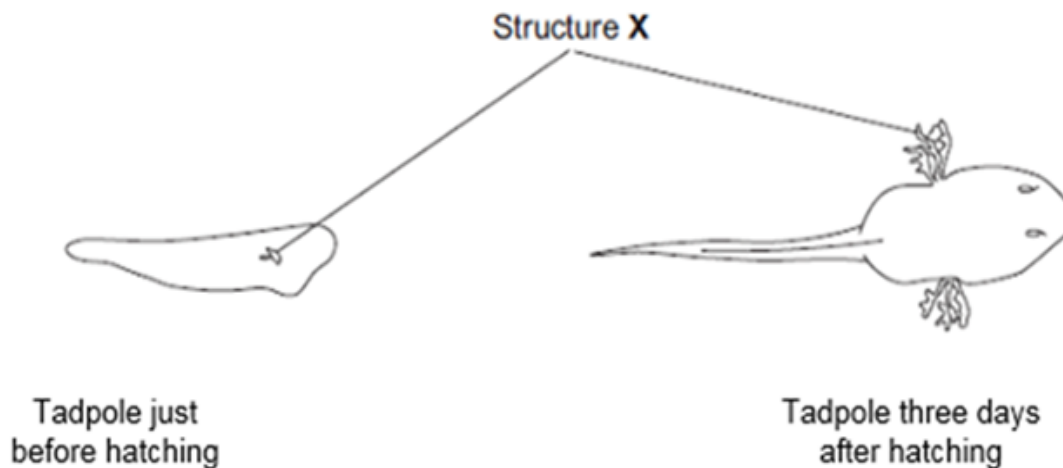
# Lesson 13 - Answers

Q1.

The young stages of frogs are called tadpoles. The tadpoles live in fresh water.

The drawings show a tadpole just before hatching and three days after hatching.

Structure X helps in the exchange of substances between the tadpole and the water.



- (a) Name **one** substance, other than food, that the tadpole needs to exchange with the water in order to grow.

oxygen / O<sub>2</sub>

Or carbon dioxide / CO<sub>2</sub>

allow O<sub>2</sub>

allow CO<sub>2</sub>

do not accept O<sup>2</sup>

do not accept CO<sup>2</sup>

(1)

- (b) Suggest how the changes in the tadpole shown in the drawings help it to survive as it grows larger.

You should **not** refer to movement in your answer.

To gain full marks you should refer to structure X.

any four from:

*ignore references to tail used for locomotion*

*ignore reference to nostrils*

- because structure X / gills has threads / filaments or is thin or tadpole has longer tail

- there is an increased surface area
- there is a shorter diffusion pathway
- therefore an increase in exchange

*ignore food*

- eyes (now visible in older tadpole)
- so that food / danger etc can be seen

*accept reference to a good blood supply*

*accept increased water flow over gills / tail will increase diffusion of gases*

(4)

(Total 5 marks)

## Active Transport

**Active transport** is the movement of dissolved substances e.g. ions and sugars, from an area of **low** concentration to an area of **high** concentration, **against a concentration gradient**. This requires **energy** from respiration.

Adaptation	Function
Branches and root hair cells	Increases the surface area of the roots for faster absorption of water
Lots of mitochondria in root hair cells	Provides energy from respiration for absorption of mineral ions by active transport

(c) Epithelial cells also carry out active transport.

(i) Name **one** food molecule absorbed into epithelial cells by active transport.

*Sugar / glucose*

*accept amino acids*

(1)

(ii) Why is it necessary to absorb some food molecules by active transport?

*They have to move from low to high concentration  
(moving against a concentration gradient)*

(1)

(ii) Suggest why epithelial cells have many mitochondria.

*Active transport needs energy  
from respiration*

(2)

(d) Some plants also carry out active transport.

Give **one** substance that plants absorb by active transport.

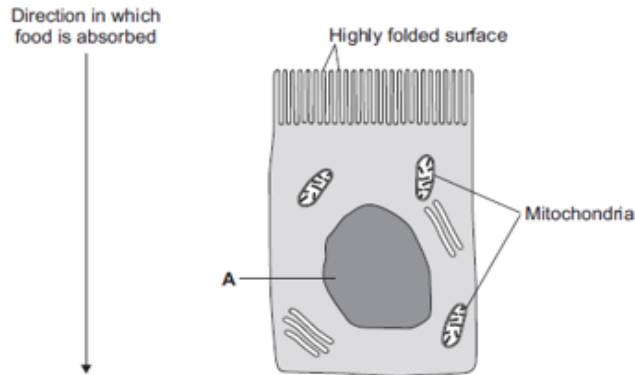
*Minerals / ions*

*accept named mineral or ion*

(1)

(Total 8 marks)

**Q1.**The image below shows an epithelial cell from the lining of the small intestine.



- (a) (i) In the image above, the part of the cell labelled **A** contains chromosomes.

What is the name of part **A**?

..... nucleus .....

(1)

- (ii) How are most soluble food molecules absorbed into the epithelial cells of the small intestine?

Draw a ring around the correct answer.

**diffusion**      **osmosis**      **respiration**

(1)

- (b) Suggest how the highly folded cell surface helps the epithelial cell to absorb soluble food.

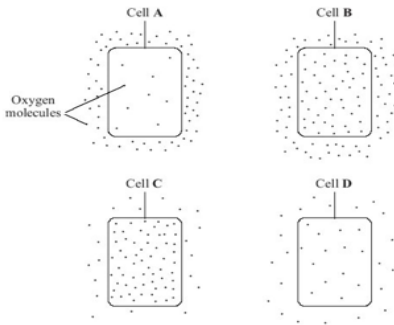
..... Increases the (gives it a larger) .....

..... surface area .....

(1)

# Lesson 14 Answers

(a) The diagrams show cells containing and surrounded by oxygen molecules. Oxygen can move into cells or out of cells.



Into which cell, A, B, C or D, will oxygen move the fastest?

**A**

(1)

(b) Draw a ring around the correct word to complete each sentence.

(i) Oxygen is taken into cells by the process of

diffusion  
osmosis  
respiration

(1)

(ii) Cells need oxygen for

breathing  
photosynthesis  
respiration

(1)

(iii) The parts of cells that use up the most oxygen are the

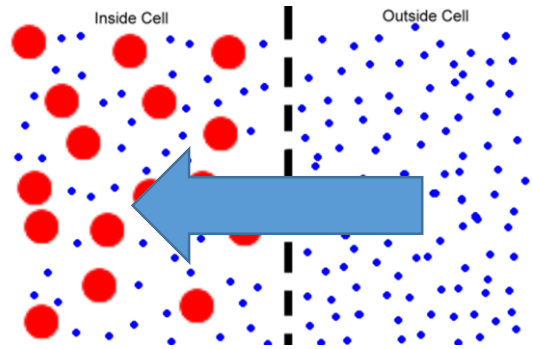
membranes  
mitochondria  
nuclei

(1)

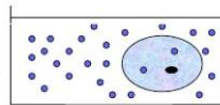
(iv) Some cells produce oxygen in the process of

diffusion  
photosynthesis  
respiration

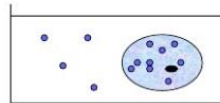
(1)



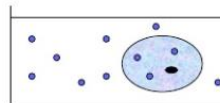
Draw an arrow to show the net movement of water by diagram explain the movement of water.



Water will move into the cell  
Solution outside is **hypotonic**



Water will move out of the cell  
Solution outside is **Hypertonic**



Water concentration is equal  
inside and outside the cell.  
Solution outside is **isotonic**

Osmosis is the movement of water from a high to low concentration (of water) across a partially permeable membrane.

- Q1. Cells, tissues and organs are adapted to take in different substances and get rid of different substances.

The table shows the concentration of four ions outside cells and inside cells.

Ion	Concentration outside cells in mmol per dm <sup>3</sup>	Concentration inside cells in mmol per dm <sup>3</sup>
Sodium	140	9
Potassium	7	138
Calcium	2	27
Chloride	118	3

- (a) Use information from the table above to complete the following sentences.

Sodium ions will move into cells by the process of diffusion.

Potassium ions will move into cells by the process of Active transport.

- (i) The bag in drink A got heavier after 20 minutes.

Explain why.

higher concentration of water outside the bag or in the drink / boiling tube

(Or concentration of sugar in the bag was higher than in the drink)

(3)

(so) water moved in (to the tubing)

*allow water moves down **its** concentration gradient do **not** allow sugar moving*

by osmosis

*do **not** allow sugar moving by osmosis **or** water moving by active transport*

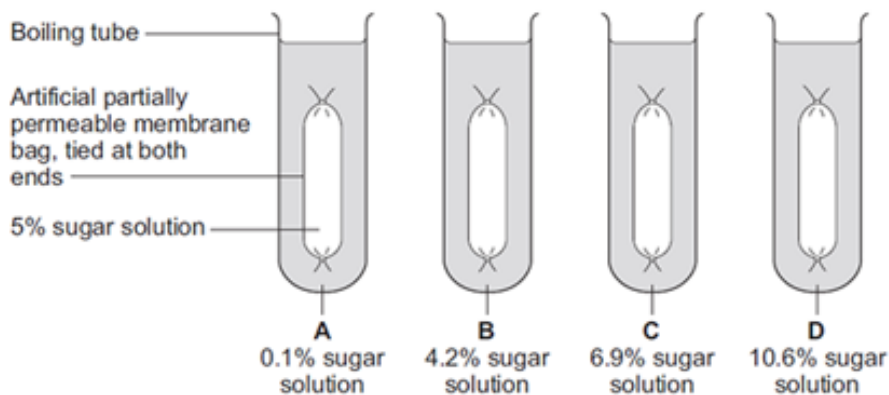


- (b) Some students investigated the effect of the different concentrations of sugar in four drinks, A, B, C and D, on the movement of water across a partially permeable membrane.

The students:

- made four bags from artificial partially permeable membrane
- put equal volumes of 5% sugar solution in each bag
- weighed each bag containing the sugar solution
- placed one bag in each of the drinks, A, B, C and D
- after 20 minutes removed the bags containing the sugar solution and weighed them again.

The diagram below shows how they set up the investigation.



- (ii) In which drink, A, B, C or D, would you expect the bag to show the smallest change in mass?

Tick (✓) one box.

A  B  C  D

(1)

- (iii) Explain why you think the bag you chose in part (b)(ii) would show the smallest change.

closest to the concentration in the bag or to 5%

allow small(est) diffusion gradient

(so rate of) diffusion / osmosis is slow

allow (so) less water moves in (to the bag)

(2)

(Total 8 marks)

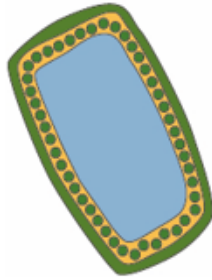
**Q2.**

The diagrams show the same cell of a common pond plant.

**Diagram A** shows the cell in a hypotonic solution.

**Diagram B** shows the same cell in a hypertonic solution.

**Diagram A**



**Diagram B**



(a) What is a **hypertonic** solution?

- more concentrated
- than the cell / cytoplasm (*must be a comparison*)
- *accept more salty / solutes / ions*
- *accept cell is less concentrated than solution for 2 marks*

(b) What word is used to describe plant cells placed in:

(i) a hypotonic solution  
**turgid**

(ii) a hypertonic solution?  
**plasmolysed / flaccid**

(c) Explain what has happened to the plant cell in **Diagram B**

- any four from:
- water left the cell (in A)
  - by osmosis
  - from dilute to more concentrated solution
  - (accept from high to low water concentration)
  - via partially permeable membrane
  - so cell membrane shrank away from cell wall

(d) Animal cells will also change when placed in different solutions.

Some red blood cells are put in a hypotonic solution.

Describe what would happen to these red blood cells **and** explain why this is different from what happened to the plant cell in **Diagram A**.

- water enters the cells (by osmosis)
- allow 1 mark for:
- they burst / lyse / lysis occurs
  - water leaves and cell shrinks (if they think it is hypertonic solution)
  - animal cells have no cell wall or plant cells have a cell wall
  - cell wall prevents lysis / bursting / allows turgidity

*allow correct description*

(4 marks)

	Diffusion	Osmosis	Active transport
Does a substance travel down a concentration gradient?	Yes	Yes	No
Does a substance travel against a concentration gradient?	No	No	Yes
Is energy needed?	No	No	Yes
Substance moved	Dissolved solutes	Water	Dissolved solutes
Extra information	Gases also diffuse	Partially permeable membrane needed	Carrier protein needed

(1)

(1)

(4)