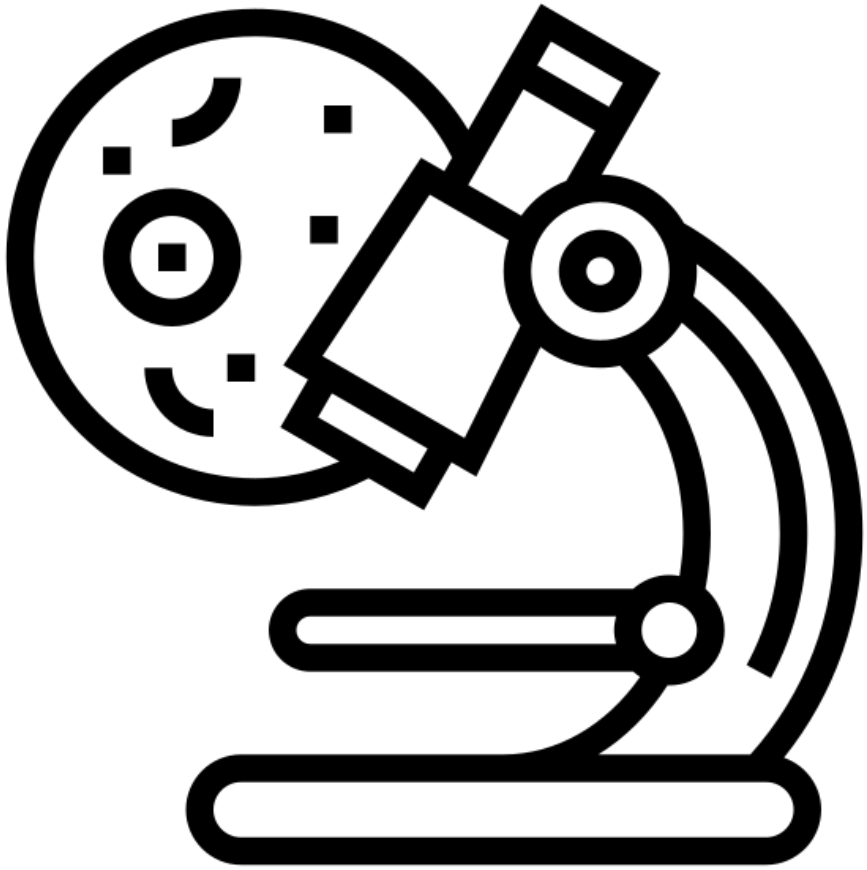
GCSE Biology Topic 1
Cell Biology



Name: _____

Class: _____

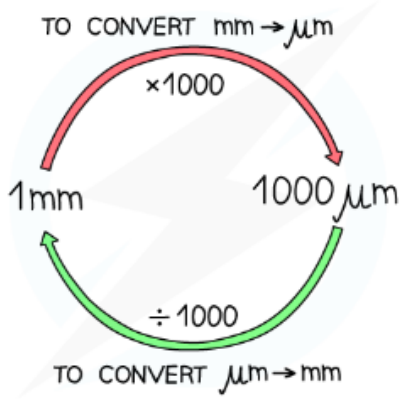
Teacher: _____

Core Questions

	Question	Answer
1	What are the two different types of cells?	Prokaryotic and Eukaryotic cells
2	What are eukaryotic cells?	Cells with a nucleus
3	What are prokaryotic cells?	Cells without a nucleus
4	Name two examples of eukaryotic cells	Animal and plant cells
5	State the function of the nucleus.	Controls all activities of the cell, contains genetic information
6	State the function of the cytoplasm.	Site for chemical reactions to take place
7	State the function of the cell membrane.	Controls what substances go in and out of the cell
8	State the function of the mitochondria.	Site of aerobic respiration, releasing energy
9	State the function of the ribosomes.	Site of protein synthesis
10	State the function of the cell wall.	Strengthens the cell, provide support
11	State the function of the chloroplasts.	Contain chlorophyll, absorb light to do photosynthesis
12	State the function of the permanent vacuole.	Contains cell sap to keep plant cells rigid, provide support
13	State three differences between animal and plant cells.	Plant cells have chloroplasts, permanent vacuole and cellulose cell wall. Animal cells do not
14	What substance makes up plant and algae cell walls?	Cellulose
15	Define 'resolution'.	The ability to distinguish between two separate points that are very close together
16	Compare light and electron microscope	Electron microscope has a higher magnification and resolution so can see and understand more subcellular structures.
17	How do we calculate the total magnification of a microscope?	Eyepiece lens x Objective lens magnifying power
18	State the equation that links magnification, image size and actual size.	Image Size = Actual Size x Magnification
19	How do convert from mm to μm	Multiply by 1000
20	How do you convert μm to mm	Divide by 1000
21	What is the name of the process by which cells specialise?	Differentiation
22	When does differentiation occur?	Most type of animals cells differentiate at early stages. Most types of plant cells retain ability to differentiate throughout life
23	What happens during cell differentiation?	The cell acquires different sub-cellular structures to enable it to carry out a certain function
24	What is the function of a nerve cell?	Carry electrical impulses around the body
25	Give ONE way in which the structure of the nerve cell adapted for its function	Branched to connect to other nerve cells/ Very long to carry impulses from one place to another
26	What is the function of a muscle cell?	Contract and relax to allow movement in the body of an animal
27	Give ONE way in which the structure of the muscle cell adapted for it's function	Lots of mitochondria for energy for contraction/ stores of glycogen for energy/ sliding proteins to make muscles contract
28	What is the function of a sperm cell	To carry genetic information to an egg cell for fertilisation in animals
29	Give ONE way in which the structure of the sperm cell adapted for it's function	Tail for movement, lots of mitochondria, acrosome containing enzymes to enter the egg cell
30	What is the function of root hair cells	Absorb water and minerals from the soil
31	Give ONE way in which the structure of the root hair cell adapted for it's function	Large surface area to increase absorptions, mitochondria for active transport of minerals.
32	What is the function of xylem cells	Transports tissue for water and dissolved ions
33	Give ONE way in which the structure of the xylem cell adapted for it's function	Made of dead cells with no end walls and hollow tube for continuous flow of water/ lignin for strength and support in vessel
34	What is the function of phloem cells	Transports of dissolved sugars and amino acids
35	Give ONE way in which the structure of the phloem cell adapted for it's function	Made of living cells supported by companion cells/ cell walls have holes called sieve plates/ have less organelles to aid flow of substances
36	What is cell division by mitosis?	Body cells divide to form two identical cells
37	What is the purpose of mitosis?	Growth and repair of cells
38	What happens during the first stage of the cell cycle?	Cell grow bigger as chromosomes duplicate and number of subcellular structures increase

39	What happens during mitosis?	One set of chromosomes is pulled to each end of the cell and the nucleus divides
40	What happens during the third stage of the cell cycle?	The cytoplasm and cell membrane divide, forming two identical daughter cells
41	what is a stem cell?	Undifferentiated cell that can differentiate into one or more specialised cell types
42	What are adult stem cells?	Stem cells from adults that can only differentiate into specialised cells
43	Where are adult stem cells found?	Bone marrow
44	What are embryonic stem cells?	Stem cells from embryos that can differentiate into any specialised cell
45	Where are embryonic stem cells found?	Early human embryos (usually from spare embryos from IVF)
46	What is therapeutic cloning?	patients cells are used to create an early embryo clone of themselves- stem cells from the embryo can be used to treat the patients' medical condition
47	Give one advantage of using therapeutic cloning	stem cells from the embryo are not rejected when transplanted because they have the same genes as the patient
48	Give one disadvantage of using therapeutic cloning	Use of embryos can be seen as unethical as potential life.
49	Give one advantage of using adult stem cells	Fewer ethical issues as obtained from adults who can consent to their use
50	Give one disadvantages of using adult stem cells	Can take long time for a suitable donor to be found. Can only differentiate into some specialised cell types, so treats fewer diseases.
51	Give to advantages of using embryonic stem cells	Can differentiate into any specialised cell, so can be use treat many diseases and easier to obtain as they are found in spare embryos from fertility clinics
52	Give two disadvantages of using embryonic stem cells.	ethical issues surrounding their use, as every embryo is a potential life. Potential risks involved with treatments, such as transfer viral infections
53	What are plant meristems?	area where rapid cell division occurs in the tips of roots and shoots
54	Give two advantages of using plant meristems to clone plants.	Rare species can be cloned to protect them from extinction. Plants with special features (e.g., disease resistance) can be cloned to produce many copies
55	What is diffusion?	Movement of particles from an area of higher concentration to an area of lower concentration
56	State three factors that can affect the rate of diffusion	Concentration gradient, temperature and surface area
57	What is the relationship between size of organism and surface area to volume ratio?	The larger the organism the smaller the surface area to volume ratio
58	What three factors increase the effectiveness of an exchange surface?	1. Having a large surface area 2. Having a thin membrane for short diffusion distance 3. Having an efficient blood supply and being ventilated
59	How are gills adapted for gas exchange in fish?	Each gill is made from lots of smaller plates called filaments, which themselves are covered in projections called lamellae this increases surface area. Dense capillary network ensures a good blood supply which flows in the opposite direction to water passing through the gills, this maintains concentration gradient
60	Define osmosis	Diffusion of water from a dilute solution to a concentrated solution across a partially permeable membrane
61	Define active transport	Movement of particles against a concentration gradient- from a dilute solution to a more concentrated solution-using energy from respiration
62	Give two examples of active transport	In the root hair cells of plants and the small intestines in animals

Unit Conversion



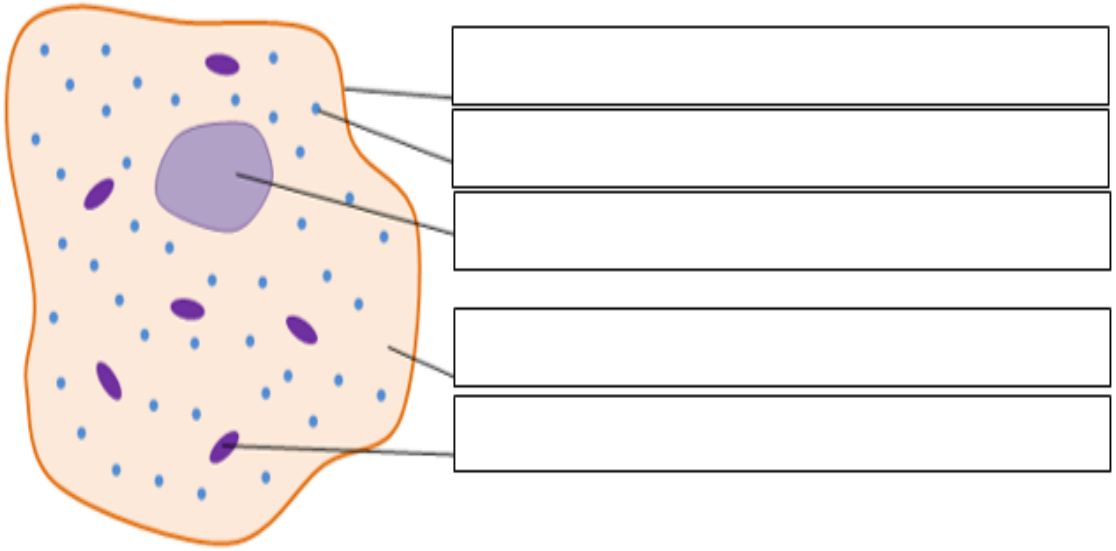
Lesson 1- Eukaryotic cells

Cells are the basic building block of an organism.
There are two different types of cells: Eukaryotic and prokaryotic.
Plant and animal cells are both eukaryotic. The way to identify Eukaryotic cells is that their DNA is enclosed within a nucleus. You will not find DNA enclosed within a nucleus in a prokaryotic cell.

The main subcellular structures within an animal cell:

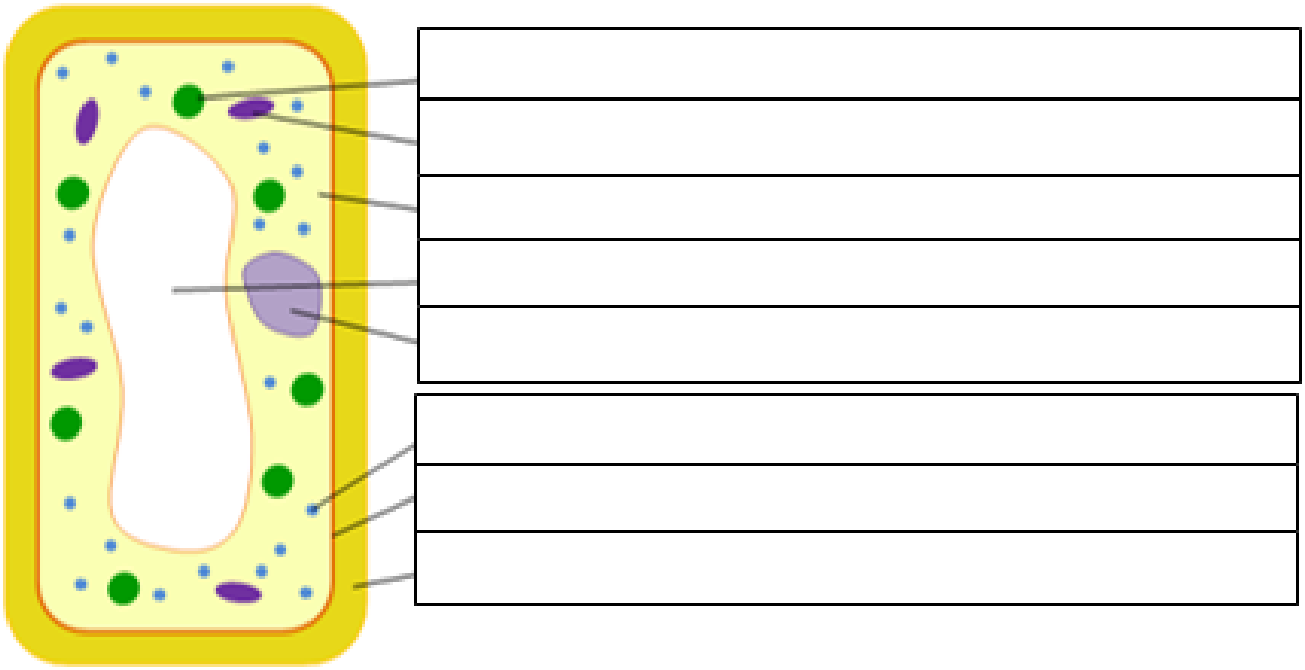
Nucleus	Contains the genetic material (DNA) which controls the activities of the cell. Has a nuclear membrane.
Cytoplasm	A gel like substance which contains all the organelles of the cell and where most chemicals reactions take place
Cell membrane	Controls entry and exit of substances e.g. exit of urea a waste substance.
Mitochondria	Site where aerobic respiration takes place to release energy for the cell
Ribosomes	Protein synthesis takes place here

1. What are the two different types of cells?
2. How is DNA organised in a eukaryotic cell?
3. Name two examples of eukaryotic cells
4. What is an organelle?
5. In which organelle does aerobic respiration take place?
6. State the word equation for aerobic respiration.
7. Why is it incorrect to say that respiration makes energy?
8. Name a reaction you've learnt about that occurs in the cytoplasm.
9. Why is the cell membrane important in animal cells?
10. Name two essential substance that enters cells via the cell membrane.
11. Name two substances that exit the cell via the cell membrane.
12. Enzymes are proteins. Explain why there are lots of ribosomes.
13. Muscles have a lot of mitochondria. Explain why.
14. Label the animal cell below:
15. Animal cells can form unicellular organisms. What is this?
16. Explain how you can identify the cell below as being eukaryotic.



Plants and algae are made up of plant cells. They have the same organelles as animals cells but have some extra organelles.	**Chloroplast**	Site of photosynthesis. Contain green pigment called chlorophyll which absorbs light.
	Permanent vacuole	Filled with cell sap. Important for keeping cells rigid to support the plant
	Cell wall	Made of a molecule called cellulose which strengthens the cell.

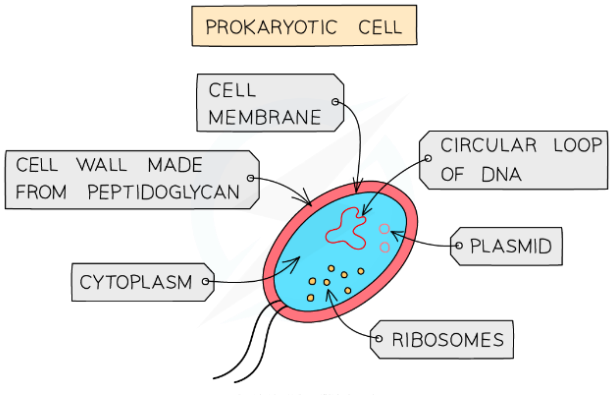
17. Why are plant cells eukaryotic?
18. Name three organelles found in plants but not in animals.
19. Name three organelles found in all eukaryotic cells?
20. In which organelle does photosynthesis take place?
21. Name the molecule found in the plant cell wall.
22. What is the function of the cell wall?
23. What is the permanent vacuole?
24. Label the plant cell below.
25. Some disease cause leaves in plants to become yellow. What part of the plant does the disease destroy?
26. An animal cell has an irregular structure/shape because it does not have an organelle that a plant has. Which organelle is this?
27. Not every plant cell contains chloroplasts. Suggest why.



28. Complete the table below with one or two ticks for each row. The first one has been done for you.

Organelle	Found in Animal Cells	Found in Plant Cells
Nucleus	✓	✓
Cell Membrane		
Cell Wall		
Permanent Vacuole		
Ribosome		
Chloroplast		
Mitochondria		
Cytoplasm		

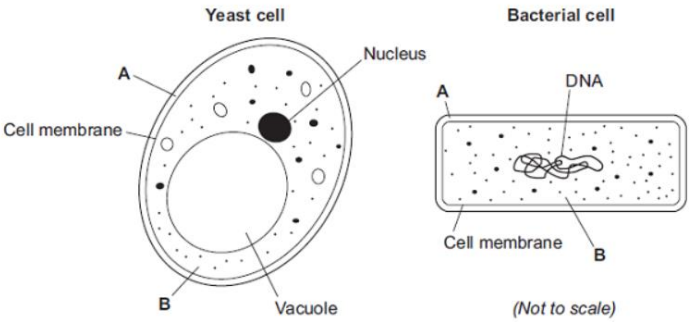
Lesson 2- Prokaryotic cells



Bacteria are single-celled organisms. They are examples of prokaryotes. They are much smaller in comparison to eukaryotes.

They have cytoplasm and a cell membrane surrounded by a cell wall. The genetic material is not enclosed in a nucleus. It is a single DNA loop and there may be one or more small rings of DNA called plasmids.

1. What is a prokaryotic cell?
2. Name an example of a prokaryotic cell.
3. How is DNA arranged differently in prokaryotic and eukaryotic cells?
4. Which cells are usually bigger, prokaryotes or eukaryotes?
5. What cell organelle do prokaryotes NOT have?
6. State the function of the above organelle.
7. Ribosomes are found in both eukaryotes and prokaryotes. What is its function?
8. Cell membrane is found in both prokaryotes and eukaryotes. State its function
9. Name two organelles found only in prokaryotes.
10. What is a plasmid?
11. Name two organelles found in both plant and bacterial cells.
12. Describe **four** differences between a bacterial and plant cell
13. Prokaryotes are always unicellular whereas eukaryotes can be unicellular or multicellular. Explain what is meant by this.
14. The cell wall in prokaryotes is made from a substance called peptidoglycan. What is the eukaryotic cell wall made from?



15. The substance you've named above is a sugar like starch. State the test for starch.
16. The diagram shows a yeast and bacterial cell
17. Name A and B
18. State two similarities between the yeast and bacterial cell
19. State two differences between the yeast and bacterial cell
20. Compare and contrast a plant and yeast cell
21. Suggest whether the yeast is a prokaryotic or eukaryotic cell. Explain your answer.
22. Both bacterial and yeast cell have a regular shape. Explain why.

23. Complete the table:

Organelle	Found in Animal Cells	Found in Plant Cells	Found in Bacteria cells
Nucleus	✓	✓	
Cell Membrane			
Cell Wall			
Plasmid			
Ribosome			
Chloroplast			
Mitochondria			
Cytoplasm			
Flagella			

Lesson 3- Microscopes

Microscopy techniques have developed over time, increasing our understanding of cell subcellular structure.

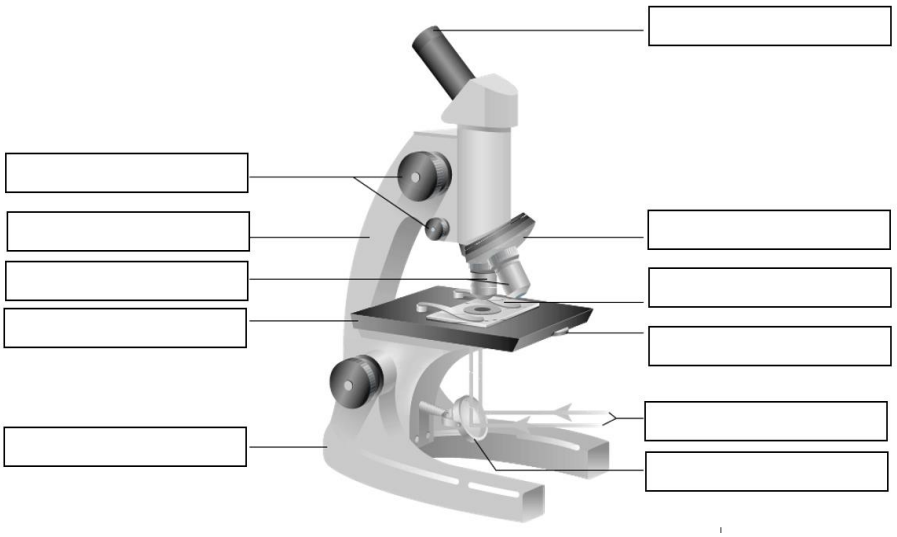
The first light microscopes were developed in the 17th Century. Scientists such as Anton van Leeuwenhoek and Robert Hooke are responsible for using microscopes to develop our first understanding of cells.

There are two types of microscopes you need to learn about: Light and Electron.

Light	Light microscopes use **light** and lenses to form a magnified image of a specimen. With a light microscope it is possible to see images of cells and large subcellular structures (like nuclei and vacuoles), although **stains** are often required to highlight certain parts of cells. You are able to view your cells in colour when using a light microscope
Electron	Electron microscopes use beams of **electrons**, rather than light, to visualise specimens The wavelength of an electron beam is much smaller than that of visible light, which gives electron microscopes a much **higher resolution** and **magnification.** They can therefore be used to study cells in much finer detail, enabling biologists to see and understand many more subcellular structures such as the mitochondrion

1. What type of specimen can be viewed under a light microscope?
2. What is a vacuum?
3. Explain why live specimen cannot be viewed under an electron microscope.
4. What is meant by the term 'resolution'?
5. What is meant by the term 'magnification'?
6. Which microscope has a higher resolution?
7. Which microscope has a higher magnification?
8. The electron microscope has helped develop our understanding of the structure of the nucleus and cell membrane. State the function of each.
9. State the sub cellular structure you would see when looking at a plant cell under a microscope that you wouldn't see when looking at an animal cell.
10. State the function of each organelle listed above.
11. Describe the advantage of using a light microscope over an electron microscope.
12. Describe the advantage of using an electron microscope over a light microscope.
13. State whether each of these statements are true or false. Correct the false statements.
    a. Light microscopes use electron beams to view specimen.
    b. You cannot view live specimen under an electron microscope
    c. Electron microscopes have a lower magnification than light microscopes
    d. When viewing specimen under a light microscope you need to use a stain/dye such as iodine
    e. Light microscopes have a higher resolution than electron microscopes
    f. Light microscopes can be used to see smaller subcellular structures
    g. Resolution is how zoomed in an image is

14. Label the light microscope below using the key words on the board:

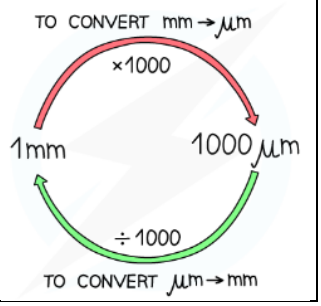


Using a light microscope:	
1.	The specimen is placed on a rectangular glass slide and a stain is added
2.	A coverslip is placed on top of the slide, and it is placed on a stage with a light source below
3.	Microscopes have three objective lenses. Always start observing an object using the lowest magnification lens first
4.	Light shines through the object and into the objective lens
5.	The light passes through the eyepiece lens and from there into your eye
6.	Use the coarse and fine focussing wheel to focus the image in view

15. What is the specimen placed on?
16. Where is the microscope slide placed?
17. What is a coverslip?
18. State the function of the above apparatus.
19. How many objective lenses are found on a microscope and what are they?
20. Which objective lens do you always start with?
21. Which focus knob do we adjust first?
22. Where is the light source in the microscope in relation to the specimen?
23. When you look under the microscope your image is blurry, what can you do?
24. Describe the path of light from the source to your eye.
25. State the disadvantages of using a light microscope.
26. What organelles can you expect to see using a light microscope?
27. You will not be able to see the mitochondria under the microscope. Explain why.
28. How can you determine whether the cell you view is prokaryotic or eukaryotic when looking at it under the microscope?

Lesson 4- Unit conversions and standard form

Next lesson we will be looking at magnification calculations.
In order to do those, we need to be able to confidently convert between different units.

You should already know how to convert between millimetres, centimetres, and metres. 1m= 100cm 1cm =10mm	Micrometres are even smaller than millimetres. **1mm= 1000µm** 1 µm = 0.001mm or 1x 10^{-3}mm To convert mm to µm x 1000 To convert from µm to mm ÷ 1000	

1. Converting between millimetres and centimetres
   a. 90cm to mm
   b. 35mm to cm
   c. 0.8cm to mm
   d. 0.5 mm to cm
   e. 0.023 mm to cm
   f. 6.7 cm to mm
   g. 0.045cm to mm

2. Converting between micrometres to millimetres
   a. 1 µm to mm
   b. 27mm to µm
   c. 2 mm to µm
   d. 18 µm to mm
   e. 150 µm to mm
   f. 46 µm to mm
   g. 234 mm to µm

3. Converting between decimals in micrometres and millimetres
   a. 0.25 µm to mm
   b. 3.4mm to µm
   c. 8.75 µm to mm
   d. 0.076 mm to µm
   e. 0.0084 µm to mm
   f. 980 mm to µm
   g. 1.56 µm to mm
   h. 0.09 mm to µm

4. Mixed practice- Challenge
   a. Convert 10cm to mm
   b. Convert 2mm to µm
   c. Convert 30 µm to mm
   d. Convert 1000mm into µm
   e. Convert 0.1 µm to m
   f. Convert 1.2 µm to cm
   g. Convert 0.145 cm to µm
   h. Convert 76µm to m
   i. Convert 860 µm to m

Standard form

When doing calculations and unit conversions, it is common to come across very big or very small numbers

Standard form can be useful when working with these numbers

Standard form is a way of writing very big and very small numbers using powers of 10

We can express 100,000 μm in standard form as **1×10^5 μm**

1 μm = 0.001mm in standard form this can be written as 1×10^{-3}mm

5. Convert these large numbers into standard form:
   a. 300 000
   b. 6 000
   c. 4 000 000
   d. 75 000
   e. 80 000 000
   f. 230 000
   g. 16 900 000
   h. 56 650 000 000

6. Convert these small numbers into standard form:
   a. 0. 001
   b. 0.0006
   c. 0.9
   d. 0.0003
   e. 0.035
   f. 0.0789
   g. 0.00067
   h. 0.000000406

Significant figures

Significant means important. The first significant digit or figure of a number is the first non-zero digit. The next digit is then called the second significant figure and so on.

You need to make sure to look at the number after the significant figure to decide if you need to round up. Don't leave out the zeros after the significant figure to ensure the number is the correct size.

Example:

Round 3692 to 1.s.f

The first non-zero digit is 3, so first significant figure is 3. But, there is a 6 next to it which means you need to round up.

Therefore, the answer is **4000 to 1.s.f**

7. Convert the answers below:
   a. 976 to 2 significant figures
   b. 93,000 to 1 significant figures
   c. 560,000 to 1 significant figures
   d. 9,500,000,000 to 1 significant figures
   e. 0.0036 converted to 1 significant figures
   f. 2.75108 converted to 3 significant figures
   g. 0.000405 to 1 significant figure
   h. 8.9762 converted to 3 significant figures
   i. 0.00893 converted to 2 significant figures
   j. 45.721 to 3 significant figures
   k. 0.0000005603 converted to 2 significant figures
   l. 890.2 to 1 significant figure

8. Complete these mixed practice questions:
   a. 329,000μm = _____μm
   b. 0. 0003μm = _____μm
   c. 0.0045μm = _____μm
   d. 9.5 mm = _____μm
   e. 0.00007mm = _____μm
   f. 256,000μm = _____mm
   g. 0.00034mm = _____μm
   h. 183,000 μm = _____mm

9. Order these numbers highest to lowest:
   - 0.9%
   - 3×10^5
   - 6.7×10^{-7}
   - 1 in 70 000
   - 3.6

Lesson 5- Magnification Calculations

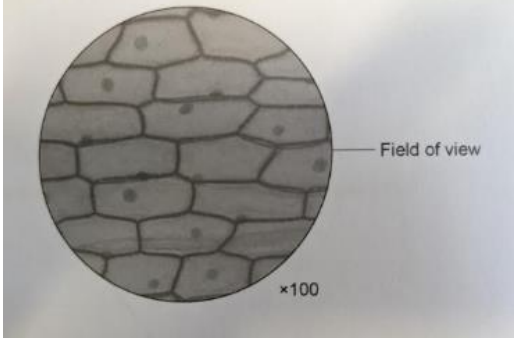
Magnification is calculated using the following equation:

$$Magnification = \frac{Image\ size}{Actual\ size}$$

Image size	The size of the magnified drawing
Actual size	The size of the object in real life, without magnification
Magnification	How much we have made the actual cell larger. As microscopes have two lenses you may be asked to calculate the **Total magnification** of the microscope: *Eyepiece lens x Objective lens*

1. Write out the equation to calculate image size
2. Write out the equation to calculate actual size
3. What is the difference between image size and actual size?
4. How do you work out the magnification of a microscope?
5. Calculate the following:
    a. Eyepiece lens x5 and objective lens x10 what is the magnification?
    b. Eyepiece lens is x10 and objective lens is x4, what is the magnification.
    c. The microscope magnification is x40 and eyepiece lens is x5. Which objective lens was used?
    d. The microscope magnification is x100 and eyepiece lens is x10. Which objective lens was used?
6. Which objective lens should you always start with when viewing a slide?
7. Which of these is the smallest unit of length?
    a. µm
    b. mm
    c. cm
8. Calculate the actual size of a sperm cell which is 50mm long under x1000 magnification.
9. Calculate the actual size of a pollen grain that looks 3cm long in the image under x100 magnification.
10. A cell has an image size of 2 mm. It is viewed with a microscope with a x80 magnification. What is the actual size?
11. If a cell is 20 µm wide and the image is 400 µm wide, what is the magnification?
12. If a cell is 32 µm wide and the image is 4800 µm, what is the magnification?
13. If magnification is 250x and object is 12 µm wide, how wide is the image?
14. A specimen is 0.3mm long and is viewed under 40x magnification. What size will the image be?
15. A cell has an image size of 0.6 cm. It is viewed with a microscope with a x20 objective lens and a x10 eyepiece lens. What is the actual size?
16. What magnification would make an image 48 µm wide from an object that is 6mm wide?
17. What magnification would make an image 4cm wide from a 2 µm object?
18. An image of a cell has a diameter of 8mm, and the actual cell has a diameter of 20 µm. What is the magnification?
19. If an image is 1mm wide and object is 2cm wide, what is the magnification?
20. A student measures an image of a cell using a ruler. It is 55mm wide and the image has been magnified by a factor of x 5000. What is the actual width of the cell in µm?
21. The root hair was viewed at a magnification of ×50. The image length of the root hair X–Y is 43 mm Calculate the real length of the root hair in micrometres (µm)
22. A cell has an actual size of 1.5 x 10^3cm. It is viewed with a microscope with a x 4.5 objective lens and a x10 eyepiece lens magnification. What is the image size in cm? Give your answer in standard form.
23. An electron microscope has a magnification of × 650 000. The length of a cell structure in an image from the electron microscope was 27 mm. Calculate the real length of this cell structure in mm. Give your answer to 2 significant figures.
24. The diagram shows a slide of onion cells. **Describe** how you could work out the mean length of cells using a microscope and a ruler. **[6 marks]**

Hint: Think about how you would get this clear image



Lesson 6- Microscope Required Practical

Aim:- Use equipment to produce a clear, focussed images of microscopic images.

Apparatus being used

- **Onion piece**
- **Cutting Tiles**
- **Scissors**
- **Microscope Slides**
- **Cover Slips**
- **Cotton bud for saliva**
- **Paper Towels**
- **Microscope**
- **Mounting Needle**
- **Iodine Solution**
- **Methylene blue**

Method for looking at <u>plant</u> cells:

1. Using a cutting tile and scissors obtain a thin layer epidermal tissue from the onion (swab inside of cheek with cotton bud for cheek cells then wipe onto slide)
2. Place a small piece of the skin onto the microscope slide.
3. Place two drops of Iodine onto the slide over the onion skin **(methylene blue for cheek cells)**
4. Use a mounting needle to lower the cover slip onto the slide.
5. Use a paper towel to remove any excess Iodine dye.
6. Use the lowest objective lens to get the microscope slide in view.
7. While looking down the eyepiece, move the stage up and down using the coarse adjustment knob.
8. Use the fine- adjustment knob to further focus until the image is clear.
9. Switch to a higher-powered objective lens and refocus if greater magnification is required.
10. Complete your microscope drawing using the rules given.

Pre-Practical Questions

1. What is the specimen placed on?
2. How many objective lenses are found on a microscope and what are they?
3. Which objective lens do you always start with?
4. What do we use to stain cheek cells and transfer them to a slide?
5. How can you obtain cheek cells?
6. What do we use to stain onion cells?
7. Why do we stain onion cells?
8. Why do we use onion skin and not a piece of onion?
9. What do we place on top of the slide which has cells on it?
10. Where do you place your prepared slide?
11. Name two safety precautions you must take with this practical

Biological drawing rules:

- When drawing your specimen, you must draw a circle first, **<u>in pencil.</u>**
- Then draw the most important part that you see through the microscope.
- On the outside of the circle, you must have the name of the specimen e.g., onion cell/cheek cell, the date, and the magnification (which lens you used).
- Use continuous lines **and** ensure no gaps in lines to draw cell walls/ membrane.
- Don't shade.
- Draw all the cells present.
- Label cell parts

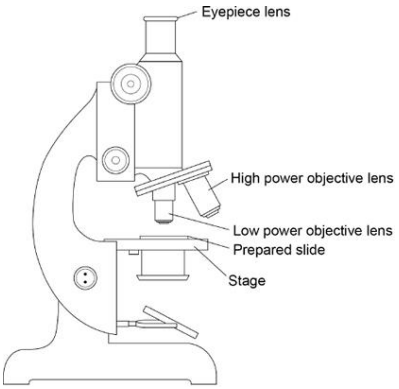
Date:
Total magnification:
Specimen:

Analysis Questions

12. State the name of the visible organelles that you could see from your diagram.
13. If the image size of a diagram is 5cm, and a magnification of x40 is used, what is the real size of the cell?
14. Explain why we can see the nucleus in the cell but not the mitochondria?
15. Which type of microscope would we need to see the smaller subcellular structures?
16. How would your onion slide look different if using the above microscope?
17. Why is it important to use a mounting needle to lower the cover slip?
18. State three rules that need to be followed when doing a biological drawing
19. A student is looking at their slide under the microscope and cannot see the image of the cell. State **3 things** the student has done wrong in their practical.
20. Describe, using bullet points, how a student can prepare a slide of a plant cell, detailing which equipment they must use.
21. A student is looking at a cell through a light microscope, what features of the cell could they use to determine whether it is a eukaryotic or a prokaryotic cell

Exam Questions

22. The figure below shows a microscope



    a. It is easier to view the cells using the low power objective lens first. Give **one** reason why. **(1)**

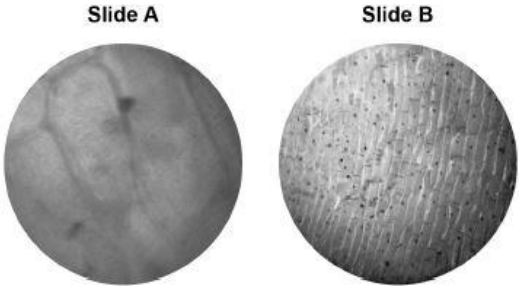
    b. To focus the image, the objective lens should be moved away from the stage.
    Give **one** reason why the objective lens should **not** be moved towards the stage. **(1)**

    c. The image of the prepared slide in **Figure 2** is viewed with the ×10 objective lens.
    The total magnification is ×5

    What was the power of the eyepiece lens used? **(1)**

    d. Root hair cells do **not** contain chloroplasts.
    Suggest **one** reason why. **(1)**

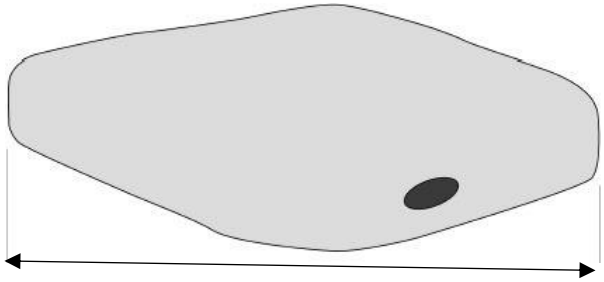
23. A student observed slides of onion cells using a microscope.
The figure shows two of the slides the student observed.



The cells on the slides are **not** clear to see.

a. Describe how the student should adjust the microscope to see the cells on Slide A more clearly. **(1)**
b. Describe how the student should adjust the microscope to see the cells on Slide B more clearly. **(2)**
c. The student made the necessary adjustments to get a clear image.

The figure shows the student's drawing of one of the cells.



The real length of the cell was 280 micrometres (μm). Calculate the magnification of the drawing.

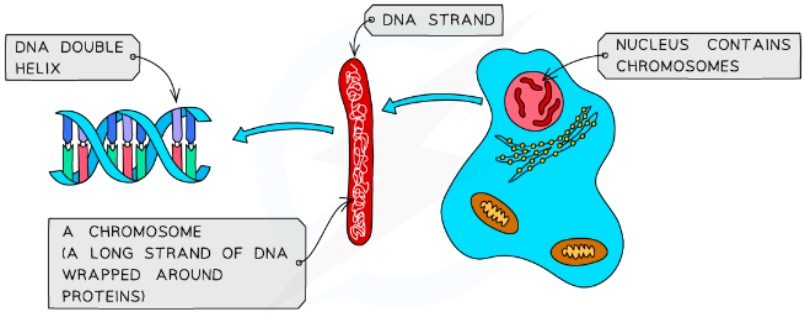
(3)

Lesson 7- Cell Cycle

In eukaryotic cells, the nucleus contains thread-like structures called chromosomes.

Chromosomes are made from highly coiled strands of relatively long DNA. In the body cells of **diploid** organisms, chromosomes are normally found in pairs.

One chromosome from each pair is inherited from the mother, the other from the father. In humans there are **23 pairs** of chromosomes.

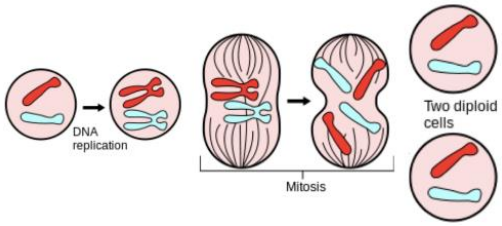


Before a cell can divide, its genetic material needs to be doubled. **Once it doubles** this is when it becomes its characteristic 'X' shape we see in microscope images of cells preparing to divide

1. In which organelle is DNA found?
2. Which type of cells do not have the above organelle
3. What are chromosomes?
4. Why are chromosomes found in pairs in the nucleus?
5. What is meant by a 'diploid' cell?
6. Gametes have half the genetic material that a normal body cell. What are gametes?
7. If a horse has 64 chromosomes in its diploid cell. How many in its gametes?
8. Name two examples
9. Describe the differences between a prokaryotic and eukaryotic cell.
10. Name the stain used to see animal cells.
11. Describe how you could prepare an animal cell to look at its nucleus under a microscope.
12. Describe how you would measure the length of the nucleus under a microscope.

Cells divide in a series of stages called the cell cycle. During the cell cycle the genetic material is doubled and then divided into **two identical cells.**

Cell division by mitosis is important in the growth and development of multicellular organisms.
The cell cycle can be split into two stages:



Stage 1-	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.
Stage 2-	This stage is called mitosis. The paired up chromosomes are pulled to each end of the cell and the **nucleus divides**.
Stage 3-	In the final stage the **cytoplasm and cell membranes divide** to form two identical cells.

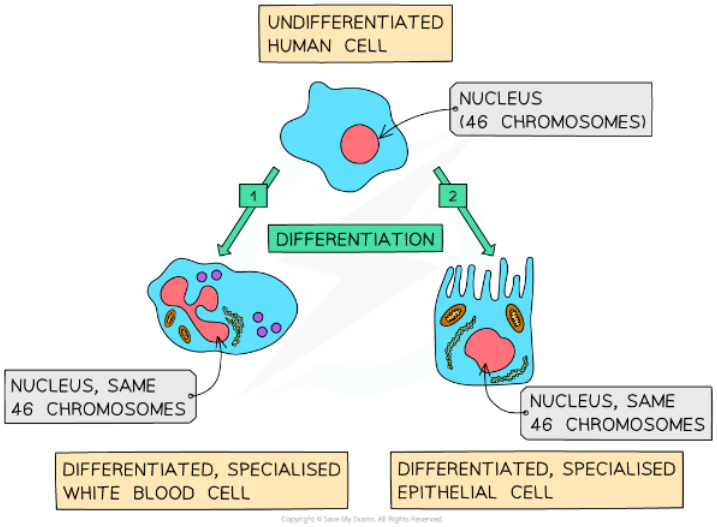
13. How many stages is the cell cycle split into?
14. What is formed at the end of the cell cycle?
15. What happens in stage one of the cell cycle?
16. What is the name given to the process that occurs during stage two of the cell cycle?
17. What is multicellular organism?
18. Why is mitosis important
19. Describe what happens during stage two of the cell cycle.
20. State the function of the cytoplasm and cell membrane.
21. Describe what happens during stage 3 of the cell cycle.
22. Correct the false statements below.
    a. Stage 3 is where the nucleus divides.
    b. During mitosis the cell membrane splits
    c. Cell cycle produce 2 genetically different cells.
    d. In the final stage of mitosis, the cytoplasm and cell membrane splits
    e. In mitosis the chromosomes double and are pulled to opposite ends of the cell
    f. Prokaryotic cells form multicellular organisms.
23. What is mitosis?
24. Explain why DNA replication and organelle duplication before mitosis is important.

Lesson 8- Stem cells and Differentiation

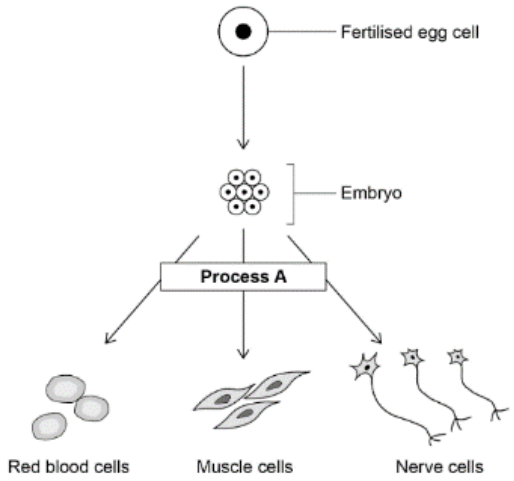
Cell differentiation is an important process by which a cell changes to become specialised. As a multicellular organism develops, its cells **differentiate** to form specialised cells.

When a cell differentiates, it develops a structure and com position of subcellular structures which enables it to carry out a certain function.

Structural differences between different specialised cells enables them to perform specific functions within the organism. For example, to form red blood cells the undifferentiated cell must form a biconcave shape and not have a nucleus to carry out its function of carrying oxygen.



1. What is differentiation?
2. When does cell differentiation happen in animals?
3. Name 3 specialised cells you've learnt about at KS3
4. Describe the adaptations for one of the above
5. What happens during the process of differentiation?
6. Why is cell differentiation important?
7. What is a zygote?
8. How many chromosomes in the cell of a human zygote?
9. What is an embryo?
10. Once the zygote is formed how does it become an embryo?
11. Once a specialised cell is made, how are more formed?
12. Why is cell specialisation (differentiation) important for the development and growth of a healthy baby from a fertilised egg?
13. State the function of ribosomes.
14. Ribosomes are important for cell differentiation. Suggest why.
15. Name process A shown in the diagram



A **stem cell** is an **undifferentiated** cell of an organism which is capable of dividing (giving rise) to many more cells of the same type (undifferentiated stem cells). From these cells, other cells can arise through the process of **differentiation**.

Animal cells therefore lose their ability to differentiate after they have become specialised. Most cells differentiate at an early stage of development so, in mature animals, cell division mainly only occurs for repair and replacement.

There are **exceptions**. Some cells in various locations throughout the body of an animal retain the ability to differentiate throughout the life of the animal. These cells are called **adult stem cells** and are mainly involved in replacing and repairing cells (such as blood or skin cells)

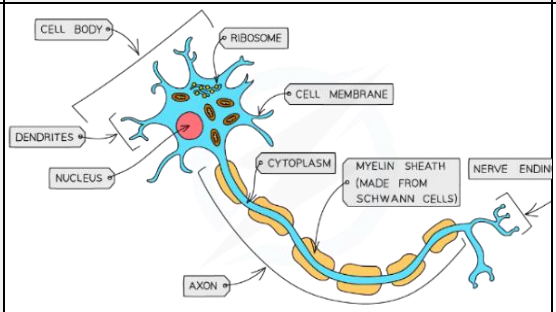
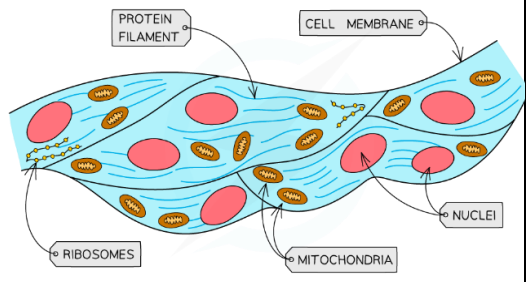
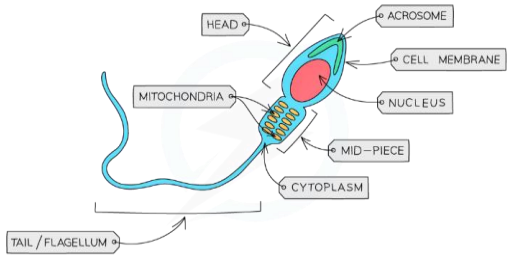
Plants differ from animals.

Many types of plant cell retain the ability to fully differentiate throughout the life of a plant, not just in the early stages of development.

16. What is a stem cell?
17. How does a stem cell become a specialised cell?
18. Describe the process by which a stem cell gives rise to many more stem cells.
19. Give two roles of cell division.
20. What is cell division by mitosis?
21. Describe a mature animal cell's ability to differentiate.
22. What are adult stem cells?
23. Describe how plant's ability to differentiate is different to animals.
24. A stem cell specialises into a red blood cell. Describe how this would happen.
25. John says red blood cells are prokaryotic because they have no nucleus. Explain why he is wrong.

Lesson 9- Specialised Cells: Animals

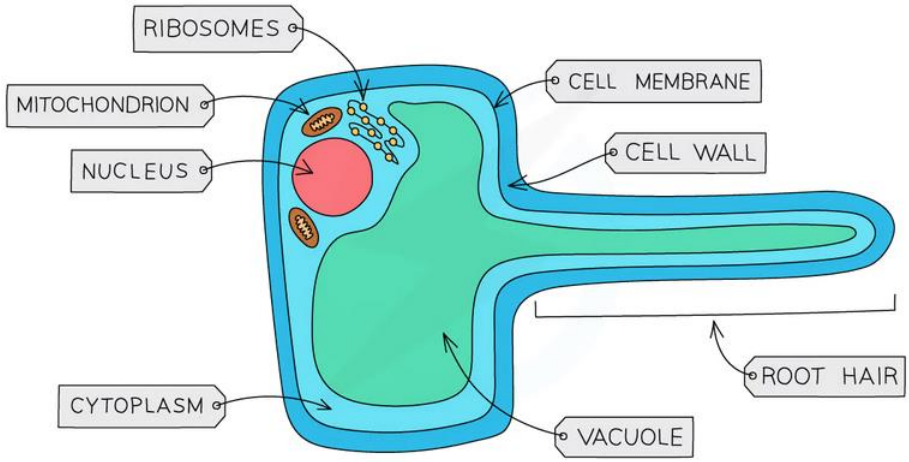
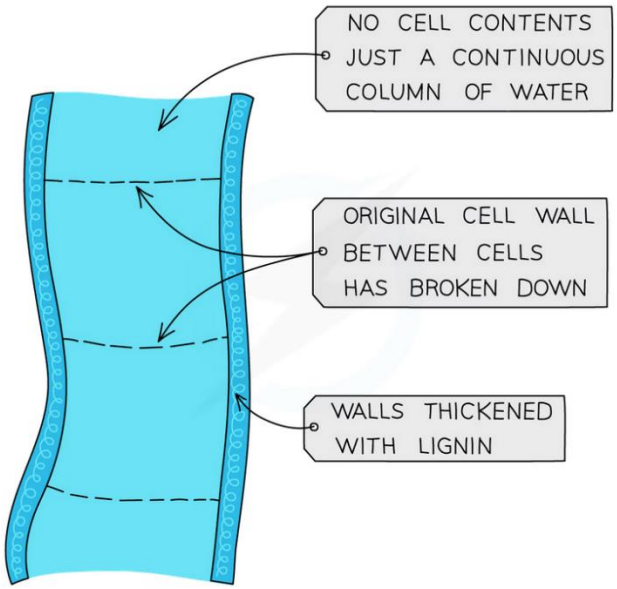
Humans are multicellular. That means we are made of lots of cells, not just one cell. In **early development** stem cells must **differentiate** into hundreds of different specialised cells. The animal cell you have learnt about is just the general animal cell, but **animal cells have to be specialised in order to carry out their function properly.**

	Diagram	Function	Adaptations
Nerve Cell		Transmit Electrical impulses	• Axon is long so it can carry signals over large distances quickly. • It has branched connections at the ends called dendrites. This allows nerve cells to communicate and quickly pass signals to each other. • Has a fatty (Myelin) Sheath surrounds nerve cell. This increases speed at which message can travel
Muscle Cell		Contract and move parts of body (like bones)	There are three different types of muscle in animals: skeletal, smooth, and cardiac. • All muscle cells have layers of protein filaments in them. These layers can slide over each other causing muscle contraction. • Large store of glycogen (can be broken down into glucose) • Have lots of mitochondria for release energy for muscle contraction
Sperm Cell		Swim to the egg, get through the egg cell membrane and fertilise it.	• Enzymes in acrosome (vesicle in the head of the sperm) to digest egg cell membrane to fertilise the egg cell. • Mitochondria in Midpiece which releases energy for the sperm to swim. • Long Tail which helps the sperm cell swim.

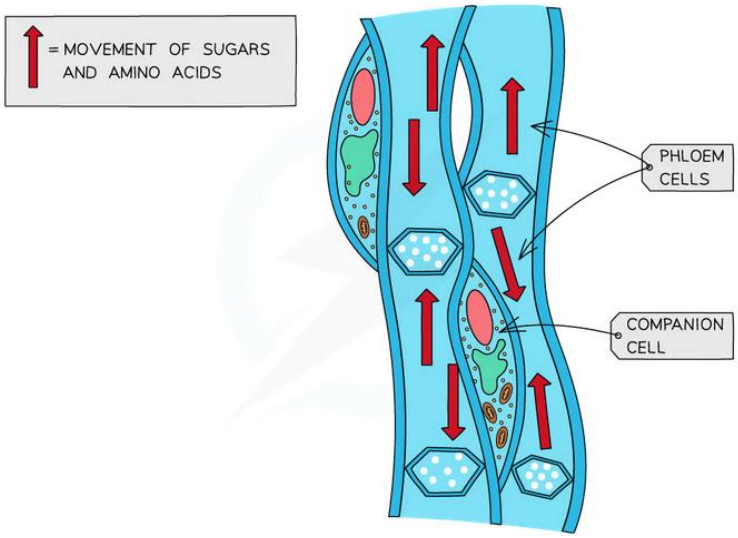
1. What is a specialised cell?
2. Name 3 specialised animal cells
3. Name the organ system that each of the above cells are found in.
4. What is the name given to an unspecialised cell?
5. Name the process by which a cell specialises.
6. What is the purpose of having specialised cells?
7. What is the function of nerve cells?
8. Why are nerve cells very long?
9. Why do nerve cells have a fatty sheath that surrounds them?
10. How do nerve cells communicate with each other?
11. State the function of muscle cells.
12. Which organelle is found in a large amount in a muscle cell?
13. Why is it helpful to have lots of the above organelle in a muscle cell?
14. Why do muscle cells have a large store of glycogen?
15. State the function of a sperm cell.
16. What are chromosomes?
17. How many chromosomes are found in a sperm cell?
18. A sperm cell has a long tail. Why do sperm cells have a long tail?
19. A sperm cell has a long tail. Describe the other adaptations of a sperm cell.
20. Muscle cells contain lots of mitochondria, which chemical reaction happens in mitochondria?
21. State the word equation for the above
22. Describe the structure and function of muscle cells.
23. Describe the structure and function of nerve cells.
24. A muscle cell cannot fertilise an egg cell. Explain why.
25. Explain the process of differentiation.
26. What is the function of the cell cycle?
27. When you are growing, your muscles also grow. Explain how muscle tissue grows.

Lesson 10- Specialised Cells: Plants

Each organ of a plant is made up of specialised cells and tissues. The **roots** are composed of **root hair cells** which absorb nutrients and water from the soil. The **stem** is made up of the **xylem** and **phloem** which help to transport water and nutrients throughout the plant. The **leaf** is composed of **palisade cells**, these have lots of chloroplasts to maximize light absorption for photosynthesis.

<table>
<tr><th colspan="2">Root Hair Cell</th></tr>
<tr><td>Diagram</td><td> 
</td></tr>
<tr><td>Function</td><td>Adaptations</td></tr>
<tr><td>Absorbs water and nutrients from the soil</td><td>• Has root hairs which create a large surface area so it can absorb lots of water and minerals.
• Thinner walls than other plant cells so that water can move through easily (due to shorter diffusion distance)
• Has many mitochondria for the process of active transport which requires energy</td></tr>
<tr><th colspan="2">Xylem Vessel</th></tr>
<tr><td>Diagram</td><td> 
</td></tr>
<tr><td>Function</td><td>Adaptations</td></tr>
<tr><td>Transports water and minerals from roots to leaves</td><td>• Xylem vessels forms long continuous columns as they have no end walls
• Cells are dead so there are hollow with no organelles to allow space for more water flow
• Outer walls are thickened with a substance called lignin, strengthening the tubes, which helps support the plant</td></tr>
</table>

Phloem Cells

Diagram	
	
Function	**Adaptations**
Transport dissolved sugars and amino acids around the plant	• Made of living cells- called sieve tube cells • They have sieve plates at end of each cell which has holes which allows sugars and amino acids to move from cell to cell • They have companion cells for support as these cells provide energy for active transport of sugars • They have very few organelles like cytoplasm but no nucleus, to maximise space for movement of dissolved sugars

1. Name three plant organs
2. Name three specialised cells found in plants
3. Which plant cells are involved in the absorption of water from the soil?
4. Which plant cells are involved in the transport of dissolved sugars
5. List 3 organelles that are present in plant cells but not animal
6. State the function of xylem cells
7. Why are xylem cells hollow?
8. What is lignin and where is it found?
9. State the function of the phloem
10. Give two ways in which sieve tube cells are adapted for their function
11. What are companion cells?
12. Why do cells in the roots have root hairs?
13. Explain why root hair cells have lots of mitochondria
14. Suggest why root hair cells do not have chloroplasts
15. Give two ways in which root hair cells are adapted for their function
16. Explain why sugars are transported around the plant
17. Describe how the xylem are adapted for their function
18. Compare and contrast the structure and function of the xylem and phloem
19. Cells in the tips of roots are actively dividing. Describe the steps in the cell cycle that allow the roots to grow
20. Describe how a root hair cell could be viewed under a microscope

Lesson 11- Uses of stem cells

A stem cell is an undifferentiated cell of an organism which is capable of giving rise to many more cells of the same type, and from which certain other cells can arise from differentiation.

There are 3 different types of stem cells you need to know about:

Embryonic stem cell	Embryonic stem, cells are important as they help to form all the different tissues and organs needed during the development of an individual. Stem cells from human embryos can be cloned and made to differentiate into most different types of human cells. Stem cells are extracted from discarded embryos from the process of IVF.
Adult stem cell	Stem cells from adult bone marrow are limited in their ability to differentiate. They mainly form cells of the blood- red blood cells and white blood cells (immune system)
Meristem cells	Meristem tissue in plants can differentiate into any type of plant cell, throughout the life of the plant. Cells from meristems in plants can be used to produce clones of plants quickly and economically. The advantages of this are: - Rare species can be cloned to protect from extinction. - Crop plants with special features such as disease resistance can be cloned to produce large numbers of identical plants for farmers.

1. What are stem cells?
2. In animals **when** do most stem cells undergo differentiation?
3. Name three specialised animal cells a stem cell could differentiate into
4. Describe how stem cells become specialised cells.
5. By what process would stem cells divide to form more copies?
6. What is an embryo?
7. What is the source of embryos for stem cells?
8. What is the dividing potential of an embryonic stem cell?
9. Describe the role of embryonic stem cells.
10. Where can adult stem cells be found?
11. What are the main types of cells that adult stem cells can differentiate into?
12. Recall the function of white and red blood cells.
13. Compare and contrast embryonic and adult stem cells.
14. What are meristem cells?
15. Where can these be found in a plant?
16. In plants, when can cells differentiate?
17. State two uses of plant cloning
18. Explain the differences between animals and plant stem cells

Using stem cells in medicine

Treatment with stem cells may be able to help conditions such as diabetes and paralysis. Stem cells for treatment can be obtained from embryos, bone marrow or obtained from a process called therapeutic cloning.

Therapeutic cloning is a process by which stem cells are made with the same genes as the patient.
Cells from a patient's body are used to create a cloned early embryo of themselves. Stem cells from this embryo can be used for medical treatments and growing new organs.

Stem cells created in this way are not rejected by the patient's body. The patient also wouldn't have to take immunosuppressants. These are drugs given to patients that supress the immune system so that foreign tissue is not rejected. The disadvantage of taking this drug is that it makes you more prone to disease.

Benefits of using stem cells	Risks of using stem cells	Issues with use of stem cells
Great potential to treat a wide variety of diseases such as paralysis Organs developed form a patient's own stem cells (Adult or from therapeutic cloning) reduces the risk of organ rejection and the **need to wait** for an organ donation. Also adults can consent to their stem cells being removed.	- Stem cells cultured in the lab could become infected with a virus which could we transmitted to the patient - There is a risk of cultured stem cells developing into cancer cells. - Low number of stem cell/egg donors	✓ Embryos from IVF or the ones made from therapeutic cloning are discarded once the stem cells have been extracted. This could have been a potential life. ✓ No consent given by embryo

19. Name two diseases that can be treated using stem cells.
20. Suggest why scientists use stem cells for treatment of diseases.
21. What is therapeutic cloning?
22. How are the embryonic stem cells obtained from therapeutic cloning identical to the patient's DNA?
23. What are immunosuppressants?
24. Explain why someone would need to take the medication above.
25. State two advantages of therapeutic cloning
26. State two disadvantages of therapeutic cloning
27. Give one advantage of using adult stem cells
28. Give two disadvantages of using adult stem cells
29. Give two advantages of using embryonic stem cells
30. Give two disadvantages of using embryonic stem cells
31. Paralysis is caused by damage to nerve cells. Describe the structure and function of nerve cells
32. Describe how stem cells could be cultured to treat someone with paralysis.
33. Describe in simple terms how nerve cells genetically identical to a patient could be obtained.
34. Suggest why it is ethically more acceptable to take stem cells from an umbilical cord instead of using stem cells from a 4-day-old embryo produced by In Vitro Fertilisation (IVF).
35. Give one advantage of using the child's own umbilical cord stem cells instead of using stem cells donated from another person.
36. Why would it not be possible to treat a genetic disorder in a child using his own umbilical cord stem cells?

Lesson 12: Diffusion

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

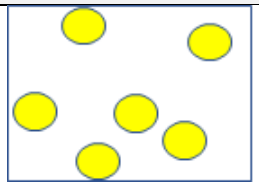
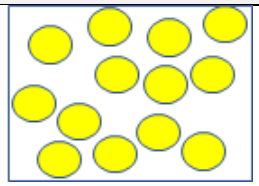
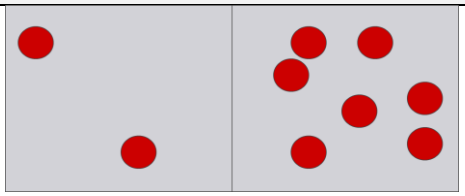
Diffusion is the movement of particles from an area of higher concentration to an area of lower concentration.

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.

Diffusion:

- Does not require energy.
- Diffusion can only happen in fluids (liquids and gases).
- Particles move **down** a concentration gradient (from high to low).

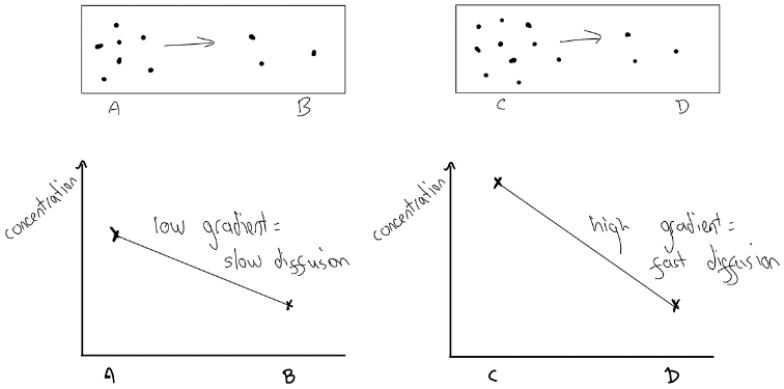
1. Define diffusion.
2. Diffusion can only happen in which two states of matter?
3. Does diffusion require energy for the process to take place?
4. In what state of matter does diffusion happen **quickest**?
5. By what process does oxygen enter red blood cells?
6. Name two waste substances that diffuse out of cells in the blood
7. Describe how each of these waste substances are removed from the body
8. Name two useful substances that diffuse from the blood into cells
9. Why does carbon dioxide diffuse into plant cells?
10. When you breathe in, does the alveoli have a high or low concentration of oxygen?
11. Complete the question in the table using the images to help you.

(a)		(b)	
			
Higher Concentration	Left Side | Right Side	**Higher Concentration**	Left Side | Right Side
Direction particles move?	To the left | To the right	**Direction particles move?**	To the left | To the right

The rate of diffusion is linked to how fast and easily the particles can move. This is very important in biology as particles need to move in and out of cells for organisms to be able to function. How quickly particles move depends on three factors outlined below:

Concentration Gradient	The greater the difference in concentration, the quicker the rate of diffusion
Temperature	The higher the temperature the more kinetic energy the particles have which means they move faster.
Surface Area of the Membrane	A membrane with a greater surface area will have a greater rate of diffusion across it as there are more " entry and exit points".

12. What is meant by the 'rate' of diffusion
13. State three factors that affect the rate of diffusion.
14. State the function of the cell membrane.
15. Describe how surface area affects the rate of diffusion
16. In the diagram to the right, explain why the rate of diffusion from A to B is higher than the rate from C to D, use the term *concentration gradient* in your answer.
17. Look at the diagram below; use the diagrams to answer the following questions.



a. Will diffusion happen from A to B or from B to A?
b. Will diffusion happen from C to D or from D to C?
c. Will diffusion be quicker in A and B or in C and D? Explain your answer.
d. Draw a concentration gradient diagram, like the examples shown above, to show what A and B are like after they have been left for a long time

18. What happens to the movement of particles as temperature increases?
19. Explain your answer for the above questions.
20. **Describe** the effect of temperature on the rate of diffusion.
21. **Explain** the effect of temperature on the rate of diffusion.
22. Explain why the exchange of oxygen and carbon dioxide in the lungs is rapid.
    Use the words: Concentration gradient, alveoli, blood, oxygen, carbon dioxide, high**er** concentration, low**er** concentration
23. A student says *"if the particles are all spread out evenly, diffusion has finished and the particles stop moving."* Explain why the student is wrong.

Lesson 13- Surface area to volume ratio

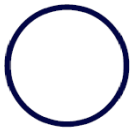
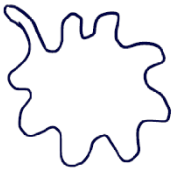
Surface Area and **Volume** are both very important factors in the **exchange of materials** in organisms.

Surface Area	Total area of the organism that is exposed to the external environment.
Volume	Total amount of space inside the organism

The surface area to volume ratio of an organism affects how easily substances can be exchanged between it, and its environment. Most bacteria are single-celled organisms. Bacteria have large surface area in comparison to their volume:

- This means that the distance between the cell membrane at a bacterial cell's surface, and the centre of the cell, is relatively low
- Substances do not have to travel very far to get where they are needed, so transport by diffusion, osmosis or active transport alone is **sufficient** for the cell to meet its needs

1. What does the term **surface area** mean in relation to organisms?
2. What does the term **volume** mean in relation to organisms?
3. What is an **exchange surface**?
4. What is the function of the cell membrane?
5. What is a unicellular organism?
6. State the name of two examples of unicellular organisms.
7. Look at the differing cells below.
    a. Which cell has the smallest surface area?
    b. Which cell has the greatest surface area?

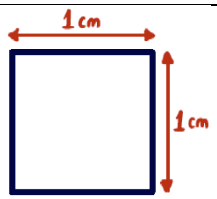
W	X	Y	Z
			

8. Look at the differing cells below.
    a. Which cell has the greatest surface area?
    b. Which cell has the smallest surface area?

A	B	C	D
			

Calculating Surface Area and Volume

You would have learnt in maths how to calculate the area and volume of differing shapes, you will need to do this in biology as well.



Calculating Area (measured in cm^2)

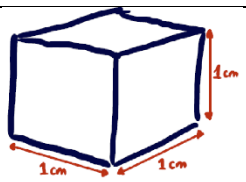
Area of 1 square = length x width

Area of 1 square = 1cm x 1cm

Area of 1 square = **$1cm^2$.**

Area of Cube = 6 x $1cm^3$

Total Area of Cube = $6cm^3$

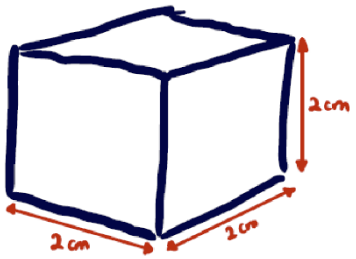
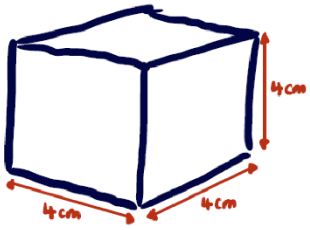
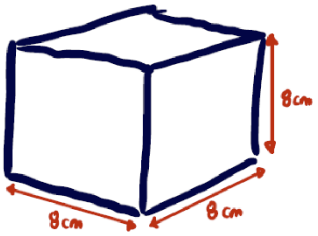


Calculating Volume (measured in cm^3)

Volume of Cuboid = length x width x height

Volume of Cuboid = 1 x 1 x 1

Volume of Cuboid = **$1cm^3$**.

(a)	(b)	(c)
		

9. For each cube calculate the **total** surface area and volume
10. Which of the above squares has the largest surface area?
11. Which of the above squares has the lowest surface area?
12. Which of the above squares would be able to have the most substances entering it at the same time?
13. Compare the surface area to volume ratio of a bacterial cell and a polar bear
14. The ratio gives us an idea of how much of the surface of an object is exposed to the external environment relative to it's volume. Calculate the surface area to volume ratio for the following and ensure your answer is simplified as much as possible:
    a. If a cell has an area of $24cm^3$ but a volume of $8cm^3$.
    b. If a cell has a total area of $96cm^2$, but a volume of $64cm^3$.
    c. What has happened to the surface area to volume ratio as the cell has got larger?

Large, multicellular organisms like humans have relatively small surface area to volume ratio. This means that the distance between the surface of the organism to its centre is relatively large.

This is why larger organisms usually have specialised exchange surfaces and transport systems; as diffusion, osmosis and active transport cannot happen sufficiently to meet a larger organism's needs due their **high metabolism**.

The effectiveness of an exchange surface is increased by:

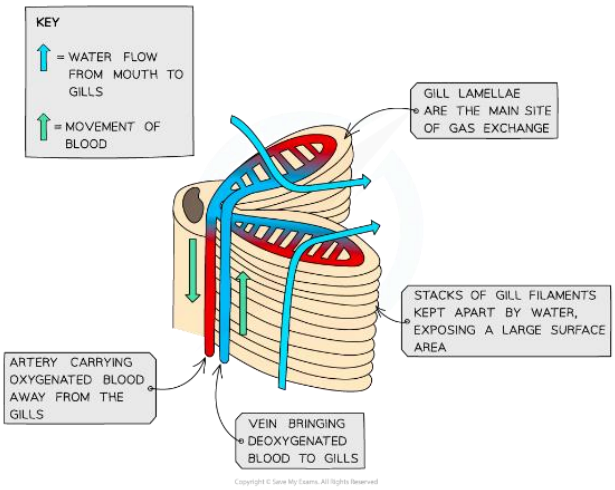
- Having a large surface area
- A membrane that is thin, to provide a short diffusion distance/path
- (in animals) having an efficient blood supply to maintain concentration gradient
- (in animals) gas exchange surfaces that are well ventilated to maintain concentration gradient

Over the course of your biology lessons, you will learn about the different exchange surfaces in plants and animals and how they're adapted. A specific example you need to learn is how fish are adapted for gaseous exchange.

Fish have gills which are responsible for Gas exchange between water flowing through the gills and the blood, to supply cells with oxygen for aerobic respiration and to remove the waste product carbon dioxide.

How the gills are adapted:

- Each gill is made from lots of smaller plates called filaments, which themselves are covered in projections called lamellae – this increases SA
- Dense capillary network ensures a good blood supply which flows in the opposite direction to water passing through the gills – this maintains a concentration gradient



15. Name two multicellular organisms
16. Compare the surface area to volume ratio of unicellular and multicellular organisms
17. Explain how multicellular organisms ensure they have a sufficient supply of substances
18. Explain why diffusion would be insufficient in multicellular organisms
19. State 3 ways to increase the effectiveness of an exchange surface
20. Explain why having a thin membrane increases the rate of diffusion
21. Describe how roots in plants are adapted for exchange
22. State the function of gills
23. Name the structures which increase the surface are of gills

24. Describe the flow of blood along the gills
25. State two ways in which the gills are adapted for gas exchange
26. Where does gas exchange take place in mammals?

Review questions:

1. Draw a plant and animal cell. Label the organelles present.
2. Compare a eukaryotic and prokaryotic cell.
3. State the equation to calculate magnification.
4. Convert 5mm into μm
5. Describe the steps you need to take to view an onion cell under a microscope.
6. Describe the stages of the cell cycle.
7. What is a stem cell?
8. Describe the process of differentiation that occurs during the early development of an organism.
9. Describe the structure and function of three specialised animal cells.
10. Describe the structure and function of three specialised plant cells.
11. State two sources of stem cells
12. State two advantages of using stem cells in medicine.
13. State three disadvantages of using stem cells in medicine.
14. Define diffusion.
15. State three factors that affect the rate of diffusion.
16. Describe how surface area to volume ratio affects the rate of diffusion.

Lesson 15: Osmosis

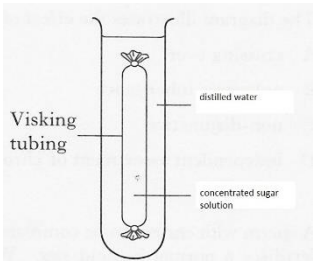
Water may move across cell membranes via osmosis. Osmosis is the diffusion of water from a dilute solution to a concentrated solution through a **partially permeable** membrane.

A dilute solution	Solution with a high concentration of water molecules and a low concentration of solute molecules
A concentrated solution	Solution with low concentration of water molecules and a high concentration of solute molecules

Plant and animal cells behave differently when placed in water. This is because plants have cell walls that prevent them from bursting. When water enters, the vacuole gets bigger and pushes against the cell membrane and wall. This makes the plant cell rigid and strong. Animal cells don't have cell walls so entry of water could cause them to burst.

Plant tissue in concentrated solution:	Plant tissue in dilute solution:
When plant tissue/cells are placed in concentrated solutions, water moves out of the plant cell via the **partially permeable** membrane into the concentrated solution. The plant tissue **decreases in mass** due to loss of water by **osmosis**.	When plant cells/tissue are placed in dilute solution or pure water, water moves into the plant cell across the **partially permeable** membrane into the concentrated solution in the plant cell. The plant tissue **increases in mass** as it gains water via **osmosis**.

1. Name the cell structure that controls the movement of materials into and out of the cell
2. What is a solute?
3. What is concentrated solution?
4. What is a dilute solution?
5. Which solution has more water, dilute or concentrated?
6. Define osmosis
7. Osmosis is a **passive** process, what does this mean?
8. Why is the membrane called 'partially permeable'?
9. Using your knowledge of what happens when plant cells are placed in water. Explain what would happen when:
   a. Animal cells is placed in a dilute solution
   b. Animal cell is places in a concentrated solution
10. What will happen to the mass of plant tissue if the solute concentration in the tissue is equal to the solute concentration in the plant.
11. Xylem vessels transport water. Describe the structure of xylem vessels.
12. Compare the structure of a plant and animal cell
13. Compare animal and plant's ability to differentiate.
14. Explain why an animal cell bursts when placed in a very concentred solution but a plant cell doesn't
15. Look at the diagram. Predict what will happen to the size of the visking tube after 30 minutes.



16. A student wants to investigate osmosis. A carrot was placed in a dilute solution.
    a. What will happen to its mass? Explain your answer.
    b. The carrot was placed in 0.4 mol/dm3 solution. Its mass did not change. Explain why this happened.
    c. What does this tell us about the concentration of the carrot?
    d. The carrot was placed in a concentrated solution. What will happen to its mass? Explain your answer.
17. Explain your answer for the above using the words dilute, concentrated and osmosis.
18. Explain how you can determine the concentration of solutes in plant tissue
19. Correct the false statements below:
    a. Water moves from an area of low solute concentration to an area of high solute concentration
    b. Water moves through a semi permeable membrane
    c. If a plant cell is placed in a concentrated solution it bursts
    d. A potato would decrease in mass when placed in a dilute solution
    e. If plant tissue doesn't change in mass, it's because it's in a concentrated solution
20. Fish are found in water; explain how they are adapted for gas exchange.
21. Explain why osmosis is a passive process. Use the words concentration gradient.
22. Explain how the vacuole helps plants remain upright

Lesson 16: Osmosis Required Practical

Aim:- To investigate the effect of solution concentration on mass of plant tissue (Potato)

Apparatus being used

- **Plant tissue (potatoes/carrot)**
- **Range of sugar concentrations**
- **Distilled (pure) water**
- **Cork borer**
- **Foil**
- **Stop clock**
- **White tile**
- **Filter paper**
- **Tweezers**
- **Boiling tubes & measuring cylinders**
- **Ruler**
- **Mass balance**

Method for looking at plant cells:

1. Use a cork borer to cut 5 vegetable cylinders and ensure they are cut the same length
2. Dry each cylinder with filter paper and then measure its mass using a mass balance. Record value in table
3. Measure 10cm^3 of each concentration of sugar solution into **labelled** boiling tubes.
4. Add one vegetable cylinder into each boiling tube and start the stop- clock. Place foil over your boiling tube.
5. After 20 minutes, remove the vegetable cylinders from the sugar solution using tweezers
6. Immediately **dry** each cylinder using filter paper and **re-weigh** it using mass balance
7. Record the mass after in your table and then calculate the percentage change in mass

$$\%\ Change\ in\ mass = \frac{change\ in\ mass}{initial\ mass} \times 100$$

Pre-Practical Questions

1. Define osmosis
2. Define the following key words:
    a. Hypertonic
    b. Hypotonic
    c. Isotonic
3. State the independent variable in your investigation
4. State the dependent variable in your investigation
5. State 3 variables you will control
6. State three factors that affect the rate of osmosis (same as diffusion)
7. Which factor are you investigating today?
8. State your hypothesis (*The higher the concentration of solution the ….)*
9. Name the apparatus used
10. Explain why the skin is removed from the potato before coring them
11. **Describe** how you will calculate the % change in mass
12. What would cause an increase in potato mass?
13. What would cause a decrease in potato mass?
14. When you draw your graph of results state what will go on the X and Y axis

Results

Concentration of solution in mol/dm^3	Mass before (g)	Mass after (g)	Change in mass(g)	Percentage change in mass %

Analysis Questions

15. Draw a graph showing your results
16. Using your graph, estimate the concentration of sugar in the potato- the point at which the solution is isotonic
17. Explain why you dried your potato when you took it out of the solution before re-weighing
18. Explain why the mass of potato increased in the 0.2mol/dm^3 solution
19. Explain why the relationship between solution concentration and % change in mass
20. Describe how you could investigate the effect of surface area on the **rate** of osmosis
21. Potato cells contains starch grains. A starch grain on a different image had a diameter of 1.2 cm. The starch grain had a real diameter of 0.008 µm. Calculate the magnification of the image

Exam questions

22. Two groups of students carried out a version of the experiment in exactly the same way but produced different results.
    Evaluate the methods the two groups used.

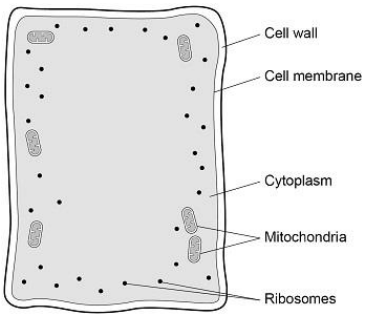
Group A

- Used one potato for the whole experiment
- Weighed each individual potato core before placing in solution
- Timed exactly 5 minutes before removing the samples
- Weighed the cores immediately after removing from solution

Group B

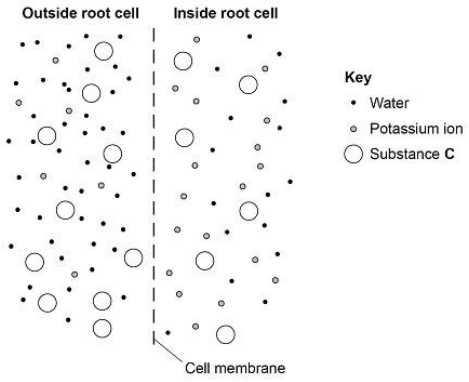
- Took each core from a different potato
- Weighed one core before and used this as the 'before' weight for all samples
- Didn't time the experiment
- Dried the samples before weighing them

23. Figure 1 shows some parts of a plant leaf cell.



    a. Name **three** parts of a plant leaf cell that are missing from Figure 1. **(3)**
    b. What is the function of the cell wall in a plant cell. **(1)**

Root cells absorb substances from the soil. **Figure 2** shows the concentration of different substances outside a root cell and inside a root cell.



    c. The cell membrane of a plant cell is partially permeable. What does partially permeable mean? **(1)**
    d. By what process does water move into the root cell in Figure 2? **(1)**
    e. Explain why substance **C** in Figure 2 does **not** move into the root cell. **(2)**

A student investigated the effect of different concentrations of sugar solution on the size of potato cubes.
This is the method used:

1. Cut one potato cube.
2. Record the size of the potato cube.
3. Place the potato cube into a beaker of sugar solution.
4. After 1 hour, record the size of the potato cube.
5. Repeat steps 1–4 using different concentrations of sugar solution.

    f. Give **three** factors the student should control in the investigation. **(3)**
    g. A potato cube is placed in sugar solution that is the same concentration as the concentration inside the potato cells.
    What will happen to the size of the potato cube?

Lesson 17: Active Transport

Diffusion and osmosis rely upon the passive transport of substances down concentration gradients, relying on the random movement of particles.

However, cells also need to be able to transport substances across the cell membrane **against a concentration gradient**. **This requires energy** released by respiration

Active transport moves substances from a more **dilute solution** to a more **concentrated solution** (against a concentration gradient). This requires energy from respiration.

Uses of active transport include:

- 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 small intestine into the blood which has a higher sugar concentration. Sugar molecules are used for cell respiration.

1. What is a concentration gradient?
2. If you transport molecules against a concentration gradient, what does this mean?
3. Name the organelle from which energy is released
4. Define active transport
5. Explain why active transport requires energy
6. Define diffusion
7. Define osmosis
8. Describe the difference between diffusion and osmosis
9. Describe the difference between diffusion and active transport
10. State the role of root hair cells
11. Where is concentration of mineral ions higher? Root hairs or soil?
12. Explain why active transport occurs in roots
13. Describe how the root hair cells are adapted for active transport
14. State two other ways in which the root hair cell is adapted for its function
15. Once water and minerals are absorbed into the root hair cell, how is water transported to the rest of the plant?
16. How is the above plant tissue adapted for its function?
17. State the role of the small intestine
18. Where is sugar concentration higher, the small intestine or blood?
19. Explain why active transport occurs in the small intestine
20. Suggest how the small intestine is adapted for active transport
21. In the small intestine, diffusion of nutrients needs to happen rapidly. State 3 ways in which the effectiveness of the exchange surface in the small intestines can be increased.
22. Explain why it is not enough for large multicellular organisms to just have well adapted exchange surfaces
23. Explain why diffusion and osmosis are passive processes