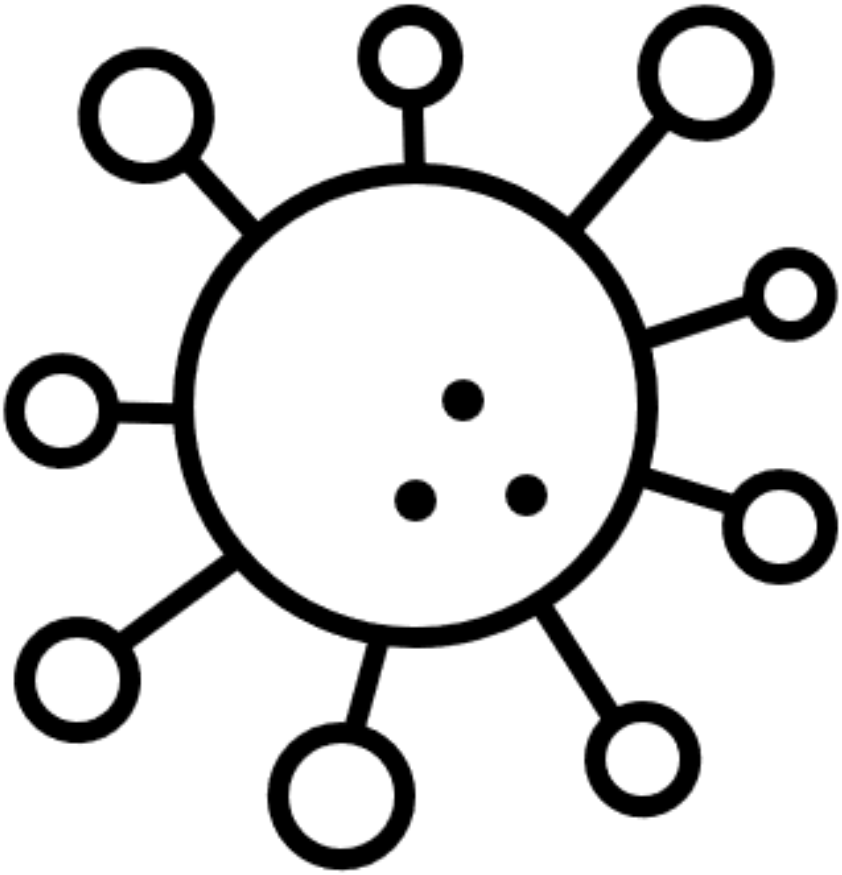
Cell transport



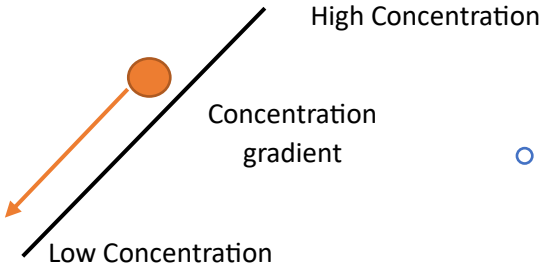
Name _____

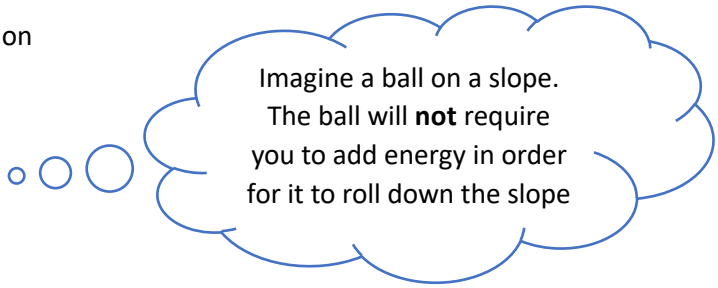
Class _____

Teacher _____

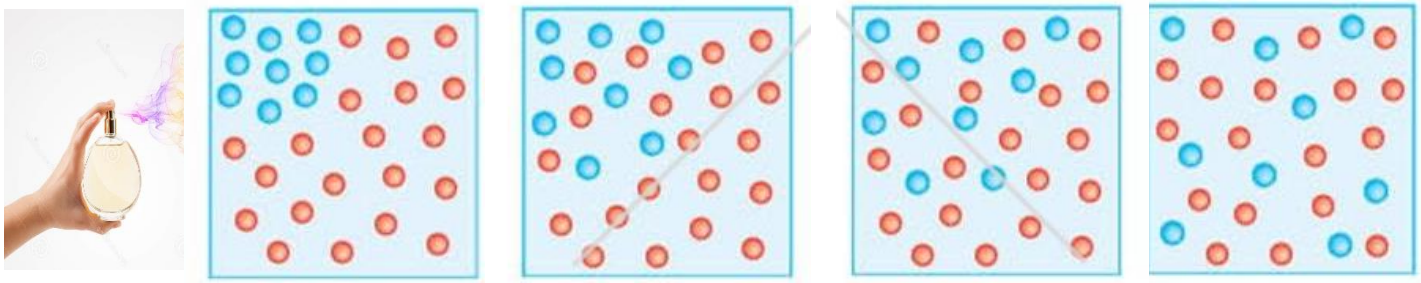
L1 Diffusion

Diffusion is the movement of particles from an area of high concentration to an area of low concentration. This goes down the concentration gradient. It is a passive process and therefore does not require energy:





This of when you spray perfume. At first you can't smell it and then gradually the particles diffuse across the space until they are evenly spread out and you can smell it.



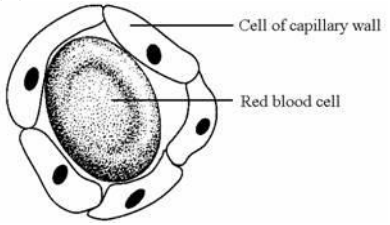
There are a few different conditions that will speed up the rate of diffusion. If the concentration gradient is very small (there is only a slight difference in the amount of particles) then the rate of diffusion is slower. If the temperature is higher, the rate of diffusion increases because the kinetic energy store of the particles increases and the particles move faster.

Your cells need to take in substances like glucose and oxygen to survive and remove substances like urea and carbon dioxide. Dissolved substances and gases can move in and out of cells by diffusion. The bigger the difference in concentration between two areas the faster diffusion will occur. The oxygen you need for respiration passes from the air into your lungs. From here it diffuses into red blood cells to be transported round the body to where it is needed, for example in muscle cells. Carbon dioxide will diffuse from the blood into the lungs.

The single most common adaptation to improve diffusion is to increase the surface area of a cell. This is commonly done by folding the cell membrane.

Independent Practice

1. What substances commonly enter cells?
2. What substances are commonly removed by cells?
3. Define diffusion
4. What is the function of the cell membrane?
5. State two factors that can affect diffusion
6. Why does increased temperature increase diffusion?
7. What diffuses from your lungs into red blood cells?
8. What diffuses from your red blood cells to your muscle cells?
9. Explain why so many cells have folded membranes along at least one surface. (2)
10. Describe the process of diffusion including any adaptations for the following statements:
    a. Carbon dioxide moves from the blood in the capillaries of your lungs to the air in the lungs (3)
    b. Male moths can track down a mate from up to 3 miles away because of the special chemicals produced by the female (3)
11. Diffusion is an important process in animals and plants.
    a. The movement of many substances into and out of cells occurs by diffusion.
    b. Describe why diffusion is important to animals and plants.
    c. In your answer you should refer to:
        - animals
        - plants
        - examples of the diffusion of named substances (6).
12. Capillaries are blood vessels in the body which join the arteries to the veins. They have walls which are one cell thick and so are able to exchange substances with the body cells.

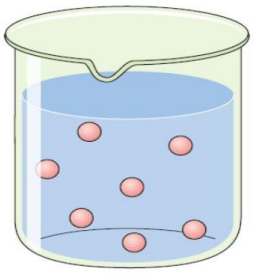


    a) Name **two** substances that travel from the muscle cells to the blood in the capillaries.
    b) Glucose is one substance that travels from the blood in the capillaries to the body cells. Explain how this happens.

L2 Osmosis

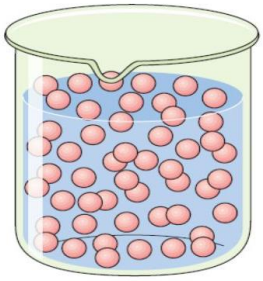
Part 10 Osmosis

Osmosis is defined as the movement of **water** from an area of high concentration to low concentration through a semi-permeable membrane. This is a special case of diffusion. It is important to realise that a solution that has a high concentration of water is called a dilute solution, because it has a low concentration of solute dissolved. Conversely, a low concentration of water is found in a concentrated solution as there is less water and more dissolve solute.



Dilute solution

Water moves from Dilute Solution to Concentrated solution

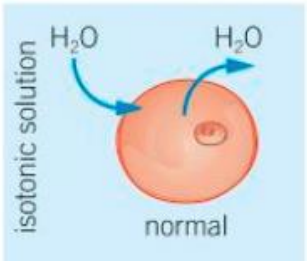


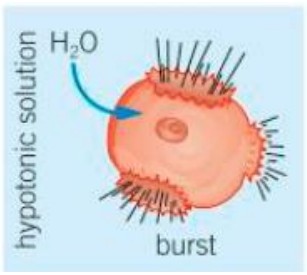
Concentrated solution

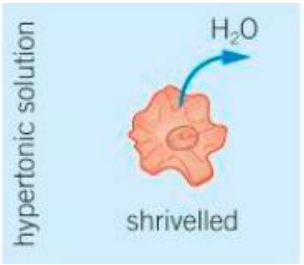
Dilute solution- Higher concentration of water

Concentrated solution- Lower concentration of water

If the water concentration outside the cell is equal to the water concentration inside the cell the solution is termed **isotonic**. A **hypotonic** solution has a higher water concentration that the cell this means water moves from the solution into the cell. Finally, a **hypertonic** solution is one in which the water concentration in the solution is lower than the cell causing water to move from the cell into the solution.

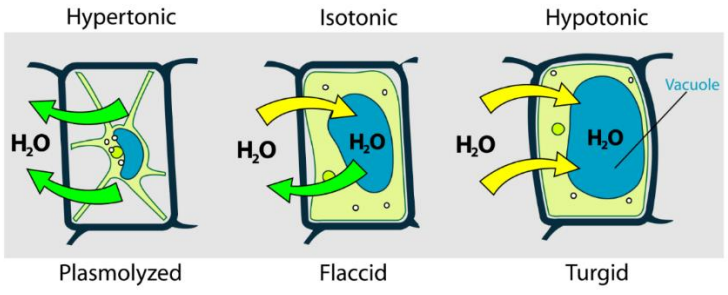






If an animal cell absorbs too much water it can burst conversely it can shrivel if it loses too much water. Plant cells do not do either of these as they have a cell wall that keeps them rigid and supports them.

Plant cells have a cell wall that prevents them from bursting or shrivelling when put in different solutions. Instead when in a hypotonic solution water moves into a plant cell and causes them to swell and appear **turgid**. When in a hypertonic solution the plant cell will lose water and appear plasmolysed. A plant cell is described as **plasmolysed** when a plant cell membrane pulls away from the cell wall.



Independent Practice

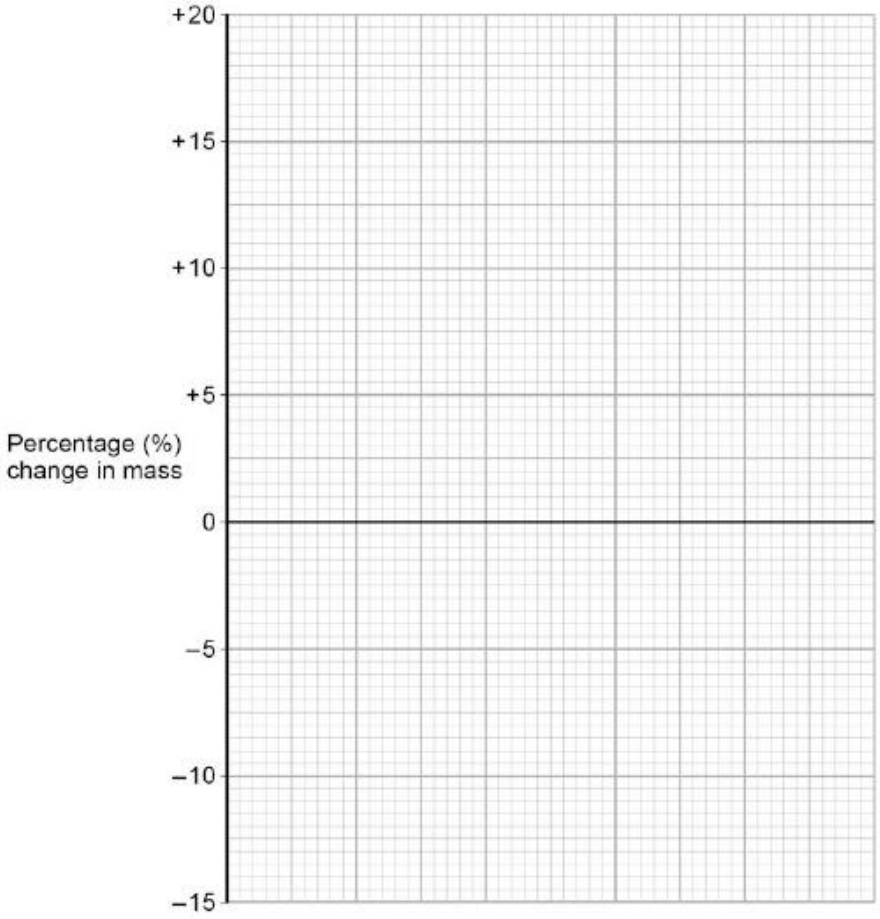
13. What moves in Osmosis?
14. Define Osmosis
15. What does semi-permeable mean?
16. What is the formula to calculate percentage change in mass?
17. Why is percentage change used instead of change in mass?
18. What does Isotonic mean?
19. If the solution is isotonic to the cell what is happening to the water?
20. What does hypotonic mean?
21. If the solution is hypotonic to the cell what is happening to the water?
22. If this keeps happening what could happen to the cell?
23. A student wants to investigate osmosis. A carrot was placed in a dilute solution.
24. What will happen to its mass? Explain your answer.
25. The carrot was placed in 0.4 mol/dm 3 solution. Its mass did not change. Explain why this happened.
26. What does this tell us about the concentration of the carrot?
27. The carrot was placed in a concentrated solution. What will happen to its mass? Explain your answer.
28. If the solution is hypertonic to the cell what is happening to the water?
29. If this keeps happening what could happen to the cell?
30. Animals that live in fresh water have a constant problem with their water balance. The single celled organism amoeba has a special vacuole that fills with water and then moves to the outside of a cell to burst. A new vacuole starts forming straight away. Explain in terms of osmosis why amoeba need vacuole

126. The table below shows the results of a students' experiment into osmosis.

Concentration of sugar solution in mol dm^{-3}	**Starting mass in g**	**Final mass in g**	**Change of mass in g**	**Percentage (%) change**
0.0	1.30	1.51	0.21	16.2
0.2	1.35	1.50	0.15	**X**
0.4	1.30	1.35	0.05	3.8
0.6	1.34	1.28	−0.06	−4.5
0.8	1.22	1.11	−0.11	−9.0

(a) Calculate the value of **X** in the table above.
(b) Why did the student calculate the percentage change in mass as well as the change in grams?
(c) Complete the graph using data from the table above.

- Choose a suitable scale and label for the *x*-axis.
- Plot the percentage (%) change in mass.
- Draw a line of best fit.



(d) Use your graph to estimate the concentration of the solution inside the potato cells.

L3 Surface area to volume ratio

All living things need substances like oxygen in the air, glucose in food sources and nutrients from food sources or soil. These substances start outside of the living thing and then they make their way into the cells inside the organism. How does this happen?

All organisms have surfaces through which substances pass through . The surfaces allow some substances through and not others. We call these membranes. Organisms produce waste substances which must be moved outside. These substances also pass through membranes. The surfaces needed for diffusion is different depending on how big the organism is.

A small organism like E.coli only needs a small amount of surface to absorb nutrients and get rid of waste. It is a single cell and only has a cell membrane around it. The nutrients pass straight from the outside through the cell membrane and so do the waste substances, in the other direction. Volume is how much space the organism occupies, it is measured in liters. E.coli has a volume of 0.00000000000000001L (your drinks bottles are 0.25L for comparison). Surface area is measured in m^2. E.coli has a cell surface area of 0.000006m. If we compare the size of the surface to the size of the membranes we say that E.coli has a large surface area to volume ratio. We can work out a number for a surface area to volume ratio by dividing the volume by the surface area

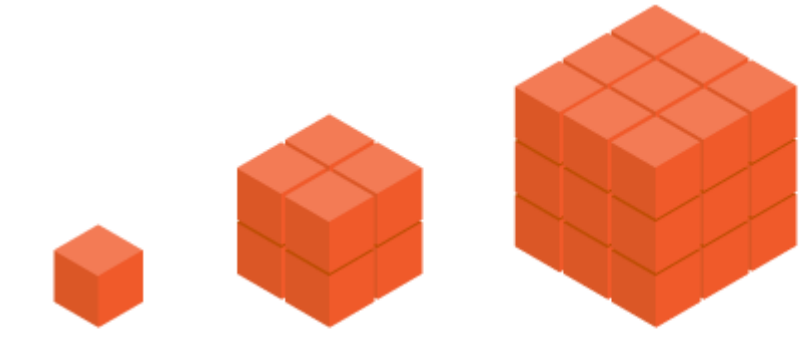
Example surface area to volume ratio for E.coli

0.000006 ÷ 0.00000000000000001L = 6000,000 : 1

Let's look at another larger organism - a whale. The whale is different to E.coli in two major ways; it is made up of trillions of cells and it takes up a lot more volume. The whale takes up 1000 000L and has a surface area of 60000m^2. The whale cannot just absorb the oxygen and nutrients from being next to food and air. The substances would take a long time to get to the cells inside the whale and these cells would die because of lack of nutrients and build up of waste. The whales surface area to volume ratio is 0.06:1. A much smaller number than E.coli. The whale has a special way of absorbing nutrients and getting rid of waste which is very different to E.coli. E.coli simply needs to be next to food and air nutrients diffuse into it and waste diffuses out. The whale needs a transport system and special absorbing areas. These absorbing areas have membranes which are folded up many times, this increases the surface area without needing lots of space. There are two special diffusion areas in the whale: the small intestine and inside the lungs.

<u>Modelling cells</u>

If we represent the cell of an organism by a cube:



1 cm	2 cm	3 cm
SA = 6 cm^2	SA = 24 cm^2	SA = 54 cm^2
Vol = 1 cm^3	Vol = 8 cm^3	Vol = 27 cm^3
SA:Vol = 6:1	SA:Vol = 3:1	SA:Vol = 2:1

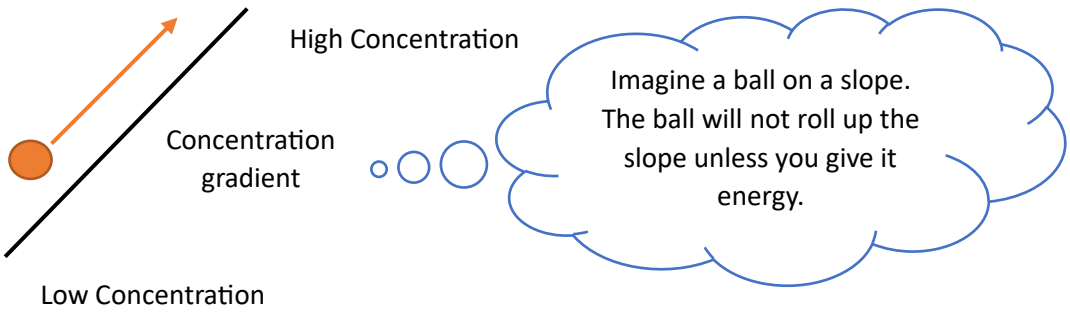
Independent practice

1. What substances do organisms need from the environment?
2. What do we call an area which an organism uses to absorb substances?
3. What else passes out of these areas?
4. Through which process do substances pass in and out of cells?
5. What determines how big the membranes for diffusion are?
6. What do we mean by the term volume?
7. What is the unit for volume?
8. If an organism is small what can we say about its surface area to volume ratio?
9. How is a whale different to an E.coli.
10. If an organism is big what can we say about its surface area to volume ratio?
11. What problem does a whale have in absorbing nutrients?
12. How does it overcome this problem?
13. What are the areas for diffusion inside a whale called?
14. Describe the surface area to volume ratio in an insect like a wasp?
15. Predict whether a wasp needs lungs. Explain your answer.
16. Frogs can absorb oxygen through their skin. Using the idea of surface area to volume ratio explain why humans cannot do this.
17. The intestines inside a cow have lots of small folds. Explain why a cows intestines have evolved like this.

L4 Active transport

Part 11 Active transport

Active transport is the movement of substances from a low concentration to a high concentration through a semi-permeable membrane. This means moving against the concentration gradient and therefore requires energy. The energy is provided by respiration in the mitochondria. This means active transport is only used in vital processes. Like diffusion and osmosis, a high surface area is used to increase the rate of active transport

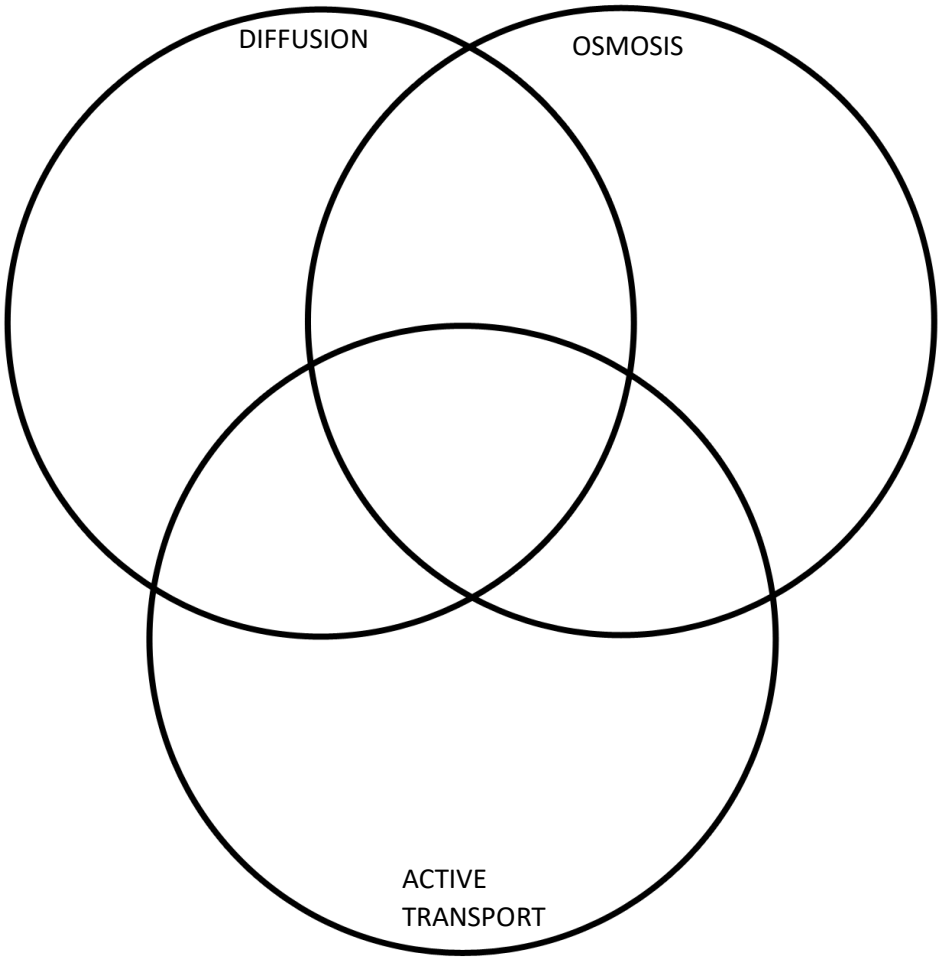


Active transport has many important roles. Two examples are below:

- Allow mineral ions to be absorbed into plant root hair cells from very dilute solutions in the soil. Plants require ions for healthy growth, so this movement is vital
- Allow 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, which is needed to produce energy.

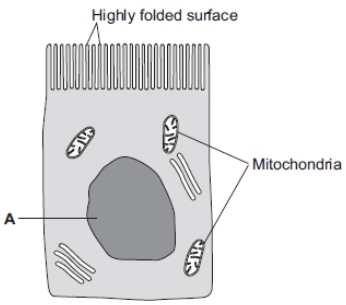
Independent practice

1. Fill out the Venn Diagram to compare the processes of diffusion, osmosis and active transport.



1. Movement of water
2. Movement of particles
3. From a high concentration to a low concentration
4. Requires energy
5. Does not require energy
6. Requires a partially permeable membrane
7. Does not require a partially permeable membrane
8. From a low concentration to a high concentration
9. Cells that do this have a lot of mitochondria

2. What is active transport?
3. True or false: Active transport cannot happen without energy
4. Which way along the concentration gradient does active transport move substances?
5. State two substances that experience active transport
6. Describe how root hair cells use active transport
7. Why is this movement important in the plant?
8. A student uses a pipette to add 3 drops of indicator to a beaker of acid. She watches the colour change and swirl through the liquid. Is this osmosis, diffusion or active transport?
9. Explain your answer to the question above
10. Explain why cells performing active transport require a lot of energy.
11. Describe how the gut uses active transport.
12. Why is this important?
13. Compare active transport and diffusion (6)
14. The cells of the small intestine have many mitochondria. Explain why they this helps them to function properly.
15. The image to the right is an epithelial cell from the lining of the small intestine
16. Name organelle A
17. Why does the cell have a many folded membrane?
18. Why does the cell need many mitochondria?
19. What process allows the cell to absorb water?
20. Name one food molecule absorbed by active transport.



21. Look at the diagram below. Label A,B,C,D with the correct keywords (diffusion osmosis active transport)