Biology year 1
Main source: Biology first, Oxforf, internet

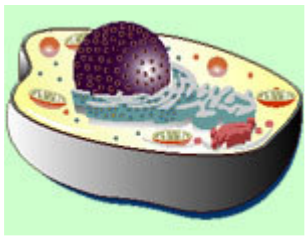
Topic: Introducing Living things

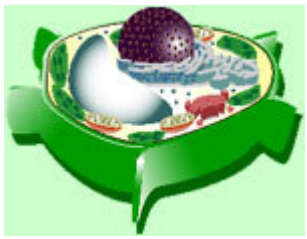
-living things and their needs (p.8-9)
-groups of living things (p.22-25)

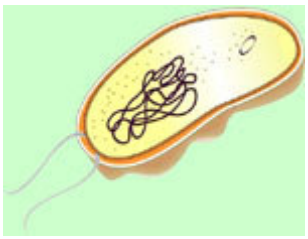
Topic: Cell

-Cells forms the basic units of all living organisms. Cells show properties that characterise life. They absorb or produce food, reproduce, are sensitive to changes in their environment and control their chemical processes.

There are lots of different types of cells that make up living organisms but they are all similar in structure. Take a closer look at some of these cells.


Animal cell (Eukaryotic)

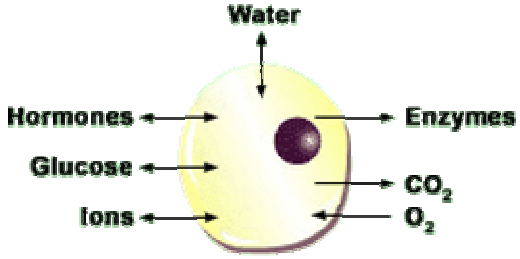

Plant cell (Eukaryotic)


Bacterial cell (Prokaryotic)

Find out about the pathways into and out of cells and how scientists investigate cell structure.

There are two types of cells: prokaryotic cells and eukaryotic cells.
The simplest cells are prokaryotic cells like bacteria. Eukaryotic cells are more complex and are found in plants, animals and fungi.

-cell structure (p.10)
-cells, tissues, organs...(p.11-12)
-pathways into and out of the cells (diffusion, osmosis, active transport)



Inside the cytoplasm of all living cells are many different molecules and ions.

Some of these molecules and ions pass through the plasma membrane into the cell. These include water, oxygen and glucose molecules, and sodium and chloride ions.
Some cells produce substances such as enzymes and hormones that also pass out through the plasma membrane.

The fact that different substances can pass into and out of cells at different rates is partly due to the properties of particles themselves and partly due to the structure of the plasma membrane. Movement into and out of the cell happens in many different ways. Have a look at how some of these processes work using the links below:

Passive transport: simple diffusion, osmosis, facilitataed diffusion

Active transport

Simple Diffusion

The basic structure of a plasma membrane is provided by a phospholipid bilayer.

Fat-soluble molecules, such as glycerol, can diffuse through the membrane easily. They dissolve in the phospholipid bilayer and pass through it in the direction of the **concentration gradient**, from a **high concentration** to a **low concentration**.

Water, oxygen and carbon dioxide can also diffuse through the bilayer, passing easily through the temporary small spaces between the 'tails' of the phospholipids.

It is important to remember that changing the concentration gradient of one substance does not change the gradient and therefore the rate of diffusion of another.

Ions and most large molecules cannot diffuse through the phospholipid bilayer. They have to go through the protein pores.

Facilitated Diffusion

Some molecules such as those that are soluble in water, cannot pass through the phospholipids in the bilayer. They are transported across the membrane by **carrier proteins**. A carrier protein will have a specific binding site for the substance it transports. Solute molecules moving about on either side of the membrane will randomly come into contact with their specific binding site. Once they bind, the protein changes shape and the molecules come off the binding site on the other side of the membrane.

Active Transport

Some solutes have a higher concentration inside the cell than outside so they have to cross the membrane against the concentration gradient. This means they can't get in by passive transport, neither simple diffusion nor facilitated diffusion works. They must enter by way of a process known as active transport. We call it active because it requires energy from the cell.

Some of the carrier proteins found in the plasma membrane provide a means for this to take place. These carriers have binding sites which pick up specific molecules. They function in one direction only and require energy to change shape and move the solute.

Osmosis

Osmosis is a special case of diffusion.

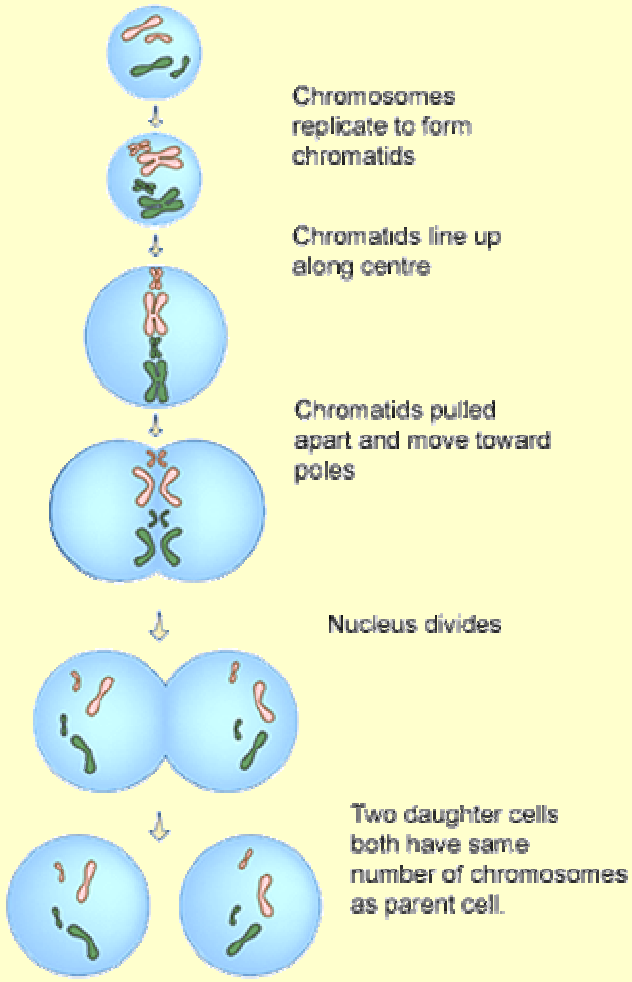
Outside the cell in the animation, there is a low concentration of solute molecules and a high concentration of water molecules . Inside the cell, there is a high concentration of solute molecules and a low concentration of water molecules.

The solute molecules can't diffuse out because the plasma membrane won't let them through. The water molecules however can diffuse in - this is osmosis. Osmosis can be defined as the passage of water molecules through a partially permeable membrane, from a region where they are in higher concentration to a region where they are in a lower concentration.

-mitosis

Mitosis

Mitosis occurs wherever an increase in number of cells is needed. It is important in the population growth of **unicellular** organisms, and in the growth and repair of **multicellular** organisms. During mitosis a cell produces two copies of itself. Each is identical to the other and to the cell from which they were formed.



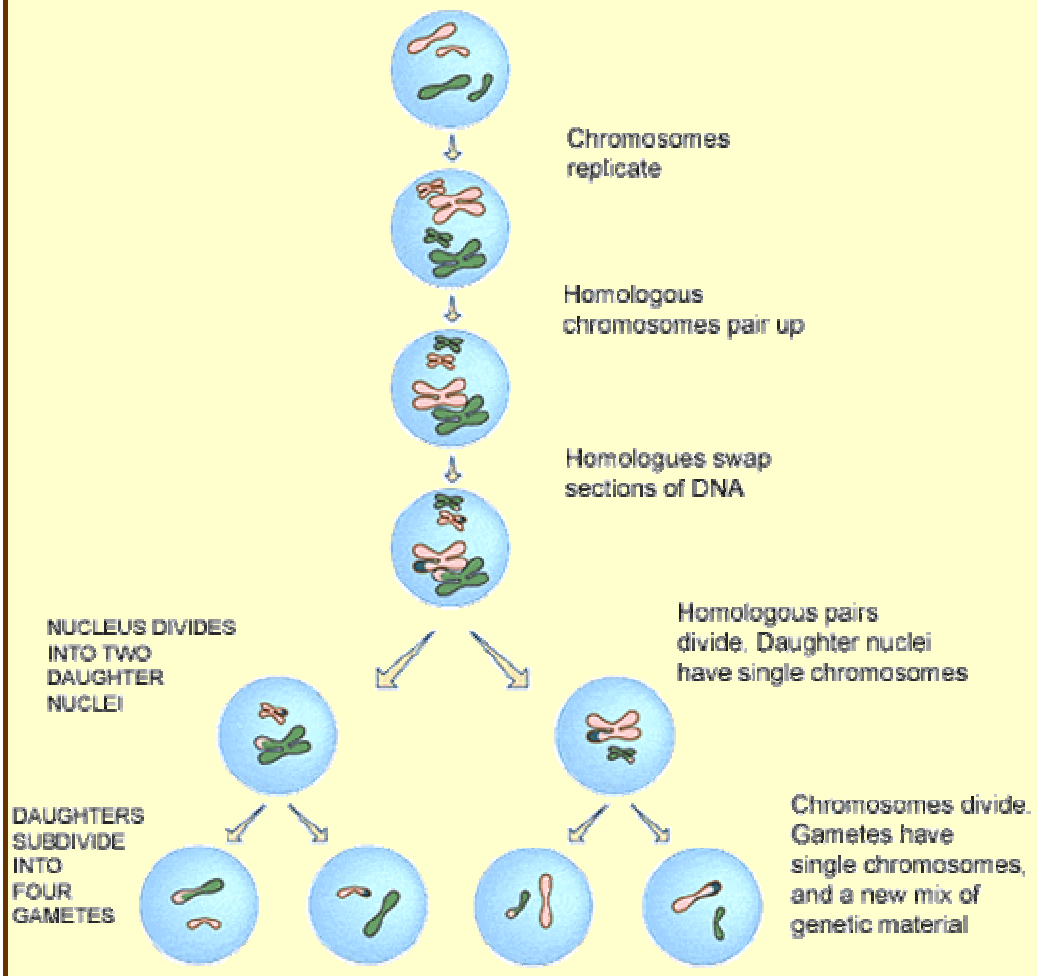
- Before a cell divides, its **chromosomes** are copied exactly. This process is called replication. The **DNA** of each chromosome is copied to form two **chromatids**. (For more on chromosomes and DNA go to **DNA and genes**)
- Pairs of chromatids migrate to the equator of the cell. Contractile **spindle fibres** are formed, stretching from each pole to the equator of the cell. Each **chromatid** attaches to a spindle fibre. When the fibres contract the pairs of chromatids are separated and dragged to opposite poles.
- A complete set of chromosomes is therefore found at each pole. These are then surrounded by a nuclear membrane. In plant cells, the daughter nuclei are separated from each other by the formation of a cell wall. In animal cells, the **cytoplasm invaginates** to form two daughter cells.

For more explanation of mitosis, visit **Reproduction and gender**

-meiosis

Meiosis

A human body cell contains 23 pairs of **chromosomes**. The gametes - sperm or eggs - contain half this number of chromosomes, which is why meiosis is sometimes called 'reduction division'. (For more on chromosomes go to **DNA and genes**)



- Before **meiosis** begins, the chromosomes are copied exactly. The **DNA** of each chromosome is replicated to form two chromatids. They then arrange themselves into homologous pairs (both coding for the same characteristics), and prepare for cell division. At this point maternal and paternal chromatids can exchange bits of DNA to recombine their genetic material and increase the potential for variation.

- The homologous pairs of chromosomes then separate and move to the poles of the parent nucleus. For each of the 23 pairs there is a 50-50 chance as to which pole the paternal or maternal pair of chromatids go.

With over 8 million possibilities there are many opportunities for variation.

- The nucleus now divides to form two daughter nuclei, each with a mixture of paternal and maternal chromosomes but with half the full complement of genetic material (and no pairs at all). This division is called Meiosis 1.
- Finally the two daughter nuclei themselves divide to form **gametes**. This second division - Meiosis 2 - works just like mitosis. The chromosomes (really pairs of chromatids) split apart to form the genetic material of the four new cells. The end result is four sex cells each with a complete but single set of 23 chromosomes.

On fertilisation the nuclei of the sperm and the egg join to form a new nucleus, called the **zygote**. The zygote contains 23 pairs of chromosomes - 23 single chromosomes from the sperm, and 23 single chromosomes from the egg.

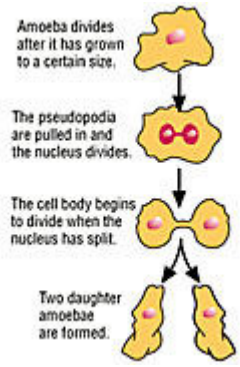
Mitosis and meiosis compared

It's really important that you don't get **meiosis** and **mitosis** confused! Take some time to look at the table below and make sure you understand all the differences between the two types of cell division.

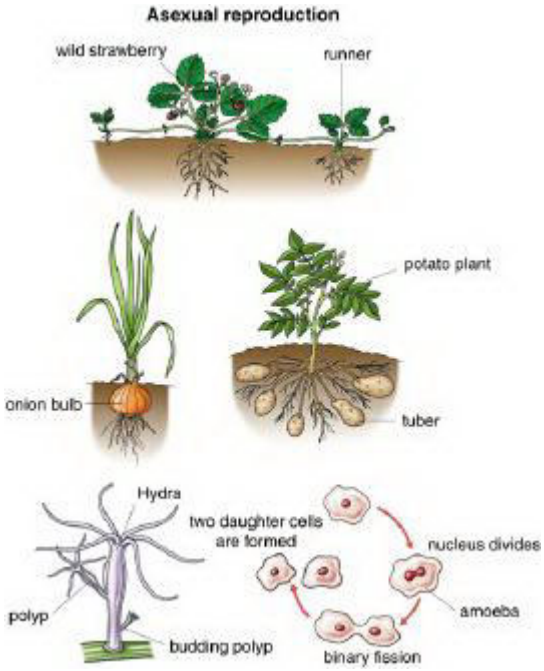
	Mitosis	**Meiosis**
Purpose	To make daughter cells identical to the parent cells - eg during growth and repair	To produce sex cells (**gametes**)
Takes place ..	In all cells apart from gametes	In the reproductive organs (ovaries and testes)
Produces how many cells?	Two daughter cells	Four gametes
What happens to number of chromosomes?	Same number as in parent cell	Half as many as in parent cell (The original number of chromosomes is restored when two gametes fuse to form a **zygote**.)
How do parent and daughter cells differ genetically?	Not at all - genetic material is copied exactly (replicated)	Contain a mixture of chromosomes from two parent gametes - so cannot be identical
Variation between daughter cells?	No - they are clones of each other	Yes - they are genetically different from each other because chromosomes get shuffled up during division

-asexual reproduction (p.73)

Asexual reproduction is the simplest form of reproduction, occurring in many simple plants and animals. Binary fission, shown here occurring in an amoeba, is one of a number of asexual reproduction processes



Examples of asexual reproduction. Asexual reproduction is the simplest form of reproduction, occurring in many plants and simple animals. Strawberry plants can reproduce by sending out runners; onion plants form bulbs; and potato plants form tubers. Amoebas divide into two (binary fission) and hydra form new hydra by budding. The offspring are always genetically identical to the parent.



Reproduction that does not involve the manufacture and fusion of sex cells (gametes) from two parents. Asexual reproduction has advantages in that there is no need to search for a mate; every asexual organism can reproduce on its own. Asexual reproduction can therefore lead to

a rapid population build-up. However, every new organism produced by asexual reproduction is genetically identical to the parent – a clone.

In evolutionary terms, the disadvantage of asexual reproduction arises from the fact that only identical individuals (clones) are produced – there is no variation. In agriculture and horticulture, where standardized production is needed, this is useful. Taking cuttings of a good variety of fruit tree is an example of artificial asexual reproduction. However, in the wild, an asexual population that cannot adapt to a changing environment or evolve defences against a new disease is at risk of extinction. Many asexually reproducing organisms are therefore capable of reproducing sexually as well.

Asexual reproduction is very common in micro-organisms. But there are also many plants that use it naturally. The blackberry or bramble spreads by allowing its stems to root where they touch the ground. However, the blackberry also reproduces sexually using its flowers.

-sexual reproduction (p.13,70-72)

Topic: Human body and health