# GCSE Science – Biology 1

## 1.1 Cells- recall what each do

Cell membrane: controls the entry and exit of substances

Cytoplasm: site of most cell reactions

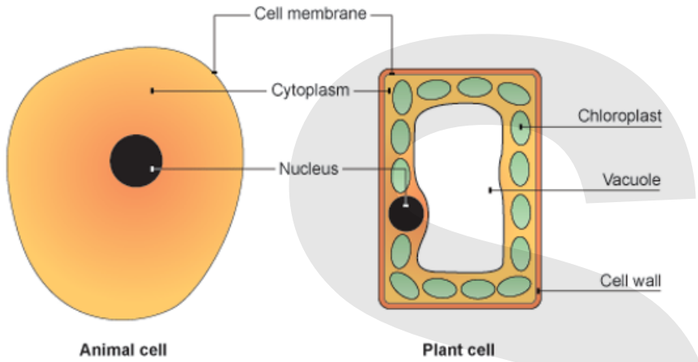
Nucleus: contains chromosomes which carry genetic information and controls the activities of the cell

Mitochondrion: site of aerobic respiration

Cell wall containing cellulose: structural support for plant cells

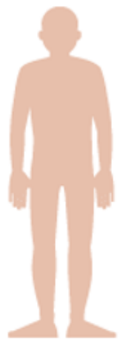
chloroplast: site of photosynthesis

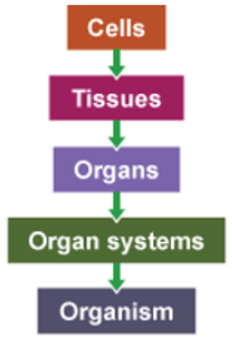
Vacuole: contains a watery sugar solution (sap), a swollen vacuole pushes the rest of the cell contents against the cell wall, making the cell firm.




## 1.2 Multicellular organisms- Made from many different types of cells

Cells with a similar function are grouped together in **tissues**. A collection of different tissues carrying out a particular function is called an **organ**. Several different organs working together to perform specific functions are called an **organ system**.






Specialised cells- **Example-anything that is specialised to is function.**

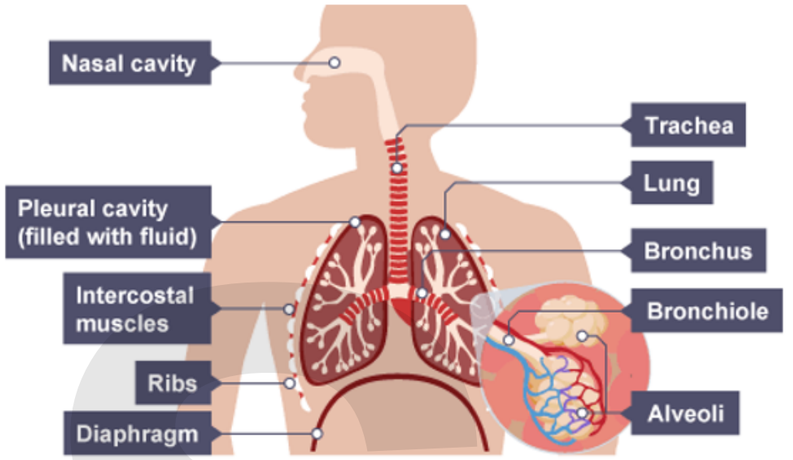
**Red blood** cells are a biconcave shape, have no nucleus, and contain haemoglobin to carry oxygen around the body.

A **nerve** cell is long and insulated with a fatty layer to carry electrical impulses around the body.

A **sperm** cell has a tail so that it can swim to the egg.

## 1.3 Respiratory system – Label diagrams, explain how to breath in and out, link diffusion, adaptations of the alviloi

Large organisms require a complex respiratory system in order to obtain a sufficient volume of oxygen to maintain a high level of aerobic respiration and to remove an equivalent volume of waste carbon dioxide.




## 1.4 Respiration- Any process that needs energy

**Respiration** involves chemical reactions that break down nutrient molecules in living cells to release energy.

**Aerobic respiration** needs oxygen. It is the release of a relatively large amount of energy in cells by the breakdown of food substances in the presence of **oxygen**.

*glucose + oxygen → carbon dioxide + water + energy in the form of ATP*

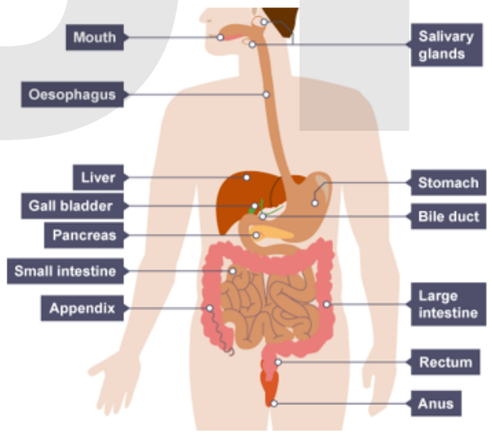
**Anaerobic** respiration does not need oxygen (unlike aerobic respiration). It is the release of a relatively small amount of energy in cells by the breakdown of food substances in the absence of oxygen.

*glucose → lactic acid + energy in the form of ATP*

The creation of lactic acid generates an **oxygen debt** that needs to be repaid after the exercise stops. This is why we keep on breathing deeply for a few minutes after we have finished exercising.

Lactic acid is harmful to the body. It has to be removed from cells and broken down following the resumption of aerobic respiration (to repay the oxygen debt).

## 1.5 Digestive system structure- Label the diagram, explain what happens at each organ



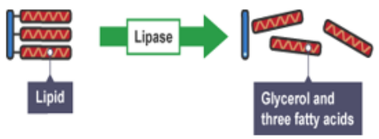

Mouth - starch digestion begins by carbohydrase/ amylase in saliva

- Stomach - secretes protease
- Pancreas - secretes lipase, proteases and carbohydrase into the small intestine
- Small intestine - continued digestion of carbohydrates to glucose, proteins to amino acids, fats to fatty acids and glycerol and absorption of digested molecules.
- Large intestine - absorption of water
- Liver - secretes bile

## 1.6 How food is broken down- how to test the blood for sugar, why food is needed to be broken down, relate to enzymes and shape

Proteins are long chains of amino acids. During digestion the enzyme **protease** breaks them down into single amino acids which are small and soluble.


Lipids are large molecules. During digestion the enzyme **lipase** breaks them down into fatty acids and glycerol. These can be used by the body to provide energy.

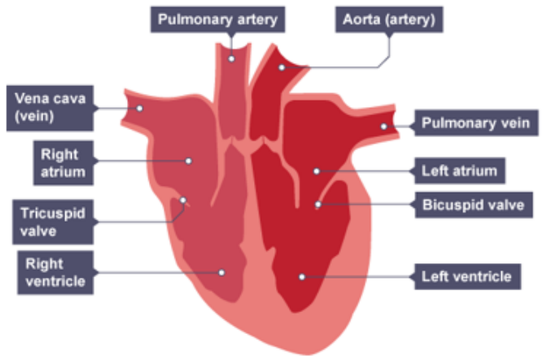



Starch is a long chain carbohydrate. It is insoluble. During digestion the enzyme **carbohydrase** breaks it down into single molecules of glucose which are small and soluble enough to be carried in the blood to the cells for respiration.

# GCSE Science – Biology 1

## 1.7 Heart – Label the heart, explain the function of the valves, explain why it is a double circulatory system

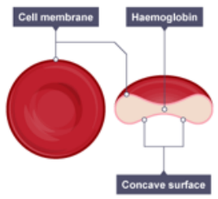
In general, blood **flows into one side of the heart** from a **vein**, goes into an **atrium**, then a **ventricle**, and **out through** an **artery**.




**Exam key information**

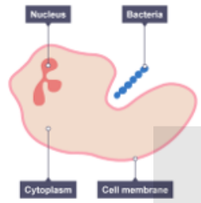
Both sides have **semilunar valves** – at the entrances to the pulmonary artery and aorta.
The right ventricle has less muscle that the left as it is pumping to the lungs and not the whole body.
Valves prevent backflow of blood.

## 1. 8 Red blood cells and phagocytes (White blood cell)- Explain the difference or how they are adapted to their function




Red blood cells have adaptations that make them suitable for this:
They contain **haemoglobin** – a red protein that combines with oxygen
They have no **nucleus** so they can contain more haemoglobin
They are small and flexible so that they can fit through narrow blood vessels
They have a **biconcave shape** (flattened disc shape) to maximise their surface area for oxygen absorption.

White blood cells defend the body against disease.
The phagocyte engulfs the bacterial cell.
The bacterial cell is broken down by **enzymes** inside the phagocyte.




Four main parts of the blood- Explain the composition of blood

Red blood cells – contain haemoglobin for transport of oxygen
Platelets – clotting
Plasma – transport of carbon dioxide, soluble food, urea, hormones and the distribution of heat
White blood cells - defense against disease

## 1. 9 Photosynthesis – Equation, where it occurs and why it occurs, related to enzyme

Green plants and other photosynthetic organisms use chlorophyll to absorb light energy and convert carbon dioxide and water into glucose, producing oxygen as a byproduct.

Light energy is absorbed by **chlorophyll** - a green substance found in **chloroplasts** in the palisade cells in the leaf absorbed light energy is used to convert carbon dioxide (from the air) and water (from the soil) into a sugar called **glucose**.

The chemical reactions of photosynthesis within the cell are controlled by enzymes.

$$carbon\ dioxide + water \xrightarrow[chlorophyll]{light} glucose + oxygen$$

**Exam key information**

**If plants are put in water the gas it would give off is oxygen.**
**Could be related to enzymes unit 1.1.**

## 1.10 Testing the leaf for starch

1. Heat a plant leaf in boiling water for 30 seconds (this kills the leaf, stopping any chemical reactions)
2. Add the leaf to boiling **ethanol** in a water bath for a few minutes (the boiling ethanol dissolves the chlorophyll and removes the green colour from the leaf - it turns white so it is easy to see the change in colour)
3. Wash with water to rehydrate and soften the leaf and spread onto a white tile
4. Add iodine solution from a dropping pipette
5. After a few minutes, the parts of the leaf that contain starch turn the iodine from brown to blue/black.

Uses of glucose in a plant- related to testing the leaf for starch

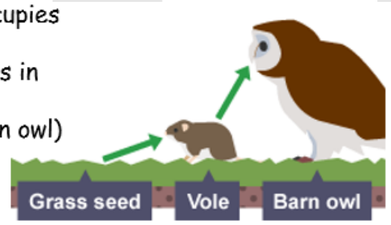
During photosynthesis a plant absorbs light energy using the pigment chlorophyll. This allows it to convert carbon dioxide and water into glucose. This glucose is:

- transported to the growing parts of the plant for use in respiration
- transformed into **cellulose**, proteins and oils
- turned into starch for storage

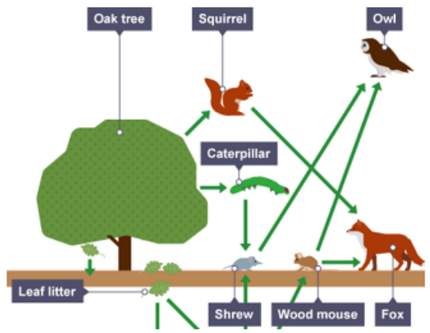
## 1.11 Food Chains- Explain the movement of energy, where energy comes from, trophic levels,

Radiation from the sun is the source of energy for living organisms. Green plants capture only a small percentage of the solar energy which reaches them.

The **producer** (grass seed) occupies the first trophic level.
The **primary consumer** (vole) is in the second trophic level.
The **secondary consumer** (barn owl) is in the third trophic level.

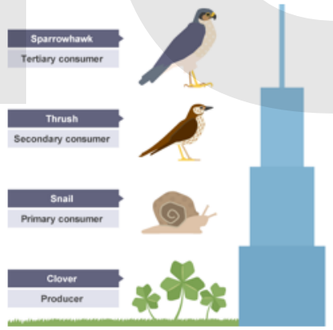



The **arrows** between each organism in the chain always point in the **direction of energy flow** from the food to the feeder.




Food webs-
Changes in the population of one organism have an effect on the populations of other organisms. This is called **interdependence**.

## 1.12 Pyramid of biomass and number- Explain the difference, Analyse data in terms of: efficiency of energy transfer, numbers of organisms and biomass.




A **pyramid of numbers** shows the **population** at each stage in a **food chain**. The wider the bar, the more **organisms** it represents.

**Biomass** is the **dry mass** of living organisms in an area (habitat) at a particular time. A pyramid of biomass represents the mass of organisms at each **trophic level**.

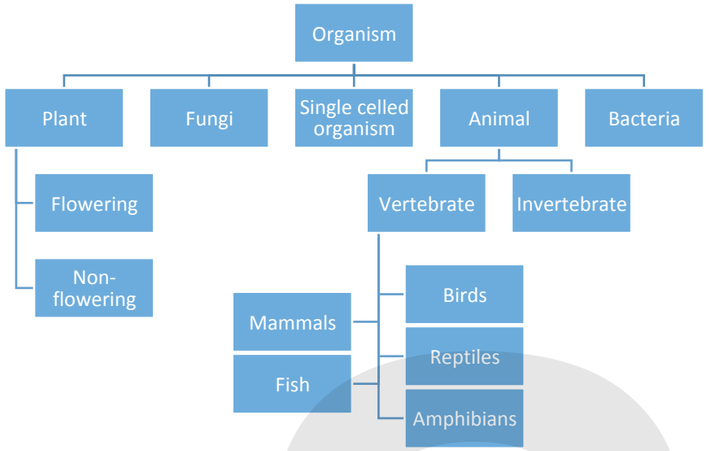

Calculating percentage energy transfer –

$$efficiency = \frac{energy\ transferred\ to\ next\ level}{total\ energy\ in} \times 100$$

# GCSE Science – Biology 2

## 2.1 – Classification

All living organisms can be classified into groups based on their characteristics. The main groups are shown below.




Non-flowering plants – do not produce flowers e.g. ferns and mosses;
Flowering plants – produce flowers;
Invertebrates – do not have a backbone e.g. insects;
Vertebrates – have a backbone.

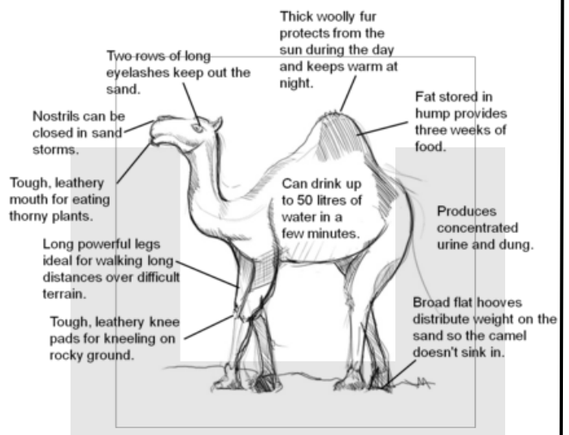
## 2.2 – Adaptations

**Morphological adaptation** is a structural change which gives an organism a greater chance of survival in its habitat.

Common examples
- Large ears- Large surface area to lose heat
- Fur- Camouflage to their environment
- Think fur- reduce heat loss

**Behavioral adaptation** is the way an organism reacts to its environment which aids its survival.

Common example
- Active during the night- too hot for the animal in the day

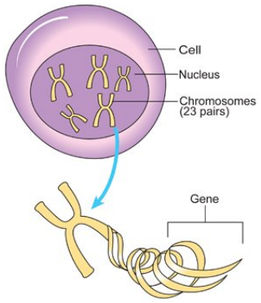



## 2.3 – DNA and chromosomes

The DNA stored inside a cells nucleus has all the information required to reproduce that organism.

However the DNA is not just thrown into the nucleus, it is arranged in 'X' shaped clumps called chromosomes.

A human cell contains 23 pairs of identical chromosomes, so 46 chromosomes in total. Other organisms contain different numbers of chromosomes, a carrot contains 9 pairs of chromosomes and an American paddle fish contains 60!




The only cells in an organisms body that contain less chromosomes are the sex cells (sperm and egg cells). Each sex cell contains half the usual number of chromosomes. This means that a human sex cell will contain 23 chromosomes in total.

So when a sperm cell and an egg cell fuse the total number of chromosomes present is 46. So you get half your genetic information from your Mum and half from your Dad.

## 2.4 – Cell division

Organisms must carry out cell division to;

- Repair damaged tissue
- Replace old/worn out cells
- Growth
- Reproduction

There are two types of cell division, Mitosis and Meiosis.

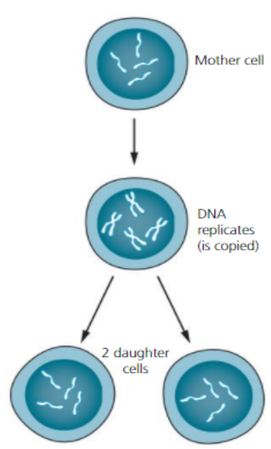



Figure 8.4 Cell division by mitosis.

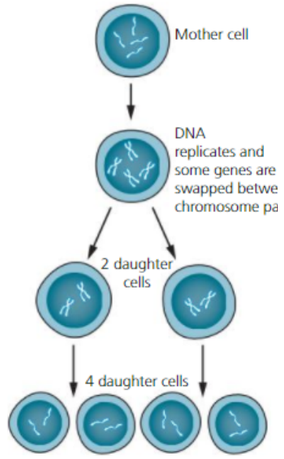
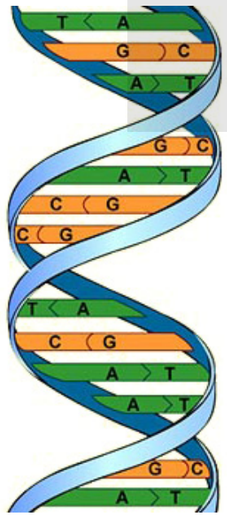



Figure 8.5 Cell division by meiosis.

## 2.5 – Fossil fuels

DNA consists of 2 long strands of alternating sugar and phosphate molecules.
- The chains are twisted to form a double helix.
- There are pairs of bases holding the chains together. The 4 bases are A (adenine), T (thymine), C (cytosine) and G (guanine). The sequence of the bases forms the instructions, in a form of code, for the making of proteins.
- The 'code' consists of triplets (groups of three) of bases along the DNA. Each triplet codes for an individual amino acid.



## 2.6 – Key terms

| Keywords | Definitions |
|---|---|
| Gamete | Gametes are sex cells, for example male gametes are sperm cells and female gametes are eggs. |
| Chromosome | A length of DNA that contains many genes, found in the nucleus and visible during cell division. |
| Gene | A short length of DNA that codes for one protein. |
| Allele | A variety of a gene |
| Dominant | The allele that shows in the phenotype whenever it is present (shown by a capital letter) |
| Recessive | The allele that is hidden when a dominant allele is present (shown by a lower case letter). |
| Homozygous | A homozygote contains 2 identical alleles for the gene involved |
| Heterozygous | A heterozygote contains 2 different alleles for the gene involved. |

# GCSE Science – Biology 2

## 2.7 – Mutations

Mutation is a change in a **gene** or **chromosome**. It is a rare, random change in the genetic material, and in some cases it can be inherited.

**Causes of mutation**

Mutation can be spontaneous. It just happens, or it can happen because of: ionising radiation, chemical **mutagens** – such as tar from cigarette smoke.

**Effects of mutation**

A mutation may be **neutral** and have no effect. For example, the protein that a mutated gene produces may work just as well as the protein from the normal gene.
A mutation may sometimes be beneficial. For example, people who are carriers (heterozygous) for the sickle cell **allele** are more resistant to malaria (a tropical disease) than people who do not have the mutated gene.
Some mutations can be harmful. A change in the gene might produce a faulty or non-functioning protein, resulting in a genetic disease, such as cystic fibrosis.

## 2.8 – Evolution

**Principles of evolution by natural selection**

The idea behind the theory of **evolution** through the process of natural selection is that all **species** of living things have evolved from simple life forms over a period of time. Individuals that are poorly adapted to their environment are less likely to survive and reproduce. Their genes are less likely to be passed on to the next generation.

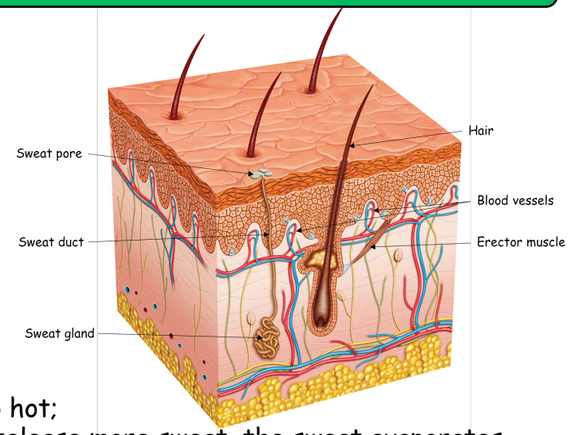
**Modelling natural selection**

**Method**

1. Use a piece of green card as a background.
2. Randomly place 20 green and 20 white pieces of string on the card to represent populations of prey organisms.
3. Using a forceps to represent the mouth of the predator, collect as many pieces of string as you can in 10 seconds.
4. Count how many green and white pieces are left and record.
5. Repeat the process twice more.

## 2.9 – Skin

The skin has a vital role in homeostasis, specifically maintaining a constant temperature.




When we are too hot;
- Sweat glands release more sweat, the sweat evaporates removing heat energy.
- The blood vessels closest to the surface of the skin dilate (get wider) allowing more heat to be lost.
- Erector muscles relax and hairs lie flat on the skin.

When we are too cold;
- Muscles contract rapidly (shivering), this requires energy from respiration, some of this energy is released as heat.
- The blood vessels closest to the skin constrict (get narrower) allowing less blood flow through the skin and conserving heat.

## 2.10 – Homeostasis

Homeostasis is the maintenance of a constant internal environment. The nervous system and hormones are responsible for this.
- Body temperature – Sweating to decrease temperature, shivering to increase.
- Blood sugar levels – Insulin (a hormone) released from the pancreases controls this.
- Water content – Controlled by the urine produced by the kidneys.

If homeostasis is not maintained then the body can start to shut down and will ultimately lead to death.

Hormones are commonly used by the body to maintain homeostasis, they are chemical messengers, carried by the blood, which control many body functions.

Insulin
Insulin is a hormone released by the pancreas to keep glucose levels in the blood within a constant range. When glucose in the blood rises, insulin is released, which causes the liver to reduce glucose in the blood by converting it into glycogen and storing it.

## 2.11 – Microorganisms

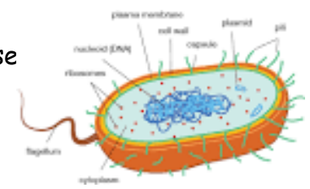
**Micro-organisms** this term is used to describe any living thing that we need to use a microscope to be able to see.
For example, bacteria, viruses, fungi and protists.

**Protists** are small organisms that are usually single celled, but eukaryotic. This means they have a nucleus.

There are good microorganism that are vital for health, for example intestinal bacteria that aid digestion.

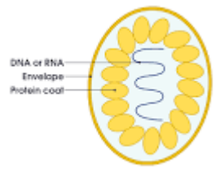
Micro-organisms that are not good for us are called **pathogens**. These cause disease and are also responsible for things like food spoilage.

**Bacteria** are single celled organisms.
They are different from animal cells because they have a **cell wall** AND **no membrane bound nucleus**.




They are thought to have been the earliest known form of life.

**Viruses** are just a protein coat with some genes in the middle. There is no cytoplasm or cell membrane.
They are even smaller than bacteria and were first seen in 1931.




## 2.12 – Pathogens

Pathogens spread in a number of ways.

For example:

**Direct contact or body fluids** Some diseases are passed on by skin-to-skin contact, eg. Skin diseases. You can also pass on disease by personal contact such as in your blood, saliva, semen and vaginal fluids.

**Aerosol infection** coughing, sneezing, talking and breathing can put droplets in the air that may contain pathogens. These are then breathed in by another person.

**Water** If the water is contaminated, drinking the water will pass on the pathogen.
There are other ways that you can pass on pathogens, such as insect bites, and contaminated food.

We can prevent these, by good personal hygiene, use of condoms, and using things like mosquito nets.