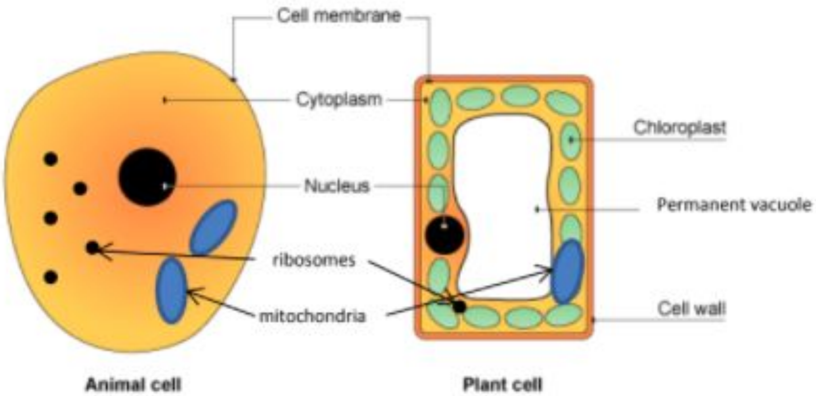
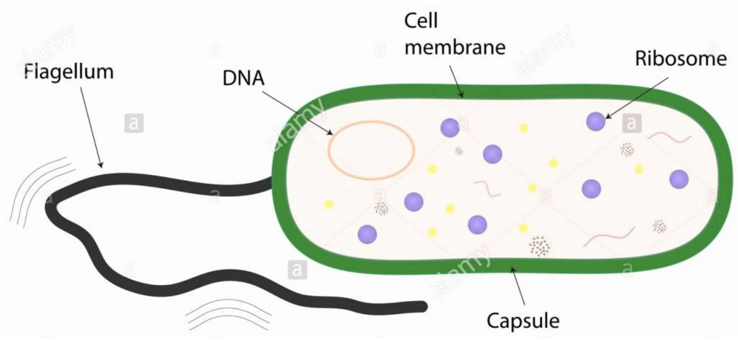
Key Terms	Definitions
Eukaryotic Cells	Cells with a nucleus – e.g. plant and animal cells.
Prokaryotic Cells	Bacterial cells; these don't have a nucleus to enclose their genetic material.
Cell Membrane	The border of all types of cell. The cell membrane separates the inside of the cell from the environment. It controls the movement of substances into and out of the cell.
Nucleus	The enclosure for genetic material found in plant and animal cells.
Cytoplasm	The interior of a cell, where most of the chemical reactions take place.
Mitochondria	Where aerobic respiration takes place.
Ribosome	Where proteins are made (synthesised)
Chloroplast	A sub-cellular structure responsible for photosynthesis – only found in plant cells and algal cells.
Permanent Vacuole	Only found in plant and algal cells – it is filled with cell sap (a store of nutrients for the cell).
Cell Wall	Never found in animal cells. It is made of cellulose, it is outside the cell membrane and it strengthens the cell.
Plasmid	A small loop of DNA, only found in prokaryotic cells.
Resolution	The measure of the level of detail you can see with a microscope.

Eukaryotic Cells



HT1 Biology: AQA GCSE Topic 1 Cells

Prokaryotic Cells - Bacteria cell



Microscopy

Use of a microscope is called microscopy. Microscopes allowed scientists to discover cells and find all the subcellular structures.

Electron microscopes were a vital invention for understanding cells. They have higher magnification and more resolving power than light microscopes, so they let you see smaller structures.

magnification = image height ÷ object height

Respiration

Respiration is a chemical reaction that happens in our cells to produce energy
Aerobic respiration:

oxygen + glucose → carbon dioxide +water

Anaerobic respiration Occurs when we are using a lot of energy and can't get enough oxygen e.g. sprinting

glucose→ lactic acid

Lactic acid is toxic. It builds up in the muscles and causes cramps. You need to breath in extra oxygen after exercise to break down the lactic acid. This is called an **oxygen debt.**

HT1 Biology: AQA GCSE Topic 1 Cells

Key Terms	Definitions
Differentiation	The process of becoming a specialised cell.
Stem cells	Undifferentiated cells that are capable of becoming any other type of cell through differentiation
Mitosis	Cell division that produces two identical daughter cells.
Culture	A population of organisms specifically grown to study e.g. a culture of bacteria
Binary fission	How bacteria multiply. Each bacterial cell multiplies by two,forming identical cells.
Contamination	Unwanted bacteria or other microorganisms mix with the bacteria you want to grow.
Aseptic	Without contaminating microorganisms
Culture medium	Substance on which things are grown, which provides nutrients e.g. agar

Aseptic technique to prepare an uncontaminated culture

1. Sterilise the Petri dishes and culture media. This ensures that there are no microorganisms present at the start.
2. Inoculating loops are used to transfer bacteria to the culture medium. These loops are passed through the flame of a Bunsen burner to sterilise them before collecting the bacteria you want to study.
3. After transferring the bacteria under study to the culture medium, the lid of the Petri dish is secured on with tape to prevent other microorganisms from entering. It is stored upside down to prevent condensation flooding the bacteria.
4. The culture is incubated (in schools at 25^0C) to allow the microorganisms to grow.

Stem cells

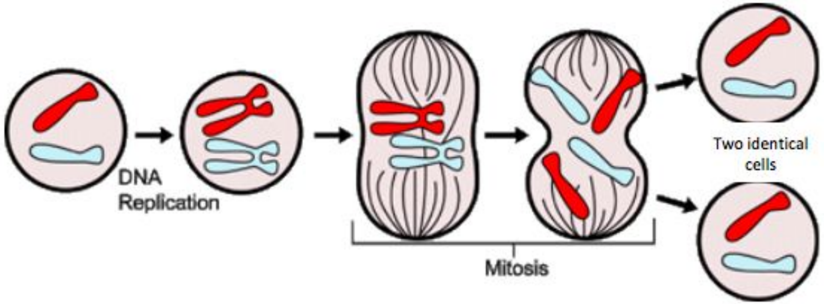
In an young **embryo**, all the cells are stem cells, so they can be taken, cloned and used to produce any human cells by differentiation.
In adults, there are not many stem cells left – most have differentiated. But there are some, for repair and replacement of specialised cells e.g. stem cells in the bone marrow can be collected, cloned and made to differentiate into any type of blood cell.

Using stem cells in this way is an active area of medical research, to treat conditions like diabetes and paralysis. Embryonic stem cells are more useful than adult stem cells as they can differentiate into any type of cell, however some people disagree with this type of research as it involves destroying the embryo.

Cell cycle

Cells divide to make new cells, for growth and repair, in the cell cycle.

1. The cell grows larger and makes more sub-cellular structures, such as ribosomes and mitochondria. (It makes enough for two cells!)
2. DNA is doubled by making an exact replica of the chromosomes. So, there are two copies of every chromosome at this point .
3. Tiny fibres in the cell pull the copies of each chromosome to opposite ends of the cell, breaking the replica chromosomes apart. This means the nucleus can divide into two, each with the full set of chromosomes.
4. The cytoplasm and cell membranes divide to form two genetically identical cells.

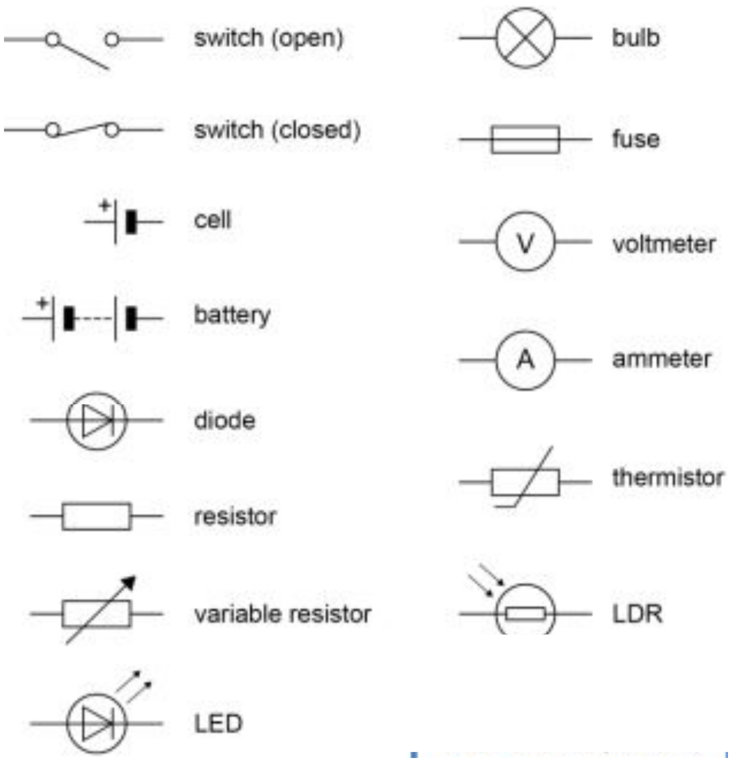


HT1 Physics: AQA GCSE Topic 2 Electricity

Key Terms	Definitions
Electric charge	A positive or negative charge. In most electrical circuits, the electric charges that are flowing are electrons – which are of course negatively charged. Symbol: Q
Current	The rate of flow of electric charge (i.e. speed). Calculated by dividing the size of the charge by the time. Symbol: I
Potential difference	Also known as voltage, or p.d.. The potential difference is a measure of how much work is done per coulomb of charge. Symbol: V
Resistance	Resistance determines the size of the current for a particular potential difference. Symbol: R

Series and Parallel Circuits

	SERIES	PARALLEL
What happens to the Potential Difference?	V splits up	V stays constant
What happens to the current?	I stays constant	I splits up
What happens to the resistance?	$R_T = R_1 + R_2 + R_3$	$1/R_T = 1/R_1 + 1/R_2 + 1/R_3$



Equations

current = charge/time

I = Q/t

Potential difference = current x resistance

V= IR

Power = current x potential difference

P= IV

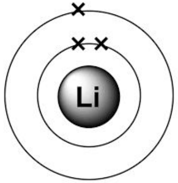
HT2 Chemistry: AQA Topic The Periodic Table and Atomic Structure

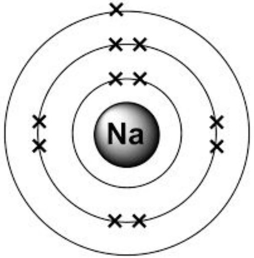
Key Terms	Definitions
Mass number	The number of protons and neutrons in an atom
Atomic number	The number of protons in an atom
Isotope	Atoms of the same element (same number of protons) with different numbers of neutrons (therefore different mass numbers).
Inert	Unreactive
Valence shell/orbital	Outer electron shell/orbital

Electron shells

Electrons are arranged at different energy levels (shells/orbitals) around the nucleus.

Energy shell	Maximum number of electrons
First	2
Second	8
Third	8

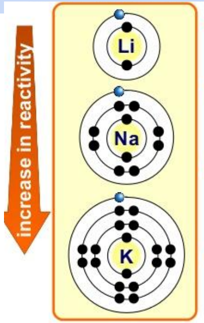




For example Lithium is in group 1. It has 3 electrons. The first 2 electrons are in the first shell, the 3rd electron is in the second shell. This is denoted as Li 2.1

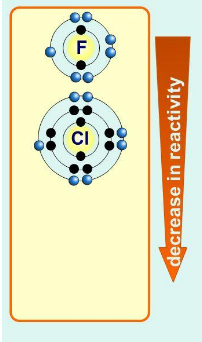
Sodium is also in group 1. It has 11 electrons. The first 2 electrons are in the first shell, the next 8 electrons are in the second shell and the final electron is in the third shell. This is denoted as Na 2.8.1

The position of the element on the periodic table indicates the number of electrons in the valence shell e.g Calium is in group 2 and has two electrons in its valence shell.



Group 1/Alkali metals

- Soft, Shiny and very reactive
- Alkali metal + water → metal hydroxide + hydrogen
  Lithium + water → lithium hydroxide + hydrogen
- Reactivity increases down the group
  - Valence electron is lost in reactions
  - The distance between the negative valence electron and the positive nucleus increases down the group
  - The forces of attraction decrease
  - The electron is more easily lost.



Group 7/ Halogens

- Boiling point increases down the group
- Reactivity decreases down the group
  - Electron is gained in reaction
  - The distance between the negative valence electron and the positive nucleus increases down the group
  - The forces of attraction decrease
  - The stronger the force of attraction, the easier it is for the atom to gain an extra electron.
- More reactive halogen will displace less reactive halogen
  Lithium bromide + fluorine → lithium fluoride + bromine

Group 8/ Group 0 / Noble gases

- Inert - full valence shell
- Colourless, odourless gases

Transition metals

- Good conductors of heat and electricity
- Bent and hammered into shape

Key Terms	Definitions
Energy store	A system or object can act as an energy store. Good examples of energy stores are objects up high (they have gravitational potential energy), fuels (they have chemical potential energy), and stretched springs (they have elastic potential energy).
Energy transfer	The change of energy from one store to another. AKA work
Dissipate	This means "spread out". When applied to energy being dissipated, this means that during energy transfers, some energy is stored in less useful ways. This can be called 'wasted' energy, since it is not transferred to form that is wanted.
Conservation of energy	A fundamental concept in physics. In a system, total energy is always conserved (it cannot be created or destroyed). However, it can be transferred from one store of energy to another.

Energy Resource	Advantages	Disadvantages
Fossil fuel	Cheap Reliable	Nonrenewable Releases greenhouse gases
Nuclear	Doesn't release greenhouse gases Reliable	Produces toxic waste
Wind	Renewable Doesn't release greenhouse gases	Unreliable - weather dependent Eye sore and noise pollution
Solar	Renewable Doesn't release greenhouse gases	Unreliable - weather dependent
Biofuel	Renewable Reliable "Carbon neutral"	Lots of land required

HT 3 Physics: AQA GCSE Topic 1 Energy

Efficiency

It is often useful to measure how much energy is transferred in the way we want, and how much is dissipated. This measure is called efficiency.

$$\text{Efficiency} = \frac{\text{useful output}}{\text{Total input energy}}$$

Since there is always some wasted energy, efficiency must always be less than 1, or less than 100% if you convert the efficiency to a percentage.

Equations

Work done (J)= force (N) x distance (m)

W=fs

Gravitational potential energy (J) = mass (kg) x gravitational field strength (N/kg) x height (m)

$Ep = m\ g\ h$

Kinetic energy (J) = 0.5 x mass (kg) x velocity^2 (m/s)

$Ek = 0.5\ m\ v^2$

Power (W) = energy (J)/ time (s)

P= E/t

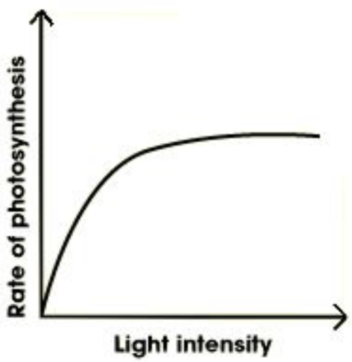
HT4: Biology: AQA GCSE Topic 2 Photosynthesis

Key Terms	Definitions
Photosynthesis	The endothermic reaction that transfers light energy to chemical potential energy. In it, simple molecules (CO_2 and H_2O) are converted into more complex molecules (glucose) that can be used for food.
vascular bundles	Veins in the leaf that transport water to the leaf and glucose away from the leaf

Factors affecting photosynthesis

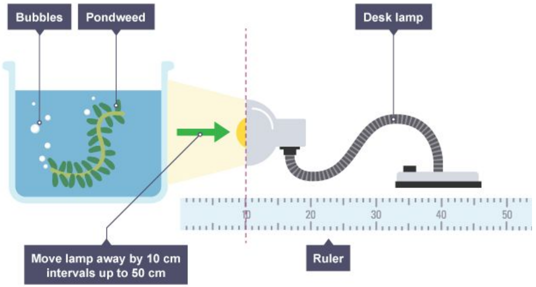
- Light
- Carbon dioxide
- Water
- Temperature

Light, carbon dioxide and temperature can limit the rate of photosynthesis - **limiting factors.** The graph shows that as light increases, photosynthesis increases. At a certain point increasing the light intensity has no effect on the rate of photosynthesis. This is because another factor is limiting the rate of photosynthesis e.g carbon dioxide or temperature,



Investigating photosynthesis

Independent variable: light intensity (move the the distance of the lamp from the pond weed)
Dependent variable: volume of oxygen produced in a minute/number of bubbles in a minute
Control variables:
Temperature
Species of pondweed/specific plant
Carbon dioxide levels



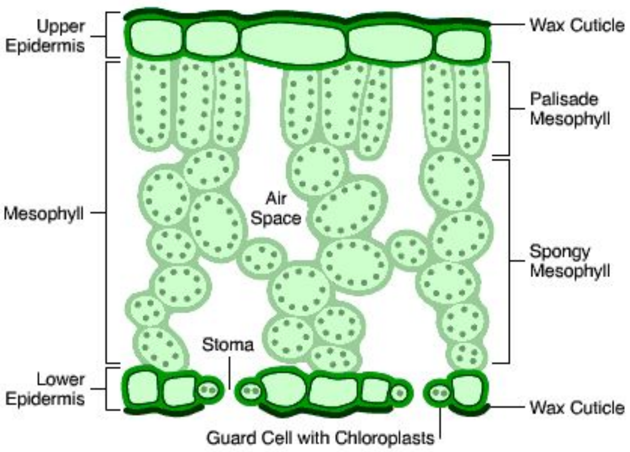
Photosynthesis:

carbon dioxide + water → oxygen + glucose

$$6CO_2 + 6H_2O \rightarrow 6O_2 + C_6H_{12}O_6$$

Photosynthesis occurs in the chloroplasts of plant cells.

Cross section of a leaf



The waxy cuticle prevents water loss from the surface of the leaf.
Stomata open and close to allow gases diffuse in and out of the cell.
The palisade mesophyll ar closely packed together to maximise photosythesis.

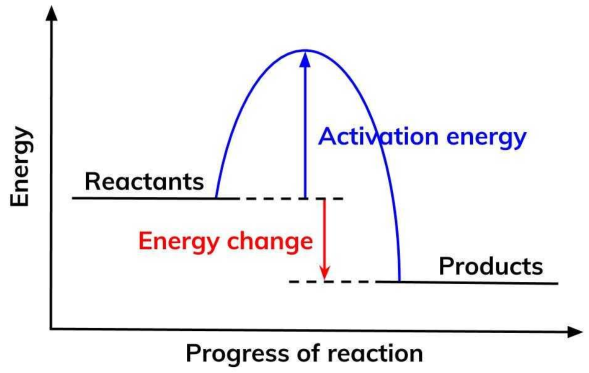
HT5: Chemistry: AQA Topic 5 Energetics

Key Terms	Definitions
Rate of reaction	The rate at which reactants are being turned into products
Catalyst	A substance which speeds up a chemical reaction without being used up
Activation Energy	The minimum energy required for a chemical reaction to take place
Frequency	The amount of times something happens in one second
Concentration	The number of particles in a given volume
Exothermic	Heat energy is transferred to the surroundings. Bonds are formed.
Endothermic	Heat energy is transferred from the surroundings. Bonds are broken.

Collision Theory Collision Theory
Reactions occur when particles collide with a certain amount of energy. The minimum amount of energy needed for the particles to react is called the activation energy, which is different for each reaction. The rate of a reaction depends on two things: · the frequency of collisions between particles. The more often particles collide, the more likely they are to react. · the energy with which particles collide. If particles collide with less energy than the activation energy, they will not react.
If the concentration of a solution is increased then there are more particles in a given volume, therefore collisions are more frequent and the chemical reaction is faster. Concentration is directly proportional to rate of reaction (if you double the concentration you double the rate

Factors which affect Rate of Reaction

- Changing temperature
- Changing pressure
- Changing the concentration of a solution
- Changing the surface area
- Adding a catalyst



Rates of Reactions Experiments
There are several experiments that can be used to measure the rate of a chemical reaction.
1. Measuring the mass lost in a chemical reaction (marble chips and acid is a good example)
2. Measuring the volume of gas produced (decomposition of hydrogen peroxide is a good example)
3. Time taken to make an X disappear (sodium thiosulphate and acid is a good example)

Bond Energies
You can calculate the energy change in a reaction from bond energies given to you in a question.
For example consider the reaction below:

$$2H-O-O-H \rightarrow 2H-O-H + O=O$$

This shows that hydrogen peroxide breaks down to make water and oxygen. We can use bond energies to work out the energy change in the reaction.

Bond	Bond energy in kJ per mole
H – O	464
O – O	146
O = O	498

The energy required to break the reactant bonds is:
2x O-H bonds = 2 x464 = 928
1 x O-O bond = 146
928+ 146 = 1074
As there is a 2 in the equation, there are two hydrogen peroxide molecules therefore this needs to be doubled:
Energy required to break reactant bonds = 1074 x 2 = 2148 klj/mol

The energy released from bond formation:
4x 464 = 1856
1 x 498= 498
Energy released to form bonds= 1856+498=2354 kj/mol

Therefore we do energy required to break reactant bonds- energy gained from making product bonds: **2184-2354=-170kj/mol**

If the value is negative then the reaction is exothermic If the value is positive the reaction is endothermic.

Equilibrium

Some chemical reactions are reversible, this means they can happen in both the forward and reverse directions.
The symbol we use to represent an equilibrium reaction is shown in the equation below:

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

In a dynamic equilibrium reaction, the forward and reverse reactions are happening at the same rate. A dynamic equilibrium has to occur in a closed system, where no reactants and products are allowed to escape.

If the equilibrium lies to the left, it means that there is a greater concentration of reactants than products.
If the equilibrium lies to the right it means there is a greater concentration of products than reactants.

Most equilibrium reactions are endothermic in one direction and exothermic in another direction. A good example is the hydration and dehydration of copper sulphate. It is exothermic when water is added to the copper sulphate, it is endothermic when water is removed.