B1 Chapter 3: Reproduction
Knowledge organiser

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Human reproduction

Adolescence

The time during which you change from being a child to being an adult is called **adolescence**. The physical changes that happen between the ages of 9–14 are called **puberty**.

These changes include:

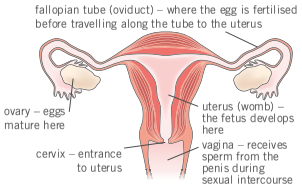
Girls: breasts develop, ovaries start to release egg cells, periods start, hips widen,

pubic and underarm hair grows, body odour develops, emotional changes, growth spurt

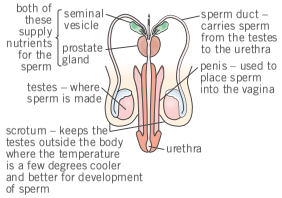
Boys: voice breaks, sexual organs develop, testes start to produce sperm, shoulders widen, hair grows on face and chest

Reproductive systems

female



male



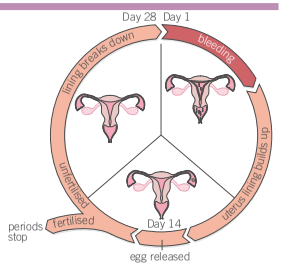
The menstrual cycle

Day 1 – blood from uterus lining leaves the body through the vagina.

Day 5 – bleeding stops. Uterus lining begins to re-grow.

Day 14 – an egg cell is released from one of the ovaries (**ovulation**).

The egg cell travels through the oviduct towards the uterus.



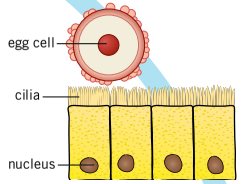
Methods of contraception

Condoms – A thin layer of latex rubber that prevents semen being released into the vagina.

Contraceptive pill – a daily tablet that contains hormones. It prevents pregnancy by stopping ovulation.

Fertilisation

An egg is released every month.



The egg cell is moved along the oviduct towards the uterus by **cilia**.

Sperm cells are produced in the **testicles/testes**.

Sperm are mixed with nutrients and fluid from the glands to form **semen**.

During sexual intercourse a man will release semen into the vagina (**ejaculation**).

If a sperm meets the egg **fertilisation** may happen.

The fertilised egg may then **implant** in the uterus lining and form an **embryo** (ball of cells)

the main steps in a baby's development (**gestation**) during pregnancy

- just a dot – 1 week – cells beginning to specialise
- 3 mm long – 4 weeks – spine and brain forming, heart beating
- 3 cm long – 9 weeks – tiny movements, lips and cheeks sense touch, eyes and ears forming
- 7 cm long – 12 weeks – fetus uses its muscles to kick, suck, swallow, and practise breathing

There are three important structures in the uterus during gestation:

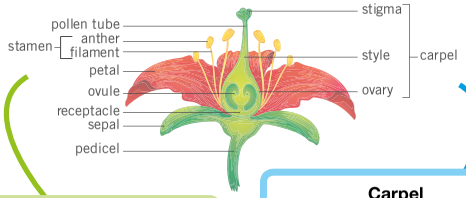
placenta – where substances pass from mother to **fetus**

umbilical cord – connects the fetus to the placenta

fluid sac – shock absorber that protects the baby.

Plant reproduction

Parts of a flower



Stamen

male part of the flower
- the **anther** produces pollen
- the **filament** holds up the anther

Carpel

female part of the flower
- the **stigma** is sticky to catch grains of pollen
- the **style** holds up the stigma
- the ovary contains **ovules**

Pollination

Pollination is the fertilisation of the ovule, which occurs when pollen is transferred from an anther to the stigma. Pollination can occur due to insects or the wind.

cross-pollination between two **different** plants

self-pollination between the male and female parts of the **same** plant

Fertilisation

The tube grows out of the pollen grain and down through the style.

The pollen nucleus moves down the tube.

The pollen nucleus joins with the ovule nucleus. Fertilisation takes place and a seed will form.

Germination

When a seed starts to grow it is called **germination**.

To germinate, seeds need:
- water – for the seed to swell and the embryo to start growing
- oxygen – for respiration and transferring energy for germination
- warmth – to help speed up the reactions in the plant.

Key terms Make sure you can write definitions for these key terms.

adolescence, anther, carpel, cervix, cilia, contraception, ejaculation, embryo, fertilisation, fetus, filament, gestation, germination, implant, menstrual cycle, ovary, oviduct, ovulation, ovule, placenta, pollen, pollination, puberty, semen, sperm duct, stamen, stigma, style, testes, umbilical cord, uterus, urethra, vagina

B2 Chapter 3: Adaptation and inheritance

Knowledge organiser

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Variation

Differences in characteristics are called **variation**.

Inherited variation

Characteristics are passed on from parents to offspring
genetic diseases
eye colour
blood group

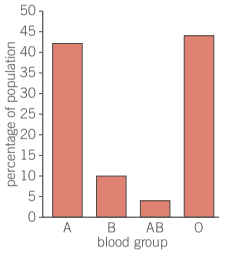
Surroundings affects your characteristics
dyed hair
tattoos
accent

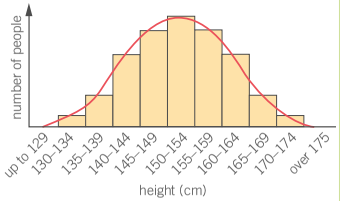
Environmental variation

Many characteristics, such as height, are affected by both inherited and environmental variation.

Discontinuous variation
can only result in certain values
(*e.g., blood group or eye colour*)

Continuous variation
can take any value within a range
(*e.g., height or hair length*)





Discontinuous variation should be plotted on a bar chart, and continuous variation should be plotted on a histogram.

Inheritance

Characteristics

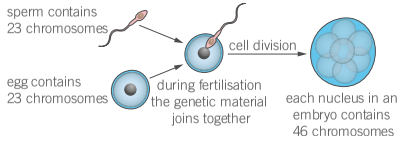
Characteristics are inherited from your parents through genetic material stored in the nucleus of cells.

We inherit half of our DNA (deoxyribonucleic acid) from our mother and half from our father.

DNA
- contains all the information needed to make an organism
- is arranged into long strands called **chromosomes**.
- each chromosome is divided into sections of DNA
- sections of DNA that contain the information to produce a characteristic are called **genes**

Scientists Watson, Crick, Franklin, and Wilkins, worked together to produce a model of the structure of DNA.

Inheritance of genetic material:



Natural selection

Organisms in a species show variation caused by differences in their genes.

Organisms with the most useful characteristics survive and reproduce.

This is called 'survival of the fittest'.

Successful genes are passed on to the offspring.

This is repeated many times and over a long time can lead to a new species.

Process of natural selection
- All living organisms have **evolved** from a common ancestor, through the process of natural selection.
- Organisms change slowly over time.
- Those better adapted to their environment are more likely to survive.

Adaptation and change

Adaptation	Competition
• Adaptations are characteristics that help an organism to survive and reproduce. *For example, the cheetah is the fastest land animal. This speed makes it a very successful predator.*	Animals compete for: food, water space (for shelter and to hunt), and mates (to reproduce). Plants compete for: light, water, space, and minerals (plants produce their own food through photosynthesis).
Environmental changes	**Competition and adaption**
• Plants and animals adapt to changes in their environments. • Habitats can change through fire, climate change, or disease causing reduced food supplies. *For example, deciduous trees look different in each season, and bears hibernate somewhere warm in the winter.*	• Predator and prey species are **interdependent**. • This occurs when a change in the population of one animal directly affects the population of the other. *For example, the number of Canadian lynx and its prey the snowshoe hare.*

Extinction

If a species is not well-adapted to its environment it will not survive, and the organisms will die before reproducing. A species becomes **extinct** when there are no more individuals of that species left anywhere in the world. The **fossil record** shows that many species that once lived have become extinct.

Factors leading to extinction:
- changes to the organism's environment
- destruction of their habitat
- new diseases
- new predators
- increased competition.

Scientists are trying to prevent **endangered** species (at risk of extinction) from becoming extinct.

For example, by using gene banks to store genetic samples from different species.
In the future these can be used for research, or to produce new individuals.

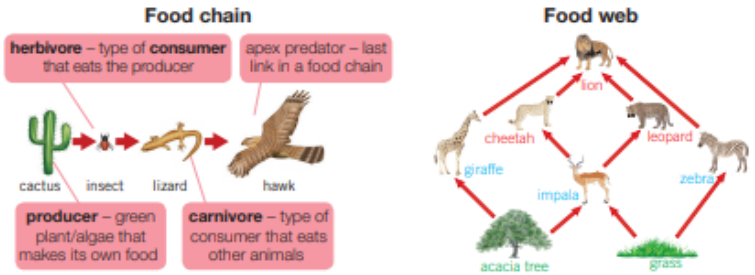
Key terms Make sure you can write definitions for these key terms.

adaptation competition chromosome continuous characteristic discontinuous DNA inherited variation environmental variation evolution extinct fossil record gene gene bank interdependent natural selection species variation

Biology - Plants and Ecosystems 1

1 Food chains and webs

- **Food chains** show the direction in which energy flows when one organism eats another
- The direction of the arrows represent the direction in which the energy flows
- **Food webs** show how a number of different food chains are connected



- **Producers** are the organisms which start the food chain, they convert energy from the Sun, making their own food, these are often plants
- **Prey** are organisms which are eaten by other organisms
- **Predators** are the organisms which eat the prey

2 Disruption to food chains

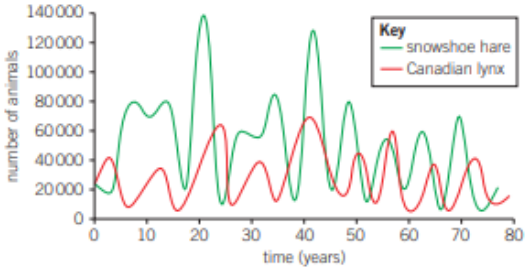
- **Interdependence** is the way in which living organisms rely on each other to survive
- A food chain will be disrupted if one of the organisms die out
- If the producer dies out the rest of the food chain will also die out unless they have a different food source
- If the **consumer** population die out the number of organisms which they eat will increase unless they are eaten by another organism
- **Bioaccumulation** is the process by which chemicals such as pesticides and insecticides build up along a food chain

3 Ecosystems

- All of the organisms which live in one area are known as a **population**
- An **ecosystem** is all of the organisms which are found in a particular location and the area in which they live in, both the living and non-living features
- A **community** are all of the areas in an ecosystem, the area in which the organisms live in is known as the **habitat**
- A **niche** is the specific role in which an organism has within an ecosystem, for example a panda's diet consists of 99% bamboo

4 Competition

- **Competition** is the process in which organisms compete with one another for resources
- Animals compete for food, water, space and mates
- Plants compete for light, water, space and minerals
- The best competitors are those who have adapted in order to best gain these resources
- As the number of a predator in a population increases the number of the prey will decrease as more are being eaten
- As the number of the predator decreases the number of the prey will increase as less are being eaten
- The relationship between the predator and the prey is known as a **predator-prey relationship**

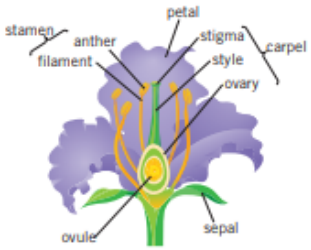


5 Parts of a flower

Stamen

Male part of the flower

- The **anther** produces **pollen**
- The **filament** holds up the anther



Carpel

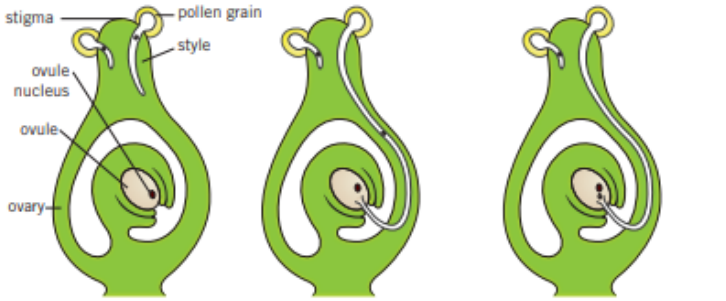
Female part of the flower

- The **stigma** is sticky to catch grains of pollen
- The **style** holds up the stigma
- The **ovary** contains **ovules**

6 Pollination and fertilisation

Pollination is the **fertilisation** of the ovule, the point at which the pollen is transferred to the ovule from the anther to the stigma, there are two types of pollination

- Cross pollination is between two different types of plant
- Self pollination happens within the same plant



The tube grows out of the pollen grain and down through the style.

The pollen nucleus moves down the tube.

The pollen nucleus joins with the ovule nucleus. Fertilisation takes place and a seed will form.

Germination is the process in which the **seed** begins to grow, for this to occur the seed needs:

- Water to allow the seed to swell and grow and for the embryo tostart growing
- Oxygen for that the cell can start respiring to release energy forgermination
- Warmth to allow the chemical reactions to start to occur within the seed

Key terms

Make sure you can write definitions for these key terms.

anther, bioaccumulation, carpel, community, competition, consumer, ecosystem, fertilisation, food chain, food web, germination, habitat, interdependence, niche, ovary, ovule, petal, predator, prey, producer, pollen, pollination, population, seed, sepal, stamen, stigma, style

Biology - Plants and Ecosystems 2

1 Respiration

- Respiration is the process in which energy is released from the molecules of food which you eat
- Respiration happens in the mitochondria of the cell
- **Aerobic respiration** involves oxygen, it is more efficient as all of the food is broken down to release energy

glucose + oxygen → carbon dioxide + water

- The glucose is transported to the cells in the blood **plasma**
- The oxygen is transported to the cells in **red blood cells**, by binding with **haemoglobin**
- Carbon dioxide is a waste product and is transported from the cells to the lungs to be exhaled

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- **Anaerobic respiration** is a type of respiration which does not use oxygen, it is used when the body cannot supply the cells with enough oxygen for aerobic respiration
- Anaerobic respiration releases less energy than aerobic respiration

glucose → lactic acid

- The **lactic acid** produced through anaerobic respiration can cause muscle cramps
- Lactic acid will build up if there is not enough oxygen present in the blood supply to break it down. This is known as an **oxygen debt**

2 Fermentation

- **Fermentation** is a type of anaerobic respiration which occurs in yeast
- Instead of producing lactic acid, yeast produces ethanol, which is a type of alcohol

glucose → ethanol + carbon dioxide

- This process can be used to form alcohol to drink or to allow bread and cakes to rise

3 Plant minerals

Plants need minerals for healthy growth, if they do not have enough of these minerals this is known as a **mineral deficiency**

Mineral	What is It used for?	What happens if there is not enough?
nitrates (contain nitrogen)	healthy growth	poor growth and older leaves yellow
phosphates (contain phosphorus)	healthy roots	poor growth, younger leaves look purple
potassium	healthy leaves and flowers	yellow leaves with deadpatches
magnesium	making chlorophyll	leaves will turn yellow

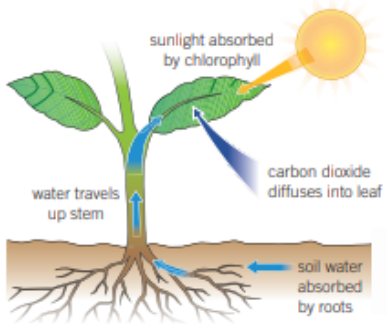
Fertilisers can be used to stop plants from suffering with mineral deficiencies

4 Photosynthesis

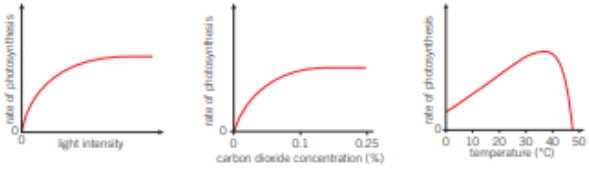
- **Photosynthesis** is the process which occurs in the chloroplasts to produce glucose using sunlight

water + carbon dioxide + sunlight → glucose + oxygen

- Any organism that can use photosynthesis to produce its own food is known as a **producer**, these are not just limited to plants but can include other organisms such as **algae**

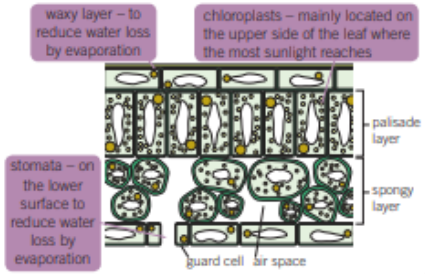


- The rate of photosynthesis can be affected by:
  - Light intensity – the higher the light intensity the higher the rate of photosynthesis up to a point
  - Carbon dioxide concentration – the higher the carbon dioxide concentration the higher the rate of photosynthesis up to a point
  - Temperature – the optimum temperature is the temperature at which photosynthesis occurs at the highest rate, before and after this the rate will be less



5 Leaves

- To best adapt for photosynthesis leaves have a number of adaptations
- They are thin to allow the most light through
- There is a lot of **chlorophyll** to absorb light
- They have a large surface area to absorb as much light as possible



Key terms Make sure you can write definitions for these key terms.

aerobic respiration, algae, anaerobic respiration, chlorophyll, mineral deficiency, fermentation, fertiliser, haemoglobin, lactic acid, magnesium, nitrates, oxygen debt, phosphates, photosynthesis, plasma, potassium, producer, red blood cells

C1 Chapter 2: Elements, atoms, and compounds
Knowledge organiser

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Atoms

Atoms are incredibly tiny particles that make up all substances.

There are 92 types of atom – one for each of the 92 elements that exist naturally.

Each type of atom has different properties (e.g., size or mass).

Elements

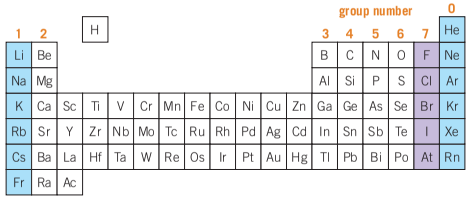
An **element**:

- cannot be broken down into other substances
- is made of one type of atom only.

Examples of elements include gold, potassium, carbon, and hydrogen.

The names and symbols of all the elements can be found on the **Periodic Table** of elements.

Elements in the Periodic Table are grouped together by their properties, which are different for each element.



The **chemical symbol** for an element is universal – it is the same in every language, even if the name of the element is different.

Some examples of chemical symbols for common elements are:

hydrogen	H	sulfur	S
carbon	C	sodium	Na
oxygen	O	chlorine	Cl
nitrogen	N	magnesium	Mg

Molecules

A **molecule** is made up of atoms all chemically bonded to each other.

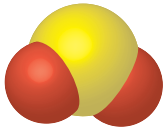
Molecules can be made up from:

several of the same type of atom

for example, *oxygen gas* O_2

two or more types of atoms

for example, sulfur dioxide SO_2



Different elements have different masses. So, in a molecule, the different atoms that make it up have different masses.

For example, a molecule of water has two hydrogen atoms and one oxygen atom.

Chemical formulae

A **chemical formula** tells you how many of each atom there are in a molecule relative to each other.

H_2O

two hydrogen atoms for every oxygen atom

$MgCl_2$

two chlorine atoms for every one magnesium atom

$NaOH$

one sodium atom for every one oxygen atom, and every one hydrogen atom

Compounds

Compounds:

- are made of two or more *different* atoms strongly joined together.
- can be broken down into other substances.

Naming compounds

In a compound made of a metal and a non-metal, the name of the metal comes first.

for example, iron bromide, magnesium fluoride

If the non-metal atom is oxygen, it is called oxide. If the non-metal atom is chlorine, it is called chloride.

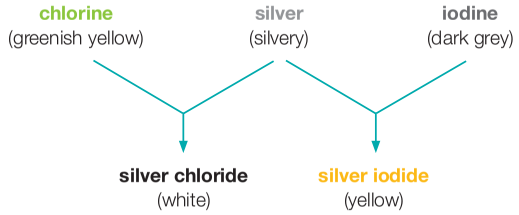
for example, copper oxide, sodium chloride

In a compound made of a non-metal and oxygen, oxygen comes second and is called monoxide if there is one oxygen atom or dioxide for two oxygen atoms.

for example, carbon monoxide, sulfur dioxide

When atoms join together to make a compound, the compound has properties that are different to the properties of the atoms that make them up.

For example, the colours of silver compounds are very different from the colours of the elements that make them up:



Key terms Make sure you can write definitions for these key terms.

atom *chemical formula* *chemical symbol* *compound* *element* *molecule* *Periodic Table*

C2 Chapter 1: The Periodic Table
Knowledge organiser

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The **Periodic Table** displays the names and symbols of all the **elements** we have discovered which are organised by their **chemical properties** and their **physical properties**.

Physical properties

The **physical properties** of an element describe how a substance behaves generally.
(*E.g.*, ***conductor*** *of electricity, dense, conductor of heat, shiny,* ***malleable****, sonorous, high melting and boiling points*)

Chemical properties

The **chemical properties** of an element describe how a substance behaves in terms of its chemical reactions.
For example, how reactive it is, what other substances it reacts with, and the products it forms in reactions.

metals are to the left of the red line
non-metals are on the right

H hydrogen																	He helium
Li lithium	Be beryllium											B boron	C carbon	N nitrogen	O oxygen	F fluorine	Ne neon
Na sodium	Mg magnesium											Al aluminum	Si silicon	P phosphorus	S sulfur	Cl chlorine	Ar argon
K potassium	Ca calcium	Sc scandium	Ti titanium	V vanadium	Cr chromium	Mn manganese	Fe iron	Co cobalt	Ni nickel	Cu copper	Zn zinc	Ga gallium	Ge germanium	As arsenic	Se selenium	Br bromine	Kr krypton
Rb rubidium	Sr strontium	Y yttrium	Zr zirconium	Nb niobium	Mo molybdenum	Tc technetium	Ru ruthenium	Rh rhodium	Pd palladium	Ag silver	Cd cadmium	In indium	Sn tin	Sb antimony	Te tellurium	I iodine	Xe xenon
Cs caesium	Ba barium	La lanthanum	Hf hafnium	Ta tantalum	W tungsten	Re rhenium	Os osmium	Ir iridium	Pt platinum	Au gold	Hg mercury	Tl thallium	Pb lead	Bi bismuth	Po polonium	At astatine	Rn radon
Fr francium	Ra radium																

metals **non-metals**

solids liquids gases at room temprature

This version of the Periodic Table does not include every discovered element.

- columns are called **groups**
- rows are called **periods**

Elements in a group normally have similar properties, meaning chemists can predict properties of elements based on their group.

Metals

- normally good conductors of heat and electricity
- shiny when cut
- malleable
- **dense** and **sonorous**
- most have high melting points

Non-metals

- often have properties the opposite of metals
- low boiling points, so are gases at room temperature
- poor conductors of electricity and heat
- dull in appearance
- low density
- **brittle** and not sonorous

Group 1

- called the **alkali metals**
- like all other metals but are very **reactive**
- react vigorously (strongly) with water
- get more reactive as you go down the group
- lower melting points than most other metals
- melting points decrease down the group
- always produce a metal hydroxide and hydrogen gas when reacted with water

Group 7

- called the **halogens**
- generally very reactive
- generally the opposite of Group 1
- melting point increases down the group while reactivity decreases.
- take part in **displacement reactions**, where an element from higher up the group takes the place of one from lower down the group in a compound.

For example: *potassium iodide + chlorine → potassium chloride + iodine*

Group 0

- called the **noble gases**
- very unreactive
- low boiling points, so are gases at room temperature
- like the halogens, their boiling points increase down the group

Key terms Make sure you can write definitions for these key terms.

alkali metal brittle conductor chemical property dense displacement reaction element group halogen malleable metal noble gas non-metal period Periodic Table physical property sonorous reactive

C1 Chapter 6: Reaction
Knowledge organiser

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Chemical reactions

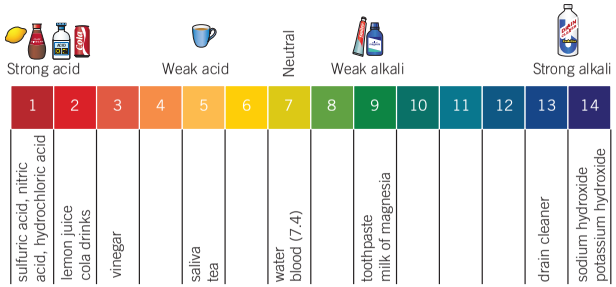
- A **chemical** reaction is a change in which atoms are rearranged to make new substances
- A **reversible** reaction is one where the products can react to get back the substances which you started with, most chemical reactions are not reversible
- You can look for signs that a chemical reaction has taken place such as flames, smells, heat change, a loud bang or gentle fizz

Acids and alkalis

- **Acids** and **alkalis** are the chemical opposites of one another
- Both acids and alkalis can be **corrosive** and **irritants**

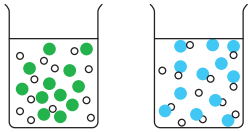
To see whether a substance is an acid or an alkali, we can use an **indicator**. Indicators show how acidic or how alkaline a solution is by showing its position on the **pH scale**, one example of this is **universal indicator**

- If the solution has a pH value of 1–6 it is **acidic**
- If the solution has a pH value of 8–14 it is **alkaline**
- If the solution has a pH value of 7 it is known as **neutral**



Acid strength

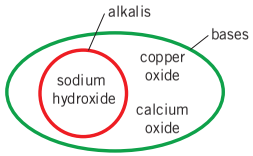
- The strength of an acid depends on how much of the acid has broken apart when it has dissolved in water
- Hydrogen chloride dissolves in water to form hydrochloric acid, this is a **strong acid** as all of the particles split up
- A **weak acid** will have particles that do not all split up



- The **concentration** of the acid is the amount of acid which has dissolved in 1 litre of water
- The more concentrated the acid, the lower the pH

Neutralisation

- **Neutralisation** reactions are any reaction in which acids react with a **base** to cancel out the effect of the acid
- These reactions form a neutral solution with a pH of seven
- A **base** is any substance which neutralises an acid
- An alkali is a base which has been dissolved in water



Salts

Salts are substances which are formed when an acid reacts with a metal or metal compound

Different acids form different types of salts:

- Hydrochloric acids form chloride
- Sulphuric acids form sulphates
- Nitric acids form nitrates

Metal reactions

When a metal reacts with an acid it will produce a salt and hydrogen gas, the fizzing that you see is the hydrogen gas being given off

metal + acid → salt + hydrogen
magnesium + hydrochloric acid → magnesium chloride + hydrogen

When a metal reacts with oxygen a metal **oxide** is formed, this process is known as **oxidation**

metal + oxygen → metal oxide
aluminum + oxygen → aluminum oxide

- When a metal reacts with water it forms a metal **hydroxide** and hydrogen gas.
- The alkali (group 1) metals react most vigorously, giving off a brightly coloured flame

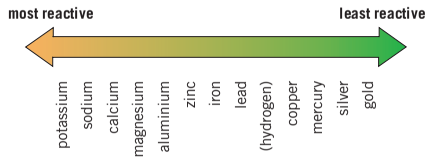
metal + water → metal hydroxide + hydrogen
sodium + water → sodium hydroxide + hydrogen

When a more reactive metal reacts with a compound containing a less reactive metal, it can take it's place, this is known as a **displacement** reaction

- If the metal on it's own is higher in the **reactivity series** than the metal in the compound a reaction will take place
- If the metal on it's own is lower in the reactivity series than the metal in the compound, a reaction will not take place

The reactivity series

- The **reactivity series** describes how reactive different metals are compared to one another
- The higher the metal is in the reactivity series the more reactive it will be this means that it will react much more vigorously



Key terms Make sure you can write definitions for these key terms.

acid, acidic, alkali, alkaline, base, chemical, chemical reaction, concentration, concentrated, corrosive, displacement, hydroxide, indicator, irritant, neutral, neutralisation, oxide, oxidation, pH scale, reversible, reactivity, reactivity series, salt, strong acid, universal indicator, weak acid

C2 Chapter 6: Reactions
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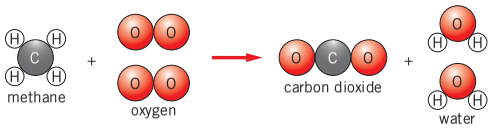
Chemical reactions

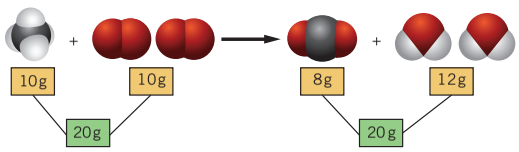
- Word equations can represent a **chemical reaction:**



- The **reactants** are on the left side of the arrow and the **products** are on the right side of the arrow
- We use an arrow instead of an equals sign as it represents that the reactants are changing into a new substance
- In a reaction, the amount of each type of atom stays the same, however they are rearranged to form a new product

Conservation of mass

- In a reaction the mass will be **conserved**, this means that the total mass of the reactants will be equal to the total mass of the products
- If it appears that some of the mass has been lost, this means that a gas has been produced and escaped, accounting for the lost mass



Balanced symbol equations show the amounts of all of the individual atoms in a reaction

- The symbols used are from the Periodic Table
- They also show:
  - Formulae of reactants and products
  - How the atoms are rearranged
  - Relative amounts of reactants and products

$$2H_2 + O_2 \rightarrow 2H_2O$$

Combustion

- **Combustion** is the burning of a **fuel** in oxygen
- A fuel is a substance which stores energy in a chemical store
- Examples of fuels include petrol, diesel, coal and hydrogen
- When a carbon based fuel undergoes combustion, it will produce water and carbon dioxide

methane + oxygen → carbon dioxide + water

- Hydrogen can also be used as a fuel, this is much better than traditional fossil fuels as it does not produce carbon dioxide:

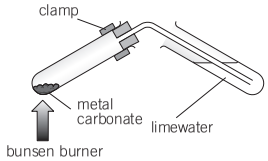
hydrogen + oxygen → water

Thermal decomposition

- A **thermal decomposition** reaction is one where the reactants are broken down (decomposition) using heat (thermal energy)
- An example of this is with metal carbonates:

zinc carbonate → zinc oxide + carbon dioxide

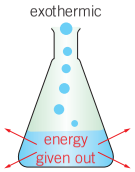
- We can test for this carbon dioxide by bubbling the gas through limewater, if the limewater turns cloudy, the gas is carbon dioxide



Exothermic and endothermic reactions

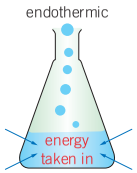
Exothermic reactions involve a transfer of energy from the reactants to the surroundings

- As energy is transferred to the surroundings this will show an increase in temperature
- Examples of exothermic reactions include combustion, freezing, and condensing



Endothermic reactions involve a transfer of energy from the surroundings to the reactants

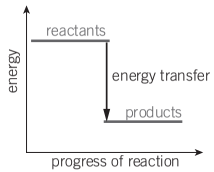
- As energy is taken into the reactants a decrease in temperature will be shown
- Examples of endothermic reactions include thermal decomposition, melting, and boiling



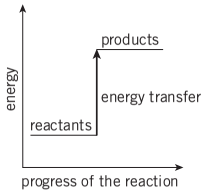
Energy level diagrams

Energy level diagrams show the values of energy between the reactants and the products in a reaction

- If the energy is greater in the reactants than the products then the reaction is exothermic as energy has been given out to the surroundings
- If the energy is lower in the reactants than the products then the reaction is endothermic as energy has been taken in from the surroundings



Exothermic



Endothermic

Bond energies

- Energy must be used to break **chemical bonds**, meaning that this reaction is endothermic
- Energy is given out when chemical bonds are made, meaning that this reaction is exothermic
- To see if a reaction is endothermic or exothermic, you must find the difference in the energy needed to break and to make the bonds in the reaction
- If the energy needed to break the bonds is less than the energy given out when making the bonds, the reaction is exothermic
- If the energy needed to break the bonds is more than the energy released when making the bonds, the reaction is endothermic

Key terms Make sure you can write definitions for these key terms.

balanced symbol equation, chemical bond, chemical reaction, combustion, conserved, conservation of mass, decomposition, fuel, endothermic, energy level diagram, exothermic, products, reactants, thermal decomposition

P1 Chapter 3: Energy
Knowledge organiser

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Energy

- **Energy** is needed to make things happen
- It is measured in **joules** or **kilojoules**

- The **law of conservation of energy** says that energy cannot be created or destroyed, only transferred
- This means that the total energy before a change if always equal to the total energy after a change

Energy can be in different energy **stores**, including:

- **Chemical** – to do with food, fuels and batteries
- **Thermal** – to do with hot objects
- **Kinetic** – to do with moving objects
- **Gravitational potential** – to do with the position in a gravitational field
- **Elastic potential** – to do with changing shape, squashing and stretching

Food and energy

- Food has energy in a chemical energy store
- Different foods contain different amounts of energy
- Different activities require different amounts of energy
- Different people need different amounts of energy depending on what they do each day

Power and energy

- **Power** is a measure of how much energy is transferred per second
- Power is measured in **watts** (W)
- Each appliance has it's own power rating to tell us how quickly it uses energy
- We can calculate power with the equation:

$$\text{power (W)} = \frac{\text{energy (J)}}{\text{time (s)}}$$

Non-renewable energy

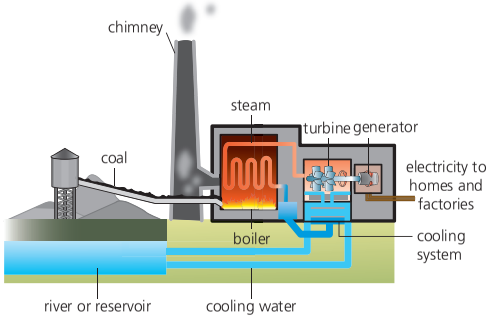
- **Non-renewable** energy cannot be replaced within your lifetime
- Non-renewable **energy resources** include coal, oil, natural gas and nuclear resources
- Coal, oil and natural gas are also known as **fossil fuels**, they release carbon dioxide when burned which contributes to global warming

Renewable energy

- **Renewable** energy can be replaced within your lifetime
- Renewable energy resources include wind, tidal, wave, biomass, solar, hydroelectric and geothermal
- Renewable energy resources do not produce much carbon dioxide, meaning that they have a smaller effect on global warming

Power stations

Thermal power stations burn coal, oil and natural gas, which are all non-renewable energy resources



Fuel is burned underneath water → Water is heated and turns into steam → The steam turns a turbine which turns a generator → Electricity is generated

Dissipation of energy

- We say that energy is **dissipated** when it is transferred to a nonuseful store, it cannot be used for what it was intended for
- Energy can be wasted through friction, heating up components or heating the surroundings
- **Efficiency** is a measure of how much of the energy has been used in a useful way, we can calculate this with the equation:

$$\text{efficiency (\%)} = \frac{\text{useful energy output}}{\text{energy input}} \times 100$$

Key terms Make sure you can write definitions for these key terms.

chemical, dissipated, efficiency, elastic potential, energy, energy resources, fossil fuels, graviational potential, joules, kinetic, kilojoules, law of conservation of energy, non-renewable, power, renewable, thermal, watts

P2 Chapter 3: Energy
Knowledge organiser

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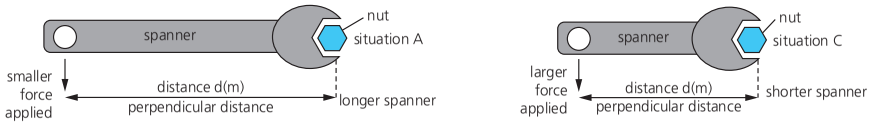
Work

- In physics, **work done** is the energy transferred when a force is used to move an object a certain distance
- Like energy, work is measured in **Joules** (J)
- Work can be done in a a range of situations e.g. lifting a book work is done against gravity, when you slide a book along a table work is done against friction
- We calculate work with the equation:

work done (J) = force (N) × distance moved (m)

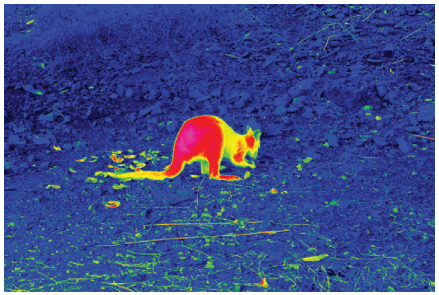
- A **simple machine** makes it easier to lift things, they reduce the force needed
- A **force multiplier** uses a smaller **input force** (what you apply) to to generate a larger **output force** (what is created)
- If you increase the distance from the pivot, less input force is needed to be used for the same output force as before
- A **lever** is an example of a force multiplier, a longer lever will require a less input force than a shorter lever to produce the same output force

The physics of unscrewing a tight nut with a spanner



Radiation

- **Radiation** is a method of transferring energy without the need for particles
- An example of radiation is thermal energy being transferred from the Sun to us through space (where there are no particles)
- This type of radiation is known as **infrared radiation**, it is a type of wave just like light
- The hotter an object is the more infrared radiation it will emit (give out)
- The amount of radiation emitted and absorbed depends on the surface of the object:
  - Darker matte surfaces absorb and emit more infrared radiation
  - Shiny and smooth surfaces absorb and emit less infrared radiation, instead reflecting this
  - The amount of infrared radiation being emitted can be viewed on a **thermal imaging camera**



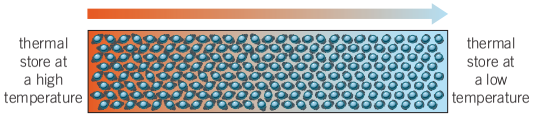
Energy and temperature

- The **temperature** of a substance is a measure of how hot or cold it is
- Temperature is measured with a **thermometer**, it has the units of degrees Celsius (°C)

- The **thermal energy** of a substance depends on the individual energy of all of the particles, it is measures in Joules (J)
- As all particles are taken into account, a bath of water at 30 °C would have more thermal energy than a cup of tea at 90 °C as there are many more particles
- The faster the particles are moving, the more thermal energy they will have
- When particles are heated they begin to move more quickly
- The energy needed to increase the temperature of a substance depends on:
  - the mass of the substance
  - what the substance is made of
  - how much you want to increase the temperature by

Conduction

- **Conduction** is the transfer of thermal energy by the vibration of particles, it cannot happen without particles
- This means that every time particles collide they transfer thermal energy
- Conduction happens effectively in solids as their particles are close together and can collide often as they vibrate around a fixed point
- Metals are also good **thermal conductors** as they contain electrons which are free to move
- In conduction the thermal energy will be transferred from an area which has a high **thermal energy store** (high temperature) to an area where there is a low thermal energy store (low temperature)
- Gases and liquids are poor conductors as their particles are spread out and so do not collide often, we call these **insulators**



Convection

- **Convection** is the transfer of thermal energy in a liquid or a gas, it cannot happen without particles
- As the particles near the heat source are heated they spread out and become less dense, this means that they will rise
- More dense particles will take their place at the bottom nearest the heat source creating a constant flow of particles
- This is known as a **convection current**
- Convection cannot happen in a solid as the particles cannot flow, they can only move around a fixed point

Key terms Make sure you can write definitions for these key terms.

conduction convection convection current force multiplier input force insulator infrared radiation lever output force simple machine temperature thermometer thermal conductor thermal energy store thermal imaging camera work done

P1 Chapter 4: Space
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Space

A **galaxy** is a collection of billions of **stars**.

The Earth is in the **Milky Way** galaxy.

Planets are large objects that **orbit** stars, and do not **produce** light.

Asteroids are rocky objects smaller than planets, that also orbit stars.

Satellites are objects that orbit planets. This includes **natural satellites** (moons) and **artificial satellites** (e.g., the International Space Station).

Meteors are bits of rock which burn up in Earth's atmosphere. They are called **meteorites** once they hit the ground.

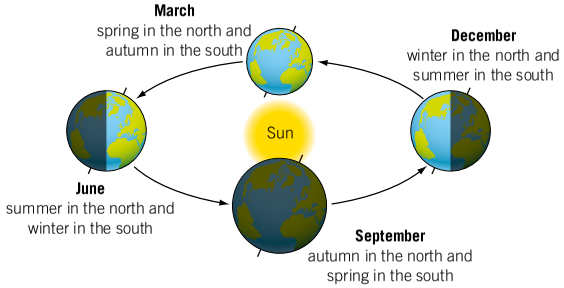
The Universe → contains billions of → **Galaxies** → contain billions of → **Stars** → are orbited by → **Planets, asteroids, and comets** → planets may have → **Moons**

The Earth

The Earth is the only place we have found life in the **Universe**.

It takes a year for the Earth to orbit the **Sun** - 365.2442 days. We add one day every fourth year (a leap year) because of the extra 0.2442 days.

The Earth's **axis** is tilted 23.4 degrees, which causes seasons (which have different day lengths and temperatures).

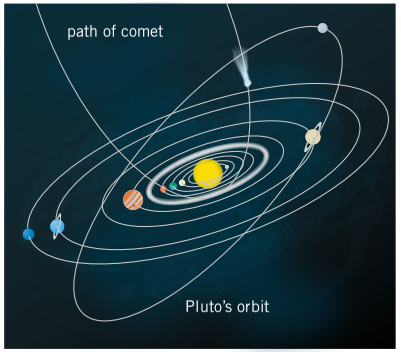


The Earth spins on its axis every 24 hours, giving us day and night.

The Solar System

Our **Solar System** is everything that orbits around the Sun. This includes:

- **Inner planets** – the **terrestrial** (rocky) planets
  - Mercury, Venus, Earth, Mars
- Asteroid belt (Including the **dwarf planet** Ceres)
- **Outer planets –** the **gas giants**
  - Jupiter, Saturn, Uranus, Neptune
- Kuiper belt objects (such as Pluto)
- **Comets** (balls of ice)



The further a planet is from the Sun, the colder its temperature is (apart from Venus, because of its thick atmosphere).

Gravity pulled gas and dust together to form the Sun about 5 billion years ago. The planets then formed from a spinning disc of gas and dust around the Sun.

An **exoplanet** is a planet that is orbiting a star that is not the Sun.

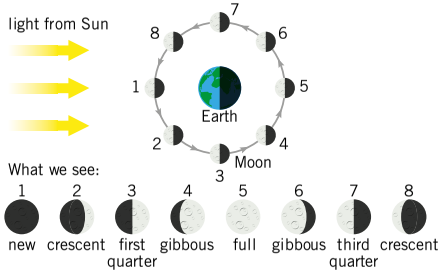
The Moon

The **Moon** orbits the Earth every 27 days and 7 hours.

It takes the same amount of time to spin on its axis, so we always see the same side.

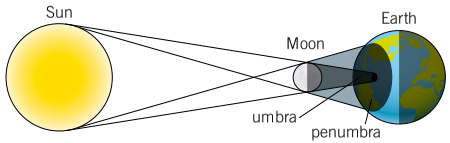
Phases of the moon

As the Moon moves around the Earth different parts are lit by the Sun, so it looks different to us.



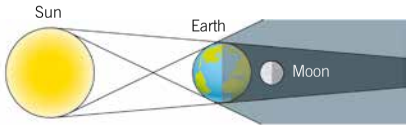
Solar eclipses

The Moon blocks light hitting part of the Earth. The **umbra** is the region of total darkness (like night), and the **penumbra** is where the light is partially blocked.



Lunar eclipses

The earth stops light hitting the Moon.



Key terms Make sure you can write definitions for these key terms.

artificial satellite, asteroid, axis, comet, dwarf planet, exoplanet, galaxy, gravity, gas giant, inner planet, lunar eclipse, meteor, meteorite, Milky Way, Moon, natural satellite, orbit, outer planet, penumbra, planet, solar eclipse, Solar System, star, Sun, terrestrial, umbra, Universe