# Atoms, Elements & Compounds: Journey of Knowledge

**Context and Introduction to Unit**
In this unit pupils will learn about materials and their properties and uses. This will link in to atoms, their basic structure and their link to elements. Pupils will explore how compounds are formed from elements and the difference between these and mixtures.
***Prior knowledge***
***KS2 NC –*** *Pupils should explore a variety of everyday materials and develop simple descriptions of these. Pupils should explain that changes occur when new materials are formed and explore these practically, giving reasons for particular uses of materials.*

**The bigger picture:**
*Links to atomic structure, the periodic table and bonding at KS4. Also links with separating mixtures and organic chemistry (mixtures of hydrocarbons). Career link – pharmacist, lab technician, science teacher.*

**CORE KNOWLEDGE**
Materials can be manmade or natural and be classified into metals and non-metals. Metals have properties such as having high melting and boiling points, being malleable, strong and some can conduct electricity. Non-metals have low melting and boiling points, cannot conduct electricity and can be brittle if solid. These properties make certain materials more suitable for certain jobs. An atom is the smallest part of an element that can exist and is in turn made up from smaller sub-atomic particles which can be found inside the nucleus (neutrons and protons) of the atoms and the area surrounding the nucleus (electrons). Atoms cannot be broken down into anything simpler – this is Daltons theory of atoms. When atoms of the same type come together they form an element. All matter is made up from atoms.
An element is made up of only one type of atom and they are represented in the periodic table. This is a table where element symbols are organised into groups and periods depending upon their properties. Some symbols are single letters, some are two letters where the first will always be a capital letter and the second will always be a lowercase letter. There are over 100 elements and these represent many of the everyday materials that we recognise but elements combine to form compounds. When atoms bond together we refer to them as a molecule, although usually this is a term used to describe when non-metals bond together.
Compounds are formed when two different types of atoms chemically combine together. Many common materials (water, carbon dioxide) are compounds. When atoms bond together, they create a new substance which rarely resembles the original elements that it was formed from. It is very difficult to return to any elements that where used to form the compound. The properties of the compound are often very different from the elements used to form it. We can often use particle models to represent elements and compounds. Magnesium is a shiny, malleable element while magnesium oxide is a white, brittle and dull compound. Compounds do not share the properties of their constituent elements which is why we use an arrow in equations, not a an equals sign. Usually, elements are represented by one coloured particle and compounds are represented by two or more different coloured particles, joined together.
When forming compounds, words or symbols (formula) can be used to represent the reactants and products, oxygen changes to oxide, fluorine, chlorine, bromine and sulfur all have –ide as their suffix e.g. sulfide, if there is a metal and two non-metals and one of them is oxygen it ends in -ate. The number of atoms on either side of the equation must be the same, despite the arrangements being different. Compound formulae can tell us how many elements and atoms there are present. E.g. $H_2SO_4$ would contain 3 elements (H, S and O) and 7 atoms (2 H, 1 S and 4 O).
Mixtures occur when elements or compounds come together but do not chemically join together meaning that they are easier to separate, using a variety of techniques explored in later units. Examples of these include air and sea water.

**ABOVE AND BEYOND**
Relative charges and mass of sub-atomic particles – electrons – and almost zero, protons + and mass of 1, neutrons 0 charge and mass of 1.

Mendeleev instrumental in development of modern PT.

Bonding between metals & non-metals – Ionic
no- metals – covalent

**VOCABULARY**
Atom
Element
Compound (etymology)
Molecule
Mixture
Particle (etymology)
Neutron
Nucleus
Electron
Proton
Neutron
Bonding
Formulae

**Reading is Power**
"Atomic Structure" pp. 10-11

**Numeracy focus**
Counting atoms, elements within a formula. Distinguishing between positive and negative charges. Comprehending how many elements there are and linking this to the wider world?

**WHERE NEXT?**
KS3 – Year 7 particles, Year 8 Periodic Table/metals and non-metals.

KS4 – Atoms & The Periodic Table, Bonding, chemical reactions.

# Year 7 Atoms, Elements & Compounds: Assessment Plan

**MAPs** – Pupils will complete mini checkpoint assessments throughout lessons in the form of extended written responses to test their knowledge, which will also be measured through formative questioning and diagnostic assessment opportunities.

**Summative assessment** – The knowledge from this unit will be tested as part of an (approx.) 30 min end of unit assessment. Knowledge from this unit will also be assessed during an end of year P2S examination which will combine the Biology, Chemistry and Physics curriculum covered so far.

| Assessment Milestones | | | |
|---|---|---|---|
| Emerging | Developing | Securing | Mastering |
| ***Pupils have basic knowledge of atoms, elements and compounds for example:***<br><br>That all matter is made of atoms.<br><br>Name some elements and compounds.<br><br>List examples of mixtures.<br><br>That different materials have different properties. | ***Pupils must be have an understanding of and be able to recall the basics of elements and compounds:***<br><br>Identify some elements based on their chemical symbol.<br><br>Substances are classed as an element, compound or mixture.<br><br>The properties of metals and non-metal. | • ***Pupils must be able to recall the following content:***<br><br>The relative sizes of an atoms particles in that the protons and neutrons are similar in mass and found in the nucleus and that electrons are much smaller and have almost no mass and orbit the nucleus.<br><br>State examples of atoms, elements and compounds including magnesium, oxygen, water, carbon dioxide.<br><br>Label the subatomic particles of a simple atomic model.<br><br>The differences between atoms, elements and compounds and how the periodic table is an arrangement of all the known elements.<br><br>Represent compounds using chemical formulae and how some symbols are single letters, some are two letters where the first will always be a capital letter and the second will always be a lowercase letter.<br><br>Properties of metals and non-metals make them suitable for different uses for example, shiny – jewellery, high melting point – metal pan<br><br>Chemical reactions are represented using word equations, for example<br>Magnesium + Oxygen -------------- Magnesium Oxide<br>Know that oxygen changes to oxide, fluorine, chlorine, bromine and sulphur all have –ide as their suffix e.g. sulphide. | ***Pupils should be able to recall all the content in the knowledge journey and demonstrate application through the following:***<br><br>Explaining how different materials have different structures and this is directly linked to the properties of these materials.<br><br>Determine the number of atoms and elements in a chemical formulae<br><br>Representing chemical reactions using balanced symbol equations. |

# Forces: Journey of Knowledge

**Context and Introduction to Unit**
*In this unit pupils will learn* forces are pushes or pulls, arising from the interaction between two objects, that non-contact forces include gravity and forces acting at a distance on Earth and in space, forces between magnets and forces due to static electricity. The idea of electric field, forces acting across the space between objects not in contact.
***Prior knowledge (KS2/KS3)***
***KS2 NC –*** *Pupils should be able to* notice that some forces need contact between two objects, but magnetic forces can act at a distance, observe how magnets attract or repel each other and attract some materials and not others, predict whether two magnets will attract or repel each other, depending on which poles are facing.

**The bigger picture:**
Links to the fundamental concepts of field, force, which are inter-linked to form unified models of the behaviour of the material universe
Career links.
*Engineering and space, Aerospace, Satellite Designers*

## CORE KNOWLEDGE

A force is a push or a pull that acts on an object due to the interaction with another object. Forces are measured in Newtons (N). Forces are divided into contact forces and non-contact forces. Contact forces involve objects physically touching and non contact forces act between objects that are not physically touching. Balanced forces refer to forces being equal and therefore objects are stationary or a constant speed. Unbalanced forces result in an object changing its speed or direction. The resultant force is the sum total of all the forces acting on an object. **Force arrows** are used to **represent** both the magnitude and direction of **forces**. These are referred to as vectors and an arrow that is double the size of another arrow represents double the force. Scalar quantities are magnitude only e.g. speed.

### Contact Forces

**Tension** is a pulling force exerted on an object by a string, rope or rod.

**Friction** is a force that acts between two touching surfaces and prevents or resists them moving against each other.

**Air Resistance** (or drag) is a force that acts against the direction of movement in air. The faster an object is travelling, the greater the air resistance.

**Water Resistance** (or drag) is a force acts against the direction of movement in water. The faster an object is travelling, the greater the water resistance.

**Upthrust** is an upwards force that acts on an object when it is in a fluid (a liquid or a gas).

**Thrust** is a driving force exerted by an engine to make an object move.

**Normal contact** is the force when an object pushes on a surface like a table, wall or the ground. The surface pushes back on the object with a balancing force. This always acts at right angles to the surface.

### Non Contact Forces

**Magnetism** is a force experienced by a magnet or a magnetic material i.e. iron, when placed in a magnetic field. This force can cause objects to attract or repel.

**Electrostatic force** is a force experienced by a charged particle in an electric field. This force can either attract or repel.

**Gravity** is a force of attraction that exists between any two masses, any two bodies, any two particles. **Gravity** is not just the attraction between objects and the Earth. It is an attraction that exists between all objects.

On Earth gravity has a strength of **10N/kg**. The gravitational field strength is different on other planets and stars. The bigger the object, the greater the GFS.

**Weight** is a force that is caused by the pull of gravity. Whereas **Mass** is the amount of substance that makes up an object measured in kg. **Weight (N) = mass (kg) x gravitational field strength (g)**

## ABOVE AND BEYOND

Explain in detail why the two forces acting on you are not two forces in the same interaction pair.

How do scientists know how much you can lift on another planet? How accurate will the figures be?

## VOCABULARY

Balanced
Unbalanced
Resultant
Vector
Scalar
Deformation - etymology
Resistance - etymology
Friction
Drag
Mass
Weight
Magnetic
Gravity
Poles
Electrons
Electrostatic – etymology

## Display

Mary Jackson – aerospace engineer who improved methods related to aerodynamics and spaceflight.

## Personal Development

Link knowledge of forces to everyday scenarios

## Reading is power

How parachutes are deployed article – how it works magazine article

## Numeracy focus

Use FIFA to calculate resultant forces, weight, mass and gravitational field strength.

## WHERE NEXT?

KS3 – Pressure, speed and acceleration
KS4 –Forces,Universe Pt 1

# Energy Stores: Journey of Knowledge

In this unit pupils will learn that we 'use energy' every day to carry out tasks and we move the energy between energy stores to do work for us. Pupils will learn that nothing is 100% energy efficient and that there is always some energy dissipation; the more of this, the less efficient the appliance/process. Pupils will learn about the relationship between transferring energy (work done) force applied and distance moved and will start to use an equation to quantify this. Pupils will learn about simple machines, such as levers, and how they make 'doing work' easier.
***Prior knowledge KS2 NC Year 5*** recognise that some mechanisms including levers, pulleys and gears allow a smaller force to have a greater effect

**The Bigger Picture:**

*Links to energy efficiency. Insulation and household energy transfers.*

***Career links.*** *Engineers, designers, roller coaster designers*

**CORE KNOWLEDGE**

**Energy stores:**

Energy can be stored as: **chemical** (energy in fuels, food, or batteries), **kinetic** (energy of moving things), **gravitational** (energy when something is high up), **elastic potential**(energy when something is stretched or squashed), **thermal** (energy in hot objects), **magnetic** (energy in magnetic materials or fields), **electrostatic** (energy from charged objects), **nuclear** (energy inside atoms).

**Energy transfers** (Pathways):

Energy can be transferred by: **electricity** (energy transferred by electrical current), **forces** (energy transferred by pushes or pulls**), heating** energy transfers from hot to cold objects) **, radiation** (energy transferred by waves i.e. heat, light or sound) or **chemical reaction**.

Any energy that is not transferred to useful energy stores is said to be wasted because it is lost to the surroundings. We say it has been Dissipated (usually as thermal energy)
This follows the Law of Conservation of Energy that Energy cannot be created or destroyed. Energy can only be transferred from one store to another (the useful + wasted output energy must add to equal the amount of the total input energy) i.e. 100 J Input → 60 J Useful output and 40 J Wasted output
Efficiency is a measure of how much of the total energy is transferred is useful. Efficiency can be written as either a decimal or percentage and can never be a larger number than 1, or higher percentage than 100%.
Calculate efficiency using the formula:

$$\frac{\text{Useful energy output}}{\text{Total energy input}} \times 100$$

Non-renewable energy resources burn or react fuel to heat water to make steam to turn a turbine which turns the generator. Renewable energy resources use wind, water etc. to turn the turbine directly so not needing to burn fuel. Renewable resources, including solar, wind, water, wave, geothermal etc can be quickly and easily replenished and do not produce carbon dioxide, or are carbon neutral but are not always reliable. Non-renewable resources, such as coal, oil, natural gas and nuclear cannot be quickly and easily replenished and do produce carbon dioxide, or radioactive waste, but are a reliable way to generate a constant supply of electricity.

**ABOVE AND BEYOND**

KS4 - Use numerical data relating to energy stores to further explore how energy behaves in systems

**VOCABULARY**

Kinetic - etymology
Gravitational
Dissipates
Elastic
Thermal - etymology
Magnetic
Electrostatic
Nuclear – link to nucleus meaning central point – not cells
Energy
Joule
Kilo –etymology
Efficiency

**Diversity**

Exploring renewable and non renewable energy resources and accessibility, across the world.

**Personal Development**

Considering our role in sustainable energy resources and their uses.

**Reading is power**

Conservation of Energy

**Numeracy**

Use FIFA model with all equations

**WHERE NEXT?**

KS3 –
Chemical reactions
Electricity & cost

KS4 -
Energy
Particle models

# Year 7 Energy Stores: Assessment Plan

**MAPs** – Pupils will complete mini checkpoint assessments throughout lessons in the form of extended written responses to test their knowledge, which will also be measured through formative questioning and diagnostic assessment opportunities.

**Summative assessment** – The knowledge from this unit will be tested as part of an (approx.) 30 min end of unit assessment. Knowledge from this unit will also be assessed during an end of year P2S examination which will combine the Biology, Chemistry and Physics curriculum covered so far.

| **Assessment Steps** | | | |
|---|---|---|---|
| Emerging | Developing | Securing | Mastering |
| ***Pupils have basic knowledge of cells:***<br><br>Recognise what energy is and where it is stored. | ***Pupils must be have an understanding of and be able to recall the basics of cells:***<br><br>List energy resources including coal, oil, natural gas, solar, wind and wave and stores including thermal, kinetic, GPE, elastic, chemical and electrical.<br><br>State that the unit for measuring energy is joules. | ***Pupils must be able to recall the following content:***<br><br>Describe different energy resources e.g. Non-renewables burn or react fuel to heat water to make steam to turn a turbine which turns the generator. Renewables use wind, water etc. to turn the turbine directly so not needing to burn fuel.<br><br>Recall forms of potential energy e.g. Chemical, gravitational, nuclear and elastic are all forms of potential energy. Thermal, electrical and vibrational are all forms of kinetic energy.<br><br>Describe situations where energy is transferred, wasted and dissipated - There is always a proportion of the energy which is NOT usefully transferred; this is wasted and spreads out, warming up the surroundings (dissipates). This has to follow the Law of Conservation of Energy so the useful output + wasted output must equal the amount of the total input energy.<br><br>Calculate useful and dissipated energy in a system by interpreting energy bar diagrams meaning that larger bars represent larger amounts of energy<br><br>Calculate efficiency using the formula<br>$\frac{\text{Useful energy output}}{\text{Total energy input}} \times 100$ | ***Pupils should be able to recall all the content in the knowledge journey and demonstrate application through the following:***<br><br>Evaluate energy efficiency by using values to justify advantages and disadvantages of using certain appliances including light bulbs.<br><br>Discuss how all materials have a store of energy inside them referencing the pathway required to change energy stores. The energy pathways are electrical, mechanical, chemical reaction, heating and vibrational.<br><br>Explain what happens to energy stores as energy is transferred by an object referring to useful and dissipated energy in a system. Energy is usually dissipated as thermal energy.<br><br>Compare non-renewable (produce $CO_2$, not easily replenished but relatively cheap to set up and generally reliable) renewable fuels ( can be replenished, clean but relatively expensive to set up) and their pros and cons. |

# Particle Model: Journey of Knowledge

**Context and Introduction to Unit**
In this unit pupils will learn about the particulate nature of matter, learning about the three states of matter and the changes that happen between these states. Pupils will carry out experiments to investigate the changes of state through observations, recording and analysing data.

***Prior knowledge***
***KS2 NC –*** *Pupils should explore a variety of everyday materials and develop simple descriptions of the states of matter (solids hold their shape; liquids form a pool not a pile; gases escape from an unsealed container). Pupils should observe water as a solid, a liquid and a gas and should note the changes to water when it is heated or cooled (Y4).*

**The bigger picture:**
*Links to heat transfer, molecules and matter in KS4 physics. Separation techniques, pure substances and mixtures in the chemical analysis topic for KS4 chemistry.*
*Career link – meteorologist.*

**CORE KNOWLEDGE**
Matter is made of particles and can exist as a solid, a liquid or a gas.
Solids and liquids have a fixed volume and cannot be compressed because the particles are touching one another. Only solids have a fixed shape as the particles cannot move freely. Liquids and gases (fluids) can flow because the particles are able to move but only gases can be compressed due to spaces between the particles. Particles in a solid have the least kinetic energy and the particles in a gas have the most kinetic energy.
Changing from a solid to liquid is melting, changing from a liquid to gas is evaporating and changing from a solid to a gas is sublimating. Particles gain kinetic energy during these changes of state and the internal energy of the system increases.
Changing from liquids to a solid is freezing and changing from a gas to a solid is deposition. When a gas turns back to a liquid this is known as condensing. This takes place in a condenser using distillation equipment. Particles lose kinetic energy during these changes of state and the internal energy of the system decreases. Energy changes are due to changes in temperature.
Internal energy comes from the movement of particles – temperature is a measure of this.
A thermometer is a device used to measure the temperature change and measurements should be taken at eye level for accuracy and recorded in a suitable table.
The equipment used to observe changes of state in ice are, tripod, beaker, Bunsen Burner and the thermometer.
***Stearic acid -*** a saturated fatty acid, a naturally occurring fat found in both animal and vegetable sources
Stearic acid is provided as a liquid in a heated water bath, this solidifies on cooling. The temperatures recorded can be used to produce a cooling graph. The point at which the stearic acid changes state is represented by a horizontal line.
When a change of state occurs the temperature remains constant and is representing by a horizontal line on a change of state graph and is described as specific latent heat. Each pure substance (a single element or compound) has its own melting and boiling point which can be used to identify that substance. Ice melts at 0°C and water boils at 100°C at standard pressure. The random movement of particles in liquids and gases is known as Brownian motion. This doesn't happen in solids.
Diffusion is the process by which particles of one substance spread out through the particles of another substance. Diffusion is how smells spread out through the air and how concentrated liquids spread out when placed in water. Diffusion happens on its own when the particles spread out from an area of high concentration, where there are many of them, to areas of low concentration where there are fewer of them. Two factors affect diffusion – the type of substance (gases diffuse more quickly than liquids) and the temperature (hotter the substance, the faster the rate of diffusion). Diffusion doesn't happen in solids as the particles are unable to move.

**ABOVE AND BEYOND**
Density = mass / volume

Water boils at a lower temperature at high altitude due to the lower gas pressure of the atmosphere.

**VOCABULARY**
Evaporation
Condensation
Melting
Freezing
Sublimation
Deposition
Temperature
Kinetic (etymology from Greek meaning 'to move')
Internal
Latent (etymology from Latin for 'being hidden')
Diffusion

**Reading is power**
"States of matter" pp. 18-19.

**Numeracy focus**
Describing changes of state graphs.

**WHERE NEXT?**
KS3 – Heating & Cooling
Ks4 – Matter, Atomic Structure

# Cells: Journey of Knowledge

**Context and Introduction to Unit**
In this unit pupils will learn about cells as the building blocks of all living organisms. Pupils will explore the use of and importance of microscopes. They will explore animal and plant cells, the components that make them up, their structure and function.  In addition to this, they will explore specialised cells and what makes the specialised.

***Prior knowledge***
***KS2 NC –*** *Pupils should have had the opportunity to explore living and non living things in both Year 5 & 6 and explore features and characteristics of these which will support work on adaptations.  They have also explored evolution and inheritance which will link to ideas about specialised cells.*

**The bigger picture:**
*Links to cell structure and division at KS4. This is in addition to exploring transport of substances in cells.*

*Career link – botanist, cell biologist, virologist, microbiologist*

**CORE KNOWLEDGE**
A unicellular organism is one which is made up of only one cell for example yeast and bacteria. Bacteria do not have a nucleus, but they may have a flagellum. This is a tail-like part of the cell that can spin, propelling the cell forwards. Unicellular organisms can contain features of both animal and plant cells. Multi-cellular organisms for example animals and plants, consist of many cells and are organised in levels; Cells, Tissues, Organs, Organ Systems, Organism. Cells are specialised based on their functions (e.g. cardiac muscle cells), groups of specialised cells form tissues (e.g. cardiac muscle tissue), groups of tissues carrying out a similar function form organs (e.g. heart), groups of organs carrying out a process form organ systems (e.g. circulatory system), groups of organ systems form the whole organisms (e.g. human). Animal cells contain a nucleus (usually circular in shape, controls the cell and contains genetic information), cytoplasm (site where chemical reactions take place), cell membrane (edge of the cell, allows substances in and out of the cell) and mitochondria (smaller oblong shape, where respiration occurs to release energy). Plant cells also consist of a cell wall (more rectangular structure on outer part of the cell which provides structural support), vacuole (contains cell sap and keeps the cell turgid) and chloroplasts (oblong shape in diagrams, where photosynthesis takes place in plants, they contain a green pigment called chlorophyll). Microscopes are used to observe small objects in detail.  Each objective lens offers a different power magnification, whilst the focus wheels allow us to gain a clear/focused image (resolution). We observe our object by looking through the eyepiece lens, and the stage is responsible for holding the microscope slide. Some light microscopes use mirrors, which allow us to direct light. We start by using the lowest power objective lens, gaining a clear image by adjusting the focus wheels, then increasing the objective lens again and repeating the process. We prepare a microscope slide by placing the specimen on the slide, ensuring this is only a thin layer to allow light to pass through. Stain the specimen so that the cells and organelles become visible, then add the cover slip at a 45-degree angle to the slide to avoid air bubbles.Magnification of an image can be calculated by using the below formula & FIFA method:

$$\text{magnification} = \frac{\text{length of image}}{\text{length of actual object}}$$

Specialised cells are those which have adapted (differentiated) to carry out specific functions (become specialised). Some specialised cells include: • Sperm cell (tail to swim). • Egg cell (cell membrane changes following fertilisation). • Red blood cell (disc like shape to increase surface area for diffusion). • Nerve cells (long to transmit electrical impulses around the body). • White blood cell (produced proteins to destroy pathogens). • Ciliated cell (cilia/hairs to waft mucus) • Muscle cell (many mitochondria to release energy). • Root hair cells (extension creates a large surface area to absorb water and mineral ions). • Palisade cell (many chloroplasts for maximum photosynthesis). Diffusion is the movement of a substance from an area of high concentration to an area of low concentration. Diffusion happens in cells across the cell membrane. Oxygen and glucose diffuse into cells for use in respiration to release energy. Carbon dioxide diffuses out of cells to be expelled from the body following respiration. Carbon dioxide diffuses into plant cells for use in photosynthesis to produce glucose.

**ABOVE AND BEYOND**
Explore the term ‘ribosomes’ and their relative function within a cell.
FIFA method for calculations.

**VOCABULARY**
Cell
Organelle
Unicellular
Microscope (etymology)
Component
Magnification (etymology)
Nucleus (etymology)
Cell membrane
Cytoplasm
Mitochondria
Cell wall
Vacuole
Chloroplasts
Respiration
Photosynthesis
Specialised
Nerve cell
Sperm cell
Root hair cell

**Diversity**
Ernest Everett – recognition of the cell membrane in cells.

**Reading is power**
60 second Science magazine page 102-103 - The scale of cells.

**Numeracy focus**
Calculate magnification.

**WHERE NEXT?**
KS3 – Movement

KS4 – Cell Biology, transport, cell division, mitosis.

# Year 7 Cells: Assessment Plan

**MAPs** – Pupils will complete the following two WOW zone task (guidance and mark schemes can be found within the lesson resources):
Compare the structure of animal and plant cells detailing the components in each. Disciplinary reading before completing the MAP.

**Summative assessment** – The knowledge from this unit will be tested as part of a 1 hour P2S exam which will combine the Biology, Chemistry and Physics curriculum covered so far.

| Assessment Steps | | | |
|---|---|---|---|
| Emerging | Developing | Securing | Mastering |
| ***Pupils have basic knowledge of cells:***<br><br>State what cells are.<br><br>Name equipment used to view cells.<br><br>Name some cells<br><br>Recognise a cell diagram<br><br>State the difference between multicellular and unicellular organisms. | ***Pupils must be have an understanding of and be able to recall the basics of cells:***<br><br>List the main parts of a cell, and name some tissues and organs.<br><br>From a diagram identify various organ systems.<br><br>Describe organisation of multicellular organisms.<br><br>State the levels of organization<br><br>State some adaptations of specialized cells | ***Pupils must be able to recall the following content (including all of the Emerging and Developing sections):***<br><br>Be able to identify and describe the roles of parts of a plant and animal cell on a diagram.<br><br>Compare structure and function of animal and plant cells.<br><br>Describe the role of diffusion in cells.<br><br>Describe the adaptations of specialized cells<br><br>Understand that materials can move across a cell membrane by the process of diffusion. | ***Pupils should be able to recall all the content in the knowledge journey and demonstrate application through the following:***<br><br>Explain why multi-cellular organisms have adapted organ systems to aid diffusion.<br><br>Calculate magnification<br><br>Explain the adaptations specialised plant and animal cells, describe diffusion and the function of organelles.<br><br>Explain the importance of cell differentiation. Give examples of materials that may need to move across a cell membrane by diffusion. |

# Movement: Journey of Knowledge

**Context and Introduction to Unit**
In this unit pupils will learn why we have a skeleton and how it works together with our muscles and enables us to move. Pupils will identify the systems of the human body, and more closely examine the skeletal muscular system and identify its components; including bones, muscles and joints.
**Prior knowledge (KS2/KS3) –** Pupils should be able to describe the simple functions of the basic parts of the digestive system in humans. Pupils should also be able to identify and name the main parts of the human circulatory system, and describe the functions of the heart, blood vessels and blood. They will recognise the role of the skeletal muscular system in exercise and its link to healthy living.

**The bigger picture:**
*Links to healthy living – role of skeletal muscular system in exercise and healthy living, risk of injury.*

*Career link - Physiotherapist*

**CORE KNOWLEDGE**

Organ systems (covered in cells unit) work together to form an organism. The muscular and skeletal systems supports the body, and cause movement by muscles and bones. The circulatory system transports substances around the body in the blood. The respiratory system uses gas exchange to produce energy. The digestive system breaks down large insoluble molecules into small soluble molecules.
The skeletal system has four functions: it protects vital organs, for example, the skull protects the brain, it supports the body, it helps the body move and it makes blood.
Our bones also contain bone marrow which makes blood cells, bone marrow can be vital in the treatment of leukaemia by using stem cells that can become other types of blood cell. Red blood cells carry oxygen through the body whilst white blood cells fight and protect against infection.
Joints allow for skeletal movement, we have hinge joints, ball and socket joints and pivot joints. Bones are held together by ligaments, the end of bones are covered in cartilage which reduce friction created by movement. Calcium is a key mineral needed for strong bones.
Biomechanics – the interaction between the skeleton and muscles, including the measurement of force exerted by different muscles. The strength of a muscle can be measured using weights; a newton meter or scale is used to measure forces in Newtons by pushing or pulling on the scales.
A newton meter – also known as a force meter – when a force is applied to the spring it gives a reading.
When moving the effort applied to a hinge joint closer, it becomes more difficult to lift the masses. The further away the effort is, the easier the masses lift.
Muscles work in pairs called antagonistic pairs to move bones about a joint. The biceps and the triceps are an example of an antagonistic pair of muscles. As the bicep contracts, the triceps relaxes and vice versa. Muscles need to rest to overcome muscle fatigue. Some muscles are stronger than others. Key muscles include the quadricep (found at the top of the leg), the pectorals (found across the chest), the calf (found at the lower back of the leg).
New technologies such as hip and knee replacements can allow people to regain movement in joints that were previously damaged/injured. Materials such as titanium are used for joint replacements due to their unreactive nature and strength properties.

**ABOVE AND BEYOND**

Identify further organ systems; reproductive and immune.
Knee cap = Patella
Collar bone = Clavicle
Jaw = Mandible

**VOCABULARY**

Cell
Tissue
Organ System
Organism
Circulatory System
Muscular Skeletal System
Digestive System
Respiratory System
Bone
Skeleton
Bone Marrow
Joints
Cartilage
Ligament
Tendons
Antagonistic Muscle Pair
Stem cell

**Diversity**

Biological male and female skeletal structures and differences. Adam Kay author of Kays Anatomy.

**Reading is Power**

Kays Anatomy – pg. 201 - Bones

**Personal development**

Cancer- bone marrow, leukaemia and stem cells

**WHERE NEXT?**

KS3 - Breathing Unit
- Digestive System Unit

KS4 - The Respiratory System
- The Nervous System

# Separating Mixtures: Journey of Knowledge

**Context and Introduction to Unit**

In this unit pupils will learn about pure and impure substances, how different techniques can be used to separate mixtures, the equipment that is required to perform these techniques and about the different situations where these techniques are suitable.

***Prior knowledge (KS2/KS3)***

KS2 – Pupils should, know that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution, use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating. They should also identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature. KS3 – particle model already covered earlier in year.

**The bigger picture:**

***Personal development opportunities*** – *purification of water in countries where fresh water is sparse.*

***Career links*** – *SOCO – analysing substances/evidence, chef – perfecting recipe's and using ingredients.*

## CORE KNOWLEDGE

A pure substance is one which contains one substance only – this can be one element or one type of compound, but having a combination of these in whatever quantity means the substance is impure and therefore a mixture. Pure substances have **fixed** melting and boiling points, mixtures melt and boil over a **range** of temperatures.

A solute is a solid that can be dissolved, a solvent is a liquid that is used to dissolve a solute and a solution is formed when a solute has successfully dissolved in a solvent. Water is a common solvent however, ethanol and propanone are other examples of solvents.

When a solid dissolves in a liquid, we can represent this in a particle model and show that solid particles (sugar) fill up the gaps between the liquid (water) particles. When a solid will not dissolve in a liquid it is said to be insoluble.

Temperature can affect the solubility of a solute in that the hotter a solvent becomes, the more solute will dissolve. This is the general pattern but temperature increases can vary depending upon the solvent.

- Filtering can be used to separate a liquid from an insoluble solid. This is can be used to make water safe to drink and help rid water of sand, rocks and other insoluble objects.
- Evaporation can be used to separate a soluble solid from a liquid (salt from water). This can be used as part of distillation to purify water. This involved heating water until it boils and as the dissolved solute (salt) has a different boiling point, they will separate.
- Distillation involves evaporation and condensation. It can be used in a similar way to evaporation only you can keep both parts of the mixture. It also allows for separating two different liquids with different boiling points.
- Chromatography is used for separating dyes and inks. It uses chromatography paper, the ink sample and a suitable solvent and results in a coloured chromatogram which can then be analysed.

We can make substances impure for specific purposes and this can affect their melting and boiling points. For example we can add salt to water which lowers its melting point to avoid ice on the roads in winter. We can also add sand to it to help increase friction to avoid slipping. Other impure substances or mixtures designed for a purpose include cleaning products, medications and fuels.

## ABOVE AND BEYOND

- Calculating Rf values in chromatograms
- Drawing and representing solubility curves
- Establishing the meaning of a formulation and describing these.

## VOCABULARY

Pure
Impure
Solvent (etymology)
Solute
Solution
Separate (etymology)
Dissolve
Soluble/Insoluble
Filtering
Dissolving
Evaporation
Chromatography (etymology)
Distillation.

## Reading is Power

**Watchdog warns of E numbers that make children misbehave – on SW ppt slides – print and copy.**

## Numeracy Focus

Accurately measuring out volumes of liquids and masses of solids.

Apply knowledge of the number scale when using boiling points of substances and to explain distillation.

## WHERE NEXT?

**KS4**

Atomic Structure – AQA C1 KS4
Chemical Analysis – AQA C12 KS4
The Earths resources – AQA C.14 KS4

# Human Reproduction: Journey of Knowledge

**Context and Introduction to Unit**

In this unit pupils will learn about reproduction in humans (as an example of a mammal), including the structure and function of the male and female reproductive systems, menstrual cycle (without details of hormones), gametes, fertilisation, gestation and birth, to include the effect of maternal lifestyle on the foetus through the placenta.

***Prior knowledge***

***KS2 NC –*** *Pupils should recognise links to animals, including humans unit at KS2 where pupils will study about changes to humans as they develop to old age and they get to evaluate the impact of certain lifestyles on their bodies and function.*

**The bigger picture:**

*This unit links into healthy lifestyles and personal development as much as the science behind reproduction.*

*Career link – healthcare professional, doctor, nurse, councillor, pharmacist.*

**CORE KNOWLEDGE**

Puberty is caused by hormones which are chemical messengers that instruct your body on how to change and prepare for adulthood, or in other words become sexually mature. Most girls begin puberty between the ages of eight and fourteen, where most boys begin between the ages of nine and fifteen. In some cases, puberty can begin earlier or later as everyone's body develops at its own pace. Some changes that occur are experienced only by biological males (e.g. testes & penis grow, voice deepens, shoulders broaden etc.), and some are experienced only by biological females (e.g. breasts grow, hips widen, menstrual cycle begins). Some changes can be experienced by both (e.g. acne, strong body odour, mood swings).The male reproductive system consists of the testes which produce sperm, the sperm duct which carries sperm from the testes to the penis, the urethra which carries urine from the bladder or sperm from the sperm duct, and the penis which carries urine or semen out of the body. The penis swells with blood and stiffens which is known as an erection and this allows males to release sperm into females during sexual intercourse. The female reproductive system consists of ovaries which store undeveloped eggs cells. Every month, an egg cell matures and is released in a process known the menstrual cycle. The system also contains oviducts which carries the egg to the uterus, the uterus which is where a developing baby grows, the cervix which is the ring of muscle at the entrance to the uterus, and the vagina which is muscular tube that leads from the cervix to the outside of the body. Gametes are known as sex cells. Male gametes are sperm cells and female gametes are egg cells, also known as an ovum. Both are specialised cells meaning they are adapted to their functions. Sperm cells have a tail to assist movement and many mitochondria to release energy for movement. Egg cells have a nutrient-rich cytoplasm to provide nutrients for the growing zygote/embryo and a cell membrane that changes following fertilisation to prevent more sperm cells fertilising the egg, The egg and sperm cell fuse together in a process known as fertilisation forming a zygote cell. Fertilisation usually occurs in the oviduct. The zygote cell grows and divides during cell division, forming an embryo. The embryo then implants into the uterine lining. The menstrual cycle takes place over 28 days in females. If an egg cell isn't fertilised, the thickened lining of the uterus starts to break down and pass out of the female, this is known as a period (menstruation). Following menstruation, a new egg is released (ovulation), this occurs at around day 14 of the menstrual cycle. If however, a sperm cell fertilises an egg cell , the uterine lining remains in place and the menstrual cycle stops. In all mammals, the time in the uterus from the moment of fertilisation until birth is known as gestation. In humans, the average gestation period is 40 weeks. After 8 weeks of growth, the embryo is then called a foetus. The growing foetus depends on oxygen and nutrients from the mother, these diffuse from mother's to foetus' blood in the placenta. Carbon dioxide and other waste products also diffuse from foetus' blood to mother's blood in the placenta. Oxygenated & nutrient rich blood then travels from the placenta to the foetus via the umbilical cord. The amniotic fluid acts as a shock absorber to protect baby from bumps, this is contained by the amniotic sac. Around 40 weeks when the baby is ready to be born, the cervix dilates and the walls of the uterus start to contract which gradually push baby out through the birth canal (uterus, cervix, vagina). The umbilical cord then needs to be cut and the placenta is then delivered as an afterbirth. If a vaginal birth is not possible, surgery known as a caesarean section can be carried out to remove the baby from the uterus. If an expectant mother chooses to drink alcohol, smoke or take drugs during her pregnancy, this can result in reduced development and lower birth weight in the new-born baby due to reduced oxygen/nutrient intake.

**ABOVE AND BEYOND**

Explore the gestation periods and methods of mating in other species.

Link fertilisation to inheritance and explore why humans created from one egg and sperm cell are unique in terms of chromosomes and genes

**VOCABULARY**

Puberty
Hormones
Reproductive system (etymology)
Penis
Sperm
Testicles
Urethra
Vagina
Cervix
Uterus
Oviduct
Ovary
Egg cell
Menstrual cycle (etymology)
Fertilisation
Foetus
Zygote
Embryo
Placenta
Umbilical cord
Amniotic fluid
Gamete
Gestation

**Diversity**

Human reproduction – biological sex at birth and procreation.

**Personal Development**

Sex education and relationships link

**Reading is Power**

I'm going through puberty – read the article

**Numeracy focus**

Considering and comparing time frames of menstruation and pregnancy

**WHERE NEXT?**

KS3 – Year 7 - Plant reproduction, Variation and inheritance

KS4 – Inheritance & Variation Biology Paper 2

# Plant Reproduction: Journey of Knowledge

**Context and Introduction to Unit**

This unit begins with a recap on plants as organisms, their general structure and basic functions of key organs. Pupils will then develop their knowledge and understanding of reproduction through looking at plant organs and methods for the processes of pollination, fertilisation, seed dispersal and germination. Pupils will explore these by looking at a variety of different plants through both looking at images and by investigating with real plants.

***Prior knowledge (KS2/KS3)***

During KS2 pupils are expected to identify and describe the functions of the parts of flowering plants. They are also expected to have started to explore the part that the parts of the flowers play in the life cycle of flowering plants including pollination, seed formation and see dispersal. Pupils should be able to label the parts of the flowering plant and link the part to the plan life cycle but will not have explored HOW these processes take place.

**The bigger picture:**

*Personal development opportunities – impact of decline of the bees on food production, look at possibility that this is due to human activity.*

*Career links – botanist.*

**CORE KNOWLEDGE**

Plants are living organisms meaning they move, reproduce, sense, grow, respire, excrete and require nutrition. They need water, sunlight and nutrients to survive. Plants have key organs including the root, stem, leaves, flower. The root anchors the plant in the group and absorbs water, the stem transports water, minerals and sugar around the plant, the leaves make food (glucose for the plant), the flower is for reproduction.

MALE – Stamen is the male reproductive part, it contains the anther which produces pollen and the filament which hold up the anther.

FEMALE – The carpel is the female reproductive part, it contains the stigma which is sticky to 'catch' pollen, the style which holds up the stigma and the ovary which contains ovules. Ovule is the female sex cell, pollen is the male sex cell.

*A scalpel can be used to slice open materials due to its sharp blade. It should be used with care and held with your forefinger applying pressure to the top of the apparatus when cutting. The flowering plant has many different parts, the tweezers can be used to pull apart these structures by carefully pinching together, grasping and removing items. The cutting boards can be used to act as a safe surface to cut on and the parts of the flower can be laid out on this, for identification.*

Pollination is the transfer of pollen from the anther to the stigma, it can be caused by wind, insects or other animals. Examples of adaptations for pollination: INSECT – brightly coloured and sweet smelling petals, pollen is sticky, anthers and stigma held firmly into flower, stigma is sticky. WIND – small petals, large quantities of pollen, low mass pollen, anther loosely attached, stigma hangs out of flower.

Fertilisation in plants occurs when the nucleus of the pollen grain joins with the nucleus of the ovule. After fertilisation the ovary develops into a fruit and the ovules become seeds. Bees are crucial for pollinating plants, particularly crops in the UK. The bee population is declining and this could decrease pollination and subsequently affect food production in the UK.

A seed can dispersed by wind (dandelion, sycamore), animal (droppings), water (Willow trees) or explosive (peapod). Seed dispersal is important because the seed needs space to grow where they do not have to compete too much for resources. Varying adaptations contribute to the ability of a seed to be dispersed effectively, including things such as wing length (sycamore), if it has a parachute design (dandelion). The independent variable is the shape/deign of the leaves. The dependent variable is the time taken to fall to the ground. The control variables are type of paper used and the height dropped from. A line graph would be the selected graph, with length of leaves on the x axis, time taken to fall on the y axis. Points are plotted with neat crosses and a line of best fit is a line which best represents the pattern/trend shown. Germination is when a seed starts to grow and requires water, oxygen and warmth for optimal conditions.

**ABOVE AND BEYOND**

Research a range of plants and explore their adaptations for seed dispersal and pollination.

Explain why light is not a requirement for germination (no sunlight underground).

**VOCABULARY**

Organism
Root
Stem
Leaves
Flower
Sex cell
Stamen, pollen, filament.
Carpel, stigma, style, ovary, ovule.
Reproduction
Pollination
Fertilisation
Adaptations (etymology)
Seed
Dispersal (etymology)
Germination (etymology)

**Reading is Power**

The life of a pine tree – how it works magazine (in purple folder)

**WHERE NEXT?**

KS3 – Photosynthesis
KS4 – Organisation

# Interdependence: Journey of Knowledge

**Context and Introduction to Unit**
In this unit pupils will learn about the energy transfer from food to your cells for survival. How energy transfer between organisms can be represented by food chains and food webs and the importance of interdependence for survival of species.
***Prior knowledge***
***KS2 NC –*** *Pupils in Year 5 should be able to describe the differences in the life cycles of a mammal, an amphibian, an insect and a bird and describe the life process of reproduction in some plants and animals. In Year 6 pupils should describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including micro-organisms, plants and animals give reasons for classifying plants and animals based on specific characteristics.*

**The bigger picture:**
*Interdependence - how organisms interact for survival. How changes within an ecosystem could lead to endangered/extinct organisms.*

*Career link – ecologist.*

**CORE KNOWLEDGE**

An **ecosystem** is the name given to a place where all living (**biotic**) and non living (**abiotic**) things can exist.
A **habitat** is a place where a plant or an animal lives. **Competition** exists between species of animals and plants for various things. Animals compete for food, water, space and mates. Plants compete for light, water, space and minerals. Plants do not compete for food as they produce their own through photosynthesis. Organisms respond to environmental factors such as light, moisture, and temperature. Investigations can provide evidence about the conditions organisms prefer. A choice chamber is a piece of equipment used to investigate how environmental factors may be favoured by certain species.
An **adaptation** is a characteristic (which can be physical, such as sharp claws, large leaves or behavioural such as stalking, hibernating, migrating or growth towards light in plants), of an organism that improves its chances of surviving and/or reproducing.
Structural adaptations – physical features of an organism e.g. long limbs for speed.
Behavioural adaptations – an adaptation which is a type of behaviour the animal exhibits e.g. migration and hibernation.
Functional adaptations – when a component or system of an organism works differently to aid survival.
A **food chain** is a diagram that shows what an organism eats and the transfer of energy between organisms. A **food web** is a set of linked food chains. The first organism is a **producer**. This is a green plant or algae that makes its own food during photosynthesis. A second organism is a **herbivore**, that only eats plants. **Carnivores** eat other animals and **omnivores** eat both plants and animals. Decomposers are also found in food webs. These are organisms (bacteria and fungi) that break down dead plants and animal material, releasing nutrients back into the soil or water. **Interdependence** is the way in which living organisms depend on each other to survive, grow and reproduce. The number of animals or plants of the same species that live in the same area is called a **population**.
Predator-prey graphs show the interdependence of two organisms. A **prey** organism is eaten by another animal and a **predator** means it eats other animals.
It is not only energy that transfers along a food chain. Some chemicals (toxic materials) can be passed on e.g. insecticides. Some of these chemicals are washed into rivers and end up in the sea. Fish absorb small amounts of these chemicals and store them in their body. Other animals eat the fish, and the insecticides are passed on. The accumulation (build up) of chemicals is called **bioaccumulation**.

**ABOVE AND BEYOND**
Pesticides
Fungicides
Around 10% of the energy available at one level of a food chain is transferred to the next level.
The use of DDT and its ban.
Biotic and abiotic factors which affect communities.
Positive and negative human interactions with ecosystems.
The importance of biodiversity.
Adaptations may be structural, behavioural or functional.

**VOCABULARY**
Bioaccumulation (etymology)
Insecticide (etymology)
Food chain
Food web
Habitat
Predator
Prey
Ecosystem
Interdependence
Population
Competition
Adaptations

**Diversity**
Jane Goodall – studying animal behavior.

**Personal development**
Sustainable living for the future.

**Reading is Power –**
'In for the kill' – How it works magazine article – found in science folder.

**Numeracy focus**
Analysing & interpreting Predator-prey graphs.

**WHERE NEXT?**

KS3 – Photosynthesis, Evolution & Extinction
KS4 – Biology Paper 2 – Ecology unit.

# Year 7 Interdependence : Assessment Plan

**MAPs** – Pupils will complete the following two WOW zone tasks (guidance and mark schemes can be found within the lesson resources):
Describe the adaptations of an artic organism.

**Summative assessment** – The knowledge from this unit will be tested as part of a 1 hour P2S exam which will combine the Biology, Chemistry and Physics curriculum covered so far.

| Assessment Steps | | | |
|---|---|---|---|
| Emerging | Developing | Securing | Mastering |
| ***Pupils have basic knowledge of interdependence:***<br><br>Constructing simple food chains.<br><br>Constructing simple food chains from a food web.<br><br>Matching provided definitions to the following key terms: carnivore, omnivore, herbivore.<br><br>Matching predator and prey organisms. | ***Pupils must be have an understanding of and be able to recall the basics of interdependence:***<br><br>An **ecosystem** is the name given to a place where all living **(biotic**) and non living (**abiotic**) things can exist.<br><br>A **habitat** is a place where a plant or an animal lives.<br><br>**Competition** exists between species of animals and plants for various things.<br><br>A **prey** organism is eaten by another animal and a **predator** means it eats other animals.<br><br>A **food chain** is a diagram that shows what an organism eats and the transfer of energy between organisms. A **food web** is a set of linked food chains. | ***Pupils must be able to recall the following content:***<br><br>Animals compete for food, water, space and mates. Plants compete for light, water, space and minerals. Plants do not compete for food as they produce their own through photosynthesis.<br>Predator-prey graphs show the interdependence of two organisms.<br>An **adaptation** is a characteristic of an organism that improves its chances of surviving and/or reproducing.<br>**Interdependence** is the way in which living organisms depend on each other to survive, grow and reproduce.<br>The number of animals or plants of the same species that live in the same area is called a **population**.<br>The first organism is a **producer**. This is a green plant or algae that makes its own food during photosynthesis. A second organism is a **herbivore**, that only eats plants. **Carnivores** eat other animals and **omnivores** eat both plants and animals. Decomposers are also found in food webs. These are organisms (bacteria and fungi) that break down dead plants and animal material, releasing nutrients back into the soil or water.<br><br>It is not only energy that transfers along a food chain. Some chemicals (toxic materials) can be passed on e.g. insecticides. Some of these chemicals are washed into rivers and end up in the sea. Fish absorb small amounts of these chemicals and store them in their body. Other animals eat the fish, and the insecticides are passed on. The accumulation (build up) of chemicals is called **bioaccumulation**.<br><br>Explain the relationship between predator prey populations from a graph. | ***Pupils should be able to recall all the content in the knowledge journey and demonstrate application through the following:***<br><br>Logically explain how bioaccumulation occurs using examples e.g. DDT, mercury and pesticides.<br><br>When provided with an image of an organism (both plants and animals) be able to suggest how it is adapted to be a good competitor.<br><br>***Pupils should also be able to use all Tier 3 vocabulary on the knowledge journey independently and in context.*** |

# Electricity: Journey of Knowledge

In this unit pupils will learn about the relationship between current, potential difference and resistance. They will know how to set up a circuit to measure current and p.d. and use this to calculate resistance. They will use these measurements to explain the behaviour of current and p.d. in series and parallel circuits. Pupils will learn how to draw accurate series and parallel circuit diagrams, using correct circuit symbols. Pupils will learn that insulators do not allow electrons to flow and so can build up electrons, which is 'static electricity'.

***Prior knowledge***

***KS2 NC*** *Pupils should be taught to: associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit, compare and give reasons for variations in how components function, including the brightness of bulbs, the loudness of buzzers and the on/off position of switches, use recognised symbols when representing a simple circuit in a diagram. (year 6)*

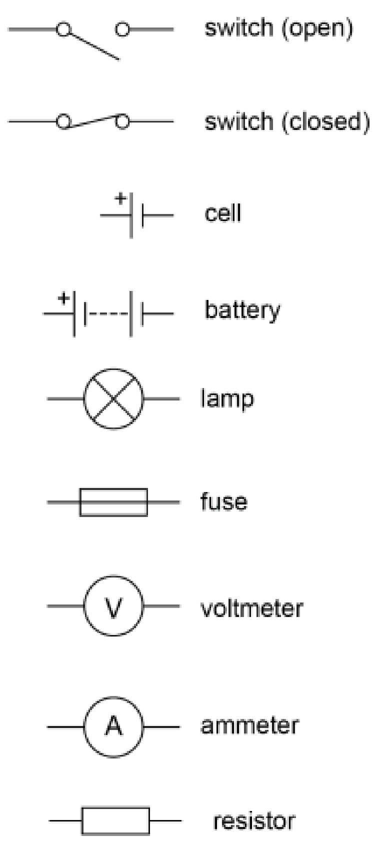
## The Bigger Picture:

*This topic links to lightning safety, mains electricity, railway lines, power lines, and why carbon fibre fishing rods can be dangerous in storms. It also connects to how circuits are used in homes, theme parks, and TV special effects.*

***Career links.*** *Electrical Engineer – designs and maintains power systems and devices.*
*Theme Park Ride Engineer - Uses circuits and control systems for ride safety.*

## CORE KNOWLEDGE

In static electricity, electrons **do not flow**. This only happens in **insulating materials**. Static charge is built up by **friction**, as electrons are transferred from one insulator to another. A charged object can **exert a non-contact force** on other objects. **Lightning** is a natural example of static electricity.
**Electricity is an energy transfer pathway**, not an energy store. In electrical circuits, **chemical energy** from batteries is transferred into **other energy stores**, such as thermal energy (e.g. heating a filament bulb), light, or sound. **Energy conservation** still applies: the total energy input equals total energy output (including wasted energy).
**Current** is a measure of the **rate of flow of electric charge** (electrons) in a circuit. It is measured in **amperes (A)** using an **ammeter**. In a **series circuit**, current is **the same at every point**. In a **parallel circuit**, current is **shared between the branches**.
**Potential difference** is the **energy transferred per unit charge**. It is measured in **volts (V)** using a **voltmeter** placed in **parallel**. It is **supplied by a battery or power pack**, which has **positive and negative terminals**. In a **series circuit**, the total p.d. is **shared** across components. In a **parallel circuit**, each branch receives the **full p.d.** of the power supply.
**Resistance** is a measure of how much a component **slows down the flow of current**. It is measured in **ohms (Ω)**.
Resistance is greater in **longer**, **thinner**, or **higher-resistance** materials (like nichrome wire).
Use the equation: **V = I × R** to calculate potential difference (V), current (I), or resistance (R).
In a series circuit current is the same throughout. p.d. is shared across components. Adding more components **increases total resistance**, which **reduces current**.
In a parallel circuit current splits between branches. Each branch gets the **full p.d.** from the power supply. This allows **independent control** of components (e.g. one bulb can be switched off without turning off another).
Common circuit components include: **Cells/Batteries** – provide energy. **Switches** – open or close the circuit. **Lamps** – transfer energy as light. **Buzzers** – transfer energy as sound. **Resistors** – limit current. **Variable resistors**– allow resistance to be changed. **Fuses** – melt and break the circuit if current is too high (safety device).




## ABOVE AND BEYOND

Lightning is caused by the rain/ice particles in the cloud rubbing together causing a large p.d. between the cloud and Earth which causes a discharge of electrons to Earth. Find the resistance of different lamps and explain the difference in brightness.

## VOCABULARY

**Current**
**Potential difference**
**Resistance**
**Circuit**
**Series**
**Parallel**
**Component**
**Cell**
**Ammeter**
**Voltmeter**
**Battery**
**Ohm**
**Ampere (Amp)**

## Reading is power

Electricity explained (60 second science P12 and 13)

## Numeracy

Use FIFA model to use the equation V = I x R

## WHERE NEXT?

KS3 – Electromagnetism and Electricity/energy cost

KS4 - Electricity, Magnetism and Electromagnetism

# Magnets & Electromagnets: Journey of Knowledge

**In this unit pupils will**: begin by understanding the properties of magnets, explore how magnets create magnetic fields, and learn to use compasses to reveal these fields. They will learn about the Earth's magnetic field. As they progress, students will delve into the concept of electromagnetism, discovering how electricity and magnetism are interconnected. Pupils will also investigate the applications of electromagnetism in everyday life.

***Prior knowledge KS2*** NC Pupils were introduced to the basic properties of magnets, such as attraction and repulsion, and encouraged to explore the characteristics of common magnetic materials. They will have learnt to identify magnetic poles and understand the basic principles of magnetic fields. At these stages, practical activities and simple experiments will have helped pupils develop a hands-on understanding of magnets, including their use in everyday objects like compasses.

**The Bigger Picture:**
Magnets play a huge part in our daily lives – not just sticking things on fridges. Medical uses include MRI scanners. School bells, car ignitions, door entry systems all use magnets. The Earth is a giant magnet.
***Career links.*** Radiographers, engineers, fire safety engineers, car mechanics

**CORE KNOWLEDGE**

Not all metals are magnetic. The only magnetic elements are **Cobalt, Iron and Nickel.** Steel is a magnetic material because it contains Iron.
The region around a magnet where a force can be felt is called the **magnetic field**. If magnetic materials enter this region, they will be attracted to the magnet. Permanent magnets have a north and a south pole. When poles are brought together magnetic force can be observed. Opposite poles will attract. Like poles will repel. Magnetic fields are invisible. The shape of a magnetic field can be shown using a plotting compass and represented by drawing field lines from north to south. Magnetic fields are strongest at the poles of a magnet.
The Earth's core contains liquid iron which moves around. Iron is magnetic and so the liquid iron causes Earth to have a magnetic field. This field has reversed historically and this can be observed in the geological record. Compass needles always line up with the Earths magnetic field, the arrow always points south when placed near the north pole of a bar magnet., this is because the Earth's north pole is a magnetic south.
Magnets can either be permanent or induced, an example of a permanent magnet is a bar magnet. Magnetism can be induced temporarily by placing magnetic materials close to a strong magnet.
An **electromagnet** uses an electrical current through a wire to generate a magnetic field around the wire. A solenoid is the term for coil of wire with many turns and is used to make an electromagnet. The strength of an electromagnet depends on the current, the core used and the number of turns of the coil in the solenoid. An Iron core is used to strengthen the magnetic field. The magnetic field is strongest closest to the electromagnet.
Electromagnets can be switched on and off and their strength can be varied. They only work while current is flowing. This makes them useful for many everyday applications such as: motors, school bells, relays, circuit breakers, loudspeakers, automatic door locks, scrap yard cranes.
Motors contain a current-carrying wire and a permanent magnet. The magnetic field generated around each of them causes them to exert a force on each other. The force causes the wire to move. This effect is called the motor effect.

**ABOVE AND BEYOND**

Critique the design of a device using an electromagnet and suggest improvements.
Suggest how bells, circuit breakers and loudspeakers work, from diagrams.
Predict the pattern of field lines and the force around two magnets placed near each other.
Predict how an object made of a magnetic material will behave if placed in or rolled through a magnetic field.

**VOCABULARY**

- Magnetic (etymology)
- Permanent magnet
- Induced magnet
- Magnetic poles
- Magnetic field
- Plotting compass
- Electromagnet (etymology)
- Solenoid (etymology)

**Numeracy**

How does altering the current affect the strength of an electromagnet? Opportunity for graphing results.

**READING IS POWER**

Magnetism (60 second science P40 and 41)

**WHERE NEXT?**

KS4 – Magnets & electromagnets

# Periodic Table, Metals & Non Metals: Journey of Knowledge

**Context and Introduction to Unit**
In this unit pupils will learn about the properties of metals and non metals. They will also explore the periodic table and the main groups within it, understanding key properties about each group and be able to describe trends and patterns.
**Prior knowledge (KS2/KS3)**
Knowledge of the periodic table is not required or covered at KS2 but pupils are expected to compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets in KS2. They are also expected to give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals.

**The bigger picture:**
***Personal development opportunities*** – *explore the wider world and the materials used to create it*
***Career links*** –
Engineer, welder, construction worker, architect, health and safety industry etc (pretty much anything that involves materials)

**CORE KNOWLEDGE**
The periodic table is made up of elements only and split into two sections, metals and non metals. Metals, found in the centre and left hand side tend to be hard, dense, good conductors of electricity and thermal energy, sonorous, ductile, generally strong and have high melting points. There are exceptions such as gold and silver and the alkali metals, which are not strong and hard. Metals will react with oxygen from the air and water which will rust metals. There are fewer non metals, found on the right hand side, in the periodic table than metals and the properties of these differ from the metals. These are mostly gases, tend to be softer (if solid), poor conductors of electricity and thermal energy and have low melting points.
Dimitri Mendeleev, a Russian chemist arranged the elements in order of atomic weight but left gaps and reordered elements based on their properties. The modern day periodic table is arranged in atomic number.
The periodic table is split into groups (columns) and periods (rows).
Group 1 are known as the alkali metals (knowledge of why they are called this can be covered in KS4). They are soft, less dense than most other metals in the PT, are shiny when cut, have lower melting points than most metals and are very reactive, especially with water. They produce hydrogen gas when they react with water and become more reactive as we move down the group. Hydrogen should appear in group 1 but doesn't because it is a gas.
Group 7 are known as the halogens. These are a group of non metal elements that do not conduct electricity and have low melting and boiling points. They are a mixture of solids, liquids and gases. Group 7 elements are very reactive and get more reactive the higher you go in the group. They also appear pale in their appearance but get darker further down the group.
Group 0 are known as the noble gases. As the name suggests, these are all gases and are very unreactive which is due to their structure (more detail at KS4). They generally do not take part in any reactions at all and are colourless gases at room temperature. As they are generally unreactive, they tend to be used around electricity and can be used in advertising signs (neon) or strip lights (argon).
Transition elements are those found in the central block of the periodic table.

**ABOVE AND BEYOND**
Begin to look at structure of atoms in the groups, what similarities and differences do they have?
Compare transition metals with metals in group 1/2

**VOCABULARY**

Metal
Non Metal
Property (etymology)
Sonorous
Ductile
Conductor (conductivity is covered in later units so this might be worth looking at etymology wise)
Strong
Periodic (etymology)
Group
Period
Trend
Pattern

**Diversity**
Mendeleev contributions to the periodic table

**Reading is Power**
"The periodic table" pp. 88-89.

**Numeracy Focus**
Identifying possible elements from melting and boiling points particularly metals vs. non metals.

**WHERE NEXT?**

KS3 – Chemical Reactions
KS4 – Atomic Structure & Periodic Table

# Chemical Reactions: Journey of Knowledge

**Context and Introduction to Unit**

In this unit pupils will learn about and investigate a variety of different chemical reactions and how to represent them using word and symbol equations. Pupils will collect, display and analyse data collecting during their investigations and use their findings to apply their knowledge to real life scenarios.

***Prior knowledge***

***KS2 NC –*** *Pupils should explore changes that are difficult to reverse, for example, burning, rusting and other reactions, for example, vinegar with bicarbonate of soda. They should find out about how chemists create new materials, for example, Spencer Silver, who invented the glue for sticky notes or Ruth Benerito, who invented wrinkle-free cotton.*

**The bigger picture:**

*Links the Chemical Changes topic in chemistry at KS4, Bioenergetics topic in Biology at KS4, particularly photosynthesis and respiration.*

*Career link – pharmacist.*

**CORE KNOWLEDGE**

Chemical reactions involve the rearrangement of atoms within substances and can be identified by observations such as a colour change, temperature change, fizzing/bubbles, light production, change in smell, precipitate forms. Physical changes are ones which involve a change in state.

Non-metal oxides dissolve to form acidic solutions while soluble metal oxides dissolve in water to form alkaline solutions. Insoluble non-metal oxides are bases which will still neutralise acids.

Chemical reactions can be represented by word or symbol equations with the reactants (the chemicals that react) on the left of the arrow and the products (the new chemicals that are formed) on the right of the arrow. Mass is conserved in a chemical reaction so symbol equations must be balanced.

- Combustion reactions occur when energy is released from a fuel, usually after burning, and are exothermic as they release energy.
- Thermal decomposition reactions happen when a large substance is broken down into smaller substances with the addition of heat energy and are endothermic.
- Oxidation reactions occur when oxygen is added to a substance. These reactions can cause problems such as the rusting of iron, the oxidation of sulfur during the combustion of fossil fuels which produce sulfur dioxide which in turn causes acid rain.
- Displacement reactions occur when a more reactive element takes the place of a less reactive element in its compound and can be predicted using the reactivity series of metals. In a displacement reaction – pupils should add chemicals to boiling tubes using a pipette, this will allow a controlled amount of solution to be added.
- Endothermic reactions absorb energy from the surroundings which usually results in the temperature of the surroundings decreasing. They can be used in sports injury packs.
- Exothermic reactions release energy into the surroundings which usually results in the temperature of the surroundings increasing. They can be used in hand warmer or self-heating cans for drinks.
- Thermometers should be used to measure temperature changes in this practical activity. The polystyrene cups are used as they are poor conductors of thermal energy and have less impact on the reaction. When carrying out, pupils should add the liquid to the cup first, take the temperature and record, before adding the solid reactant. Then the end temperature should be taken after at least 2/3 minutes (use a stop clock)
- Catalysts can be used to shorten the pathway of a reaction and reduce the amount of energy required for a reaction to take place.

**ABOVE AND BEYOND**

Identifying endothermic and exothermic reactions from reaction profiles.

**VOCABULARY**

Reactant
Product
Endothermic (etymology "inside heat" from a mixture of old French and Latin)
Exothermic (etymology "outside heat" from a mixture of old French and Latin)
Combustion
Displacement
Soluble
Insoluble
Precipitate
Decomposition (etymology from the *de-* which means undo and *composition* which means to assemble or put together).
Thermal (etymology from the Greek for 'heat')
Catalyst

**Reading is Power**

"The laws of thermodynamics" pp. 78-79

**Numeracy Focus**

Calculating temperature changes in reactions and identifying endothermic and exothermic reactions from experimental data.

**WHERE NEXT?**

KS4 – Chemical Changes and Energy Changes topics in chemistry.

KS4 Physics – Conservation of Energy.

KS4 – Bioenergetics in Biology.

# Acids and Alkalis: Journey of Knowledge

**Context and Introduction to Unit**
In this unit pupils will learn about the properties of acids and alkalis. Pupils will be able to identify acids and alkalis by using indicators and make their own natural indicator. Neutralisation investigations will also be carried out to relate the real life importance of these types of reactions. The investigations will allow pupils to develop their planning, practical and analytical skills, including numeracy.
***Prior knowledge KS2 NC –*** *Pupils should be able to explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda.*

**The bigger picture:**
*Links to chemical changes and reactions– uses in the manufacture of medications and industrial chemicals.*

*Career link – chemical engineer.*

**CORE KNOWLEDGE**
Indicators are chemicals that show whether a chemical is acidic, alkaline or neutral. The most popular indicator is universal indicator as it also denotes acidity and alkalinity. Natural indicators can be made from red cabbage. *Red cabbage must be cut up into small pieces – this can be done prior to lesson – speak to technicians. Add boiling water to the red cabbage – this will break down the cell walls and allow for the colour to leak out. If stirring this, use a glass rod and observe care when handling. A pipette can be used to add small amounts of the liquid to mystery samples on a spotting tile. A spotting tile is a piece of apparatus with small dimples that allow for small samples to be analysed.* Digital probes can also identify the pH of a substance but should be cleaned with distilled water between each use to prevent contamination. The pH scale is a number scale from 0 to 14. It tells us how acidic or alkaline an *aqueous solution* is. The pH scale is used to classify *solutions* as acidic, alkaline or neutral. Neutral solutions are exactly pH 7. Acidic solutions have pH values less than 7. The closer to pH 0, the more acidic a solution is. Alkaline solutions have pH values more than 7. The closer to pH 14, the more alkaline a solution is.
Acids are chemicals that can be irritants or corrosive and have a pH of less than 7. The lower the pH, the more acidic. Acids turn universal indicator red or orange/yellow. Edible acids have a sour taste e.g. citric acid.

Hydrochloric acid forms chloride salts.
Sulfuric acid forms sulfate salts.
Nitric acid forms nitrate salts.

The first part of the salt name is derived from the metal present in the base/alkali
Bases are chemicals that are the opposite of acids and have a pH above 7. The higher the pH, the more alkaline. Bases turn universal indicator blue or purple. Alkalis are types of bases that are soluble. Not all bases are soluble (e.g. some metal oxides like copper oxide). Bases are usually used in cleaning products but also include things like indigestion tablets. Solutions that have a pH of 7 are neutral and turn universal indicator green.
Bases can **neutralise** acids to form a type of salt and water.

General Word equation Acid + Base → Salt + Water
e.g. Hydrochloric Acid + Copper Oxide → Copper Chloride + Water

Making a salt involves reacting an acid and base together, ensuring that the base is added in excess. This excess is then filtered off to leave the mixture of salt and water. To separate these out, crystallization must be carried out to evaporate the water, leaving behind salt crystals.
Neutralisation reactions have a range of practical uses from curing heart burn to neutralising acidic soil so that crops can grow. If too much base/alkali is added to an acid the pH will rise above neutral so it important the correct quantity and pH. The opposite is true if too much acid is added to a base/alkali.
C**oncentrated** acid contains a **large number** of acid particles dissolved per unit volume. A **dilute** acid contains a **small number** of acid particles dissolved per unit volume.

**ABOVE AND BEYOND**
Formulae:
HCl
$H_2SO_4$
$HNO_3$
NaOH
NaCl

**VOCABULARY**
Acid/acidic
Alkali/alkaline
Base/basic
Neutral/neutralisation – etymology
Indicator
pH scale
Salt
Soluble
Corrosive
Irritant

**Reading is Power**
"The pH Scale" pp. 126-127.

**Numeracy Focus**
Ordering acidity and alkalinity. As acidity increases, pH decreases and as alkalinity increases, pH increases.

**WHERE NEXT?**
KS4 – Chemistry Paper 1 – Chemical Changes.

# Heating and Cooling: Journey of Knowledge

In this unit pupils will learn about heating and thermal equilibrium: temperature difference between 2 objects leading to energy transfer from the hotter to the cooler one, through contact (conduction) or radiation; such transfers tending to reduce the temperature difference; use of insulators.
***Prior knowledge KS2 NC*** *Pupils should be taught to: compare and group together a variety of everyday materials on the basis of their simple physical properties, They should think about the properties of materials that make them suitable or unsuitable for particular purposes and they should be encouraged to think about unusual and creative uses for everyday materials, observe that some materials change state when they are heated or cooled, and measure or research the temperature at which this happens in degrees Celsius (°C).*

**The Bigger Picture:**

*Links to temperature and heat transfer, methods of reducing energy transfer and insulation of buildings*

***Career links.*** *Energy Manager, Boiler engineer, Insulation and energy consultant*

## CORE KNOWLEDGE

Temperature and heat are not the same thing. Temperature is how hot or cold an object is. It is measured in degrees Celsius, °C, with a thermometer. Thermal energy is to do with the movement of the particles inside matter. Thermal energy is the total kinetic energy of all the particles and is measured in Joules. Heating makes particles vibrate more (solid) and move faster (liquid and gas), so they have more kinetic energy. The thermal energy of a material depends upon the number of particles (mass), the temperature and the type of material. Heat energy can flow by conduction, convection or radiation and always flows from a region of high temperature to a region of low temperature (hot to cold). This is known as Thermal Equilibrium.
**Conduction** is the transfer of heat energy without overall movement of the particles. Conduction occurs mainly in solids – most liquids are really poor conductors and hardly any conduction happens in gases. When a solid absorbs heat energy, the atoms vibrate faster and collide into each other, allowing thermal energy to be transferred from one particle to the next (from the hot to cold). A thermal conductor is something that transfers thermal energy really well. Examples of **thermal conductors** include, metals such as copper and iron. Metals are good conductors of heat energy because they contain free electrons. A **thermal insulator** is something that doesn't transfer thermal energy well. Examples of insulators include trapped air, wool, plastic, rubber etc.
**Convection** is the transfer of heat energy by movement in a fluid (liquids and gases). Convection currents are formed when heated particles become less dense and rise. As particles then lose thermal energy they start to become more dense and fall. Thermal energy is spread throughout the fluid by this process.
**Radiation** is the transfer of energy without particles. Energy is instead transferred by waves. Hot objects emit infrared radiation. Very hot objects also emit light. Objects which take in thermal radiation are absorbers of heat. Objects which give out or produce thermal radiation are called emitters of heat. Black/dull/matt surfaces are the best absorbers and emitters of radiation. Objects which are poor emitters or absorbers of radiation will reflect energy away from their surface. Silver/shiny surfaces are good reflectors. All objects emit thermal radiation. The hotter the object the more radiation it emits. A thermogram can be used to visualise infrared radiation. These can be used when assessing the energy efficiency of a house.
Strategies for reducing heat loss in the home include fitting draft excluders, double or triple glazing, loft insulation, cavity wall insulation, carpets, curtains etc.

## ABOVE AND BEYOND

Explain how density is linked to conduction and convection. Explain Why is it very difficult for hot air balloons to reach high altitudes.
Explain how colours (black/silver) and surfaces (matt/shiny) affect radiation, give examples where this can be utilised
Research different methods of insulation and explain in detail how they work to reduce energy transfer.

## VOCABULARY

Conduction
Convection
Radiation
Insulation
Transfer
Emit
Absorb
Reflect
Thermal
Density
Thermogram

## READING IS POWER

Window Glazing – how do they help keep our homes warm? How it works pg. 38

## NUMERACY

Using thermometers to measure temperatures accurately. Drawing graphs

## WHERE NEXT?

KS4 – Energy

# Electrical Energy Transfers and Cost: Journey of Knowledge

In this unit pupils will learn that we ‘use energy’ every day to carry out tasks e.g. heating water, moving the body, allowing a car to move, producing light from bulbs, candles etc. This energy is a fixed amount in the universe, starting from the Big Bang and we just move it around from energy store to energy store to allow things to ‘do work’ for us. Much of the energy we use is in the form of fuel, including food, and in the form of electricity, and we have to pay for this. Pupils will learn about power and will be able to link this to rate of energy transfer. And will be able to relate this to paying for domestic electricity usage. Pupils will learn how electricity is generated; renewable and non-renewable resources and the advantages and disadvantages of specific resources.

***Prior knowledge KS2 NC*** *Pupils have had very little instruction linked specifically to ‘energy’. In Year 4 they learnt to* ***identify common appliances that run on electricity.***

**The Bigger Picture:**

*Links to environmental impact of generating electricity and the need to move to renewable resources and energy efficiency.*

***Career links.*** *The ‘green’ economy, nuclear industry, electrical engineers*

**CORE KNOWLEDGE**

Energy is a finite concept. Energy can be defined as the ability to do work. The energy we have on earth as well as all energy in the universe came from the Big Bang and we cannot create or destroy this energy – we just transfer it around to allow us to do work.

Power is a measurement of the rate of energy transfer. **Power (W) = Energy transferred (J) ÷ time (s)** .Power is measured in Watts. 1 Watt is the same as 1 Joule of energy transferred each second. The power rating of an appliance tells us how quickly the appliance transfers energy (usually electrical). Much of the early work done to define power and it’s applications in the industrial world was carried out by James Watt at the start of the Industrial Revolution.

Electrical energy must be paid for and our electricity meters record the total amount of electricity our homes use. Some households receive a bill every 3 months, known as the billing period, which they then must to pay. Others use top up meters to pay as they go.
Opting to use more energy efficient appliances such as LED bulbs use less electricity and so will have lower cost.

We can rearrange the equation: **Energy transferred (KWh) = Power (KW) x time (hr)** to work out the amount of energy a household has used for their bill. This is calculated in **kilowatt hours,** not joules**.**

A kilowatt-hour (or kWh) is the standard unit of energy transfer that utility companies use to charge homes for their gas and electricity. It refers to the use of power over a period of time – for example a 1 kW drill used for 1 hour will use 1 kWh of energy.

**ABOVE AND BEYOND**

Evaluate the social, economic and environmental consequences of using a resource to generate electricity, from data.
Suggest actions a government or communities could take in response to rising energy demand.
Suggest ways to reduce costs, by examining data on a home energy bill.

**VOCABULARY**

Energy
Power
Appliance
met**er**
Watt
Kilo
Kilowatt hour
Renewable resource
Non-renewable resource
Turbine
generator

**Reading is power**

How to Read Your Electricity Bill - in Energy Science Folder.

**Personal Development**

Life skills - budgeting finances for paying bills within the home.

**Numeracy**

Use FIFA model with all equations – convert W – kW and kW – W.
Recognise 1 watt = 1J/s
Calculate energy cost and payments.

**WHERE NEXT?**

Energy Physics Paper 1

# Health & Nutrition: Journey of knowledge

**Context and Introduction to Unit** In this unit pupils should understand the content of a healthy human diet: carbohydrates, lipids (fats and oils), proteins, vitamins, minerals, dietary fibre and water, and why each is needed. Carryout calculations of energy requirements in a healthy daily diet. Understand the consequences of imbalances in the diet, including obesity, starvation and deficiency diseases. Outline the tissues and organs of the human digestive system, including adaptations to function and how the digestive system digests food (enzymes simply as biological catalysts).

***Prior knowledge (KS2/KS3)*** ***KS2 NC*** – Pupils should be introduced to the importance of exercise and nutrition for humans. Identified that animals, including humans, need the right types and amount of nutrition, and that they cannot make their own food; they get nutrition from what they eat. Pupils should know the main body parts associated with the digestive system, for example, mouth, tongue, teeth, oesophagus, stomach and small and large intestine and explore questions that help them to understand their special functions.

**The bigger picture:**

*Links to food production and health. SMSC balanced diet and health issues.*

*Career link – Nutritionalist, drugs councillor, health care professional, dietician*

**CORE KNOWLEDGE**

A balanced diet consists of carbohydrates and lipids (fats and oils) which both provide energy, proteins used for growth and repair, vitamins and minerals which keep you healthy, fibre to keep food moving through the gut and water which is needed in all cells of the body. A balanced diet means eating foods that contain nutrients in the correct amount. This does not look the same for all people; factors such as biological sex, age and lifestyle will impact how much of each nutrient different people require. Food labels give details of the energy values in certain foods. Energy is measured in J, kJ or calories – all units are valid. The traffic light colours on food labels help us to make healthy choices; green indicates a low value which is a healthier choice, orange indicates a medium value and red indicates a high value which can affect our health. Foods with mainly red labels should be eaten less often in smaller amounts. Food contains a store of chemical energy. If food is burnt under a test tube containing water, chemical energy in the food is transferred to the thermal energy store of the water, causing the water to heat up. The hotter the water gets, the more energy there is in the food. Obesity is a disease involving an excessive amount of body fat that increases the risk of heart disease, stroke, diabetes and some cancers. Coronary Heart Disease (CHD) involves the blood vessels that provide the heart with oxygenated blood becoming narrowed, starving the heart of oxygen. If the blood vessel becomes completely blocked, the result is a sudden and potentially fatal heart attack. Starvation is a deficiency in energy intake (calories) that can cause permanent organ damage, poor immune function, fatigue and eventually death. Tooth decay is damage to a tooth caused by dental plaque (a layer of bacteria on teeth) turning sugar in food to acid. The result of tooth decay could be holes in teeth, gum disease and dental abscesses. Tooth decay can be prevented by consuming fewer sugary foods/drinks and using fluoride toothpaste. A deficiency disease is a state of lacking a nutrient that is essential for healthy body function, usually a vitamin or mineral. Each vitamin & mineral has its own specific function in the body, the vitamin or mineral that is deficient determines the disease that occurs. A vitamin A deficiency can result in night blindness (difficult to see in low light). A vitamin C deficiency can result in scurvy (bleeding gums & bleeding under skin). A vitamin D deficiency can result in rickets (bones soften leading to bowed legs). A calcium deficiency can result in osteoporosis (bones become brittle & more likely to fracture). Am iron deficiency can result in anaemia (number of red blood cells decrease causing extreme tiredness & shortness of breath). Digestion is the breakdown of large, insoluble molecules into small soluble molecules. Food starts in the mouth, travels down the oesophagus by peristalsis (muscular contractions) to the stomach, food then enters the duodenum (start of the small intestine) before moving through the small intestine by peristalsis, continuing into the large intestine, the waste food is stored in the rectum before exiting the body through the anus. The liver, pancreas and gall bladder are also involved in digestion, but food does not travel through these organs. Digestion occurs due to digestive juices such as saliva, gastric juices and pancreatic juices containing enzymes that break down the food. The stomach contains hydrochloric acid which kills bacteria on food and provides the right conditions for enzymes in the stomach. Bile neutralises the acidic food as it leaves the stomach to provide the right conditions for enzymes in the small intestine. Bile also emulsifies lipids. The small intestine contains villi which increase the surface area of the small intestine lining, allowing more small, soluble food molecules to be absorbed into the bloodstream. The large intestine contains bacteria which live on the fibre in your diet that cannot be digested. Probiotic foods, like yoghurt, contain these useful bacteria. Enzymes are known as biological catalysts, they break down the large, insoluble molecules into small, soluble molecules that can be absorbed into the bloodstream. Each enzyme is specific to the food molecule that it breaks down. Amylase breaks down starch into glucose. Protease breaks down protein into amino acids. Lipase breaks down lipids into fatty acids & glycerol. The pancreas and small intestine produce and release all three enzymes, the salivary glands produce amylase only and the stomach produces protease only. Enzyme action is affected by temperature and pH. Drugs are chemical substances that have an effect on the body by altering the chemical reactions that take place in our cells. Drugs can be taken for medicinal or recreational purposes. Medicinal drugs may treat infection (e.g. antibiotics) or a disease (e.g. chemotherapy), control symptoms (e.g. painkillers) or control healthy but unwanted processes that occur in the body (e.g. contraceptive drugs). Recreational drugs are drugs taken for enjoyment or relaxation and include both legal (alcohol, caffeine and nicotine) and illegal drugs (cannabis, cocaine, LSD, heroin etc). Drugs can be placed into four categories; they may be depressants (they slow down brain activity causing relaxation, e.g. alcohol); stimulants (opposite effect of speeding up brain activity causing increased alertness, energy and focus, e.g. nicotine); hallucinogens (distorted perceptions causing hallucinations, e.g. LSD); or opioids (bind to pain receptors in the brain causing pain relief e.g. heroin).

**ABOVE AND BEYOND**

The duodenum connects the stomach to the small intestine. The liver and pancreas are also involved in digestion however, food does not pass through. Bile is produced in the liver and stored in the gall bladder. Bile neutralises and emulsifies lipids.

**VOCABULARY**

Carbohydrates
Lipids
Proteins
Vitamins
Minerals
Fibre
Obesity
Malnutrition
Deficiency
Digestion
Enzymes
Oesophagus
Intestine
Bacteria
Coronary Heart Disease
Rectum
Probiotic
Villi

**Personal Development**

Tooth decay – concerns, causes and impacts on life and employment opportunities.

**Diversity**

Examining deficiency diseases, BMI focussing on genders, age, sex and the impact of exercise relating to gender in sport.

**Reading is Power**

Digestion

**WHERE NEXT?**

KS4 – Biology Paper 1 Organisation

**Numeracy development**

Nutritional content from food wrappers. Discuss UK statistics comparing overweight and underweight children. Time for food to digest. pH of different parts of the digestive system for optimum conditions.

# Breathing and Respiration - Journey of Knowledge

**Context and Introduction to Unit**
In this unit pupils will learn about respiration and its importance in living organisms. Pupils will learn about the differences between aerobic and anaerobic respiration, how they are similar, how they differ and the implications of each. Pupils will also learn about the structure and function of the respiratory system.
***Prior knowledge - KS2 NC –*** *Pupils have explored what are the essential requirements for life and will have included oxygen and food. Pupils have been introduced to the term respiration in the unit 'cells' when learning about the mitochondria. Pupils have learnt about chemical reactions and the terms reactants and products in the unit 'Atoms and Elements'. Pupils have explored other systems in humans, looking at digestive in Year 5 and circulatory in Year 6. Pupils will be aware of the terms 'organ system' and 'organs' and this knowledge should be checked at the start of the unit so pupils understand that the respiratory system is an organ system and can identify the organs within it.*

**The bigger picture:** Respiration releases energy, the importance of this process for organisms to survive.
*Career link – Respiratory Physiologist*
https://www.artp.org.uk/Careers

**CORE KNOWLEDGE**
The key components of the gas exchange system are: trachea, bronchus, bronchiole, alveolus, diaphragm, intercostal muscles, ribcage. The gas system is a mechanical system which allows the body to breathe air in (inhale) and breathe air out (exhale) of the body. Adaptations of the gas exchange system include: lots of alveoli creating a large surface area, alveoli have thin walls providing a short diffusion pathway and each alveolus is surrounded by capillaries (blood vessels) providing a good blood supply. Each adaptation allows for efficient gas exchange.
**Inhalation -** The muscles between your ribs contract- this pulls your ribcage up and out, the diaphragm moves down. This increases the volume inside your chest, the pressure inside your chest decreases and this draws air into the lungs. **Exhalation -** The muscles between your ribs relax- this pulls your ribcage down and in, the diaphragm relaxes moving up. This decreases the volume inside your chest, the pressure inside your chest increases and this pushes air out the lungs. A spirometer is a device used to measure lung volume, including tidal volume and vital capacity. The basic components of a spirometer include a mouthpiece, a chamber to collect exhaled air, and a recording mechanism.
**Asthma** - the inside walls of the airways in your lungs can become inflamed and swollen. In addition, membranes in your airway linings may secrete excess mucus. The result is an asthma attack. During an asthma attack, your narrowed airways make it harder to breathe, and you may cough and wheeze.
**Smoking** - the lungs are lined with cilia – little hair like structures that do the important job of sweeping particles out of your airways. Smoking damages the cilia and stops them from working properly. Smoking causes the airways to become inflamed and to produce more mucus which can lead to a chronic cough. The airways also start to narrow as a result of the damage caused by smoking, making it harder for air to flow in and out of your body, leading to breathlessness.
**Respiration** is a chemical reactions that releases energy when glucose and oxygen react in the mitochondria of the cells of living organisms.
**Aerobic respiration – requires oxygen** Glucose + oxygen → carbon dioxide + water + (energy) Oxygen comes from the air we inhale, glucose comes from the food we eat (carbohydrates) and some drinks. The water produced is exhaled as water vapour, lost in urine and sweated out. The carbon dioxide produced is exhaled into the air. Limewater is used to test for the presence of carbon dioxide. Limewater goes from clear to cloudy if there is a positive result.
**Anaerobic respiration in animals – does not require oxygen -** Glucose → lactic acid (some energy)
Anaerobic respiration only happens during vigorous exercise and produces energy in very small amounts. Lactic acid is a waste product produced during anaerobic respiration. A build up of lactic acid in your muscles leads to cramp and fatigue.
Practical opportunity – Does exercise affect heart rate? The independent variable is the length of exercise. The dependent variable is pulse per minute. The control variables are type of exercise, rest period, prior health conditions. A line graph would be the selected graph, with length of exercise on the x axis, pulse per minute on the y axis. Points are plotted with neat crosses and a line of best fit is a line which best represents the pattern/trend shown.
**Anaerobic respiration in microorganisms (fermentation)** Glucose → ethanol + carbon dioxide
Fermentation has economic importance in the manufacture of bread (carbon dioxide helps bread to rise) and alcoholic drinks (ethanol is alcohol).

**ABOVE AND BEYOND**
Formulae:
$CO_2$, $O_2$, $C_6H_{12}0_6$

**VOCABULARY**
Respiration
Diaphragm
Gas exchange
Alveoli
Capillaries
Inhale
Exhale
Anaerobic
Aerobic
Glucose
Oxygen
Carbon dioxide
Lactic acid
Mitochondria
Energy
Muscles
Fatigue
Ethanol
Fermentation
Efficient

**Diversity**
Impact of exercise, exploring gender in sport and physiology of biological males and females.

**Personal development**
Respiratory problems and the effects of smoking.

**Numeracy development**
Composition of different gases in the air. Balancing symbol equations. Analysing data showing the effect of exercise on breathing rate. Calculating lung volume.

**Reading is Power**
60 second science - Respiration

**WHERE NEXT?**
KS4 Biology - Organisation and Bioenergetics.

# Breathing and Respiration Homework

1. Describe the changes that occur in the lungs when we inhale.

2. How does smoking affect gas exchange?

3. How does asthma affect gas exchange?

4. Where does respiration occur? Why is it an important process for all living organisms?

5. What is the difference between aerobic and anaerobic respiration?

6. What is the effect of lactic acid build up in the body?

https://www.bbc.co.uk/bitesize/topics/zvrrd2p/articles/zdqx2v4

# Plants Organisation & Photosynthesis: Journey of Knowledge

**Context and Introduction to Unit**

In this unit pupils will learn about the chemical reaction photosynthesis, learning about how the plant obtains the raw materials for this, where it happens and the factors affecting the rate. Pupils will make links plants being a food source and sustainability issues with a growing population. They will link their knowledge of photosynthesis to greenhouse design to improve food security.

***Prior knowledge KS2 NC –*** *Pupils should be able to label the organs of a flowering plant. They will recognise the basic requirements of plants for life (as simple as water, light, nutrients and room). Pupils should also be aware of plant life cycles including pollination and seed dispersal (note – most of this is early KS2 so knowledge will need to be revisited as may not have been covered in Year5/6).*

**The bigger picture:**

*Links to food production – need for food security and to aid the development of drugs. Greenhouse design.*

*Career link – botanist.*

**CORE KNOWLEDGE**

Photosynthesis is an endothermic reaction that takes place in the chloroplasts of plant cells. Photosynthesis mainly takes place in the plant's leaves. This reaction combines carbon dioxide and water using energy from sunlight which is absorbed by chlorophyll (a green pigment found in chloroplasts). Glucose and oxygen are produced.

Carbon Dioxide + Water → Glucose + Oxygen

Limiting factors are factors that can slow down the rate of photosynthesis. These are temperature, light intensity and carbon dioxide (TLC). Increasing light intensity increases the rate of photosynthesis until another factor becomes limiting. Increasing carbon dioxide concentration increases the rate of photosynthesis until another factor becomes limiting. The highest rate of photosynthesis is in warm temperatures (30°C). The effect of limiting factors on the rate of photosynthesis can be shown using sketch graphs. The effect of a limiting factor on the rate of photosynthesis can be investigated by measuring the growth of a young plant. The glucose produced during photosynthesis is used in the production of new cells and tissues; more photosynthesis = more glucose produced = more plant growth. When changing one of the limiting factors, the other two factors must be controlled. By measuring the initial height of the plant and the final height of the plant, the growth of the plant can be calculated. The plant that is exposed to the highest light intensity, highest carbon dioxide concentration or temperature closest to 30°C will photosynthesise more and therefore have the highest growth. The leaf can be split into four sections; the waxy cuticle, the upper epidermis, the palisade mesophyll, the spongy mesophyll and the lower epidermis. The waxy cuticle reduces water loss from the leaf. The palisade layer is the specific site of photosynthesis within the leaf as it is packed with palisade cells that contain many chloroplasts. The spongy mesophyll has gaps between cells, allowing gases (oxygen and carbon dioxide) to diffuse to/from the palisade mesophyll. The lower epidermis contains guard cells which open and close stomata (tiny pores on the underside of the leaf). Carbon dioxide enters the leaves through the stomata by diffusion. Stomata close to reduce water loss from the leaf. This typically happens at night when photosynthesis does not occur so carbon dioxide is not needed or at midday when high temperatures can increase water loss. The glucose produced from photosynthesis can be used during respiration to release energy. Glucose is also used for the production of cellulose which is used in cell wall formation, lipids which are used in cell membrane formation and amino acids which are used for protein-synthesis. If glucose is not being used it is immediately converted to starch molecules for storage and then broken down back into glucose if needed for respiration, cellulose/lipid/amino acid production. If starch is present in the leaf this provides evidence that the leaf is photosynthesising. The reagent used to test for starch is iodine solution. If starch is present, the iodine solution will change from brown to blue-black. Other parts of the plant may also test positive for starch. The roots have a store of starch which provides energy for the absorption of mineral ions from the soil. The stem has a store of starch to transport sugar around the plant in the phloem (a sieve-like/perforated vessel in the stem that transports sugar). Seeds also have a store of starch to be used for protein-synthesis and provide energy for growth. A plant obtains mineral ions from the soil. The mineral ions move into the plant through specialised root hair cells in the roots. The mineral ions travel through the plant in the xylem (a hollow vessel in the stem that transports water & mineral ions). Mineral ions are responsible for the overall healthy growth of the plant. Nitrate ions are used to make amino acids (used for protein-synthesis). Magnesium ions and iron ions are used in chlorophyll production. Potassium ions control water uptake. Phosphorous ions promote healthy root and shoot growth. If a plant has a mineral deficiency, this means the plant is lacking in one or more mineral ions. Mineral deficiencies can result in stunted growth and chlorosis (discolouration of the leaf).

**ABOVE AND BEYOND**

Formulae:

$CO_2$

$O_2$

$C_6H_{12}0_6$

Glucose is stored as starch because starch is insoluble.

**VOCABULARY**

Photosynthesis (etymology).
Endothermic
Sunlight
Carbon dioxide
Water
Roots
Stem
Leaves
Waxy cuticle
Upper epidermis
Palisade mesophyll
Spongy mesophyll
Lower epidermis
Palisade cells
Limiting factor
Iodine solution
Reagent
Starch
Chlorophyll (etymology).
Chloroplasts (etymology).

**Personal development**

Demand for more food as the human population increases – sustainability.

**Reading is Power**

60 second science magazine 'Photosynthesis'

**Numeracy development**

Balanced symbol equation for photosynthesis. Use data to describe the pattern/trend of limiting factors from a graph. Calculate a mean using results from practical.

**WHERE NEXT?**

KS4 – Biology Paper 2 – Bioenergetics unit.

# Year 8 Plants and Photosynthesis: Assessment Plan

**MAPs** – Pupils will complete the following two WOW zone tasks (guidance and mark schemes can be found within the lesson resources):

1. Write out the word equation for photosynthesis and describe how the raw materials are obtained.

2. Provide limiting factor graphs – Using the secondary data describe how each factor affects the rate of photosynthesis. Include data in your descriptions.

**Summative assessment** – The knowledge from this unit will be tested as part of a 1 hour P2S exam which will combine the Biology, Chemistry and Physics curriculum covered so far.

| **Assessment Milestones** | | | |
|---|---|---|---|
| Emerging | Developing | Securing | Mastering |
| ***Pupils have basic knowledge of how plants make food:***<br><br>Pupils understand and can recall that plants make their own food. With support with the reactants and products they can arrange them into the equation for photosynthesis.<br><br>Pupils can make basic links to how plants grow e.g. they will not grow without water or without sunlight. | ***Pupils must be have an understanding of and be able to recall the basics of how plants make food:***<br><br>Photosynthesis is a chemical reaction that takes place in the leaves of plants. This reaction makes the 'food' for the plant.<br><br>Carbon dioxide + water → glucose + oxygen | ***Pupils must be able to recall the following content:***<br><br>Photosynthesis is a chemical reaction that takes place in the leaves of plants. This reaction makes the 'food' for the plant.<br><br>Carbon dioxide + water → glucose + oxygen<br><br>Carbon dioxide enters the leaves through the stomata from the air. Water enters the roots from the soil.<br><br>The reaction requires light energy. Chlorophyll is a pigment found in chloroplasts. Chlorophyll absorbs light energy needed for photosynthesis.<br><br>The palisade cells are the specific site of photosynthesis within the leaf. These contain lots of chloroplasts.<br><br>Describing limiting factor graphs using the terms increase, decrease, rate, optimum, limiting factor and using quantitative information.<br><br>Explain starch tests on a variegated leaf. | ***Pupils should be able to recall all the content in the knowledge journey and demonstrate application through the following:***<br><br>Formulae:<br>$CO_2$<br>$O_2$<br>$C_6H_{12}0_6$<br><br>Glucose is stored as starch because starch is insoluble.<br><br>Independently plot data for limiting factors, choosing the method to display data, deciding appropriate scales, accurate plotting and appropriate lines of best fit.<br><br>***Pupils should also be able to use all Tier 3 vocabulary on the knowledge journey independently and in context.*** |

# Earths Structure: Journey of Knowledge

**Context and Introduction to Unit**
Pupils will learn about the Earths structure, the rocks that make up our planet and how these are formed. They will also explore the idea behind some of the uses of these rocks and the properties of these. Pupils will also have the chance to look at ceramics and composite materials, explore their properties and suggest uses for these.

***Prior knowledge (KS2/KS3)***
Pupils have compared and grouped together different kinds of rocks on the basis of their appearance and simple physical properties, they should also be able to recognise soils are made from rocks. Pupils will also have some knowledge of materials and properties having explored these also in KS2 and in the Year 7 topic, Atoms, Elements, Compounds and Mixtures.

**The bigger picture:**
*Personal development opportunities – examine the Earth and explore the possibilities that some of the materials afford us in society and how they impact our lives.*
*Career links – geologist, builder/tradesman*

**CORE KNOWLEDGE**

The Earth is split into 3 main layers - crust, mantle, core. The core is split into two sections itself, an inner core which is solid iron/nickel and an outer core which is liquid. The crust is the section of Earth that we live on and is the thinnest section. The mantle is mostly solid rock but can flow due to activity in the core, this is just below the crust. Finally, the core is found at the centre of the Earth.

The Earth is made up of 3 different types of rock:

- **Sedimentary** – these are formed in layers, usually porous and are generally soft rocks (they can be scratched easily) Examples of these include sandstone and limestone. Different sediment builds up on top of each other over time and due to compaction and cementation, the sediment sticks together
- **Igneous** – these are hard, durable rocks and are difficult to break. Igneous rocks are often used in pavements and examples include granite, basalt and obsidian. They are formed from magma cooling down and depending upon if it cools quickly (outside volcano) or slowly (inside volcano), the crystals can be large (granite) or small (basalt).
- **Metamorphic** – these are formed by changing other, existing types of rock through heat and high pressure over years. Examples of these include marble and slate, they are not porous and can be useful in kitchen worktops or roofing tiles.

The rock cycle is a process that shows us how each type of rock is formed and the links between each ones formation. This can be represented in a diagram and details how sedimentary rocks can be changed into metamorphic rocks and consequently, igneous rocks.
Weathering and erosion are processes by were rocks can be broken down into smaller pieces depending upon the type of weathering. There are 3 types: Biological (plants and animals breaking them up), Chemical (acid in rain water reacting with rock and breaking it up) and Physical (temperature changes in water that has settled in cracks can break them apart when frozen/thawed).

Composites are materials made up from more than one material, specifically chosen to improve the properties of the object.
Ceramics are useful compounds - hard, strong, brittle, electrical insulators and high melting points (bricks). These are more suitable for jobs like buildings/crockery etc because of these properties.

Polymers are very long chain molecules made from small repeating units called monomers. Polymers occur naturally, but can also be manufactured. Synthetic polymers are better known as plastics and are made in chemical reactions, they have a range of uses.

**ABOVE AND BEYOND**

Link weathering to environmental issues (acid rain, burning fossil fuels)
Formation of composite materials
Polymers – what are they and how are they similar to ceramics and composites.

**VOCABULARY**
Earth
Crust
Mantle
Core
Magma
Lava
Sedimentary
Metamorphic (etymology)
Igneous
Rock
Cycle (etymology)
Ceramic
Composite (etymology)

**Display –**
Stephanie Kwolek – invented Kevlar, an example of a composite material.

**Reading is Power**
"Journey to the centre of the Earth" pp. 76-77

**Numeracy focus**
Describing relative sizes of earth composition.

**WHERE NEXT?**

KS3
The Earths atmosphere AQA C13

KS4
Using our resources AQA C15 KS4
Chemical Changes AQA C5 KS4

# Year 8 Earths Structure: Assessment Plan

**MAPs** – Pupils will complete the following WOW zone tasks (guidance and mark schemes can be found within the lesson resources):

**Using data (supplied in lesson resources), identify which materials could be ceramics and suggest suitable uses for these.**

**Summative assessment** – The knowledge from this unit will be tested as part of a 1 hour P2S exam which will combine the Biology, Chemistry and Physics curriculum covered so far.

| **Assessment Milestones** | | | |
|---|---|---|---|
| Emerging | Developing | Securing | Mastering |
| ***Pupils have basic knowledge of the Earths materials/structure, for example:***<br><br>Identify the 3 layers of the Earth<br><br>State the three different types of rock that can be found in the ground.<br><br>Recognise that weathering is where rocks are broken down<br><br>Ceramics are things such as bricks and crockery | ***Pupils must be have an understanding of and be able to recall the basics of rocks and weathering:***<br><br>Make links between the layers of the Earth and their relative sizes.<br><br>Give an example of an igneous, sedimentary and metamorphic rock.<br><br>Identify some of the stages of the rock cycle.<br><br>Weathering can be physical, chemical or biological. | ***Pupils must be able to recall the following content:***<br><br>State the 'composition' of each layer of the Earths structure.<br><br>Describe the structure of sedimentary, metamorphic and igneous rocks, make reference to the properties and uses of the three types of rock.<br><br>Simply state the stages in the rock cycle and label a diagram to show how each type of rock is formed.<br><br>Describe the process of weathering in each situation.<br><br>Identify materials as being ceramics and suggest why these are suitable for their jobs based on their properties.<br><br>Describe how the three types of rocks are formed linking processes from the rock cycle.<br><br>Link environmental issues such as acid rain to chemical weathering and state some effects of these.<br><br>Describe how composite materials are formed, referencing materials being combined and linking advantages of these kinds of materials. | ***Pupils should be able to recall all the content in the knowledge journey and demonstrate application through the following:***<br><br>Use data on changes in environmental conditions (increased use of fossil fuels/more extreme weather) and link these to how forms of weathering would be impacted.<br><br>Make links to other materials in the environment that may be composites and justify their decisions based on their prior knowledge.<br><br>***Pupils should also be able to use all Tier 3 vocabulary on the knowledge journey independently and in context.*** |

# Climate and Earths resources: Journey of Knowledge

**Context and Introduction to Unit**
In this unit pupils will learn about the Earth's atmosphere as well as the challenges we face in climate change, an increasing population and the increased demands for the Earth's resources. Pupils will analyse data and evaluate evidence for climate change. Pupils will also work to think of creative solutions to the problems outlined above.
***Prior knowledge***
KS2 NC - Living things – Pupils recognise how environments change and how humans can impact the environment.

**The bigger picture:**
*Global climate change is happening and the planet needs a new generation of scientists to help save it by looking for alternatives to fossil fuels and plastics.*

*Career link – climate change scientist.*

**CORE KNOWLEDGE**
The Earth's atmosphere is about 4/5 nitrogen, 1/5 oxygen and trace amounts of other gases such as argon and carbon dioxide. The early atmosphere was mainly carbon dioxide with no oxygen.

Humans use a range of resources from the Earth including oil, coal, natural gas, metals, stone, sand, soil and water etc. These can be used as fuels or for building and construction. Some of these are a finite resource and supplies are limited due to increased demand due to increased population – metals, fossil fuels. Increase in population has meant an increase in the combustion of fossil fuels and an increase in agriculture. This has resulted in more greenhouse gases being put into the atmosphere. These gases trap the Sun's energy which results in a gradual increase in global temperatures, resulting in global warming.
Carbon dioxide is put into the atmosphere from respiration, combustion and decomposition of dead animals and plants. Carbon dioxide is only removed from the atmosphere by photosynthesis. This is part of the carbon cycle which depicts the ways carbon can be added and removed from our atmosphere. Deforestation could result in an increase of carbon dioxide due to less photosynthesis.

Climate change is causing more extreme and unpredictable weather. Rising temperatures also cause a rise in sea levels and melting of ice caps which can cause habitats of many species to be destroyed (possibly leading to extinction) and the flooding of low lying areas. This can have massive environmental and economic consequences.

Reduction in fossil fuel use by using renewable energy resources is one way of combating the amount of carbon dioxide in the atmosphere. In addition to this more energy efficient and energy saving measures such as energy efficient light bulbs, walking or cycling as well as turning off electrical appliances when not in use. However, certain energy resources are more suitable at present due to the technology available and cost linked to development of new technologies.

The more reactive metal, the more difficult it is to extract. Carbon can be used to displace metals less reactive than itself from its ores. This is referred to as reduction, as often the compound has the oxygen removed from it, using carbon. More reactive metals need to be extracted by electrolysis. Metals can be extracted from their ores to mix with other metals to make alloys, which have different uses than pure metals. Very unreactive metals, such as gold are not bonded to other elements therefore are found in their natural state. Factors including the impact on a local area, sustainability, cost and availability need to be considered when deciding on metal extraction methods.
Recycling metals could prolong their use. Plastics are also a finite resource and as such should be reused or recycled. Plastics should not be sent to landfill as we are running out of the raw materials to make plastics and they are non-biodegradable. Recycling reduces energy usage including up to 60% in the production of paper and 60-70% in in recycling tin and steel cans.

**ABOVE AND BEYOND**
Formulae:
$O_2$
$CO_2$
$N_2$
$CH_4$

**VOCABULARY**
Atmosphere
Composition
Fossil fuel
Combustion
Pollution/pollutant
Greenhouse gas
Greenhouse effect
Global warming
Recycle
Reuse
Metal ore
Climate change
Carbon cycle
Nonbiodegradable
Environmental
Social
Economic
Finite

**Diversity**
Human impact on the climate – analyse impacts and imagery.

**Reading is Power**
How much does it cost when cows burp? (found in climate folder)

**Numeracy Focus**
Analysing graphs and calculating increases in carbon dioxide concentration over time.

**WHERE NEXT?**

KS4 – Physics Paper 1 – Energy Resources.

KS4 – Chemistry Paper 2 – Earth's Atmosphere and Using Resources.

# Year 9 Climate & Earths resources : Assessment Plan

**MAPs** – Pupils will complete the following WOW zone tasks (guidance and mark schemes can be found within the lesson resources):

**Summative assessment** – The knowledge from this unit will be tested as part of a 1 hour P2S exam which will combine the Biology, Chemistry and Physics curriculum covered so far.

| Assessment Milestones | | | | |
|---|---|---|---|---|
| Emerging | Developing | Securing | Mastering | Excelling |
| ***Pupils have basic knowledge of the …., for example:*** | ***Pupils must be have an understanding of and be able to recall the basics of …:*** | ***Pupils must be able to recall the following content:***<br><br>. | ***Pupils should be able to recall all the content in the knowledge journey and demonstrate application through the following:*** | ***Pupils should be able to recall all the content in the knowledge journey and be able to independently apply knowledge to the following:***<br><br>***Pupils should also be able to use all Tier 3 vocabulary on the knowledge journey independently and in context.*** |

# Speed and acceleration: Journey of Knowledge

**Context and Introduction to Unit**
In this unit pupils will learn about balanced and unbalanced forces, calculating speed and representing speed on a distance time graphs. They will explore the relative speed of objects and describe the motion of objects relative to one another.
**Prior knowledge (KS2/KS3)**
Pupils knowledge of this topic is limited at KS2. Pupils learn about forces, how they interact and explore some situations involving balanced and unbalanced forces.

**The bigger picture:**

***Career links*** –
Transport engineer, performance engineer, personal trainer, traffic enforcement officer

**CORE KNOWLEDGE**
Forces can be both balanced and unbalanced. If the force on an object is greater in one direction, the object will move in that direction as the forces are unbalanced. If the forces on an object are equal the object will either remain stationary or continue moving at a constant speed (more on this in KS4). Forces are measured in Newtons (N) and you can add forces together or subtract them to find out the overall resultant force on an object. E.g. if the forwards force moving a car is 100 N and the resistive force pushing the car backwards is 30 N, the resultant force is 70 N forwards.
Speed is a measure of how fast something travels in a particular time. In science, speed is measured in meters per second (m/s), but can also be seen written in km/h or mph.
Speed is calculated by dividing the distance travelled by the time take to travel that distance.

$$\textbf{Speed}\ (\mathbf{m/s}) = \frac{\boldsymbol{distance}\ (\boldsymbol{m})}{\boldsymbol{time}\ (\boldsymbol{s}).}$$

The speed of an object is always relative to the observer. If you have travelled in a car on the motorway, you may have noticed that other cars passing by appear to move slowly past you, even though you know the actual speeds of the two cars are very high. This is because of their relative motion to each other. The speed an object appears to be moving is known as its relative motion.
We can represent the speed of an object by plotting a distance/time graph. These graphs inform us of when an object is moving or remains stationary. Depending upon the gradient of the lines on the graph, it tells us if an object is moving quickly or slowly. The steeper the line, the more quickly something is moving. A horizontal line shows that an object is stationary. Acceleration is a measure of how quickly speed is changing.
The stopping distance of an object (such as a car) depends upon the thinking distance of the operator plus the braking distance of the object. Factors such as consumption of alcohol or drugs affect thinking distance whilst the road and tyre conditions affect the braking distance.

**ABOVE AND BEYOND**

Calculate speeds at given points on a graph
Interpret a range of distance / time graphs with increasing difficulty

**VOCABULARY**

Balanced
Unbalanced
Resultant (etymology)
Newton
Speed
Distance
Time
Calculate
Motion (etymology)
Acceleration

**Diversity**
Understanding gender impact when talking about speed and acceleration related to running and athletics.

**Reading is power**
Newton's Laws of Motion (60 second science P58 and 59)

**Numeracy**
Calculations using the formula speed=distance/time
Drawing & interpreting distance/time graphs

**WHERE NEXT?**

KS4 – Forces

# Moments and Work: Journey of knowledge

In this unit pupils will learn about the relationship between transferring energy (work done), force applied and distance moved, and will start to use an equation to quantify this. Pupils will learn about simple machines, such as levers, and how they make ‘doing work’ easier.
***Prior knowledge KS2 NC Year 5 -*** Recognise that some mechanisms including levers, pulleys and gears allow a smaller force to have a greater effect.

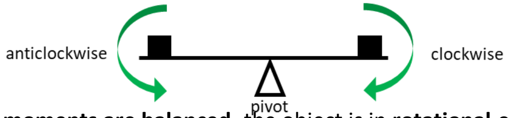
**The Bigger Picture:**
This topic connects to how energy is transferred and conserved in homes, from lifting loads to improving insulation and reducing energy waste.
***Career links:*** *Mechanical Engineer, Structural Engineer*

## CORE KNOWLEDGE

Work is done when energy is transferred from one store to another. Work is also done when a force causes an object to move. The bigger the force or the greater the distance, the more work is done.
**Work done (W**) is a measure of energy transfer when a force (F) moves an object through a distance Machines make work easier by reducing the force needed. Levers and pulleys do this by increasing the distance moved and reducing the required force — this is called **mechanical advantage.**
Practical Opportunity: Comparing work done with and without simple machines
Lifting a load directly requires more force. Using a pulley or ramp spreads out the effort over a longer distance, reducing the force needed. This shows how machines make work easier by reducing force and increasing distance.
**Work done (W)** is a measure of energy transfer when a force (F) moves an object through a distance (s). To calculate the work done on an object when a force moves it, use the equation:

**work done = force × distance** $(W = F \times s)$

Work done is measured in **joules (J)**. Force is measured in **newtons (N)**. Distance moved along the line of action of the force is measured in **metres (m)**. When work is done, **energy is transferred** from one energy store to another, and so: **energy transferred = work done.** One joule of work is done when a force of 1 N causes a movement of 1 m. This means that work done can also be measured in newton-metres (Nm): **1 J = 1 Nm**
A **moment** is the turning effect of a force. Moments act about a chosen point (the pivot) in a **clockwise or anticlockwise** direction. The **pivot** is the point around which the object can rotate or turn – also known as a **fulcrum**. On a seesaw the pivot is the point in the middle.




When the **clockwise and anticlockwise moments are balanced**, the object is in **rotational equilibrium** and does not turn. It makes calculations easier to measure the **perpendicular distance** between the line of action of the force and the pivot. For example, if you apply a force to a spanner, it rotates. The pivot is at the bolt.

**Practical Opportunity: Investigating how force and distance affect moments**
Increasing the force or moving it further from the pivot increases the moment. A larger moment on one side will tip the seesaw. Balance is restored (rotational equilibrium) when the moments on both sides are equal.
To calculate the size of a moment, use the following equation:

**Moment of a force (Nm) = force (N) × perpendicular distance from the pivot (m)** $M = F \times d$

Moment (M) is measured in newton-metres (Nm). Force (F) is measured in newtons (N). Perpendicular distance from the pivot (d) is measured in metres (m).
Moments help us understand everyday examples like opening doors, using spanners, or balancing objects such as seesaws or wheelbarrows.

## ABOVE AND BEYOND

Re-arrange the formula: work done (J) = force (N) x distance moved (m) to compare energy transferred for objects moving horizontally. Compare and contrast the advantages of different levers in terms of the forces need and distance moved

## Numeracy

Use FIFA model with all equations

## VOCABULARY

Energy
Joule
Kilo -etymology
Machine
Lever
Pulley
Moment
Pivot
Load

## Reading is power

Conservation of energy (60 second science P132 and 133)

## WHERE NEXT?

AQA GCSE Physics Paper 2: Forces (levers and moments) and Paper 1: Energy (work done and energy transfers).

# Light: Journey of Knowledge

In this unit pupils will learn about the similarities and differences of light waves and waves which travel through matter. They will learn about the different types of reflection and explain, through ray diagrams, how light is reflected and refracted. Pupils will learn about how light behaves in the human eye, including the action of the lens and the retina. Pupils will make comparisons between the eye and a camera. Pupils will learn that white light is a mixture of different wavelengths of light, each of which gives a different colour.

***Prior knowledge***

***KS2 NC*** Pupils should be taught to: recognise that light appears to travel in straight lines; use the idea that light travels in straight lines to explain that objects are seen because they give out or reflect light into the eye; explain that we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes; use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them. (Year 6)

**The Bigger Picture:**

Understanding of how difficult is can be for people who are visually impaired to navigate around schools and how we can improve facilities.

***Career links.*** *Optician, ophthalmologist, lighting engineer, photographer, radiographer*

## CORE KNOWLEDGE

Transparent materials allow light to travel through them, translucent materials scatter some of the light meaning that the image cannot be seen clearly. Opaque materials do not allow light to travel through. They produce shadows when light hits them. Luminous objects emit light. Non-luminous objects reflect or absorb light.

Light waves are transverse waves and travel in straight lines from a light source and do not transfer matter but are an energy transfer (radiation).

Light waves travel much faster ($3.0 \times 10^9$ m/s in a vacuum) than waves which travel through matter, including sound waves. All light waves travel at the speed of light and can be reflected, refracted, transmitted and absorbed by different materials.

We see due to light passing through a convex lens, which changes shape, to refract the light to focus the image through the pupil onto the photo-sensitive retina. This compares with a camera which focuses the light onto a chemical or electrical photosensitive screen (film or CCD).

We use ray diagrams to show the formation of an image in a mirror and in a pinhole camera and also the refraction (changing direction) of light.

Transparent materials transmit light. Translucent materials absorb some light but transmit the rest. Opaque materials absorb all light incident on them. Smooth surfaces give a specular reflection, this is where the reflection is uniform (all rays reflect parallel). Materials without a completely smooth surface will cause diffuse reflection where light is scattered in different directions.

White light is a mixture of different wavelengths of light, each of which gives a different colour and a prism can be used to separate the wavelengths to show the separate colours. We see colour due to the object absorbing all wavelengths except those corresponding to the colour of the object, which are reflected into our eyes. The colours of light in increasing frequency are Red, Orange, Yellow, Green, Blue, Indigo, Violet which can be remembered using the mnemonic Richard Of York Gave Battle In Vain.

## ABOVE AND BEYOND

In a rainbow the red light has the longest wavelength and is refracted the most – the violet, the shortest wavelength and is refracted the least.

Curved mirrors can be used to concentrate the incident radiation and can be used as solar cookers.

## VOCABULARY

Transverse (etymology Latin transvetere – turn across)
Vacuum (etymology Latin vacuus - empty)
Transmit (etymology Latin amplus - large)
Absorb (etymology Latin ab – from sorbere – suck in)
Translucent (etymology Latin trans – through
lucere – to shine)
Transparent (etymology Latin trans – through
parere – appear)
Diffuse (etymology Latin dis – away fundare - pour)
Specular

## Reading is Power

Human Vision – Pg 130 – 60's science magazine

## Numeracy

Interpretation of angles linked to reflection and understanding of values and units of light speed

## WHERE NEXT?

KS4 – Waves

# Sound: Journey of Knowledge

In this unit pupils will learn that there are different types of waves: water, sound and light. Pupils will learn about some of the properties of waves (reflection, absorption, transmission). They will make links between the size and height of a vibration and the pitch and loudness of a sound. Pupils will recall the speed of sound and the range of human hearing, and that of some animals. Pupils will learn about uses of pressure waves including microphones and ultrasound.

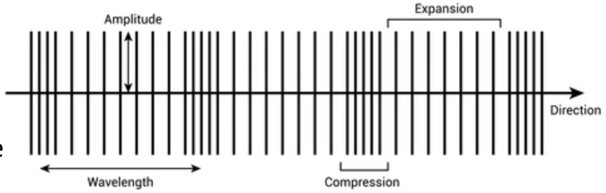
***Prior knowledge KS2 NC*** Pupils should be taught to: identify how sounds are made, associating some of them with something vibrating; recognise that vibrations from sounds travel through a medium to the ear; find patterns between the pitch of a sound and features of the object that produced it; find patterns between the volume of a sound and the strength of the vibrations that produced it; recognise that sounds get fainter as the distance from the sound source increases.

**The Bigger Picture:**
*Links to possible damage to hearing from exposure to loud sounds. Use of specific frequencies for improving mental health.*
***Career links.*** *Physiotherapist, sound engineer, musician*

**CORE KNOWLEDGE**

**SOUND WAVES**

All waves transfer energy from one place to another. Sound is one example of a wave. Sound travels from a source e.g. a loudspeaker and transfers energy to the objects which absorb it for example, your ears. Sound waves, pressure waves and primary waves ( a type of seismic wave produced by earthquakes), are **longitudinal waves**. In a **longitudinal wave**, the vibration is parallel to the direction of energy transfer.




Sound waves are produced by making an object vibrate (transferring energy). The more energy that is transferred, the greater the vibration (**amplitude**) and so the louder the sound. Sound waves need a medium (substance) to travel and travel at different speeds through air (330 m/s), liquid and solid. Sound waves cannot travel through a **vacuum**. When sound is reflected this is known as an echo.
Sound waves can be displayed using an **oscilloscope** into a transverse shaped pattern that we can see. An oscilloscope will represent compressions as peaks.
The **frequency** of a sound wave is the number of waves per second, this is called pitch and is measured in **hertz** (Hz). Higher frequency = higher pitched sounds. Lower frequency = lower pitched sounds
Humans have an **auditory range** of 20 Hz – 20 000 Hz. Sounds with frequencies above this range are called **ultrasound**. Uses of sound include medical scans – ultrasound scans and navigation/fishing – sonar and cleaning – sonic cleaners. Sound waves can also be used to transfer information by converting electrical signals in a microphone.
Animals such as bats and dolphins have a higher auditory range than humans and also use ultrasound to communicate and navigate.

**OBSERVED WAVES**

Water waves are ripples that travel through water. Water waves are transverse waves and can be reflected from surfaces. When two waves meet, they either add together or cancel each other out. This change of two waves into one wave is called **superposition**.

**ABOVE AND BEYOND**

The tiny bones in our ears are there to amplify the sound wave from the outer ear drum to inner ear drum.

**Sonar** (sound navigation ranging) is a technique that uses sound propagation (usually underwater, as in submarine navigation) to navigate, communicate with or detect objects on or under the surface of the water, such as other vessels.

**VOCABULARY**

Oscillation (etymology Latin *oscillare* – to swing)
Vibration
Frequency (etymology Latin *frequens* – crowded)
Undulation (etymology Latin *unda* – a wave)
Hertz (etymology Heinrich Hertz)
Auditory (etymology Latin *audire* – to hear)
Diaphragm (etymology Greek dia – through phragma – a fence)
Transverse (etymology Latin *transvetere* – turn across)
Longitudinal
Medium/media
Oscilloscope (etymology Latin *oscillare* – to swing and scope – to look at)
Amplitude (etymology Latin *amplus* - large)

**Personal Development**

Dangers associated with loud music/sounds and maintenance of key organs for hearing.

**Reading is power**

The Science of Music – how it works magazine

**Numeracy**

Interpreting graphs and calculating speed of sound in different mediums

**WHERE NEXT?**

KS4 – Coordination & Control, Waves

# Sound: Journey of Knowledge

In this unit pupils will learn that there are different types of waves: water, sound and light. Pupils will learn about some of the properties of waves (reflection, absorption, transmission). They will make links between the size and height of a vibration and the pitch and loudness of a sound. Pupils will recall the speed of sound and the range of human hearing, and that of some animals. Pupils will learn about uses of pressure waves including microphones and ultrasound.

***Prior knowledge***

***KS2 NC*** Pupils should be taught to: identify how sounds are made, associating some of them with something vibrating; recognise that vibrations from sounds travel through a medium to the ear; find patterns between the pitch of a sound and features of the object that produced it; find patterns between the volume of a sound and the strength of the vibrations that produced it; recognise that sounds get fainter as the distance from the sound source increases. (year 4)

**The Bigger Picture:**

*Links to possible damage to hearing from exposure to loud sounds. Use of specific frequencies for improving mental health.*

***Career links.*** *Physiotherapist, sound engineer, musician*

## CORE KNOWLEDGE

Waves are also called oscillations.
Water waves are caused by disturbing the surface of water (putting in energy), these waves are transverse waves. These waves can be reflected, and add or cancel – superposition.

Sound waves are produced by making an object vibrate (putting in energy) – this vibration causes a pressure wave which causes a diaphragm to vibrate (e.g. ear drum, loudspeaker cone). The more energy that is put in the bigger the vibration (This is called amplitude) and the louder the sound.

Sound waves need a medium (substance) through which to travel and travel at different speeds through air (343 m/s), water and solids. Sound waves cannot travel through a vacuum.
Sound waves can be reflected and these are called echoes.
Sound waves are longitudinal waves and can be converted by an oscilloscope into a transverse pattern that we can see.
The frequency of a sound wave is the number of waves per second, this is called pitch and is measured in hertz (Hz). Higher frequency = higher pitched sounds - Lower frequency = lower pitched sounds

Humans have an auditory range of 20 Hz – 20 kHz. Sounds with frequencies above this range are called ultrasound. Bats and dolphins have a higher auditory range than humans and use ultrasound to communicate.
Pressure waves transfer energy and ultrasound pressure waves can be used for cleaning and physiotherapy
Sound waves can transfer information by converting electrical signals in a microphone.
WATER WAVES - Water waves are undulations or ripples that travel through water with a transverse motion. They can be reflected from surfaces. When waves meet, they add or cancel out, something called **superposition**.

## ABOVE AND BEYOND

The tiny bones in our ears are there to amplify the sound wave from the outer ear drum to inner ear drum.

**Sonar** (sound navigation ranging) is a technique that uses sound propagation (usually underwater, as in submarine navigation) to navigate, communicate with or detect objects on or under the surface of the water, such as other vessels.

## VOCABULARY

Oscillation (etymology Latin oscillare – to swing)
Vibration
Frequency (etymology Latin frequens – crowded)
Undulation (etymology Latin unda – a wave)
Hertz (etymology Heinrich Hertz)
Auditory (etymology Latin audire – to hear)
Diaphragm (etymology Greek dia – through
phragma – a fence)
Transverse (etymology Latin transvetere – turn across)
Longitudinal
Medium/media
Oscilloscope (etymology Latin oscillare – to swing and
scope – to look at)
Amplitude (etymology Latin amplus - large)

## Personal Development

Dangers associated with loud music/sounds and maintainance of key organs for hearing.

## Reading is power

The Science of Music – how it works magazine

## Numeracy

Interpreting graphs and calculating speed of sound in different mediums

## WHERE NEXT?

KS4 – Coordination & Control, Waves

# Inheritance and Variation: Journey of Knowledge

**Context and Introduction to Unit**
In this unit pupils will learn about inheritance and why most organisms are not identical due to variation. Both inherited, environmental or a combination of both can determine key characteristics of an organism.

***Prior knowledge***
***KS2 NC –*** *Pupils should recognise that living things produce offspring of the same kind, but normally offspring vary and are not identical to their parents.*

**The bigger picture:**
*DNA profiling can be used to determine the likelihood of inheriting a genetic disorder.*

*Career link – forensic scientist, genetic counsellor, clinical geneticist.*

**CORE KNOWLEDGE**
Genetic information is stored in the nucleus of cells. DNA contains all of the information needed to make an organism. DNA is described as having a double-helix structure, two polynucleotide strands intertwined around one another. DNA contains four complimentary bases; adenine (A), thymine (T), guanine (G) and cytosine (C). A pairs with T while G pairs with C. Chains of DNA are coiled into structures called chromosomes. Human body cells have 46 chromosomes (23 pairs). Gametes contain half the number of chromosomes of a normal body cell. During fertilisation, the egg cell and sperm cell's nuclei fuse together, this results in inheritance of half of the DNA from the mother and half of the DNA from the father, 23 chromosomes from the egg cell and 23 chromosomes from the sperm cell. Scientists worked out the structure of DNA in the 1950s. Rosalind Franklin made 'X-ray diffraction' images of DNA. James Watson and Francis Crick used information from one of her images to work out a model for the structure of DNA. Work by Maurice Wilkins, a colleague of Franklin, supported their model. Watson and Crick were able to work out how DNA was arranged. Gene banks are increasingly being used to preserve genetic material for use in the future. A cryobank is another type of gene bank. Embryos, sperm or eggs are stored at very low temperatures in liquid nitrogen (at –196 °C). They can be thawed out later for use in breeding programmes. Heredity is the process by which genetic information is transmitted from parents to offspring. The 23rd pair of chromosomes is responsible for sex, the egg cell carries an 'X' chromosome, sperm cells can carry an 'X' or 'Y' chromosome. A combination of 'XX' results in a biological female whilst a combination of 'XY' results in a biological male. An offspring's sex is always a 50% chance of biological female and 50% chance of biological male. Small sections of DNA are called genes. Genes determine our physical characteristics such as eye colour and hair colour. A mutation is caused by a change in the DNA. Alleles are different forms of the same gene (e.g. everybody has a gene that codes for eye colour; however, one person's gene might code for blue eyes whilst another person's codes for green eyes). Each gene contains two alleles, this two-letter code is known as a genotype and the physical characteristic that it represents is known as a phenotype. Alleles can be dominant or recessive. A dominant allele only requires one copy of the allele for the trait to be expressed; it masks the effect of a recessive allele if both are present. Brown eyes are typically dominant over blue eyes. A recessive allele requires two copies of the allele for the trait to be expressed. Attached earlobes are typically a recessive allele along with many genetic disorders. If a genotype contains two different alleles, it is heterozygous. If a genotype contains two of the same alleles, it is homozygous. Scientists use Punnett square diagrams to show what happens to the alleles in a genetic cross and make predictions about the phenotype that an offspring will inherit. To complete a Punnett square write one parent's alleles across the top and the other parent's down the side, fill in the boxes by combining the alleles from the top and side for each square, complete a conclusion that details the percentage of each outcome; each box is worth 25%. Differences in phenotypes are known as variation. Inherited variation is variation in phenotypes that people inherit from their parents (e.g. lobed or lobeless ears, blood group, eye colour). Environmental variation is variation in phenotypes caused by your surroundings. Factors such as diet and lifestyle can cause environmental variation. Some examples of variation can be a result of both inherited and environmental (e.g. skin colour and hair colour). Discontinuous variation are characteristics that can only result in certain categories e.g. gender, blood group and eye colour. Continuous variation are characteristics that can take any value within a range e.g. height, body mass and arm span. Discontinuous data should be plotted using a bar chart, whilst continuous data should be plotted using a line graph. Genetic modification involves removing, altering or adding genes to an organism. Scientists can use genetic modification to produce an organism with desired characteristics. Genetic modification can be used to increase food production however the long-term health impacts of eating GM foods are unknown, and the initial cost is expensive. Genetic modification can also impact food chains and lead to extinction. Selective breeding involves using animal and plant breeding to selectively develop a particular characteristic over many generations. GM is much more precise and quicker than selective breeding, GM also allows characteristics to be altered more dramatically and does not require the two organisms to be from the same species.

**ABOVE AND BEYOND**
Genotype determines the phenotype.
Extra chromosome leads to Downs Syndrome.
Gametes are sex cells – egg and sperm.
Genetic modification.
Punnett squares for genetic diseases.

**VOCABULARY**
Inherited variation
Environmental variation
Interspecific
Intraspecific
Continuous
Discontinuous
Chromosomes
Genes
DNA
Genotype
Phenotype
Heterozygous (etymology)
Homozygous (etymology)
Mutation
Alleles
Punnett square

**Diversity**
Nettie Stevens - biological sex determination and chromosomes.
Watson, Crick, Wilkins & Franklin

**Personal Development**
Exploring family trees and deciphering these.

**Reading is Power**
'Incredible Magazine' – The Genetic Revolution

**Numeracy Focus**
Number of chromosomes in a human body cell and a gamete

**WHERE NEXT?**
KS3 – Evolution & Extinction
KS4 – Inheritance and variation unit.

# Year 8 Inheritance and Variation : Assessment Plan

**MAPs** – Pupils will complete the following two WOW zone tasks (guidance and mark schemes can be found within the lesson resources):
Describe the structure of DNA.

**Summative assessment** – The knowledge from this unit will be tested as part of a 1 hour P2S exam which will combine the Biology, Chemistry and Physics curriculum covered so far.

| Assessment Milestones | | | |
|---|---|---|---|
| Emerging | Developing | Securing | Mastering |
| ***Pupils have basic knowledge of how characteristics can be passed on from parents, for example:***<br><br>Pupils would be able to state that some characteristics are passed down from parents to offspring.<br><br>Pupils would recognize that not all of our traits are passed down from parents.<br><br>Pupils would recognize that we are not identical to our parents but we do have similarities.<br><br>Pupils would identify egg and sperm from diagrams. | ***Pupils must be have an understanding of and be able to recall the basics of variation:***<br><br>Defining inherited and environmental variations and classifying examples.<br><br>Identifying continuous and discontinuous variation from graphs. | ***Pupils must be able to recall the following content:***<br><br>**Inherited characteristics** come from your parents through the genetic material stored in the nucleus of cells. DNA contains all the information needed to make an organism. **DNA** is arranged into **chromosomes**. Humans have 46 chromosomes, 23 from the egg cell and 23 from the sperm cell. A **mutation** is caused by a change in the DNA. **Alleles** are different forms of the same gene.<br><br>Scientists us Punnett squares to show what happens to the alleles in a genetic cross. Differences in characteristics are known as **variation. Inherited variation** - characteristics people inherit from their parents i.e. lobed or lobe less ears, blood group, eye colour, nose shape and dimples. & **Environmental variation** – caused by your surroundings. Factors such as diet and lifestyle can cause environmental variation.<br><br>**Discontinuous variation** are characteristics that can only result in certain categories e.g. gender, blood group and eye colour.<br>**Continuous variation** are characteristics that can take any value within a range e.g. height, body mass and arm span.<br><br>Completing Punnett squares with minimal scaffolding. | ***Pupils should be able to recall all the content in the knowledge journey and demonstrate application through the following:***<br><br>Critically evaluating genetic modification.<br><br>Recognise the difference between DNA and genes.<br><br>Independently drawing Punnett squares and forming conclusions.<br><br>Using the terms genotype, phenotype and allele correctly in context. |

# Evolution & Extinction: Journey of Knowledge

**Context and Introduction to Unit**
In this unit pupils will learn about evolution and how species have evolved from three billion years ago through the process of Natural Selection. Pupils will learn about the importance of biodiversity is ensuring the human population survives.

***Prior knowledge***
***KS2 NC –*** *Pupils should recognise that living things have changed over time and that's fossils provide information about living things that inhabited the Earth millions of years ago. Pupils should identify animals and plants adapted to suit their environment in different ways and that adaptation may lead to evolution.*

**The bigger picture:**
*Fossils provide evidence to support evolution through Natural Selection. Charles Darwin was a Naturalist who produced the Origin of species.*

*Career link – Paleotologist*

## CORE KNOWLEDGE

While sailing the Galápagos Islands, Charles Darwin observed that similar species of finches had different beak shapes depending on the island they inhabited, each adapted to specific food sources. These observations led him to propose the theory of natural selection to explain evolution, suggesting that species evolve over time as advantageous traits become more common through survival and reproduction. The variation between species (interspecific variation) and between individuals of the same species (intraspecific variation) means some organisms compete more successfully, which can drive natural selection. Natural selection is the process by which species change over time in response to environmental changes and competition for resources. Firstly, organisms in a species show variation caused by differences in their genes (mutation). The organism with the characteristic best suited to the environment will survive and reproduce (survival of the fittest). Genes from successful organisms are passed to the offspring in the next generation. The process is repeated many times. Over time this can lead to the development of a new species. Fossils are the preserved remains of a dead organism from millions of years ago and provide evidence of evolution. Fossils can be formed from hard body parts, such as bones and shells, which do not decay easily or are replaced by minerals as they decay. Parts of organisms that have not decayed because one or more of the conditions needed for decay are absent can be preserved in amber, peat bogs, tar pits or in ice. Traces of organisms, such as footprints, burrows and rootlet traces can also be preserved - these become covered by layers of sediment, which eventually become rock. Extinction occurs when there are no more individuals of a species alive. Factors that may lead to extinction include new diseases, new predators, increased competition for resources or a natural disaster such as an asteroid collision or volcanic eruption. Changes in the environment may leave individuals within a species, and some entire species, less well adapted to compete successfully and reproduce, which in turn may lead to extinction. Biodiversity is the variety of living organisms. It is measured as the differences between individuals of the same species, or the number of different species in an ecosystem. The biggest threats to biodiversity currently are habitat loss, mainly due to deforestation, urbanisation, and agriculture and climate change, which disrupts ecosystems and species' ability to adapt. Biodiversity can be maintained through breeding programmes, protection and regeneration of habitats, and gene banks.

**ABOVE AND BEYOND**
Gene banks store genetic samples from different species. In the future they could be used for research, or to produce new individuals. Examples include seed banks, cryobanks, tissue banks and pollen banks. The importance of maintaining biodiversity and the use of gene banks to preserve hereditary material.

**VOCABULARY**
Heredity
Hereditary
Interspecific
Intraspecific
Variation
Mutation
Reproduction
Survival
Population
Natural selection
Fossil
Extinction
Biodiversity
Competition

**Personal Development**
Link to modern day humans and how we have evolved, why is evolution important?

**Reading is Power**
Fossils pg.26-27

**Diversity**
Watson, Crick, Wilkins and Franklin – link to previous topic Inheritance and Variation along with Nettie Stevens.

**Numeracy focus**
Discuss magnitude of time relating to 3 billion years ago.

**WHERE NEXT?**
KS4 – Biology Paper 2 – Inheritance and variation, Evolution and Ecology.

# Year 8 Evolution: Assessment Plan

**MAPs** – Pupils will complete the following two WOW zone tasks (guidance and mark schemes can be found within the lesson resources):
1.Evolution quiz.

**Summative assessment** – The knowledge from this unit will be tested as part of a 1 hour P2S exam which will combine the Biology, Chemistry and Physics curriculum covered so far.

| Assessment Steps | | | |
|---|---|---|---|
| Emerging | Developing | Securing | Mastering |
| ***Pupils have basic knowledge of evolution:***<br><br>Species are extinct if there are no living examples.<br><br>**Fossils** provide examples of extinct organisms.<br><br>Organisms have evolved over time. | ***Pupils must be have an understanding of and be able to recall the basics of evolution:***<br><br>**Extinction** is when there are no more individuals of a species alive.<br><br>Factors that may lead to extinction include new diseases, new predators, increased competition for resources or a catastrophic event such as an asteroid collision or massive volcanic eruption.<br><br>Evolution is how organisms have changed over time. | ***Pupils must be able to recall the following content:***<br><br>**Biodiversity** is the variety of living organisms. It is measured as the differences between individuals of the same species, or the number of different species in an ecosystem.<br><br>**Evolution** is the theory that living organisms evolved through Natural selection from three billion years ago.<br><br>Changes in the environment may leave individuals within a species, and some entire species, less adapted to compete successfully and reproduce, which in turn may lead to extinction.<br><br>**Natural selection** is the process by which species change over time in response to environmental changes and competition for resources. Stages of natural selection:<br>1 – Organisms in a species show variation caused by differences in their genes (mutation).<br>2 – The organism with the characteristic best suited to the environment survive and reproduce – survival of the fittest.<br>3 – Genes from successful organisms are passed to the offspring in the next generation.<br>4 - The process is repeated many times. Over time this can lead to the development of a new species.<br><br>A **mutation** is caused by a change in the DNA. | ***Pupils should be able to recall all the content in the knowledge journey and demonstrate application through the following:***<br><br>Gene banks store genetic samples from different species. In the future they could be used for research, or to produce new individuals. Examples include seed banks, cryobanks, tissue banks and pollen banks.<br><br>***Pupils should also be able to use all Tier 3 vocabulary on the knowledge journey independently and in context.*** |

# Pressure: Journey of Knowledge

In this unit pupils will learn about the atmospheric pressure, decreases with increase of height as weight of air above decreases with height. pressure in liquids, increasing with depth; upthrust effects, floating and sinking. pressure measured by ratio of force over area – acting normal to any surface.

***Prior knowledge***

***KS2 NC*** *Pupils should be taught to: find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching, compare and group materials together, according to whether they are solids, liquids or gases, Pupils should observe water as a solid, a liquid and a gas and should note the changes to water when it is heated or cooled,*

**The Bigger Picture:**

*Links to deep sea diving, submarines, sinking and floating, pressure in aerosols/bottles and atmospheric pressure*

***Career links.*** *Pressure vessel engineer, Gas Plant operators, Hydraulic engineering*

## CORE KNOWLEDGE

Pressure is the amount of force applied to an object over a certain area. Drawing pins have a large force applied over a small area and therefore have a large pressure. We use the following equation to calculate pressure:

**pressure = force ÷ area** $(P = \frac{F}{A})$

Pressure (P) measured in pascals, Pa. Force (F) measured in Newtons, N. Area (A) measured in metres squared, $m^2$.

Density is the amount of particles per unit area. In a fluid, matter with a higher density will sink and matter with a lower density will float/rise. Density can be calculated using the formula:

**Density = mass ÷ volume** $(\rho = \frac{m}{v})$

Density (ρ) measured in kilograms per metre cubed, $kg/m^3$. Mass (m) measured in kilograms, kg. Volume measured in metres cubed, $m^3$.

Upthrust is simply a force that pushes upwards in a fluid. When an object is put into a fluid, there are two forces acting on it - its weight (gravity) pulling it down and upthrust pushing it up. Upthrust is caused by fluid particles colliding with an objects surface and exerting a force over that surface. If the Upthrust is larger than the weight of the object, the object will float. If weight is greater than Upthrust an object will sink.

Gases and liquids have internal pressure caused by the particles colliding with each other. Internal pressure increases when there is more fluid above, so pressure increases with depth and decreases with height/altitude. Deeper down in water, pressure will be much greater than near to the surface.

Gas pressure is caused by force exerted by a gas on the walls of its container. Gas particles collide with the walls of their container. Increasing temperature increases gas pressure because the particles have more kinetic energy. This means the particles collide with the inside of the container more frequently so with more force.

Atmospheric (gas) pressure also decreases with altitude (height). This is because, as the altitude (height) increases: the number of air molecules decreases, the weight of the air decreases, there is less air above a surface. This is why aircraft that fly at high altitudes must be pressurised. If the air pressure is too low, humans cannot take in oxygen quickly enough to meet their bodies' needs.

An imbalance of pressure between the inside and outside of objects is the reason that balloons pop at high altitude (explode), submarines can collapse at lower depths (implode) and is how straws work.

## ABOVE AND BEYOND

Explain why hydraulic systems can be referred to as "Force multipliers". Carryout simple calculations and link them to ratios. Research the following questions and challenge the misconceptions.

(1 )What happens if you fire a gun inside an aeroplane and why?

(2) Find out the cruising altitude of a plane and the reasons for flying at this height – why not higher or lower?

(3) Explain how straws/rubber suckers work?

## VOCABULARY

Pressure
Pneumatics (Pneu – French for tyre)
Hydraulics
Atmosphere pressure
Up thrust
Volume
Area
Force
Explode
Implode

## Reading is power

Titan sub implosion: What we know about catastrophic event - BBC News

## Numeracy

Use FIFA model for equations:

- Pressure = force ÷ area
- Density = mass ÷ volume

## WHERE NEXT?

KS4 - Forces

# Space: Journey of Knowledge

In this unit pupils will learn that the solar system can be modelled as planets rotating on tilted axes while orbiting the Sun, moons orbiting planets and sunlight spreading out and being reflected. This explains day and year length, seasons and the visibility of objects from Earth. Our solar system is a tiny part of a galaxy, one of many billions in the Universe. Light takes minutes to reach Earth from the Sun, four years from our second nearest star and billions of years from other galaxies.

***Prior knowledge  KS2 NC Year 5***

Pupils should describe the movement of the Earth and other planets relative to the sun in the solar system. They should describe the movement of the moon relative to the Earth, describe the sun, Earth and moon as approximately spherical bodies and use the idea of the Earth's rotation to explain day and night and the apparent movement of the sun across the sky.

**The Bigger Picture:**

*Links to awareness of the human curiosity about where we came from and our place in Space. Opportunities to bring in the everyday innovations linked to space travel.*

***Career links.*** *Space Communicators; astrophysicist, engineers, ESA, NASA*

## CORE KNOWLEDGE

As Earth orbits the Sun, it rotates on its axis. Each rotation takes **24 hours**. This period of time is called a day. The half of the Earth facing the Sun is in daylight and the half facing away is night-time.  Earth takes approximately **365 days** to orbit once around the Sun. This length of time is called a year. A Lunar Month is **28 days** and is measured by the time taken for the moon to orbit the earth once. The moon does not rotate.

As Earth moves through its orbit around the Sun, different parts of the planet are tilted closer or further from the Sun, because of the tilt in Earth's axis. It is the distance from the Sun caused by the Earth's tilt that causes the seasons: spring, summer, autumn and winter. The UK is in the top half (**northern hemisphere**) of the Earth. When the northern hemisphere is tilted towards the Sun it is summer in the UK. When the northern hemisphere is tilted away from the Sun, it is winter. In Spring, the temperature and day length increase. In Autumn, they decrease. In regions near to the North Pole it is daylight 24 hours per day in summer.

The solar system is made up of the Sun (our nearest star) and the objects that orbit around it, including planets, asteroids and comets. Planets orbit the Sun in roughly circular paths, and moons orbit around planets. Asteroids and comets move in paths which are more oval in shape. The solar system is a part of the Milky Way galaxy, one of many billions in the Universe. The four planets that orbit closest to the Sun are: **Mercury, Venus, Earth** and **Mars.** These planets are known as **terrestrial planets** and are made mostly of rock and metal. The word terrestrial means 'earth-like', and these planets all have solid surfaces. Most terrestrial planets have atmospheres, but the conditions on their surfaces would not allow humans to survive there. There are four more planets much further from the Sun: **Jupiter, Saturn, Uranus** and **Neptune**. These planets are called the **gas giants** and they are very massive, and many times larger than the terrestrial planets. They are made of mostly hydrogen and helium gas, and they are all surrounded by rings and moons. Many planets have moons which are natural **satellites**. A moon is a lump of matter that orbits a planet e.g. The Moon orbits the Earth or Deimos and Phobos orbit Mars.  As well as planets and moons, the solar system also contains dwarf planets, which are too small to be considered planets. Even further out are the comets of the Oort Cloud. Every so often one of these comets is disturbed and heads towards the Sun. It then becomes visible in the night sky.

Our Sun is a **star**. It seems much bigger than other stars in the sky because it is much closer to Earth. Stars form groups called galaxies. A **galaxy** can contain many millions of stars, held together by the force of **gravity**.

Light takes 8 minutes to reach Earth from the Sun and it is four years from our nearest star and billions of years from other galaxies. Distances in space are measured in light years because the distances are so great. A Light-year is the distance light travels in one year.

## ABOVE AND BEYOND

Predict patterns in day length, the Sun's intensity or an object's shadow at different latitudes.
Make deductions from observation data of planets, stars and galaxies.
Compare explanations from different periods in history about the motion of objects and structure of the Universe.

## VOCABULARY

Amazing opportunities to look at the Greek/Latin/Arabic language links.

Planet
Terrestrial
Solar System
Universe
Galaxy
Light year
Stars
Orbit
Exoplanet
Astronomical

## Display

Mae Jemison – first African American woman in space aboard Endeavour in 1992.

## Diversity

Maggie Adderin-Pocock /Steven Hawking – representation in Space education/discovery

## Numeracy

Calculations using astronomical measures- why do we use the light year? How far is a light year?

## Reading is power

The Big Bang Theory (60 second science P 8 and 9)

## WHERE NEXT?

KS4 – Space (sep science only)

# KS2

## Earth and space

### Statutory requirements

Pupils should be taught to:

- describe the movement of the Earth, and other planets, relative to the Sun in the solar system
- describe the movement of the Moon relative to the Earth
- describe the Sun, Earth and Moon as approximately spherical bodies
- use the idea of the Earth's rotation to explain day and night and the apparent movement of the sun across the sky.

# National Curriculum KS3

## Space physics

- gravity force, weight = mass x gravitational field strength (g), on Earth g=10 N/kg, different on other planets and stars; gravity forces between Earth and Moon, and between Earth and Sun (qualitative only)
- our Sun as a star, other stars in our galaxy, other galaxies
- the seasons and the Earth's tilt, day length at different times of year, in different hemispheres
- the light year as a unit of astronomical distance.