Science Knowledge Organisers

Year 8 PC2 (February Exam)

Kettering Science Academy

What is a 'knowledge organiser'?

A knowledge organiser is simply a collection of the all of the information which your teacher would like you to be able to **recall** from a particular topic. That means that it **does not have everything on it** for a unit of study but it does have **the most essential things to learn.**

A knowledge organiser has lots of facts and definitions on it. Did you know that there is as many new words in studying science as there is in studying a language?

A knowledge organiser does **not develop skills**, so good revision will involve **lots of practice questions** as well as learning the content of these organisers.

What do I do with it?

For most of us, the first thing that we learned at school in reception was our phonics sounds. We learned them by repetition – seeing them again and again until the association between the sound and the image stuck. We need to do the same thing with these knowledge organisers!

Your teacher will probably be using knowledge organisers as you are taught. They will be referred to in class and you should have regular small tests on what you have learned.

Our knowledge organisers are deliberately broken into small lesson sized chunks for you to learn. Typically a teacher may ask you to 'learn box 2 and 3' for a homework.

By the time you come to an assessment – an exam or test – you should already be familiar with the knowledge organisers and already know some of it. They can then be relearned as a part of the revision and assessment preparation procedure.

Retrieval Practice

A key part of learning anything is the act of trying to remember. In class, your teacher will be helping you to do this by asking lots of questions and setting quizzes. **The more often you try to remember something the more likely you are to remember it**. With knowledge organisers you can achieve the same thing at home.

Why are we doing this?

Research has shown that **the more you know** the **more you can learn.** By being able to recall the facts, you are able to understand more complicated ideas because you **already know what the key words mean.** You will also already have a set of ideas in your mind that the new ideas can connect to (this is often referred to as a **schema**).

What are the best techniques for memorising using a knowledge organiser?

READ COVER WRITE

Make sure you are working somewhere quiet and that you have something to write with and some paper. Focus on learning on part of the knowledge organiser only, for example box one. Read through it carefully several times. When you think you've got it, cover over the knowledge organiser and write it all down. Then check what you've been able to remember. Read the bits that you could not recall, cover and write again.

TEST ME

Once you have learned the sections, its time to see if you can remember larger amounts.

Ask a friend or family member to test you on the content of the knowledge organiser page. They don't need to be experts – only to say whether you have remembered it correctly.

TEST EACH OTHER

If you are revising with class mates, testing each other is great. By doing this you are thinking about what you need to know when you are answering questions but also when you are checking to see if your class mate is right. This works well on video calls!

MAKING FLASH CARDS

Some students find making flash cards really helps. You are thinking about what needs to be learned as you write! But don't fall into the trap of writing them and never using them! Once written they should be used regularly – you can test yourself with them or test each other!

Spaced Learning

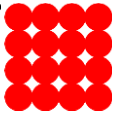
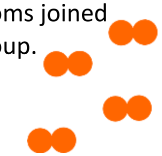
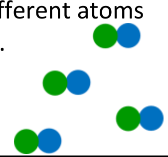
All of the techniques work best when they are done **little and often**. Aim to repeat something you have learned a week – studies have shown that once you learn something, if you see it again after a week recall is better long term. Then again after a month… and so on.

Application

Once you have memorised some of the information, or have made a good start, it's a good idea to start trying to **use that knowledge**. Websites like **Seneca** and **Educake** provide great banks of questions for this.

7H Atoms, Elements and Molecules

1. The Air We Breathe

Particles	Tiny pieces of matter that make up everything.
Atoms	The simplest particles of matter that make up everything.
Elements	A substance made up of one type of atom. 
Molecules	Two or more atoms joined together in a group. 
Compound	Two or more different atoms joined together. 
Mixture	Two or more substances jumbled together but not chemically joined together. 
Periodic Table	A table that lists all of the known elements.
Air	A mixture of different gases- nitrogen, oxygen, argon, carbon dioxide
Pure	A substance made up of a single element/compound and nothing else.

2. Earth's Elements

Chemical Symbols	The 1 or 2 letters given to each element
Earth's Crust	Made up of oxygen, iron, silicon, aluminium, calcium and other elements.
Naturally Occurring Elements	Usually found as compounds, some found pure. Can be extracted from compounds by simple chemical reactions.
Properties	What an element is like, its appearance and how it behaves.
Recycling	Using a material again to save resources and make sure we don't run out.
Carbon	Can be found as diamond and graphite. The different properties of each form are due to the ways the atoms are joined together.

3. Metals and Non-Metals

Common Metal Properties	Solid, high melting point, strong, flexible, malleable, shiny and good conductors of heat and electricity.
Metals	Three-quarters of all elements are metals- found on the left side of the periodic table.
Common Non-Metal Properties	Low melting points, brittle, not shiny and poor conductors of heat and electricity.
Malleable	Able to be beaten and bent into shape.
Flexible	Able to bend without breaking.
Conductor	A substance that allows something to pass through it (e.g. heat, electricity).
Brittle	Not easily bent- breaks under pressure.
Magnetic	Iron, nickel and cobalt are the only magnetic elements.
Mercury	The only metal that is liquid at room temperature.

4. Making Compounds

Silicon Dioxide	The most common compound in the Earth's crust- found in sand, quartz and granite.
Forming Compounds	The first stage often involves heating a mixture of elements. Energy is often given out when elements react to form compounds.
Iron Sulfide	Compound formed by heating a mixture of iron and sulfur.
Bonds	Formed between atoms when compounds are formed.
Iron Sulfide Properties	Iron can be separated from sulfur using a magnet but iron sulfide is not magnetic.
Metal Ores	A rock containing a compound of a metal.
Naming Compounds	If one of the elements in the compound is a metal its name goes first. the non-metal at the end of the compound's name has its name changed so it sends in -ide.

5. Chemical Reactions

Chemical Reaction	A change in which one or more new substance is formed.
Word Equation	Used to model chemical reactions.
Reactants	The starting substances- written on left of word equation.
Products	The new substances made- written on right of word equation.
Thermal Decomposition	Using heat to break down a compound- used to extract metals from their compounds.
Thermal Decomposition of Mercury Oxide Mercury oxide → mercury + oxygen	
Carbonates	Compounds containing a metal, carbon and oxygen.
Calcium Carbonate	Found in limestone, chalk and marble.
Thermal Decomposition of Calcium Carbonate Copper carbonate → copper oxide + carbon dioxide	
Test for Carbon Dioxide	Carbon dioxide turns limewater cloudy.
-ate	A compound that contains two elements plus oxygen will end in -ate. (e.g. zinc sulfate contains zinc, sulfur and oxygen)

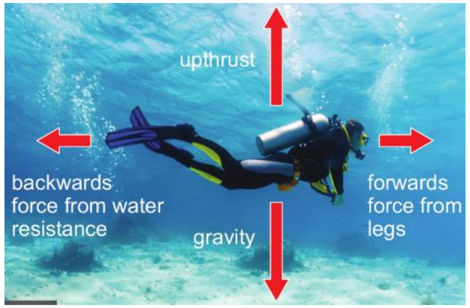
Lesson	Memorised?
1. The Air We Breathe	
2. Earth's Elements	
3. Metals and Non-Metals	
4. Making Compounds	
5. Chemical Reactions	

7K Forces

1. Different Forces

Force	A push or a pull.
Contact Forces	The thing providing the force needs to touch an object to affect it. *Friction, air resistance, water resistance, upthrust*
Upthrust	The force that makes things float.
Air Resistance	A force acting on objects moving through the air.
Water Resistance	A force acting on objects moving through water.
Non-Contact Forces	Forces that can affect an object from a distance. *Gravity, static electricity, magnetism*
Gravity	A force that pulls objects downwards.
Static Electricity	A force that attracts things.
Magnetism	A force that attracts objects made of iron, nickel or cobalt.
Newton (N)	The units for measuring forces.
Weight	The force of gravity pulling on something- measured in Newtons (N)
Mass	The amount of matter that makes up something- measured in kilograms (kg)
Representing Forces	We draw arrows on force diagrams to show the direction of a force; a bigger arrow shows a bigger force.

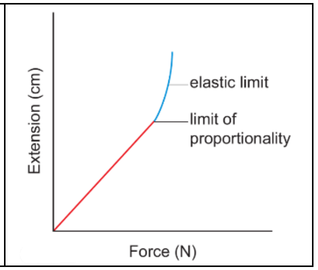
Force Diagram



2. Springs

Stretched	Made longer
Compressed	Made shorter
Spring	Made from coils of wire,
Extension	The difference between the original length and the stretched length.
Elastic	An object that returns to its original length when the force is removed.
Investigating Extension	Hang a spring from a clamp and measure its length. Add increasing numbers of masses and measure the extension each time.
Hooke's Law	Extension is proportional to the force applied.
Proportional	A relationship between two variables where if one doubles, the other will double.
Limit of Proportionality	The point at which the extension and force are no longer proportional.
Elastic Limit	The point at which the spring cannot return to its original length.
Force Meter	Springs are used inside to measure the force.

How Extension Depends on Force



3. Friction

Friction	Force between two touching objects.
Increasing Friction	Using certain materials like rubber (used on racing cars to stop them from sliding off the road).
Reducing Friction	Make surfaces smooth or by using lubricants such as oil or grease.
Lubrication	Adding a lubricant
Friction Damage	Friction can wear things away like brake pads on a bike. Friction between parts of a car can cause it to overheat and stop working.

4. Pressure

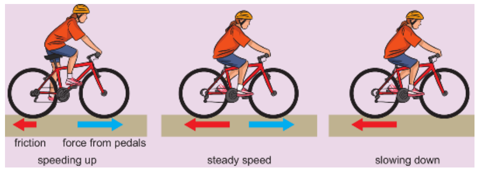
Pressure	The amount of force pushing on a certain area.
The Size of Pressure	Depends upon the size of the force and the size of the area it is pushing on.
Pressure in Sport	Snowshoes spread out weight, reduce pressure and stop people sinking into soft snow.
Pressure in Everyday Life	It is easier to cut something with a sharp knife because it has a smaller edge so the force is concentrated over a smaller area.
Pressure formula	$\text{pressure} = \frac{\text{force}}{\text{area}}$

Pascal (Pa)	The units for measuring pressure. $1Pa = 1N/m^3$

5. Balanced and Unbalanced Forces

Balanced Forces	Two forces of the same size acting upon an object in opposite directions. Balanced forces will not change the speed of a moving object.
Unbalanced Forces	When one of the forces acting upon an object is larger than the other. If acting on a moving object unbalanced forces will change its speed.
Stationary	Not moving- stationary objects have balanced forces acting on them.

Force Diagram



Lesson	Memorised?
1. Different Forces	
2. Springs	
3. Friction	
4. Pressure	
5. Balanced and Unbalanced Forces	

8A Food and Nutrition

1. Nutrients

Diet	The food that you eat- provides the raw materials your body needs for energy.
Nutrients	Food substances that provide the raw materials- carbohydrates, fats, proteins, vitamins, minerals
Carbohydrates	Starch and sugars
Fats	Liquid fats are oils. Fats and oils are called lipids.
Fibre	Made of plant cell walls- not used by the body. Helps food move through the intestines and stops them getting blocked.
Uses of Water	• a lubricant • dissolves substances to be carried around body • fills up cells, holding shape • sweat to cool you down
Food Labels	Show the amounts of different nutrients in food.
Starch Food Test	Add 2 drops of iodine. If it turns **blue-black** starch is present.
Protein Food Test	Add 5 drops of biuret solution. If it turns **purple** protein is present.
Fat Food Test	Rub on some white paper and hold up to the light. fats will leave a greasy mark

2. Uses of Nutrients

Uses of Carbohydrates	The body's main source of energy. *Bread, potatoes, pasta*
Uses of Fats	Another source of energy that is stored in your body. Some is stored under the skin to insulate the body. *Dairy products, fried food*
Maintaining Mass	The amount of fuel you use needs to balanced by the amount you eat.
Kilojoules (kJ)	The units for measuring the energy in food.
Respiration	The process that releases energy from food.
Energy Needs	Depends on age, sex and how active you are.
Uses of Proteins	Make new cells allowing us to grow and repair our bodies. *Meat, fish, cheese, beans, milk*
Uses of Vitamins and Minerals	Used in small amounts to maintain health.
Vitamin A	Needed for healthy skin and eyes.
Vitamin C	Helps cells in tissues stick together properly.
Calcium	Needed to make bones.
Iron	Makes red blood cells.

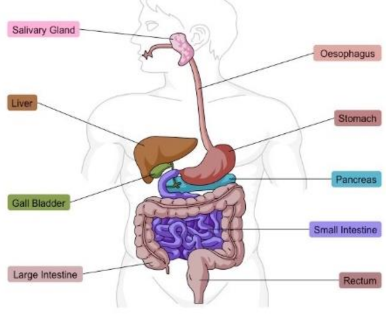
3. Balanced Diets

Balanced Diets	Eating a range of foods in the right amounts.
Malnutrition	Having too much / too little of a nutrient in your diet.
Deficiency Disease	Caused by lacking certain nutrients for a long time.
Kwashiorkor	Lack of protein causing a 'pot belly'.
Night Blindness	Lack of vitamin A.
Scurvy	Lack of vitamin C causing painful joints and bleeding gums.
Rickets	Lack of calcium / vitamin D causing bones not to form properly.
Anaemia	Lack of iron causing tiredness and shortness of breath.
Starvation	Lacking nearly all nutrients needed.
Obesity	Caused by eating food containing more energy than you need.
Heart Attack	Fat clogs arteries so little blood reaches the heart.
Reference Intakes	How much of each nutrient should be eaten in a day.

4. Digestion

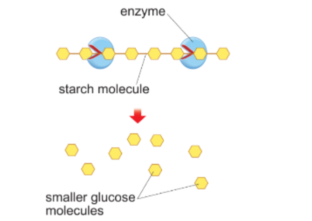
Digestion	Turning large insoluble molecules into small soluble ones.

Digestive System



Mouth	Teeth grind food and saliva helps digest food.
Gullet	(oesophagus / food pipe) Muscles contract pushing the food down.
Stomach	Food churned with acid.
Small Intestine	More digestive juices added- small digested molecules absorbed into body.
Large Intestine	Water is removed from undigested food- faeces formed.
Rectum	Stores faeces
Anus	Faeces pushed out body- egestion.
Gut Bacteria	Microorganisms needed to help digest food.
Enzymes	Substances that speed up the breaking down of large molecules- biological catalysts.

5. Absorption

Digesting Starch	
Blood	Digested nutrients dissolve in the blood plasma and are carried around the body to cells.
Diffusion	Movement of particles from an area of high concentration to low concentration.
Small Intestine Adaptations.	Has lots of tiny finger-shaped villi to increase surface area. Each villus has a folded top that forms microvilli. Villi walls are one cell thick for easier diffusion.
Alcohol	Causes fewer digestive enzymes to be released and can damage villi.

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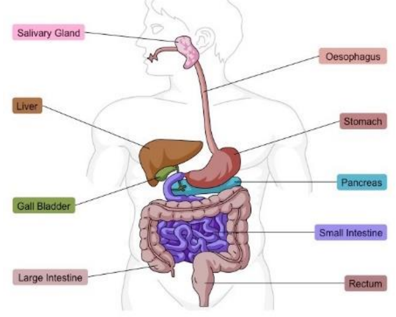

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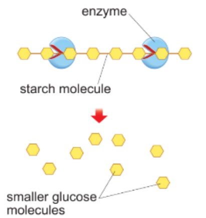

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2. Uses of Nutrients	
3. Balanced Diets	
4. Digestion	
5. Absorption	

8D Unicellular Organisms

1. Unicellular or Multicellular	
Cells	The basic unit of life. All organisms are made up of cells.
Unicellular	An organism made up of one cell.
Microorganisms	Organisms that are so small they can only be seen with a microscope.
Multicellular	An organisms made of many cells.
Diffusion	When particles spread to fill the area that they are in.
Kingdoms	All living organisms can be grouped into one of the five kingdoms.
Prokaryotes	Unicellular organisms that do not have a nucleus.
Protoctists	Mainly unicellular organisms. All have a nucleus.
Fungi	Mainly multicellular organisms that do not make their own food and have a nucleus.
Plants	Multicellular organisms that have a nucleus and make their own food.
Animals	Multicellular organisms that have a nucleus, do not make their own food and do not have a cell wall.
Bacteria	A type of microorganisms in the prokaryote kingdom.

Viruses	Not classed as living organisms because they cannot live without being inside a host.

2. Microscopic Fungi	
Asexual Reproduction	Producing new organisms from one parent only.
Budding	Type of asexual reproduction used by fungi in which a small new cell grows out from a parent cell.
Aerobic Respiration	Glucose + oxygen → carbon dioxide + water
Anaerobic Respiration	A type of respiration which does not require oxygen.
Fermentation	The anaerobic respiration of microorganisms. Glucose → carbon dioxide + water
Population	The number of a certain organism found in a certain area.
Limiting Factor	Something that stops a population growing.

3. Bacteria	
Lactic Acid	Produced by the anaerobic respiration of bacteria. Glucose → lactic acid
Enzymes	A substance that can speed up some processes in living organisms.
Binary Fission	Type of asexual reproduction used by bacteria in which a cell splits into two.
Chromosome	A long molecule that contains instructions for organisms and their cells.
Flagella	A tail-like structure that rotates, allowing a unicellular organism to move.

Statement Key	A series of descriptive statements used to work out what something is.

4. Protoctists	
Algae	A type of protoctist that uses photosynthesis.
Photosynthesis	Carbon dioxide + water → glucose + oxygen
Chloroplast	Found in plant and some protoctist cells- the site of food production through photosynthesis.
Chlorophyll	The green substance inside chloroplasts that absorbs light.
Producers	Organisms that are able to make their own food- always the start of a food chain.
Food Chains	A way of showing what eats what in an ecosystem.
Energy Transfer	Represented by an arrow on a food chain diagram.
Pyramids of Numbers	A way of showing the numbers of different organisms in a food chain.
Poison	Can build up and become more concentrated as you move along a food chain.

5. Decomposers & Carbon	
Ecosystem	All the physical environmental factors and all the organisms that are found in a habitat.
Decomposers	Organisms that feed on dead organisms or animal waste which allows substances to be recycled.
Decay	The breakdown of dead organisms or animal waste.
Soluble	A substance that can dissolved in a liquid.
Carbon Cycle	Shows how carbon compounds are recycled in an ecosystem.
Combustion	Burning fuels and releasing carbon dioxide into the air.
Feeding	Transfers carbon compounds stored in plants to the animals eating them.
Carbohydrates	A nutrient used as the main source of energy.
Proteins	A nutrient used for growth and repair.
Fats	A nutrient used for storing energy and as a thermal insulator.

Lesson	Memorised?
1. Unicellular or Multicellular	
2. Microscopic Fungi	
3. Bacteria	
4. Protoctists	
5. Decomposers & Carbon	

8E Combustion

1. Burning Fuels

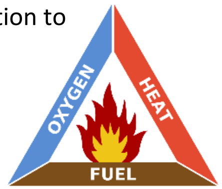
Fuel	A chemical substance from which stored energy can be transferred usefully to make things happen.
Fuel Cell	Used in hydrogen-powered vehicles, releasing energy from hydrogen.
Fuel Cell Word Equation Hydrogen + oxygen → water	
Reactants	The starting substances- on left of word equation.
Products	The new substances made- on right of word equation.
Combustion	Burning, usually in air. The reaction gives out energy which is transferred to the surroundings by heating or light.
Fossil Fuels	Fuels formed from living organisms that died millions of years ago- *petrol, diesel*
Hydrocarbons	Only contain carbon and hydrogen atoms- *petrol, diesel*
Combustion of Hydrocarbons	The carbon and hydrogen atoms react with oxygen. The carbon reacts to form carbon dioxide.
Carbon Dioxide	Carbon dioxide will turn limewater cloudy.

2. Oxidation

Oxidation	Reacting with oxygen.
Oxide	Compound formed by oxidation.

Metal Oxides	Formed when metals react with oxygen. *metal + oxygen → metal oxide*
Conservation of Mass	Mass is never gained or lost in a chemical reaction. The atoms in reactants just rearrange to form the products, no new atoms are made and none disappear.
Heating Zinc in Air	Forms a white powder zinc oxide. The mass will appear to increase because the zinc has combined with the oxygen in air.
Gas Products	If the product is a gas it may escape and make it seem like the mass has decreased.
Phlogiston	A substance scientists used to think explained why things burned that was then proven not to exist.

3. Fire Safety

Exothermic	A reaction that releases energy that we can feel as heat- *combustion*
Thermometer	Used to measure a change in the temperature.
Fire Triangle	Three factors allow combustion to occur. 
Putting Out a Fire	You must remove at least one of the three factors.
	**Explosive** Heating may cause an explosion.
	**Flammable** These substances catch fire easily.
	**Oxidising** These substances release oxygen.
Fire Extinguishers	Work by cooling a fire or stopping oxygen getting to the fuel.
Oil Fire	Water will sink through the oil and turn to steam making the fire spread out. Use foam or a fire blanket to keep oxygen away.
Electrical Fire	Water conducts electricity so you may get a serious shock. Turn off the electricity and use a powder or carbon dioxide extinguisher.

4. Air Pollution

Complete Combustion	Carbon burns in plenty of air only forming carbon dioxide.
Incomplete Combustion	Not enough oxygen for all the carbon to react with.
Products of Incomplete Combustion	• carbon dioxide- linked to global warming • carbon monoxide- poisonous gas • soot- damage lungs and trigger asthma
Impurities	Small amounts of other substances in fuels.
Sulfur Dioxide	Formed when hydrocarbons have a sulfur impurity.
Nitrogen Oxide	Formed by high engine temperatures causing nitrogen and oxygen in air to react.
Pollutants	Something that can harm living things and damage the environment.
Catalytic Converter	Found in cars to react carbon monoxide with more oxygen forming carbon dioxide. Also breaks down nitrogen oxides.

Acid Rain	Sulfur dioxide and nitrogen oxides rise into the air and dissolve in water vapour. The rain is now more acidic.
Controlling Acid Rain	Neutralisation reactions used to remove acidic gases from chimney smoke. Acidic soil /water can be neutralised by adding calcium carbonate.

5. Global Warming

Greenhouse Gases	Trap energy from the Sun in the atmosphere *e.g. carbon dioxide*
Greenhouse Effect	Energy trapped by greenhouse gases is transferred back to the Earth's surface causing it to warm up.
Earth's Temperature Over Time	The temperature of the Earth has fluctuated over time it is rising rapidly now though.
Global Warming	Increase in global temperature due to more greenhouse gases in the air and the greenhouse effect.
Climate Change	Resulting from global warming- changes to weather patterns, more storms, flood, droughts, etc.
Evidence	There is now lots of evidence for global warming. average temperatures are increasing and ice caps are melting.

Lesson	Memorised?
1. Burning Fuels	
2. Oxidation	
3. Fire Safety	
4. Air Pollution	
5. Global Warming	

8G Metals and Their Uses

1. Metal Properties

Physical Properties	The properties that describe a substance on its own. *(colour, strength, density, etc.)*
Chemical Properties	How a substance reacts with other substances.
Properties of Metals	High melting points, strong, flexible, malleable, shiny, good conductors.
Copper	Used in electrical circuits because it is a good conductor of electricity and unreactive. Used in water pipes because it is unreactive, non-poisonous and malleable.
Aluminium	Used in window frames because it is strong and light.
Metals & Oxygen	Most metals react with oxygen. metal + oxygen → metal oxide *e.g. zinc + oxygen → zinc oxide*
Metals & Halogens	Metals react with halogens and other non-metals. *e.g. zinc + fluorine → zinc fluoride*
Catalysts	Speed up chemical reactions without being permanently changed themselves.
Catalytic Converter	Found in cars to help convert dangerous gases into harmless ones- often contain platinum, palladium and rhodium.

2. Corrosion

Corrosion	Any reaction with oxygen at the surface of a metal.
Rusting	The corrosion of iron.

Word Equation for Corrosion of Titanium

titanium + oxygen → titanium oxide

Symbol Equation for Corrosion of Titanium

$Ti + O_2 \rightarrow TiO_2$

Formula	Used to represent the products and reactants in a symbol equation.
Ratio	Comparison of the proportion of two quantities *e.g. in TiO_2 there are two oxygen atoms for every titanium- the ratio is 1:2*
Rusting of Iron	More complex than general corrosion- requires water as well.

Rusting of Iron Word Equation

Iron + oxygen + water → iron hydroxide

Preventing Rust	Use a barrier such as paint/plastic/oil to keep away air/water

3. Metals and Water

Reactivity of Metals

Metal	Reaction with oxygen in air	Reaction with cold water
potassium	🔥	🔥
sodium	🔥	✓✓✓
lithium	🔥	✓✓
calcium	🔥	✓✓
magnesium	🔥	✓
aluminium	✓✓✓	•••
zinc	✓✓	•••
iron	✓✓	•••
tin	✓	•••
lead	✓	•••
copper	✓	✗
mercury	•••	✗
silver	•••	✗
gold	✗	✗
platinum	✗	✗

Increasing reactivity (↑)

Key

🔥	can catch fire	✓✓✓	reacts very quickly	✓✓	reacts quickly
✓	reacts	•••	slow or partial reaction	✗	no reaction

Reactivity	How quickly / vigorously something reacts.
Reactivity Series	A list of metals in the order of their reactivity.
Metals & Water	Metals produce metal hydroxides and hydrogen when reacting with water. *(sodium + water → sodium hydroxide + hydrogen)*

4. Metals and Acids

Potassium - Lithium	React explosively with dilute acids.
Calcium - Zinc	React very quickly with dilute acids.
Iron - Lead	React slowly with dilute acids.
Copper - Platinum	Do not appear to react with dilute acids at all.
Effervescence	The production of a gas. Occurs when metals react with an acid.
Metals & Acids	Metals react with acids to form hydrogen and a salt.

Metals & Acids Word Equation

metal + acid → salt + hydrogen

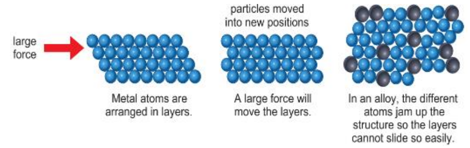
e.g. magnesium + sulfuric acid → magnesium sulfate + hydrogen

Naming Salts	The first word in the salt is the metal the second depends on the acid used.
Hydrochloric Acid	HCl – forms salts ending in chloride
Sulfuric Acid	H_2SO_4 – forms salts ending in sulfate
Nitric Acid	HNO_3 – forms salts ending in nitrate
Obtaining Salts	Mix the acid and the metal. Filter the solution to remove any excess metal. Heat the solution to evaporate water leaving just the solid salt.

5. Pure Metals and Alloys

Pure	Substance made up of one type of atom.
Alloys	Mixtures of metals.
Solder	Lead mixed with tin- lower melting point than lead used for fixing pipes / electrical equipment.
Duralumin	Aluminium mixed with copper and magnesium making it lighter and stronger. Used in aircraft.
Stainless Steel	Iron mixed with carbon, chromium and nickel making it stronger and more resistant to corrosion. Used in cutlery.

Explaining How Alloys Are Strong



Melting / Boiling Points	Melting and boiling points for pure substances are fixed and occur at precise temperatures. Alloys melt and boil over a range of temperatures.

Lesson	Memorised?
1. Metal Properties	
2. Corrosion	
3. Metals and Water	
4. Metals and Acids	
5. Pure Metals and Alloys	

8K Energy Transfers

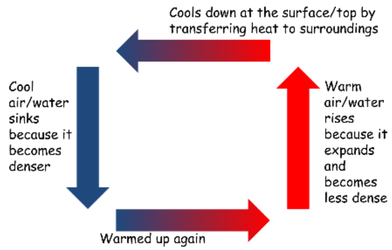
1. Temperature Changes

Temperature	How hot or cold an object is. *Measured in degrees Celsius (°C)*
Internal / Thermal Energy	The energy stored in the movement of particles. *Measured in Joules (J)*
Factors Affecting Amount of Internal Energy Stored	• temperature • material • mass
Energy Transfer	Always from a hotter object to a cooler one.
Evaporation	When a liquid turns into a gas. A way of transferring energy.
Cooling by Evaporation	The fastest moving particles escape a liquid to form a gas. The particles left are storing less energy so the temperature of the remaining liquid is lower.

2. Transferring Energy

Transferring Energy	Energy can be transferred by heating via evaporation, conduction, convection and radiation.
Radiation	A way of transferring Energy by heating through waves (it does not need a medium).
Emitting Radiation	All things give out (emit) infrared radiation, the hotter it is the more it emits.
Thermal Images	Instruments that measure infrared radiation and convert into maps of temperatures.
Conduction	When a solid is heated the particles vibrate more and these vibrations are passed through the solid transferring energy.
Thermal Conductors	Energy is transferred easily through them- metals.
Thermal Insulators	Energy is not transferred through them easily- wood / plastic.
Convection	In fluids (liquids and gases) when part of it is heated it become less dense and rises. Cooler fluid moves in to take its place and a convection current forms.

Convection Diagram



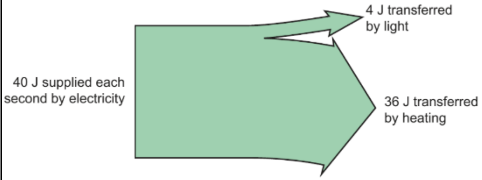
3. Controlling Transfers

Cold Climates	Houses are kept warm by burning fuel for heating and insulating houses to keep warmth inside.
Good Insulators	Brick, wood, carpet, feathers, wool.
Air	A very poor conductor because the particles are far apart
Hot Climates	Houses are kept cool by painting them white (light and shiny surfaces reflect infrared radiation).
Solar Panels	Painted black because dark colours absorb and emit infrared radiation well.
Vacuum Flask	Designed to reduce energy transfers and keep contents hot: • Plastic stopper to stop convection (and it is an insulator). • Glass walls with silver coating reflect radiation back in. • Vacuum between walls so no conduction or convection can occur.

4. Power and Efficiency

Power	The amount of energy transferred by an appliance per second.
Watts (W)	The units for measuring power. 1000W = 1kW (kilowatt)
Power Ratings	Tell us how much energy an appliance transfers.
Efficiency	The amount of useful energy transferred by a device compared with the amount of energy supplied to it.
Sankey Diagram	A diagram that represents energy transfers.

Sankey Diagram Example



Efficiency Formula

$$\text{efficiency} = \frac{\text{useful energy transferred}}{\text{total energy supplied}} \times 100\%$$

5. Paying for Energy

Kilowatt-hour (kWh)	The amount of energy transferred in 1 hour by an appliance. Used by energy companies to measure energy use.

Energy Use Formula

$$\underset{(\text{kWh})}{\text{energy use}} = \underset{(\text{kW})}{\text{power rating}} \times \underset{(\text{hours})}{\text{time}}$$

Saving Money on Electricity / Gas Bills	Not using as much energy will save money. Insulating houses and using more efficient appliances will help with this.
Payback Time	How long it will take you to save the money that an efficiency measure costs.
Payback Time Formula	$\text{payback time} = \frac{\text{cost of change}}{\text{saving per year}}$

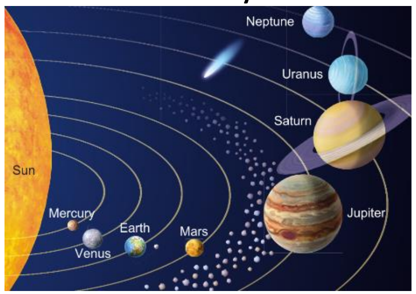
Lesson	Memorised?
1. Temperature Changes	
2. Transferring Energy	
3. Controlling Transfers	
4. Power and Efficiency	
5. Paying for Energy	

8L Earth and Space

1. Gathering the Evidence

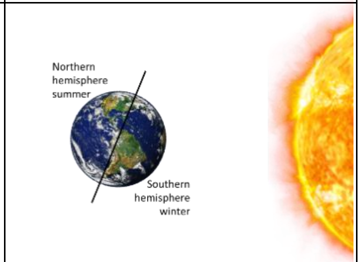
Astronomer	A scientist that studies space.
Early Astronomers	Could only use their eyes to make observations.
Ptolemy	Egyptian astronomer (*90-168*) Proposed a model with the Earth in the centre and the Moon, Sun and planets orbiting the Earth.
Nicolaus Copernicus	Polish astronomer (*1473-1543*) Suggested the Earth and other planets move in circles around (orbit) the Sun.
Reaction to Copernicus' Model	It was not accepted straight away. However observation made by Galileo using one of the first telescopes provided more evidence to support it.
Johannes Kepler	German astronomer (*1571-1630*) Proposed the model used today. The Sun is at the centre with the planets moving around in elliptical orbits. Moons orbit planets.

The Model of the Solar System

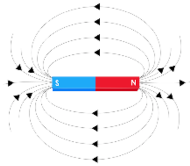


Phases of the Moon	The Moon appears different shapes at different times due to its position relative to the Earth and Sun. 
Spacecraft	Allowed scientists to investigate space more by collecting samples and taking readings on other planets.

2. Seasons

Summer	Longer days than nights, Sun high in the sky.
Winter	Longer nights than days, Sun not very high in the sky.
Cause of Seasons	Due to the tilt of the Earth's axis by 23.5°.
Causing Summer	When the northern hemisphere is tilted towards the Sun it is summer in the UK.
Causing Winter	When the northern hemisphere is tilted away from the Sun it is winter in the UK.
Causing Seasons Diagram	
Summer Sun	Because the Sun is higher in the sky in summer the heat is more concentrated, making it feel warmer

3. Magnetic Earth

Compass	A magnet that points north.
North-Seeking pole	The end of a bar magnet that points north- shortened to north pole.
South-Seeking pole	The end of a bar magnet that points south- shortened to south pole.
Attract	When two magnets are pulled together. Opposite poles will attract each other.
Repel	When two magnets are pushed apart. The same poles will repel each other.
Magnetic Field	The area around a magnet where it has an effect. Can be found using iron filings or a small compass.
Magnetic Field Diagram	
Magnetic Field Strength	Strongest closest to each pole, the field gets weaker as you get further from the magnet.
Magnetic Field Direction	The direction of a magnetic field is always from the north pole towards the south pole.

4. Gravity in Space

Gravity	Force exerted by all objects with mass trying to pull other objects towards it.
Bigger Mass	The bigger the mass of an object, the stronger the force it exerts.
Weight	The force of gravity pulling on you. *Measured in Newtons (N)*
Gravitational Field	The space around the Earth where gravity attracts things.
Gravitational Field Strength (*g*)	At the surface of the Earth it is about 10 newtons per kilogram (N/kg).
Weight Formula	Weight = mass x g
Gravity and Orbits	The force of gravity keeps the Earth in its orbit of the Sun.
Satellite	Anything that orbits a planet.
Natural Satellite	Moons are examples of natural satellites.
Artificial Satellite	Can be put into orbit around Earth for photographing / transmitting TV programs etc

5. Beyond the Solar System

Constellation	Pattern of stars
Stars	Huge balls of gas that give out large amounts of energy. The Sun is a star.
Stars At Night	Appear less bright than the Sun because they are further away.
Galaxies	Large groups of stars.
Milky Way	The galaxy our Sun is in.
Universe	Made up by all of the millions of galaxies.
Light Year	Measurement of distance- the distance travelled by light in 1 year. Approximately ten million million kilometres.
Proxima Centauri	Nearest star to the Sun, about 4.22 light years away.

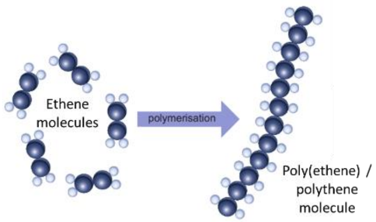
Lesson	Memorised?
1. Gathering the Evidence	
2. Seasons	
3. Magnetic Earth	
4. Gravity in Space	
5. Beyond the Solar System	

9E Making Materials

1. About Ceramics	
Ceramics	Range of hard, durable, non-metallic materials, generally unaffected by heat. *e.g. glass, china*
Ceramic Properties	• Hard, strong and brittle • High melting point and heat resistant • Good insulators of heat and electricity • Very unreactive
Glass	Hard, rigid, unreactive and can be transparent making it ideal for windows, bottles and jars.
Porcelain	Rigid, strong when compressed and an electrical insulator making it ideal to support electrical cables on pylons.
Ceramics	Heat resistant so used for brakes in high-performance cars
Raw Materials	Clays are used for making pottery and sand for glass.
Using Clay	When heated, chemical reactions occur forming new compounds. When cooled, crystals form and bind together in the ceramic.
Crystal Size	Dependent upon speed of cooling. Slower cooling produces larger crystals.
Lattice Structure	Grid-like structure formed by crystals.
Bonds	Because atoms in a lattice structure are joined by strong bonds it explains why ceramics are so stiff and have high melting points.

2. Polymers	
Polymer	Substances that have molecules made of long chains of repeated groups of atoms.
Monomer	Small molecule joined with the identical molecules to form polymers.
Rubber	Polymer from certain trees. Soft and sticky when hot, but hard and brittle when cold.
Vulcanisation	Rubber is heated with sulfur to form cross-links between molecules making it harder and tougher.
Natural Polymer	Polymers found naturally. *e.g. rubber, DNA, proteins*
Synthetic Polymers	Polymers made in laboratories mainly using raw materials from crude oil.
Polymerisation	Reaction that joins together monomers into chains.

Forming Polythene Diagram



Exothermic	Reactions that transfer energy to the surroundings. e.g. polymerisation
Endothermic	Reactions that absorb energy from the surroundings.

3. Composite Materials	
Composite Material	Combinations of 2 or more materials with properties of each. *e.g. concrete, paper*
Laminated Glass	Combines layers of glass with a clear polymer
Laminated Glass Properties	Laminated glass is rigid and hardwearing like glass but holds together under impact.
Making Composite Materials	Many are made by mixing fibres into a liquid resin which then sets hard.
GRP (Glass Reinforced Plastic)	Composite of glass fibres in a polyester resin. Used in boatbuilding as it is strong, light and slightly flexible.
Concrete	Composite material made from a mixture of cement, sand, aggregate and water.
Concrete Properties	Strong, hardwearing and easy to mould into shapes.
Aggregate	Crushed rocks
Reinforced Concrete	In building works, steel rods are also added to make it even stronger.
Cement	Mainly calcium oxide which is made by roasting calcium carbonate (limestone) in a thermal decomposition reaction which is endothermic

Thermal Decomposition of Limestone

Calcium carbonate → calcium oxide + carbon dioxide

4. Problems With Materials	
Finite	Limited resource that will eventually run out.
Fossil Fuels	Usually used in the manufacture of materials.
Incomplete Combustion	Produces carbon monoxide and soot due to lack of oxygen
Sulfur Dioxide	Caused by sulfur impurities in fuel. Leads to acid rain.
Nitrogen Oxides	Caused by high combustion temperatures. Form acid rain.
Carbon Dioxide	Traps the Sun's energy, increasing the greenhouse effect, leading to global warming.
Carbon Capture Technology	Technology used to remove carbon dioxide from waste gases given off.
Toxic Substances	Pass along the food chain as organisms eat smaller animals.
Non-Biodegradable	Materials that do not break down naturally.

5. Recycling Materials	
Recycling	Using the same materials again.
Recycling Benefits	Reduce use of finite resources, save fuel/energy, reduce landfill use.
Recycling Metals	Can be melted down and used again.
Recycling Glass	Can be crushed, melted and moulded into new glass.
Recycling Polymers	Difficult and expensive to separate different polymers so recycling levels are low.
Recycling Paper	Water added, filtered, heated and mixed to form pulp, squeezed and dried to form paper.
Recycling Concrete	Crushed using large machines and used aggregate.

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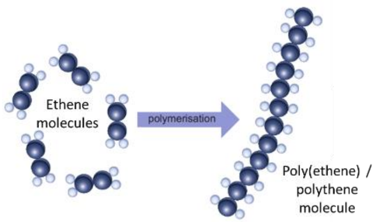

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