



While you were away

Lesson 1: Atoms, Elements and Compounds

1. What particles are found in the nucleus of an atom?
2. What is the difference between an element and a compound?

Lesson 2: Separating Techniques

1. What method is used to separate a soluble salt from a solution slowly?
2. How does fractional distillation work?

Lesson 3: Periodic Table

1. How are elements arranged in the modern periodic table?
2. What was Mendeleev's contribution to the development of the periodic table?

Lesson 4: Group 1

1. Why do Group 1 elements become more reactive as you go down the group?
2. What happens when lithium reacts with water?

Lesson 5: Group 7

1. Why do halogens become less reactive as you go down Group 7?
2. What trend is observed in the melting and boiling points of halogens?

Lesson 6: Group 0

1. Why are noble gases unreactive?
2. What are the physical properties of noble gases at room temperature?

Lesson 7: Comparing Group 1 Elements

1. How does atomic size affect the reactivity of Group 1 elements?
2. Why is it easier for lower Group 1 elements to lose an electron?

Lesson 8: Transition Metals

1. What are typical properties of transition metals compared to Group 1 metals?
2. Why are transition metals often used as catalysts in chemical reactions?

Lesson 9: Chemical Bonds

1. What is ionic bonding and which types of elements does it occur between?
2. What is covalent bonding and which types of elements does it occur between?

Lesson 10: Ionic Bonding

1. What happens to metals and non-metals during ionic bonding?
2. Why do ionic compounds have high melting and boiling points?

Lesson 11: Ionic Compounds

1. What structure do ionic compounds form?
2. Why can ionic compounds conduct electricity when molten or in solution?

Lesson 12: Properties of Ionic Compounds

1. Why do ionic compounds not conduct electricity when solid?
2. What type of forces hold ions together in an ionic compound?

Lesson 13: Covalent Bonding

1. Why do simple covalent molecules have low melting and boiling points?
2. Why don't covalent compounds conduct electricity?

Lesson 14: Properties of Small Molecules

1. What type of forces exist between particles in small covalent molecules?
2. Why do small molecules not conduct electricity?

Lesson 15: Polymers

1. What are polymers made of?
2. What type of bonds hold atoms together in polymer chains?

Lesson 16: Giant Covalent Structures

1. Why does diamond have a high melting point?
2. What allows graphite to conduct electricity?

Lesson 17: Metallic Bonding

1. What allows metals to conduct electricity?
2. How are metal ions arranged in metallic bonding?

Lesson 18: Properties of Metals and Alloys

1. Why are metals good conductors of electricity?
2. What role do delocalised electrons play in the properties of metals?

Lesson 19: Allotropes of Carbon

1. What is Buckminsterfullerene used for?
2. What makes carbon nanotubes useful in strengthening materials?

Lesson 20: Nanoparticles

1. What size range defines nanoparticles?
2. What is a potential risk of using nanoparticles?

SUBJECT: Science

UNIT: C1 Atomic Structure and The Periodic Table



Atoms

Contained in the **nucleus are protons and neutrons**. Moving around the nucleus are the electron shells containing the electrons. They are negatively charged. Electrons are arranged with 2 electrons on the 1st shell, 8 on the second shell and 8 on the third shell.

Overall, atoms have no charge; they have the same number of (positive) protons to (negative) electrons.

Ambitious Vocabulary

Chromatography,
isotope, atomic radius,
Distillation, condensing

Elements

Elements are made of atoms with the same atomic number. Atoms can be represented by symbols.
N₂ – Nitrogen, F – Fluorine. O₂ – Oxygen S₈ – sulphur

Isotopes – An isotope is an element with the same **number of protons, but a different number of neutrons**. They have the same atomic number but different mass number. ¹H ²H ³H.

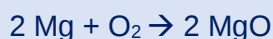
Compounds – A compound is when two or more elements are chemically joined. e.g. CO₂, NaCl, HCl

Chemical equations –

A chemical equation can be shown by using a word equation

Magnesium + oxygen → Magnesium Oxide.

Also a symbol equation



To balance equations there must be the same number of atoms on both sides of the equation.

Mixtures, Chromatography and Separation

Mixtures – in a mixture there are no chemical bonds, so the elements are easy to separate. Examples of mixtures are air and salt water.

Chromatography – To separate out mixtures of two liquids with different solubility.

Filtration – To separate solids from liquids.

Evaporation – to separate a soluble salt from a solution. A quick way of separating out salt from water.

Crystallisation – To separate a soluble salt from a solution, a slower method of separating out salt.

Distillation – Separating a mixture of liquids with two boiling points by evaporating one liquid and then condensing it.

Fractional distillation – Separating out a mixture of liquids with multiple boiling points (crude oil).

History of the atom

Scientist	date	Discovery
John Dalton	Start of 19 th Century	Atoms were first described as solid spheres
JJ Thomson	1897	Plum pudding model – the atom is a ball of charge with electrons scattered
Earnest Rutherford	1909	Alpha scattering experiment – mass concentrated at the centre; the nucleus is charged, Most of the mass is in the nucleus. Most atoms are empty space.
Niels Bohr	1911	Electrons are in shells orbiting the nucleus
James Chadwick	1940	Discovered that there are neutrons in the nucleus.

Equations and Maths

To Calculate the relative atomic mass, use the following equation

$$\text{RAM} = \frac{\text{sum of (isotope abundance} \times \text{isotope mass number)}}{\text{Sum of abundances of all isotopes}}$$

Group 7 and Noble gases

Halogens

The halogens are non-metals: Fluorine, chlorine bromine, iodine. As you go down the group they become less reactive. It is harder to gain an extra electron because it's outer shell is further away from the nucleus. The melting and boiling points also become higher.

Noble gases

The noble gases include: helium, neon and argon. They are un-reactive as they have full outer shells, which makes them very stable. They are all colourless gases at room temperature.

Development of the periodic table.

Dimitri Mendeleev period table was ordered by atomic mass. He left gaps to show that he believed there was some undiscovered elements.

The **modern periodic table** Elements are ordered by proton number. It has metals on the left and non-metals on the right. It is ordered in groups and periods.

Group 1 elements

The **alkali metals** are soft, very reactive metals. They all have one electron in their outer shell, making them very reactive. They are low density. As you go down the group, they get bigger and it is easier to lose an electron that is further away from the nucleus.

They react with water to produce hydrogen.

Lithium + water → lithium + hydrogen hydroxide

SUBJECT: Science

UNIT: C2 Bonding



States of Matter

Solids, liquids, and gases are the three states of matter. The processes of changing between them are: melting, evaporating/boiling, condensing, freezing, and sublimation. Evaporation and boiling are different, evaporation occurs at any temperature, boiling requires heating.

Ambitious Vocabulary

Limitations
Intermolecular
Delocalised

Giant Covalent Structures

Diamond

Each carbon atom is bonded to four other carbon atoms making diamond very strong. It has high melting and boiling points so requires large amounts of energy to break the strong covalent bonds. Does not conduct electricity.

Silicon dioxide

Similar structure and properties to diamond.

Graphite

Carbon atoms arranged as hexagons. Each carbon is bonded to three other carbons and has one free delocalised electrons that is able to move between layers. Layers are held together by weak intermolecular forces so can slide over each other easily but high melting and boiling points so large amounts of energy to break strong bonds. Can conduct electricity.

Graphene

One layer of graphite. Very strong so high melting and boiling points. Has delocalised electrons so can conduct electricity.

Particles in solids, liquids, and gases

Solids – regular arrangement, particles close together in fixed position, strong forces, low energy and can only vibrate.

Liquids – irregular arrangement, close together, free to move, weaker forces, more energy.

Gases – irregular arrangement, particles separate, very weak forces, lots of energy, move randomly.

State Symbols

In chemical reactions, the three states of matter are represented as symbols: solid (s), liquid (l), gas (g), aqueous (aq). Aqueous solutions are formed when a substance is dissolved in water.

Metallic Bonding

Occurs between metals only. Positive metal ions are surrounded by a sea of delocalised electrons. The ions are tightly packed and arranged in rows. Delocalised electrons mean metals conduct electricity.

Ionic Bonding

Occurs between a metal and a non-metal. Metals lose electrons and become positively charged. Non-metals gain this electron and become negatively charged. Opposite charges are attracted by electrostatic forces. Ionic compounds form structures called giant ionic lattices. There are strong electrostatic forces of attraction so they have high melting and boiling points and cannot conduct electricity when solid but can when molten or in a solution,

Fullerenes and Nanotubes

Molecules of carbon that are shaped like hollow tubes or balls arranged in hexagons/pentagons that are used to deliver drugs into the body. Buckminsterfullerene is an example of a fullerene. Carbon nanotubes are tiny carbon cylinders that can conduct electricity and strengthen materials without adding weight to them. There are some risks of nanoparticles as they can be inhaled and then initiate harmful reactions and toxic substances can bind to them.

Limitations of the Particle Model

The chemical bonds are not represented in diagrams of the particle model. Particles are represented as solid spheres which is inaccurate as atoms are mostly empty space and not always spherical.

Formation of Ions

Ions are charged particles. They can be either negatively or positively charged and are made when elements lose or gain electrons. Metals lose electrons to become positively charged. Non-metals gain electrons to become negatively charged.

Covalent Bonding

Occurs between two non-metals. Shares a pair of electrons between atoms. Simple covalent molecules have low melting and boiling points due to the weak intermolecular forces between particles. Do not conduct electricity as they have no delocalised electrons.

Nanoscience

Nanoscience refers to structure that are 1-100nm in size. They have a high surface to volume ratio.

Polymers

Long chain molecules that are made up of smaller units called monomers. Atoms in polymer chains are held together by strong covalent bonds.