

UNIT 1 Kinetic Theory and Atomic Structure

Recommended Prior Knowledge Students should have followed an introductory/foundation level course in chemistry. This unit would make a suitable 'starter unit' for the O'level chemistry course.

Context This unit should be studied very early in the course. The concepts of kinetic theory and atomic structure are necessary prior learning for most of the other units.

Outline Students study the kinetic theory of solids, liquids, gases and solutions and are introduced to ideas about atomic structure. This unit contains core learning for all other units, therefore pupils of all abilities need to study all of the concepts.

	Summary of learning Outcomes (see syllabus for full detail)	Suggested Teaching Activities	Further teacher guidance	Online resources
2.1 a	<p>Kinetic particle theory</p> <p>Describe solids, liquids and gases and their interconversion in terms of the kinetic theory:</p> <ul style="list-style-type: none"> - movement of particles, - energy changes involved. 	<p>Pupils should be familiar with diagrams or computer animations of 'particles in boxes' to represent solids, liquids and gases. Students should be able to describe each state change using ideas about the arrangement and movement particles in each state.</p> <p>Discuss by showing experiments or pictures of substances undergoing changes of state e.g. ice melting, water evaporating, steam condensing, flow chart of the water cycle.</p> <p>Suggested experiments: Observing state changes. Plotting a heating curve for water.</p>	<p>There is an opportunity to practise the use of thermometers and stop clocks, Syllabus learning objective 1.1(a)</p> <p>Pupils use a thermometer to measure the temperature change every 30s as water is heated and boils. If available, a temperature probe can be used to show graphs on a computer.</p>	<p>www.schoolscience.co.uk click on 'chemistry' then '11-14' then 'Materials'</p> <p>www.cornwallis.kent.sch.uk/intranet/elearn go to 'Year 7' → 'Science' → 'Matter'</p> <p>www.chemsoc.org/networks/learnnet/classic_exp.htm download & look at experiments 20, 23, 26, 36, 37</p> <p>www.presentingscience.com/corus/states/index.htm use virtual lab to look at the m.pt. and b.pt. of different substances</p> <p>www.wpbschoolhouse.btinternet.co.uk/page10/page10.htm</p>

				Click on 'States of Matter' from list www.harcourtschool.com/activity/states_of_matter/ a simulation
b c	Discuss everyday examples of diffusion.	Students should practice describing diffusion using ideas about the arrangement and movement of particles at different temperatures. Suggested experiments: Use a dropping pipette to run coloured fruit juice under cold water in a beaker. Repeat using hot water. Spraying air freshener onto a watch glass and asking pupils to raise their hands as they smell it travelling through the room.		http://www.ncsec.org/team16/diffusion.html simple introductory experiments www.chemsoc.org/networks/learnnet/classic_exp.htm download & look at experiment 27 www.brainpop.com/science/matter/ introductory material
d		Make coffee or tea using hot and cold water and observe the differences.		
d	State qualitatively the effect of molecular mass and temperature on the rate of diffusion.	Suggested experiment: Set up a long horizontal tube with rubber bungs at each end. Insert cotton wool soaked in conc. ammonia at one end, and cotton wool soaked in conc. hydrochloric acid at the other.	A white ring of ammonium chloride forms nearest the hydrochloric acid end, because HCl gas is heavier, and so diffuses more slowly. This is an early opportunity to introduce the idea of relative molecular mass.	
2.3 a	Structure and properties of materials. Describe the difference between elements, compounds and mixtures.	Suggested experiment: Investigate the properties of iron and sulphur (appearance, magnetic properties, density compared to water, effect of dilute acid) and then a mixture of the two. The elements can then be heated to form a compound and the properties of the	Students need learn definitions for elements, compounds and mixtures and to be able to identify them from formulae and 'particles in boxes' diagrams.	Downloadable element flashcards, games and worksheets (care re non-systematic names): http://sphs.spusd.net/groves/apchem.html

		<p>compound compared.</p> <p>Demonstrations: Heated Na into Cl₂ gas; the explosion between H₂ and O₂</p>	<p>Emphasis placed on the fact that compounds can differ greatly in properties from the elements they are made from.</p> <p>Alloys as examples of useful mixtures.</p>	<p>http://education.jlab.org/index/pages/elementgames.html</p> <p>www.chemsoc.org/networks/learnnet/classic_exp.htm download & look at experiment 14</p> <p>www.wpbschoolhouse.btinter.net.co.uk/page10/page10.htm Click on 'Elements Compounds and Mixtures'</p>
1.2 e f	<p>Methods of purification and analysis use melting point and boiling point data to identify substances and their purity</p> <p>explain that the measurement of purity in everyday substances (e.g. drugs, foodstuffs) is important</p>	<p>Suggested activity: An experiment to plot a cooling curve for stearic acid or phenyl salicylate (salol) (pure substances), and for wax (a mixture). Data loggers can be used if available. Melt each in a boiling tube in a water bath of boiling water. Plot temperature against time as the solid cools and solidifies.</p> <p>Students can practise using data books or an online database by looking up the melting points of elements and compounds (e.g. all elements in group I or VII)</p>	<p>Students should recognise that pure substances have sharp melting points but impure substances and mixtures melt over a range of temperature. Again emphasise the energy changes involved in the cooling pattern. This activity forms a basis for work on Group trends in Unit 2</p>	<p>www.webelements.com</p> <p>www.chemsoc.org/viselements</p> <p>www.miamisci.org/af/sln/phases/</p>
a b	<p>describe methods of purification by the use of a solvent, filtration and crystallisation, distillation and fractional distillation. Explain the difference between simple distillation and fractional distillation.</p>	<p>Suggested experiments: Separating mixtures e.g. salt from rock salt, pure water from sandy sea water. Demonstration: propanone from a propanone/water mixture using a heating mantle</p>	<p>This links to water purification (Syllabus learning objectives 10.2 (c) and (d))</p> <p>Stress the usefulness of fractional distillation as it appears later for industrially separating fractions from crude oil or the gases from air.</p>	<p>For background information on Salt extraction: www.british-salt.co.uk www.lionsaltworkstrust.co.uk</p> <p>www.chemsoc.org/networks/learnnet/classic_exp.htm Look at experiment 1 and 99 http://www.boc.com/education/index.html</p>

				www.wpbschoolhouse.btinter.net.co.uk/page10/page10.htm Click on 'Elements Compounds and Mixtures'
c	describe chromatography and interpret chromatograms using known samples and R _f values	Suggested experiments: Chromatography of food colourings or ink from felt tip pens. Dyes from sugar coated sweets can be used by transferring the dye to filter paper using a damp paint brush. Students can carry out chromatography of permanent inks using methanol as a solvent.	This links to the identification of amino acids from hydrolysed proteins (11.5 (k)), a technique used to diagnose some illnesses e.g. diabetes. The separation of food colourings can be carried out on paper and thin layer chromatography – the R _f values change using the different methods.	Use Google to search for images of 'chromatography'; click on the image tab then enter 'chromatography' – there are lots of colourful images available to show to students as well as examples of other types of chromatographs including gas/liquid. www.chemsoc.org/networks/learnnet/classic_exp.htm Look at experiments 4, 40, 71
d	explain the need to use locating agents in chromatography of colourless compounds			
2.2	Atomic Structure	Suggested activities:	Students need to learn the definitions of key terms e.g. proton, neutron, electron, proton number, nucleon number. The terms atomic number and mass number are used throughout as well as proton and nucleon number.	www.science.howstuffworks.com/atom
a	State the relative charges and masses of a proton, neutron and an electron. Define atomic (proton) number and mass (nucleon) number. Define the term isotopes and know that some are radioactive. Be able to interpret and use atomic symbols as shown on the Periodic Table Be able to use diagrams to represent atoms with electrons arranged in shells.	Students use information from the Periodic Table to draw the atoms of the first twenty elements using crosses to represent electrons in circles to represent electron shells. These can be made colourful and used to make a class wall display. Diagrams such as these can be particularly useful in emphasising the difference between isotopes. Isotopes with unstable nuclei are radioactive.	The concept of relative atomic mass (A_r) can be introduced here in relation to the values quoted in the Periodic Table (Syllabus learning outcome 3(e))	http://www.schoolscience.co.uk/content/index.asp click on 'Inside Atoms' http://www.crocodile-clips.com/absorb/AC4/m3.htm click on 'free chapters' and go to 'structure of the atom' and click on 'view unit' www.schoolscience.co.uk

				<p>Click on: 'Physics' → 14-16 → 'A world of atoms'</p> <p>www.s-cool.co.uk/contents.asp click on 'GCSE revision' then 'Chemistry' then choose topic: 'Atomic Structure'. Use the 'Quick learn' section.</p> <p>www.wpbschoolhouse.btinternet.co.uk/page10/page10.htm Click on 'Atomic Structure' and 'Atomic Structure and Radioactivity'</p>
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