GCSE
SCIENCE

Science hub meeting

Booklet 2: Extracts from GCSE science schemes of work

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Contents

Extract from GCSE Biology Scheme of Work:

Topic 1 – Cell biology

4.1.3 Transport in cells

Spec ref.	Summary of the specification content	Learning outcomes *What most students should be able to do*	Suggested timing (hours)	Opportunities to develop Scientific Communication skills	Opportunities to develop and apply practical and enquiry skills
4.1.3.1	Diffusion Substances can move into and out of cells across membranes by diffusion. Definition of diffusion and factors affecting rate. Oxygen, carbon dioxide and urea passes through cell membranes by diffusion. Single celled organisms have a bigger surface area to volume ratio than multicellular organisms, so transfer sufficient substances across their surface.	Define the term 'diffusion'. Explain how temperature, concentration gradient and surface area affect the rate of diffusion. Give examples of substances that diffuse into and out of cells. Calculate and compare surface area: volume ratios. Explain how the small intestine and lungs in mammals, and roots and leaves in plants, are adapted for exchange of substances. Describe and explain how an exchange surface is made more effective.	2	Observe demos and suggest explanations: • Time how long it is before students can smell a perfume placed in a corner of the room. • Is the rate of diffusion different for different gases? Use concentrated ammonium hydroxide and hydrochloric acid in a large glass tube. • Does temperature affect the rate of diffusion? Fresh beetroot placed in iced water and warm water. Record observations and suggest explanations. Watch a video or computer simulation of diffusion on BBC or McGraw-Hill website.	Choose investigations as appropriate: • Potassium permanganate in beaker of water; potassium permanganate on agar • Investigate diffusion of different acids and alkalis through agar • Investigate rate of diffusion of glucose through cellulose tubing • Use digital microscope to observe diffusion of particles in milk or yogurt solution Model diffusion.

	Multicellular organisms require specialised organ systems to exchange sufficient substances. Factors affecting the effectiveness of an exchange surface.			Role play diffusion in gases and liquids at different temperatures and concentrations. Observe micrographs of exchange surfaces in plants and animals. Make drawings and relate structure to function. Produce a mind map to summarise diffusion and exchange surfaces.	Observe slides or micrographs of villi, alveoli, root hair cells and leaves. Calculate surface area: volume ratios for different sized objects or using data about organisms.
4.1.3.2	Osmosis Water may move across cell membranes by osmosis. Osmosis is the movement of water from a dilute solution to a more concentrated solution through a partially permeable membrane. **Required Practical: Osmosis** Investigate the effect of a range of concentrations of salt or sugar solutions on the mass of plant tissue.	Define the term 'osmosis'. Apply knowledge of osmosis to unfamiliar situations and make predictions.	2	Set up a simple osmometer at the start of the lesson and measure how far the liquid in the capillary tube rises during the lesson. Explain the movement of water molecules as a special type of diffusion through a partially permeable membrane. Predict and explain what will happen to cellulose tubing bags filled with water or sugar solution, placed in beakers of water or sugar solution. Observe and explain the effects of water and concentrated salt solution on cells of onion/ beetroot/ rhubarb. Use a model to show osmosis or get students to make a model.	Make predictions with explanations. Investigate the effect of water and concentrated salt solution on onion/ beetroot/ rhubarb cells. Model osmosis.

				Watch a computer simulation of osmosis in plant and animal cells. Watch a video clip of osmosis in blood cells.	
4.1.3.3	Active transport This topic is covered in section 4.2.3.2 Plant organs and referred to when teaching digestion and absorption. There are links with 4.3.3.1 Plant diseases.				

Extract from GCSE Chemistry Scheme of Work:

Topic 4 – Chemical changes

4.4.2 Reactions of acids

Spec ref.	Summary of the specification content	Learning outcomes *What most candidates should be able to do*	Suggested timing (hours)	Opportunities to develop Scientific Communication skills	Opportunities to develop and apply practical and enquiry skills
4.4.2.1	Acids react with some metals to produce salts and hydrogen.	Knowledge of reactions limited to those of magnesium, zinc and iron with hydrochloric and sulfuric acids. (HT only) Explain in terms of gain or loss of electrons, that these are redox reactions. (HT only) Identify which species are oxidised and which are reduced in given chemical equations. WS 4.1	1		Investigate the reactions of the following metals with sulfuric acid: • magnesium • zinc • iron. Write word and balanced symbol equations for these reactions. Use the balanced symbol equations to identify which species have been oxidised and which have been reduced. Explain why each species has been oxidised or reduced.
4.4.2.2	Acids are neutralised by alkalis (eg soluble metal hydroxides) and bases (eg insoluble metal hydroxides	Predict products from given reactants.	2	Define the term neutralisation. Using common reactants, predict the products.	Investigate the following reactions: • acids + soluble metal hydroxide • acid + insoluble metal hydroxide

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	and metal oxides) to produce salts and water, and by metal carbonates to produce salts, water and carbon dioxide. The particular salt produced in any reaction between an acid and a base or alkali depends on: • the acid used (hydrochloric acid produces chlorides, nitric acid produces nitrates, sulfuric acid produces sulfates) • the positive ions in the base, alkali or carbonate.	Use the formulae of common ions to deduce the formulae of salts.			• acids + metal carbonates. Write word and balanced symbol equations for these reactions.
4.4.2.3	Soluble salts can be made from acids by reacting them with solid insoluble substances, such as metals, metal oxides, hydroxides or carbonates. The solid is added to the acid until it no more reacts and the excess solid is filtered off to produce a solution of the salt.	Describe how to make pure, dry samples of named soluble salts from information provided. WS 2.3, 2.4	2	Extended writing: describe how to make a pure, dry sample of a soluble salt. Define the terms: • soluble • insoluble. Explain what is meant by a soluble salt.	**Required practical 1:** Preparation of a pure, dry sample of a soluble salt from an insoluble oxide or carbonate using a Bunsen burner to heat dilute acid and a water bath or electric heater to evaporate the solution. AT skills covered by this practical activity: 2, 3, 4 and 6

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	Salt solutions can be crystallised to produce solid salts.			Explain why reactants are often used in excess.	
4.4.2.4	Acids produce hydrogen ions (H^+) in aqueous solutions. Aqueous solutions of alkalis contain hydroxide ions (OH^-). The pH scale, from 0 to 14, is a measure of the acidity or alkalinity of a solution, and can be measured using universal indicator or a pH probe. A solution with pH 7 is neutral. Aqueous solutions of acids have pH values of less than 7 and aqueous solutions of alkalis have pH values greater than 7. In neutralisation reactions between an acid and an alkali, hydrogen ions react with hydroxide ions to	Describe the use of universal indicator or a wide range indicator to measure the approximate pH of a solution. Use the pH scale to identify acidic or alkaline solutions. WS 1.2, 2.6, 4.1	2	Define the following terms: • acid • base • alkali • neutral. Recall the pH numbers for the following solutions: • acidic • alkaline • neutral. Write the symbol equation for the neutralisation of an acid and an alkali.	Measure the pH of a variety of the following solutions: • acidic • alkaline • neutral. Practical: measure the pH change when a strong acid neutralises a strong alkali. This is best done using a data logger and pH probe or digital pH meter. AT3.

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	produce water. This reaction can be represented by the equation: $H^+ (aq) + OH^- (aq) \rightarrow H_2O (l)$				
4.4.2.5	The volumes of acid and alkali solutions that react with each other can be measured by titration using a suitable indicator.	Describe how to carry out titrations using strong acids and strong alkalis only (sulfuric, hydrochloric and nitric acids only) to find the reacting volumes accurately. (HT Only) Calculate the chemical quantities in titrations involving concentrations in mol/dm^3 and in g/dm^3. WS 2.4, 2.6 MS 1a, 1c, 2a	2		**Required practical 2:** Determination of the reacting volumes of solutions of a strong acid and a strong alkali by titration. (HT only) determination of the concentration of one of the solutions in mol/dm^3 and g/dm^3 from the reacting volumes and the known concentration of the other solution. AT skills covered by this practical activity: 1 and 8.
4.4.2.6 (HT only)	A strong acid is completely ionised in aqueous solution. Examples of strong acids are hydrochloric, nitric and sulfuric acids. A weak acid is only partially ionised in aqueous solution.	Use and explain the terms dilute and concentrated (in terms of amount of substance), and weak and strong (in terms of the degree of ionisation) in relation to acids.	1	Explain the meaning of the following terms: • dilute • concentrated • weak • strong.	Use universal indicator or a pH probe to measure the pH of hydrochloric acid, ethanoic acid, sodium hydroxide and ammonium hydroxide. Be careful to use the same concentration of each. Measure the pH of different acids at different concentrations.

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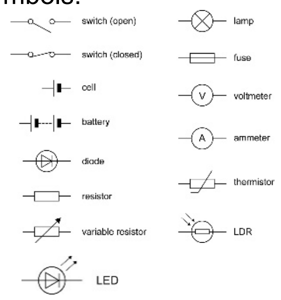
	Examples of weak acids are ethanoic, citric and carbonic acids. For a given concentration of aqueous solutions, the stronger an acid, the lower the pH. As the pH decreases by one unit, the hydrogen ion concentration of the solution increases by a factor of 10.	Describe neutrality and relative acidity in terms of the effect on hydrogen ion concentration and the numerical value of pH (whole numbers only). WS 4.1 MS 2h		Explain why strong acids are completely ionised in aqueous solutions but a weak acid is only partially ionised. Recall examples of strong and weak acids. Describe neutrality in terms on hydrogen ion concentration. Describe relative acidity in terms of hydrogen ion concentration.	Compare the rate of reaction when magnesium is dipped in hydrochloric acid and ethanoic acid of the same concentration. AT 8

Extract from GCSE Physics Scheme of Work:

Topic 2 – Electricity

4.2.1 Current, potential difference and resistance

Spec ref.	Summary of the specification content	Learning outcomes *What most candidates should be able to do*	Suggested timing (hours)	Opportunities to develop Scientific Communication skills	Opportunities to develop and apply practical and enquiry skills
4.2.1.1	How to draw circuit symbols.	Circuit diagrams use standard symbols: 	0.5	Recall circuit symbols. Identify circuit symbols used in a circuit. Construct circuit diagrams using standard symbols. Ask questions such as: • Why are circuit symbols used? • How are the electrical components connected together to form a circuit? • What happens to the energy store of a cell/battery when it is connected into a circuit? Play generation game with the circuit symbols shown on a PowerPoint. Give pupils 2 minutes to draw and	Set up simple circuits from circuit diagrams. Circuits need to include voltmeters and ammeters so that students are aware of how these devices are connected.

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				label all of them – allow less time for more able pupils.	
4.2.1.2	Electric currents are the flow of charge. Equation for electric current as the rate of flow of charge should be known.	For electrical charge to flow through a closed circuit the circuit must include a source of potential difference. Electric current is a flow of electrical charge. The size of the electric current is the rate of flow of electrical charge. Charge flow, current and time are linked by the equation: $charge\ flow =$ $current\ x\ time$ $[Q = I\ t]$ charge flow, *Q*, in coulombs, C current, *I*, in ampere, A time, *t*, in seconds, s	1	Define potential difference. State the name of the particle that carries the electrical charge round a circuit. Ask questions such as: • What is an electric current? • Which particle moves to cause an electric current? • What makes the particle move? Define an electric current. Describe and explain why an electric current will flow in a circuit. Describe different models of electricity including: • marbles moving down a ramp with masses placed on the ramp to represent atoms • rope models of electricity with knots or marks on the rope to represent electrons • students modelling the electrons taking energy (sweets) from the	Demonstrate models of electricity and discuss what each part of the model represents and what makes the particles move. Examples could include the rope model, sweets model, water flow model, etc. Model the flow of an electric current using various models and also video clips available on YouTube, eg [Modelling electric current](#). Describe how the model represents an electric current and the limitations of the model.

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				battery (teacher) to a component (cup held by a pupil). Evaluate the benefits and drawbacks of each model. Calculate the charge flow, current or time when given the other two values. State the units used for each quantity.	
4.2.1.3	The current in a series circuit.	The current at any point in a series circuit has the same value as the current at any other point in the same circuit..	1	Draw a circuit that can be used to measure the current in a component. Describe how the current varies in a series circuit. Explain why the current at each point in a series circuit must be the same in terms of electrons not being lost from the wire.	Investigate the current at various points within a series circuit. Does the current vary if the ammeter is placed either side of a component? Link this idea about the current in a series circuit being the same throughout the circuit to the models of electricity looked at previously.
4.2.1.3	How the resistance of a component affects the current through it.	The current through a component depends on both the resistance of the component and the potential difference across the component. The greater the resistance of the component the smaller the current for a given	1	Define resistance. Describe and explain how increasing the resistance in a circuit will affect the current through the circuit.	What is resistance? Why are materials with low resistance chosen for power cables? What are superconductors?

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		potential difference (p.d.) across the component.			Model the effect of resistance on a circuit. You can do this with clear tubing and coloured water to act as the current. Pinch the tubing to show higher resistance. Investigate how increasing the resistance of a circuit affects the current.
4.2.1.3	How potential difference, current and resistance are linked. Equation linking potential difference, current and resistance should be known. How to find the resistance of electrical components by experiment.	Current, potential difference or resistance can be calculated using the equation: $potential\ difference = current\ x\ resistance$ $[V = I R]$ potential difference, V, in volts, V current, I, in amperes, A resistance, R, in ohms, Ω Explain the design and use of a circuit to measure the resistance of a component by measuring the current through, and potential difference across, the component.	1	Use the equation $V = I R$ to calculate the potential difference (voltage), current or resistance when given the other two values. State the correct SI units for each quantity (potential difference, current and resistance). How does the type of metal used for a wire affect its resistance? Why do expensive scart leads have gold plating on them? What factors affect the resistance of a given length of wire? Draw a circuit that can be used to find the resistance of an electrical	How can the resistance of a component be calculated using the current and potential difference? Why does increasing the potential difference in a circuit also increase the current? What is meant by resistance? Find the resistance of some electrical components using current and potential difference readings. **Required practical:** Use circuit diagrams to set up and check appropriate circuits to

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		Students should set up and use a circuit to investigate a factor/ the factors that affect the resistance of an electrical component(s).		component using a voltmeter and an ammeter.	investigate the factors affecting the resistance of electrical circuits. This should include: • the length of a wire at constant temperature • combinations of resistors in series and parallel (8.2.3). Explain how the circuit for determining the resistance will give you the value of resistance from a simple calculation or graphical methods. Analyse the results of the investigation to describe and explain how the resistance is affected.
4.2.1.4	Ohm's law and the conditions needed for it to apply. Current-potential difference graphs for electrical components.	The current through an ohmic conductor (at a constant temperature) is directly proportional to the potential difference across the resistor. This means that the resistance remains constant as the current changes.	1	Define what is meant by an ohmic conductor. What components are ohmic conductors? Describe the conditions for which Ohm's law is valid.	Find the resistance of a resistor by experiment. Plot an I-V graph for the resistor, disconnecting the power supply unit between readings to let the resistor cool down. Calculate the resistance from the graph and compare with

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				Explain why Ohm's law is not valid when the temperature of the conductor increases in terms of collisions. Draw the I-V graph for an ohmic conductor. Explain the shape of the I-V graph of the ohmic conductor.	the known value from the colour coding on the resistor. **Required practical *:** Use circuit diagrams to construct appropriate circuits to investigate the I–V characteristics of a variety of circuit elements including a filament lamp, a diode and a resistor at constant temperature. (8.2.4) *This activity is spread over two sessions.
4.2.1.4	How the resistance of electrical components change with external conditions. Current-potential difference graphs for electrical components.	The resistance of components such as filament lamps, diodes, thermistors and LDRs is not constant; it changes with the current through the component. The resistance of a filament lamp increases as the temperature of the filament increases. The current through a diode flows in one direction only. The diode has a very high resistance in the reverse direction.	1.5	Draw the I-V graphs for a filament lamp and a diode. Explain the shape of the resulting graph in terms of resistance and current. Draw graphs to show how the resistance of an LDR will vary with light intensity and of a thermistor with temperature. Why do the current-potential difference graphs for diodes and	**Required practical *:** Use circuit diagrams to construct appropriate circuits to investigate the I–V characteristics of a variety of circuit elements including a filament lamp, a diode and a resistor at constant temperature. (8.2.4) Plot the graphs for these components and explain the resulting shape in terms or resistance.

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		The resistance of a thermistor decreases as the temperature increases. The resistance of an LDR decreases as light intensity increases.		filament lamps look different to that of an ohmic conductor? Calculate the resistance of an LDR or a thermistor given the range of resistances for that component and the conditions that it is placed in. Describe and explain real world applications of thermistors and LDRs including thermostats and switching on lights.	Plan and carry out an investigation into how the resistance of an LDR varies with light intensity and how the resistance of a thermistor varies with temperature. *continued from the previous session.

Contact us

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