Unit 1: Principles and Applications of Biology

Learning Activities and Resources

This section offers a preview of how a scheme of work may be designed for this unit. It includes suggestions for each aspect of the specification, and suggested resources to coincide with the teaching and learning planner activities and resources. Both resources can be used alongside each other or in isolation.

Please note that the suggestions provided below are suggestions and are not mandatory, this resource is to support delivery of the qualification.

No.	Lesson Title	Topic	Spec Ref	Learning Objectives	Learning Tasks/Activities	Resources	Self-Directed Study	Differentiation	Stretch and Challenge
1	Introduction to Cell Structure and Function	A1 - Structure and function of cells and tissues	A1.1.2	1. Understand the basic structure of eukaryotic cells. 2. Identify key organelles in plant and animal cells. 3. Explain the role of organelles in cell function.	Whole-class teaching: Presentation on eukaryotic cell structure (15 min). Activity: Create jelly cells with sweets to represent organelles (e.g., gummy sweets for nucleus, sprinkles for ribosomes) for plant and animal cells (30 min). Discussion: Compare plant and animal cell structures in small groups (15 min).	STEM.org.uk: Cell organelle resources (https://www.stem.org.uk/resources/elibrary/resource/34589/cell-suitable-home-teaching). Sweets, bowls, labels for jelly cell activity.	Research the function of one organelle (e.g., mitochondria) and write a 100word summary (1-2 hours). Watch a video on cell structure (e.g., Khan Academy) and list three key points (30 min).	Support: Provide prelabelled diagrams for jelly cell activity. Extension: Include prokaryotic cells in the comparison.	Create a short video explaining how organelle structure relates to function (2-3 hours).

2	Comparing Plant and Animal Cells	A1 - Similarities and differences between animal and plant cells	A1.1.2 A1.3	1. Identify similarities and differences between plant and animal cells. 2. Create a game to reinforce organelle knowledge. 3. Explain the functional significance of structural differences.	Small group activity: Design a card or board game (e.g., pair matching game with organelle names and functions) (40 min). Present games to the class and play in groups (20 min).	Wordwall: Virtual cell organelle matching game (https://wordwall.net/resource/123456/cell-organelle-matchinggame). Cardstock, markers, game templates.	Create a digital version of the card game using Quizlet (1-2 hours). Read an article on plant vs. animal cells and summarize differences (1 hour).	Support: Provide a list of organelles and functions for the game.	Design a game that includes prokaryotic cell structures (2 hours).
3	Identifying Cell Organelles	A1 - Identifying different cell organelles	A1.2	1. Label organelles in plant and animal cell diagrams. 2. Describe the function of each organelle. 3. Organize similarities and differences using a Venn diagram.	Individual activity: Label highresolution diagrams or electron micrographs (20 min). Create a Venn diagram comparing cell structure, organelles, functions, and cell type (25 min). Class discussion to share Venn diagrams (15 min).	Histology Guide: TEM cell structures (https://histologyguide.com/). Diagram worksheets, electron micrographs.	Write a 150-word explanation of how organelle differences support cell function (1-2 hours). Review a labelled cell diagram online and quiz yourself on organelle functions (30 min).	Support: Provide partially completed Venn diagrams. Extension: Include prokaryotic cells in the Venn diagram.	Research organelle adaptations in specialized cells (e.g., chloroplasts in guard cells) (2 hours).

4	Microscopy and Slide Preparation	A1 - Using a microscope and preparing slides	A1.2 A1.5	1. Prepare and stain microscope slides of plant and animal cells. 2. Use a microscope to observe cell structures.	Laboratory activity: Prepare slides of cheek cells (methyl blue) and onion skin cells (iodine) (30 min). Observe slides under a microscope and create annotated drawings (30	STEM Learning: Cheek cell practical methodology (https://www.stem.org.uk/resources Hawkins).	Watch a video on microscope techniques and summarize key points (30 min).	Support: Provide preprepared slides for observation.	Write a short report comparing optical and electron

				3. Calculate cell sizes using IAM calculations.	min). Perform IAM calculations to estimate cell sizes (30 min).	Microscopes, slides, stains, graticules.	Practice IAM calculations using provided micrographs (1 hour).	Extension: Calculate cell sizes using electron micrographs.	microscopy (2 hours).
5	Prokaryotic Cell Structures	A1 - Subcellular features of prokaryotes	A1.1.1 A1.4	1. Identify subcellular structures in prokaryotic cells. 2. Calculate cell sizes using electron micrographs. 3. Compare prokaryotic and eukaryotic cells.	Whole-class activity: Label electron micrographs of prokaryotic cells (20 min). Perform IAM calculations for prokaryotic cell sizes (20 min). Group discussion on prokaryotic vs. eukaryotic cells (20 min).	IB Guides: Prokaryotic cell electron micrographs (https://ibguides.com/biology/notes/prokaryotic-cells). Electron micrograph images.	Create a comparison table of prokaryotic and eukaryotic cells (1 hour). Research bacterial cell wall types (e.g., Grampositive vs. Gramnegative) (1 hour).	Support: Provide labelled prokaryotic cell diagrams. Extension: Research bacterial cell wall differences.	Analyse the evolutionary significance of prokaryotic structures (2 hours).

6	Knowledge Check - Cell Structure	A1 - Knowledge check	A1.1A1.5	1. Consolidate knowledge of cell structure terminology. 2. Apply knowledge in interactive quizzes. 3. Review key concepts through peer discussion.	Individual activity: Complete quizzes on Quizlet, Kahoot, or Quizizz (30 min). Peer review of quiz results and glossary creation (30 min).	Quizlet: Cell structure flashcards (https://quizlet.com/_/cellstructure). Quiz platforms, glossary templates.	Create a personal glossary of 10 key cell structure terms (1 hour). Review cell structure notes and create a concept map (1 hour).	Support: Provide a premade glossary.	Design a quiz question set for peers (1-2 hours).
7	Introduction to Specialized Cells	A2 - Structure and function of specialized cells	A2.1	1. Understand the concept of stem cells and differentiation. 2. Discuss the role of specialized cells in multicellular organisms. 3. Identify examples of specialized cells.	Whole-class teaching: Introduce stem cells and differentiation via video (20 min). Group discussion on stem cell applications and ethics (20 min). Q&A session to clarify concepts (20 min).	YouTube: Stem cells video (https://youtu.be/-uno7Uj2cjk). Nature article: Stem cell therapy (https://www.nature.com/articles/s41392-022-01134-4).	Summarize a recent stem cell research article (100 words, 1-2 hours). Watch a TED Talk on stem cells and note key points (30 min).	Support: Provide guided notes on stem cells. Extension: Discuss embryonic vs. adult stem cells.	Debate the ethical implications of stem cell research (2 hours).

8	Specialized Cell Identification	A2 - Specialized cell activity	A2.1	1. Identify characteristics of specialized cells. 2. Share information about specialized cells with peers. 3. Relate cell structure to function.	Small group activity: Students assigned a specialized cell, circulate to gather info (30 min). Create a table summarizing cell types and functions (30 min).	Quizlet: Specialized cells flashcards (https://quizlet.com/ /specialise d-cells).	Research one specialized cell type in detail (1-2 hours). Create a flashcard set for specialized cells (1 hour).	Support: Provide a list of cell types and functions. Extension: Include less common cell types (e.g., guard cells).	Create a poster linking cell structure to function (2 hours).
9	Plant Tissue Dissection	A2 - Investigating plant tissues	A2.1	1. Dissect plant parts to identify tissues. 2. Explain the function of specialized plant cells. 3. Relate cell structure to tissue function.	Laboratory activity: Dissect plant parts (roots, stem, flower) (40 min). Create annotated diagrams of plant tissues (30 min). Discuss position of specialised cells in plant anatomy in small groups (20 min).	Science Sparks: Flower dissection (https://www.sciencesparks.com/plant-sciencedissect-a-flower). Dissection kits, plant specimens.	Write a 150-word report on plant tissue functions (1-2 hours). Watch a video on plant anatomy and summarize (30 min).	Support: Provide predissected plant parts. Extension: Compare monocot and dicot tissues.	Research adaptations of xerophytic plant tissues (2 hours).
10	Transpiration in Plants	A2 - Investigating transpiration	A2.1	1. Investigate transpiration using celery. 2. Explain how transpiration relates to cell structure.	Laboratory activity: Set up celery in food-coloured water (15 min, results observed next day). Discuss results in relation to xylem function (30 min). Summarize findings in pairs (15 min).	Science on the Shelves: Celery transpiration (https://www.york.ac.uk/res/sots/activities/celery.htm). Celery, food colouring, knives.	Watch a video on transpiration and summarize key points (30 min). Research transpiration in	Support: Provide pre-cut celery samples.	Design an experiment to test environmental effects on

				3. Analyse water movement in plants.			different plant types (1 hour).		transpiration (2 hours).
11	White Blood Cells	A2 - White blood cells	A2.1	1. Understand white blood cell structure and function. 2. Create a visual representation of white blood cell action. 3. Relate structure to immune function.	Whole-class teaching: Watch video on white blood cells (15 min). Individual activity: Create a cartoon strip depicting white blood cell actions (30 min). Share cartoons in small groups (15 min).	YouTube: White blood cells video (https://youtu.be/qWSWWPZYGHU). Drawing materials, cartoon templates.	Research one type of white blood cell in detail (1-2 hours). Create a concept map of immune system components (1 hour).	Support: Provide cartoon strip templates. Extension: Include all white blood cell types in the cartoon.	Create a short animation of white blood cell action (2-3 hours).
12	Sex Cells	A2 - Sex cells	A2.1	1. Describe sperm and egg cell structure and function. 2. Create 3D models of sex cells. 3. Explain the process of fertilization.	Whole-class teaching: Introduce sex cells via video (15 min). Individual activity: Create 3D models of sperm and egg cells using clay (40 min). Group activity: Discuss how structure is adapted to function in sex cells (35 min).	YouTube: Sperm and egg cells video (https://youtu.be/CuxaXghfyeE). Modeling clay, paper, cameras.	Write a 150-word explanation of fertilization (1-2 hours). Research reproductive technologies (1 hour).	Support: Provide premade models for reference.	Research assisted reproductive technologies (2 hours).

13	Knowledge Check - Specialized Cells	A2 - Knowledge check	A2	1. Consolidate knowledge of specialized cell terminology. 2. Apply knowledge in interactive quizzes. 3. Review key concepts through peer discussion.	Individual activity: Complete quizzes on Quizlet or Kahoot (30 min). Peer review of quiz results and glossary creation (30 min).	Quizlet: Specialized cells flashcards (https://quizlet.com/_/specialised-cells). Quiz platforms, glossary templates.	Create a personal glossary of 10 specialized cell terms (1 hour). Review notes and create a mind map of specialized cells (1 hour).	Support: Provide a premade glossary.	Design a quiz question set for peers (1-2 hours).

14	Introduction to Biological Tissues	A3 - Structure and function of biological tissues	A3.1	1. Define cell, tissue, organ, organ system, and organism. 2. Understand the hierarchy of biological organization. 3. Explain the role of tissues in organ function.	Whole-class teaching: Recap cell theory and organization (20 min). Group discussion on tissue functions in organs (20 min). Create a flowchart of biological organization (20 min).	BBC Bitesize: History of the cell (https://bitesizebio.com/166/history-of-cell-biology/).	Create a flowchart of biological organization levels (1 hour). Research tissue types and their roles (1 hour).	Support: Provide a template for the flowchart.	Research tissue engineering applications (2 hours).
15	Epithelial Tissue Microscopy	A3 - Epithelial tissue	A3.1.1 A3.1.2	1. Observe epithelial tissue under a microscope. 2. Compare squamous, goblet, and ciliated cells. 3. Relate cell structure to tissue function.	Laboratory activity: View prepared slides of epithelial cells (40 min). Create annotated diagrams comparing cell types (30 min). Discuss observations in small groups (20 min).	Medicine LibreTexts: Epithelial tissue microscopy (https://med.libretexts.org/Bookshelves/Anatomy_and_Physiology/Examining_epithelial_tissue). Microscopes, prepared slides.	Research one type of epithelial tissue in detail (12 hours). Review epithelial tissue slides online and quiz yourself (30 min).	Support: Provide preannotated diagrams.	Analyse epithelial tissue adaptations in different organs (2 hours).

16	Endothelial Tissue Microscopy	A3.2 - Endothelial tissue	A3.2.1	1. Identify structure of endothelial tissue. 2. Explain functions of endothelial tissue. 3. Relate risk factors to development of atherosclerosis.	Laboratory activity: View prepared slides of endothelial cells (40 min). Create annotated diagrams comparing cell types (30 min). Discuss observations in small groups (20 min).	Microscopes, prepared slides	Summarize endothelial tissue functions in 150 words (1-2 hours).	Support: Provide preannotated diagrams.	Analyse endothelial tissue adaptations in different organs (2 hours).
17	Respiratory and Cardiovascular Diseases	A3 - Respiratory and cardiovascular diseases	A3.1.3	1. Research COPD and/or atherosclerosis 2. Create a slide presentation on disease impacts. 3. Peer teach findings.	Small group activity: Research COPD (30 min). Prepare and present slide deck (30 min).	NHS: Cardiovascular diseases (https://www.nhs.uk/conditions/cardiovascular-disease/). ASH: Smoking and respiratory disease (https://ash.org.uk/resources/smoking-and-respiratory-disease).	Research smoking cessation programs (1 hour).	Support: Provide research templates.	Propose a public health campaign to reduce smoking (2 hours).
18	Muscular Structure and Function	A3 - Structure and function of muscles	A3.3	1. Understand gross and microscopic muscle structure. 2. Compare fast and slow twitch muscle fibres. 3. Perform a chicken wing dissection.	Whole-class teaching: Introduce muscle structure via video (20 min). Laboratory activity: Dissect chicken wing (40 min). Create comparison table of fast and slow twitch fibres (30 min).	YouTube: Muscular system overview (https://youtu.be/rMcg9YzNSEs). ASTA: Chicken wing dissection (https://assist.asta.edu.au/sites/assist.asta.edu.au/files/SOP%20Performing%20a%20chicken%20wing%20dissection.pdf). Chicken wings, dissection kits.	Research muscle fibre types in athletes (1-2 hours). Watch a video on muscle physiology and summarize (30 min).	Support: Provide predissected wings.	Analyse muscle adaptations in elite athletes (2 hours).

19	Nervous Tissue and Neurones	A3 - Structure and function of nervous tissue	A3.4.1 A3.4.2 A3.4.3	1. Compare myelinated and non-myelinated neurones. 2. Create flashcards on neurone differences. 3. Analyse nerve impulse conduction speed.	Whole-class teaching: Discuss neurone types via video (15 min). Create flashcards on myelinated vs. non-myelinated neurones (25 min). Compare impulse speed graphs (20 min).	YouTube: Action potential (https://youtu.be/nV_OEvln9Xs). Flashcard templates, graph data.	Summarize neurone differences in 100 words (1 hour).	Support: Provide premade flashcards.	Research neurodegenerative diseases affecting neurones (2 hours).
20/21	Synaptic Transmission	A3 - Synaptic transmission	A3.4.4 A3.4.5 A3.4.6	1. Understand synapse structure and function. 2. Create a stop-motion model of synaptic transmission. 3. Explain neurotransmitter roles in contributing to health.	Whole-class teaching: Introduce synapses via video (15 min). Small group activity: Create stopmotion model using clay (60 min). Annotate a synapse diagram (10 min). Discussion of imbalances of brain chemicals including Dopamine in Parkinsons (35 min)	YouTube: Nervous system synapse (https://youtu.be/VitFvNvRIIY). Modeling clay, cameras.	Research one neurotransmitter in detail (1-2 hours). Create a flowchart of synaptic transmission (1 hour).	Support: Provide preannotated synapse diagrams.	Create an animation of synaptic transmission (23 hours).
22	Structure and Function of Water	B1 - Structure and function of water	B1.1 B1.2	1. Understand water's chemical structure. 2. Investigate water's properties through experiments.	Whole-class teaching: Discuss water's structure via animation (15 min). Laboratory activity: Carousel of experiments (surface tension, cohesion, polarity, capillary action)	YouTube: Water structure animation (https://youtu.be/A88ih2PQDNs). Homeschool Scientist: Water properties experiments	Summarize water's biological importance in 150 words (1-2 hours). Watch a video on	Support: Provide experiment result templates.	Research water's role in enzyme function (2 hours).

				3. Relate properties to biological roles.	(30 min). Micro-teach in groups on water's properties (15 min).	(https://thehomeschoolscientist.com/testing-the-properties-ofwater/). Soap, pepper, paper clips, food colouring, paper towels.	water's role in cells and note key points (30 min).		

23	Introduction to Carbohydrates	B2 - Structure and function of carbohydrates	B2.1 B2.2	1. Recall carbohydrate structure and function. 2. Create a mind map of carbohydrate knowledge. 3. Discuss carbohydrate roles in biological systems.	Whole-class teaching: Mind map activity on carbohydrates via video (20 min). Group discussion on carbohydrate functions (20 min). Expand mind map in pairs (20 min).	YouTube: Carbohydrates biochemistry (https://www.youtube.com/watch?v=carbohydrates-sugarsbiochemistry).	Expand mind map with additional research (1 hour). Research carbohydrate sources in diet (1 hour).	Support: Provide a starter mind map.	Research carbohydrate metabolism disorders (2 hours).
24	Carbohydrate Structure Modelling	B2 - Structure of carbohydrates	B2.1 B2.2	1. Model monosaccharides, disaccharides, and polysaccharides. 2. Understand chemical bonding in carbohydrates. 3. Relate structure to function.	Small group activity: Create carbohydrate models using sweets and toothpicks (40 min). Produce a key for model components (20 min).	Sweets, toothpicks, modelling guides.	Research one carbohydrate type in detail (1-2 hours).	Support: Provide premade models. Extension: Model complex polysaccharides (e.g., starch).	Analyse carbohydrate digestion pathways (2 hours).
25	Testing for Carbohydrates	B2 - Testing for carbohydrates	B2.3	1. Perform tests for simple sugars and carbohydrates. 2. Analyse test results in relation to structure. 3. Summarize findings using quizzes.	Laboratory activity: Test samples with Benedict's solution and iodine (30 min). Complete interactive quiz on results (15 min). Discuss findings in pairs (15 min).	BBC Bitesize: Food test practical (https://www.bbc.co.uk/bitesize/guides/z88hcj6/revision/5). Quizizz: Biomolecule quizzes (https://quizizz.com/admin/quiz/5c9d5baab2e4c6001afc0f9f/biomolecules). Benedict's solution, iodine, samples.	Write a lab report on carbohydrate testing (1-2 hours).	Support: Provide result tables.	Design an experiment to quantify sugar content (2 hours).

26	Protein Structure Modelling	B3 - Structure and function of proteins	B3.1 B3.2	1. Understand protein structure levels. 2. Build protein models using pipe cleaners and beads. 3. Relate structure to function.	Whole-class teaching: Demonstrate protein modelling (15 min). Individual activity: Build protein models (alpha helices, beta strands) (45 min).	Science and Math with Mrs. Lau: Protein structure activity (https://www.scienceandmathwithmrslau.com/2014/09/hands-onbiochemistry-beads-pipecleaners). Pipe cleaners, coloured beads.	Research one protein's structure and function (1-2 hours). Create a diagram of protein folding (1 hour).	Support: Provide prebuilt models. Extension: Model a specific protein (e.g., haemoglobin).	Analyse protein misfolding diseases (2 hours).
27	Protein Structure Testing	B3 - Structure and function of proteins	B3.3	1. Discuss how to test for the presence of proteins	Whole class activity: Biuret test	Biuret Test for Protein: Principle, Procedure, Results, Uses	Complete interactive learning activity on protein structure (1 hour)	Support: Provide practical support as required	Research limitations of protein biuret test (1 hour)
28	Introduction to Nucleic Acids	B4 - Structure and function of nucleic acids	B4.1 B4.2	1. Discuss DNA discovery history. 2. Understand DNA structure and components. 3. Create annotated DNA drawings.	Whole-class teaching: Discuss Rosalind Franklin's role (20 min). Individual activity: Use virtual lab to visualize DNA, create annotated drawings (40 min).	Nature: Rosalind Franklin article (https://www.nature.com/articles /d41586-023-01313-5). Illumina: DNA structure virtual lab (https://www.illumina.com/content/dam/illuminamarketing/apps/dnaday/index.html).	Summarize Franklin's contribution in 100 words (1 hour). Watch a video on DNA history and note key points (30 min).	Support: Provide preannotated DNA diagrams.	Debate the ethics of DNA discovery credit (2 hours).

29	DNA Modelling and Mutations	B4 - DNA model	B4.1 B4.2	1. Create a 3D DNA model. 2. Discuss DNA mutations and consequences. 3. Relate DNA structure to function.	Small group activity: Build DNA double helix using sweets or molymods (40 min). Group discussion on mutation effects (20 min).	YouTube: Making DNA with sweets (https://www.youtube.com/watch?v=5-f1ja_xn1U). Sweets or molymods.	Research one type of DNA mutation (1-2 hours). Create a diagram of DNA replication (1 hour).	Support: Provide premade DNA models.	Analyse mutation impact on protein synthesis (2 hours).

30	DNA Extraction from Fruit	B4 - Extract DNA from fruit	B4.1 B4.2	1. Extract DNA from fruit cells. 2. Explain the purpose of each extraction step. 3. Relate DNA extraction to cell structure.	Laboratory activity: Extract DNA from strawberries (45 min). Discuss the role of mashing, detergent, and heating (30 min). Summarize findings in pairs (15 min).	FutureLearn: DNA extraction procedure (https://www.futurelearn.com/info/courses/biochemistry/0/steps/21918). Fruit, detergent, extraction materials.	Write a lab report on DNA extraction (1-2 hours).	Support: Provide stepby-step instructions.	Design an experiment to optimize DNA extraction (2 hours).
31	Introduction to Lipids	B5 - Structure and function of lipids	B5.1 B5.2	1. Understand triglyceride, phospholipid, and cholesterol structure. 2. Create a table comparing lipid properties. 3. Discuss lipid functions.	Whole-class teaching: Discuss lipid structure via video (15 min). Create a table comparing lipid properties (30 min). Class discussion on lipid roles (15 min).	YouTube: Lipid overview (https://youtu.be/Ezp8F7XJHWE) LibreTexts: Functions of projects (https://med.libretexts.org/Courses/Metropolitan_State_University_of_Denver/Introduction_to_Nutrition_(Diker)/05%3A_Lipids/5.3%3A_Functions_of_Lipids).	Summarize lipid functions in 150 words (1-2 hours).	Support: Provide a partially completed table.	Research lipidrelated disorders (e.g., atherosclerosis) and link to previous content (2 hours).

32	Lipid Structure Modelling	B5 - Structure of lipids	B5.1 B5.2	1. Create paper models of lipid structures. 2. Identify key components (glycerol, fatty acids, phosphate groups). 3. Relate lipid structure to function.	Small group activity: Produce paper models of lipids (40 min). Discuss model components in groups (20 min).	Behind the Biology Lessons: Lipid paper models (https://behindthebiologylessons.wordpress.com/2023/12/27/using-lipids-as-the-basis-of-asynoptic-lesson/). Paper, art supplies.	Research one lipid type in detail (1-2 hours). Create a diagram of lipid bilayer formation (1 hour).	Support: Provide pre-cut paper models. .	Analyse lipid bilayer formation in membranes (2 hours).
33	Functions of Lipids	B5 - Function of lipids	B5.2 B5.3	1. Research lipid functions (energy storage, insulation, membrane formation). 2. Create a slide presentation on lipid functions.	Small group activity: Research lipid functions and prepare slide deck (20 min). Present findings to the class (20 min). Testing for presence of lipids (20 mins)	LibreTexts: Functions of lipids (https://med.libretexts.org/Courses/Metropolitan_State_University_of_Denver/Introduction_to_Nutrition_(Diker)/05%3A_Lipids/5.3%3A_Functions_of_Lipids).	Summarize one lipid function in 100 words (1 hour). Research lipid roles in cell	Support: Provide research templates.	Propose a study on lipid dietary impacts (2 hours).

				3. Discuss how to test for presence of lipids.			signalling (1 hour).		
34	Lipid Discussion - Reindeer Hooves	B5 - Class discussion about reindeers	B5	1. Understand unsaturated fatty acids in membranes. 2. Discuss environmental impacts on lipid composition. 3. Debate lipid differences in reindeer.	Whole-class discussion: Analyse reindeer hoof lipid composition (30 min). Group debate on proposed explanations (30 min).	YouTube: Lipid overview (https://youtu.be/Ezp8F7XJHWE).	Research fatty acid saturation in other animals (1-2 hours). Create a diagram of membrane lipid structure (1 hour).	Support: Provide discussion prompts.	Propose an experiment to test lipid adaptation hypotheses (2 hours).

35	Knowledge Check - Biological Molecules	B5 - Knowledge check	B1-B5	1. Consolidate biological molecule terminology. 2. Apply knowledge in interactive quizzes. 3. Review concepts through peer discussion.	Individual activity: Complete quizzes on Quizlet or Kahoot (30 min). Peer review of quiz results and glossary creation (30 min).	Quizlet: Biological molecules flashcards (https://quizlet.com/ /biologicalmolecules).	Create a personal glossary of 10 biological molecule terms (1 hour). Review notes and create a concept map (1 hour).	Support: Provide a premade glossary.	Design a quiz question set for peers (1-2 hours).
36	Introduction to Cell Transport Mechanisms	C1 - Cell transport mechanisms	C1.1	1. Identify cell membrane components. 2. Understand the fluid mosaic model. 3. Discuss membrane component roles in transport.	Whole-class teaching: Discuss cell membrane structure via video (15 min). Individual activity: Create a presentation on the fluid mosaic model (30 min). Class discussion to share presentations (15 min).	YouTube: Inside the cell membrane (https://youtu.be/qBCVVszQQNs) . NHGRI: Cell membrane structure (https://www.genome.gov/genetics-glossary/Cell-MembranePlasma-Membrane).	Summarize the fluid mosaic model in 100 words (1 hour). .	Support: Provide presentation templates.	Research membrane repair mechanisms (2 hours).
37	Membrane Permeability	C1 - Membrane permeability	C1.1 C1.2	1. Investigate temperature effects on membrane permeability. 2. Analyse results using a	Laboratory activity: Test beetroot cylinders at different temperatures (45 min). Analyse results with a colorimeter (30	SNAB Biology: Temperature and membranes (https://snabbiology.com/effectof-temperature-on-cell-	Write a lab report on membrane permeability (1-2 hours).	Support: Provide result tables.	Design an experiment to test solvent effects on
				colorimeter. 3. Relate findings to membrane structure.	min). Discuss findings in pairs (15 min).	membranes). Beetroot, colorimeter, water baths.	Research membrane fluidity factors (1 hour).		membranes (2 hours).

38	Diffusion in Agar Cubes	C1 - Diffusion	C1.2	1. Investigate diffusion rates in agar cubes. 2. Analyse cube size effects on diffusion. 3. Relate diffusion to cell size.	Laboratory activity: Create agar cubes, place in HCl, measure diffusion (45 min). Analyze results in groups (30 min). Summarize findings (15 min).	Royal Society of Biology: Diffusion experiment (https://practicalbiology.org/exchange-ofmaterials/diffusion/effect-ofsize-on-uptake-by-diffusion). Agar, HCl, indicators.	Summarize diffusion principles in 100 words (1 hour). Research diffusion in biological systems (e.g., alveoli) (1 hour).	Support: Provide pre-cut agar cubes. Extension: Quantify diffusion rates mathematically.	Analyse diffusion in biological systems (2 hours).
39	Osmosis in Potato or Eggs	C1 - Investigating osmosis	C1.2	1. Investigate osmosis using potato or eggs. 2. Calculate percentage mass change. 3. Explain osmosis in relation to membranes.	Laboratory activity: Place potato slices or de-shelled eggs in solute solutions, measure mass changes (45 min). Plot results on a graph (30 min). Discuss osmosis in pairs (15 min).	Data Classroom: Potato osmosis lab (https://dataclassroom.com/potato-osmosis-lab). YouTube: Naked egg osmosis (https://www.youtube.com/watch?v=SrON0nEEWmo). Potatoes, eggs, vinegar, solute solutions.	Write a lab report on osmosis (1-2 hours). Research osmotic regulation in cells (1 hour).	Support: Provide precalculated mass change tables.	Design an experiment to measure osmotic potential (2 hours).
40	Researching Cell Transport Mechanisms	C1 - Research cell transport mechanisms	C1.2	1. Research facilitated diffusion, active transport, endocytosis, and exocytosis. 2. Peer teach transport mechanisms. 3. Compare energy requirements of transport processes.	Small group activity: Research assigned transport mechanism (30 min). Peer teach to class (30 min).	BiologyInsights: Cell transport guide (https://biologyinsights.com/celltransport-mechanisms).	Summarize one transport mechanism in 100 words (1 hour). Create a comparison table of transport	Support: Provide research templates. Extension: Include vesicular transport examples.	Research transport defects in diseases (2 hours).

							mechanisms (1 hour).		
41	Salt Regulation in Aquatic Animals	C1 - Discussion about aquatic animals	C1.2	1. Understand active transport in salt regulation. 2. Debate active transport in marine organisms. 3. Relate transport to homeostasis.	Whole-class discussion: Debate salt regulation in sea creatures (30 min). Create a flowchart of active transport in osmoregulation (30 min).	BiologyInsights: Cell transport guide (https://biologyinsights.com/celltransport-mechanisms).	Research osmoregulation in one marine species (1-2 hours). Watch a video on osmoregulation and summarize (30 min).	Support: Provide discussion prompts. Extension: Compare freshwater and marine osmoregulation.	Propose a study on osmoregulatory adaptations (2 hours).
42	Knowledge Check - Cell Transport	C1 - Knowledge check	C1	1. Consolidate cell transport terminology. 2. Apply knowledge in interactive quizzes. 3. Review concepts through peer discussion.	Individual activity: Complete quizzes on Quizlet or Kahoot (30 min). Peer review of quiz results and glossary creation (30 min).	Quizlet: Cell transport flashcards (https://quizlet.com/ /celltransport).	Create a personal glossary of 10 cell transport terms (1 hour). Review notes and create a concept map (1 hour).	Support: Provide a premade glossary.	Design a quiz question set for peers (1-2 hours).

43	Enzyme Activity and Conditions	C2 - Enzymes as biological catalysts	C2.1 C2.2	1. Understand enzyme structure and function. 2. Investigate factors affecting enzyme activity. 3. Analyse enzyme reaction results.	Laboratory activity: Carousel of experiments (pH on amylase, temperature on lipase, concentration on trypsin, catalase and hydrogen peroxide) (60 min). Present findings in a science fair format (30 min) (this could be a selfdirected learning activity)	YouTube: Basic biology enzymes (https://www.youtube.com/watch?v=TLhBJQ2Q4QQ). Royal Society of Biology: Enzyme activity (https://practicalbiology.org/biomolecules/factors-affectingenzyme-activity). Enzyme substrates, equipment.	Write a lab report on one enzyme experiment (1-2 hours). Research enzyme inhibitors and their uses (1 hour).	Support: Provide result templates. Extension: Test additional variables (e.g., inhibitors).	Design an experiment to test enzyme kinetics (2 hours).

44	Factors affecting enzyme activity	C2 - Enzymes as biological catalysts	C2.3	1. Understand enzyme structure and function. 2. Investigate factors affecting enzyme activity. 3. Analyse impact of factors on enzyme activity					
45	Introduction to Homeostasis	C3 - Homeostasis	C3.1	1. Define homeostasis and its importance. 2. Identify systems under homeostatic control. 3. Create a collaborative mind map.	Whole-class teaching: Discuss homeostasis via video (15 min). Create a collaborative mind map of homeostatic systems (30 min). Class discussion to refine mind map (15 min).	YouTube: What is homeostasis? (https://youtu.be/quQr6X1Q58I). WebMD: Homeostasis overview (https://www.webmd.com/a-to-zguides/what-is-homeostasis).	Summarize one homeostatic system in 100 words (1 hour). Research homeostatic mechanisms in humans (1 hour).	Support: Provide a starter mind map.	Research homeostasis in extreme environments (2 hours).

46	Feedback Loops in Homeostasis	C3 - Negative feedback loops	C3.2	1. Understand negative feedback loops. 2. Create flow diagrams of corrective mechanisms. 3. Apply feedback concepts to scenarios.	Whole-class teaching: Discuss feedback loops via video (15 min). Individual activity: Create flow diagrams for scenarios (30 min). Share diagrams in pairs (15 min).	YouTube: Homeostasis feedback loops (https://www.youtube.com/watch?v=Iz0Q9nTZCw4).	Research one feedback loop in detail (1-2 hours). Create a diagram of feedback loop mechanisms (1 hour).	Support: Provide flow diagram templates.	Analyse feedback loop disruptions in diseases (2 hours).
47	Positive feedback loops	C3 - Positive feedback loops	C3.3	1. Understand positive feedback loops. 2. Create flow diagrams of corrective mechanisms. 3. Apply feedback concepts to scenarios.	Whole-class teaching: Discuss feedback loops via video (15 min). Individual activity: Create flow diagrams for scenarios (30 min). Share diagrams in pairs (15 min).				
48	Homeostatic Systems	C3 - Systems under	C3.2 C3.3	1. Research a homeostatic system. 2. Peer teach findings.	Pair activity: Research a homeostatic system and present (30 min).	PBS Learning Media: Body control simulator (https://www.pbslearningmedia.org/resource/tdc02.sci.life.reg.bodycontrol/body-controlcenter/).	Write a 150-word summary of a homeostatic system (1-2 hours).	Support: Provide research templates.	Analyse feedback loops in disease states (2 hours).
	Peer Teaching	homeostatic control		3. Explore homeostasis using a virtual simulator.	Use body control simulator to explore responses (30 min).				
49	Case Study - Guardsman Collapse	C3 - Discussion about homeostasis	C3.4 C3.5	1. Analyse a homeostatic failure case study. 2. Discuss corrective mechanisms.	Small group activity: Discuss Guardsman collapse video and propose solutions (40 min). Class discussion to agree on best solutions (20 min).	YouTube: Royal Guard faints (https://youtu.be/_Wqulwx5Tdk).	Research heatstroke prevention strategies (1 hour).	Support: Provide discussion prompts.	Propose a public health campaign for heatstroke prevention (2 hours).

				3. Propose prevention strategies.					
50	Guest Speaker - Homeostasis in Disease	C3 - Guest speaker	C3.4 C3.5	1. Understand homeostasis in medical contexts. 2. Discuss diabetes or cardiovascular disease management. 3. Relate clinical insights to biological concepts.	Guest speaker session: Diabetes specialist or cardiovascular clinician (40 min). Q&A and discussion on homeostasis in disease (20 min).	Contact local specialists or arrange remote sessions.	Summarize the guest talk in 150 words (1-2 hours).	Support: Provide question prompts for Q&A.	Propose a research study on homeostasis in disease (2 hours).
51	Knowledge Check - Homeostasis	C3 - Knowledge check	C3	1. Consolidate homeostasis terminology. 2. Apply knowledge in interactive quizzes. 3. Review concepts through peer discussion.	Individual activity: Complete quizzes on Quizlet or Kahoot (30 min). Peer review of quiz results and glossary creation (30 min).	Physics and Maths Tutor: Homeostasis flashcards (https://www.physicsandmathstutor.com/biology-revision/gcseaqa/homeostasis/).	Create a personal glossary of 10 homeostasis terms (1 hour). Review notes and create a concept map (1 hour).	Support: Provide a premade glossary.	Design a quiz question set for peers (1-2 hours).

52	Exam Practice and Revision	Unit 1 Exam practice		1. Understand exam format and command words. 2. Practice exam-style questions.	Whole-class teaching: Review sample assessment materials (20 min). Individual activity: Complete past paper questions and peer mark (40 min).	Pearson: Sample assessment materials (https://qualifications.pearson.com/en/qualifications/aaq/applied-science.html). Pearson Exam Wizard	Complete one past paper section (1-2 hours). Review exam command words	Support: Provide annotated mark schemes. Extension: Analyse high-	Create an examstyle question and mark scheme (2 hours).
				3. Apply mark schemes to evaluate answers.		(https://qualifications.pearson.com/en/support/supporttopics/exams/examwizard.html).	and practice responses (1 hour).	mark responses.	

Unit 2: Principles and Applications of Chemistry

Learning Activities and Resources

This section offers a preview of how a scheme of work may be designed for this unit. It includes suggestions for each aspect of the specification, and suggested resources to coincide with the teaching and learning planner activities and resources. Both resources can be used alongside each other or in isolation.

Please note that the suggestions provided below are suggestions and are not mandatory, this resource is to support delivery of the qualification.

No	Lesson Title	Topic	Spec Ref	Learning Objectives	Learning Tasks/Activities	Resources	Self-Directed Study	Differentiation	Stretch and Challenge
1	Introduction to the Periodic Table and Atomic	A1.1 Features of the periodic table and relationship with	A1.1.1 A1.1.2 A1.1.3	1. Understand the structure of the periodic table (groups, periods, blocks, symbols,	Starter (10 mins): Class discussion on the periodic table layout and purpose. Display a periodic table and ask students to identify key features (groups, periods, atomic number).	Periodic table (hard copy or interactive: https://www.rsc.org/periodic-table/),	Research the history of the periodic table and prepare a short summary (100 words) on	Support: Provide a simplified periodic table with key features labelled and a step-by-step	Analyse the atomic structure of an element from Period 4 and predict its properties based

	Structure	atomic structure		atomic number, mass number). 2.Describe the atomic structure of atoms and ions using subatomic models. 3.Calculate relative atomic mass from isotope data.	Main Activity 1 (20 mins): Whole-class teaching on atomic structure. Teacher draws subatomic models (e.g., helium, carbon, sodium) on the board, involving students in deducing proton, neutron, and electron numbers from periodic table data. Main Activity 2 (20 mins): Small group activity calculating relative atomic mass from isotope data (e.g., chlorine: 75% Cl-35, 25% Cl-37).	Worksheet on isotope calculations (e.g., LibreTexts problems: https://chem.libretexts.org/), Whiteboards and markers for group work	Mendeleev's contributions. Complete additional isotope calculation problems from LibreTexts	guide for isotope calculations. Extension: Include more complex isotopes (e.g., copper) with fractional abundances.	on its position in the periodic table.

					Students work in pairs to solve problems and share answers. Plenary (10 mins): Quick quiz on periodic table features and atomic structure using multiple-choice questions to reinforce key terms.		(Problems 2.3.12.3.5).		
2	Electronic Configurations	A1.2 Electronic structure	A1.2.1 A1.2.2 A1.2.3	1. Explain energy levels, subshells, and orbitals. 2. Determine electronic configurations for atoms and ions (up to atomic number 36). 3. Use electron-	Starter (10 mins): Recap atomic structure with a quick whiteboard activity where students identify the number of electrons in given elements. Main Activity 1 (20 mins): Teacher-led explanation of energy levels, subshells, and orbital filling rules (Aufbau, Pauli, Hund's). Use sodium (Na) and Sodium Oxide as examples.	Periodic table (hard copy), Electron configuration worksheets (LibreTexts: https://chem.libretexts.org/),	Complete LibreTexts problems 3.1.13.1.10 on electron configurations. Watch Crash Course	Support: Provide a reference sheet with orbital filling order and worked examples. Extension: Include transition metals (e.g., iron) with 3d	Predict the electronic configuration of an ion with an unusual charge Fe^{3+} and explain stability.

				inboxes diagrams and *spd* notation accurately.	Main Activity 2 (20 mins): Individual activity: Students complete electron-in-boxes diagrams and *spd* notation for elements like magnesium, chlorine, and their ions. Address misconception of filling 3d before 4s. Plenary (10 mins): Peer review of configurations, with students swapping answers to check for accuracy.	Electron Orbital Simulator (http://electronorbitalsimulator.com/)	Chemistry video on electronic configurations.	subshell configurations.	
3	Ionisation Energy and Periodic Trends	A1.3 Ionisation energy	A1.3.1 A1.3.2 A1.3.3	1. Define first and successive ionisation energies. 2. Analyse trends in ionisation energy across periods and groups.	Starter (10 mins): Quick discussion: Why do some elements require more energy to ionize? Link to nuclear charge and shielding. Main Activity 1 (20 mins): Teacher presents first and successive ionisation energy definitions using nitrogen and magnesium as examples. Students write equations for	Periodic table (hard copy or https://www.rsc.org/periodic-table/trends), Ionisation energy data (WebElements: https://www.webelements.com/), Graph paper and calculators	Complete LibreTexts problems 3.3.13.3.5 on ionisation energy trends. Research factors affecting ionisation energy (nuclear charge, shielding).	Support: Provide pre-plotted ionisation energy graphs with guiding questions. Extension: Include data for Period 4 elements to compare trends.	Explain anomalies in ionisation energy trends (e.g., between nitrogen and oxygen) using electron pairing and subshell stability.
				3. Interpret successive ionisation energy data to deduce electronic structure.	specific ionisation energies. Main Activity 2 (20 mins): Individual activity: Students plot log (ionisation energy) vs. electron number for an unknown element and deduce its electronic structure. Plenary (10 mins): Class discussion on trends in ionisation energy across Period 3, addressing misconceptions about ionisation energy equations.				

4	Knowledge Check	Content area A	A1	1. Consolidate knowledge of content area A. 2. Apply knowledge in interactive quizzes. 3. Review key concepts through peer discussion.	Individual activity: Complete quizzes on Quizlet or Kahoot (30 min). Peer review of quiz results and glossary creation (30 min).	Past paper questions Quizlet	Revision of content area A		
5	Types of Chemical Bonding	B1.1- B1.3 Bonding and structure	B1.1 B1.2 B1.3	1. Compare metallic, ionic, and covalent bonding. 2. Draw dot-and-cross diagrams for ionic and covalent compounds. 3. Predict properties based on bonding and structure types.	Starter (10 mins): Brainstorm types of bonding and their characteristics. Address misconception that ionic bonding is electron transfer. Main Activity 1 (20 mins): Teacher-led overview of bonding types (metallic, ionic, covalent) with diagrams (e.g., NaCl, CH_4 copper). Main Activity 2 (20 mins): Small group activity: Students draw dot-and-cross diagrams for compounds like NaCl, NH_3, and predict properties (e.g., melting point, conductivity).	Periodic table (hard copy), Dot-and-cross diagram worksheets (LibreTexts: https://chem.libretexts.org/), Molymod kits (https://molymod.com/)	Complete LibreTexts problems 4.1.1â€“4.1.3 on dot-and-cross diagrams. Watch Crash Course Chemistry video on bonding.	Support: Provide templates for dotand-cross diagrams with partially completed examples. Extension: Include compounds with dative bonds (e.g., NH_4^+).	Analyze exceptions like aluminum chloride (covalent despite metal-nonmetal) and explain bonding.
					Plenary (10 mins): Class sorts compounds into bonding types and justifies predictions.				

6	Molecular Orbitals and Bond Strength	B1.3 Covalent bonding (molecular orbitals)	B1.3	1. Explain sigma and pi molecular orbital formation. 2. Relate bond length to bond strength and energy. 3. Address misconception that pi orbitals are two separate orbitals.	Starter (10 mins): Recap covalent bonding with a whiteboard activity drawing dot-andcross diagrams for double/triple bonds (e.g., O_2,N_2). Main Activity 1 (20 mins): Teacher explains sigma and pi orbital formation using diagrams (e.g., ethene for pi bonds). Use analogy of 'two ears, one auditory system' for pi orbitals. Main Activity 2 (20 mins): Students draw displayed formulae and predict bond strength for molecules like C2H4 and N2 Plenary (10 mins): Discuss how bond length affects bond energy, linking to reactivity.	ChemTube 3D (https://www.chemtube3d.com/), LibreTexts problems 5.3.1-5.3.4 on molecular orbitals	Watch Crash Course Chemistry video on molecular orbitals. Complete LibreTexts problem 5.1.1 on bond strength.	Support: Use 3D models to visualize orbital overlap. Extension: Include molecules with dative bonds (e.g., CO).	Research hybridization in ethene and explain its role in pi bond formation.
7	Physical properties of substances	B1.4 Typical physical properties of substances	B1.4	1. Describe and compare typical melting points of substances with ionic, covalent, and metallic bonding, and explain how bonding and structure influence these melting points. 2. Explain how the type of bonding and structure in a	Starter (10 mins): Bonding bingo: Give each student a bingo card with different keywords (e.g., ionic, covalent, metallic, high melting point, conducts electricity, etc.). Read out definitions or examples; students cross off the correct keyword. Main acitivity 1 (20 mins): Properties sorting challenge: Provide students with cards showing different substances (e.g., sodium chloride, graphite, copper, diamond, silicon dioxide, etc.) and cards with physical properties (high/low melting point,	Free printable and virtual bingo card generator https://quizlet.com/search?query=bonding-and-properties&type=sets https://www.chemguide.co.uk/atoms/bondingmenu.html	https://www.chemguide.co.uk/atoms/bondingmenu.html	Support: provide summary keywords for activities Extension: Research why some covalent substances (e.g., diamond vs. iodine) have vastly different melting points, relating this to their	Silicon dioxide and sodium chloride both have high melting points, but for different reasons. Explain, using diagrams, if necessary, how the structure and bonding in each leads to this property

				substance determines its electrical conductivity. 3. Interpret and predict the physical properties (melting point and electrical conductivity) of given substances based on their bonding type and structure.	conducts/does not conduct electricity, etc.). Main activity 2 (20 mins): Each group is assigned a substance from the previous activity. They create a mini-poster or whiteboard presentation explaining why that substance has its particular melting point and electrical conductivity, referencing bonding and structure. Plenary (10 mins): Teacher runs a quick-fire quiz (e.g., Kahoot, Socrative, or hands-up true/false) with questions on melting points and conductivity of different substances.			molecular or giant covalent structures	
8	Molecular Shape	B1.5 Molecular shape	B1.5	1. Predict molecular shapes using electron pair repulsion theory.	Starter (10 mins): Discuss limitations of 2D dot-and-cross diagrams. Show a 3D model of NH_3. Main Activity 1 (40 mins): Teacher introduces electron pair repulsion theory and common molecular shapes (e.g.,	Molymod kits (https://molymod.com/), Electronegativity table (https://www.rsc.org/periodic-table/trends), PhET	Complete LibreTexts problems 5.2.1-5.2.5 on molecular shapes. Research electronegativity	Support: Provide a molecular shape chart with bond angles.	Predict the polarity of a molecule with multiple functional groups (e.g., CH_3OH).

					linear, tetrahedral). Students use Molymod kits to build molecules (e.g., CH_4, H_2O). Plenary (10 mins): Class discussion on different molecular shapes and links to following lesson (electronegativity and polarity).	molecular shape simulation	trends across the periodic table.	Extension: Include complex molecules like SF_6	

9	Polarity	B1.6 Electronegativity and polarity	B1.6	1. Explain electronegativity and its effect on bond polarity. 2. Determine molecular polarity based on shape and electronegativity.	Starter (10 mins): Students construct mindmaps on different types of chemical bonds Main activity (20 mins): Teacher introduces concept of electronegativity and relatedness to molecular shape Main activity (20 mins): In groups students given molecular models or cut out shapes and asked to sort into different shapes, identify bond polarities and polarity. Plenary (10 mins): Each student answers three questions on a slip of paper: Define electronegativity in your own words. Is H_2O a polar molecule? Explain why or why not. Draw a molecule with polar bonds but is overall nonpolar.	Electronegativity and bond polarity (apply) (practice) | Khan Academy https://phet.colorado.edu/en/simulations/molecule-polarity	Read through Electronegativity - Chemistry LibreTexts	Support: Provide hint sheet for group activity Extension: Provide more complex molecules	Research and bring in an example of a real-world application where molecular polarity is important (e.g., soap, water solubility, etc.).

10	Intermolecular Forces	B1.7, B1.8 Intermolecular forces	B1.7 B1.8	1. Identify types of intermolecular forces (London dispersion, dipole-dipole, hydrogen bonding). 2. Predict physical properties (e.g., boiling point) based on intermolecular forces. 3. Explain the role of hydrogen bonding in water's properties.	Starter (10 mins): Discuss why some covalent compounds are gases while others are solids. Address misconception that covalent bonds are weak. Main Activity 1 (20 mins): Teacher presents types of intermolecular forces with examples (e.g., CH boiling point order for given molecules. Main Activity 2 (20 mins): Peer teaching: Students research one property of water influenced by hydrogen bonding (e.g., surface tension) and present findings. Plenary (10 mins): Class sorts molecules by $_4$, HCl, H_2O). Students predict intermolecular force type and justifies predictions.	Molymod kits (https://molymod.com/), LibreTexts problems 6.3.16.3.5 on intermolecular forces, ChemTube 3D ice structure (https://www.chemtube3d.com/)	Complete LibreTexts problems 6.3.66.3.10 on intermolecular forces. Watch Fuse School video on intermolecular forces.	Support: Provide a table comparing intermolecular forces and their effects. Extension: Include cyclic hydrocarbons like cyclohexane.	Explain why graphite conducts electricity despite being a non-metal.

11	Hydrogen bonding	B1.8 Hydrogen bonding	B1.8	1. Identify and explain the conditions required for hydrogen bonding to occur between molecules 2. Investigate and compare the physical properties of substances with and without hydrogen bonding through experimentation. 3. Analyse the outcomes of experimentation and relate to hydrogen bonding.	Starter (10 mins) What are hydrogen bonds mindmap activity Main activity: Practical experiment on hydrogen bonds Plenary: Research activity around hydrogen bonds.	What are hydrogen bonds? | 16-18 years | Lesson plan | RSC Education	Produce a slide deck presentation on hydrogen bonded molecules.	Support: Provide key word glossary for explanation Extension: Link practical activities to uses of hydrogen bonded molecules	Ask students to link hydrogen bonding to viscosity.
12	Knowledge Check	Content area B	All B	1. Consolidate knowledge of content area B. 2. Apply knowledge in interactive quizzes. 3. Review key concepts through peer discussion.	Individual activity: Complete quizzes on Quizlet or Kahoot (30 min). Peer review of quiz results and glossary creation (30 min).	Past paper Questions Quizlet	Revision of content Area B		

13	Period 3 Physical Properties	C1.1 Physical properties of Period 3 elements	C1.1	1. Describe trends in physical properties (melting point, conductivity) across Period 3. 2. Relate properties to bonding and structure. 3. Compare atomic and ionic radii trends across Period 3.	Starter (10 mins): Recap periodic table structure. Ask students to predict melting point trends across Period 3. Main Activity 1 (20 mins): Teacher-led discussion on Period 3 properties (e.g., sodium vs. phosphorus). Students plot melting point data. Main Activity 2 (20 mins): Paired activity: Students explain conductivity trends using bonding types (e.g., sodium conducts, sulfur does not). Plenary (10 mins): Discuss ionic radii trends, addressing misconception that they follow atomic radii patterns.	Periodic table (https://www.rsc.org/perio dic-table/trends), Chemix School periodic table data (https://www.chemixchemistry-software.com/), Graph paper	Complete LibreTexts problems 3.2.13.2.5 on atomic and ionic radii. Research exceptions like graphite's conductivity.	Support: Provide pre-plotted data for analysis. Extension: Include Period 4 elements for comparison.	Predict the physical properties of a Period 4 element based on Period 3 trends.
14	Physical properties of period 3 practical	C1.1 Physical properties of Period 3 elements	C1.1	1. Investigate trends in period 3 elements	Starter: Turn and talk activity for 5 mins on trends across period 3, teacher to summarise. Main activity (40 mins): Students to test the physical properties of a variety of period 3 elements. Plenary activity (10 mins): Students to conclude the experiment and relate structure to physical properties identified.	atomic and physical properties of period 3 elements	atomic and physical properties of period 3 elements	Supported: Provide support with practical requirements. Extension: Link to group physical properties	Exam question on physical properties of period 3.

15	Oxidation Numbers and Redox Reactions	C1.2 Oxidation number and redox reactions	C1.2	1. Assign oxidation numbers to elements in compounds. 2. Construct and balance halfequations and redox equations.	Starter (10 mins): Introduce OIL-RIG acronym with examples (e.g., Mg, Cl). Main Activity 1 (20 mins): Teacher explains oxidation number rules using PCl_5. Students assign oxidation numbers to given compounds. Main Activity 2 (20 mins): Individual activity:	ChemicalAid oxidation number calculator (https://www.chemicalaid.com/), LibreTexts problems Q11.1.1- Q11.2.5 on redox	Complete LibreTexts problems Q11.2.1 - Q11.2.3 on redox equations. Watch a video on redox	Support: Provide a step-by-step guide for balancing halfequations. Extension: Include complex redox	Balance a redox equation in acidic conditions.
				3. Use the OIL-RIG acronym to identify oxidation and reduction.	Students construct half-equations (e.g., Fe) and combine them into redox equations. Plenary (10 mins): Peer review of balanced equations, addressing charge balance misconceptions.		reactions (e.g., Chemguide).	reactions (e.g., $KMnO_4$ reactions).	
16	Chemical Properties of Period 3 Compounds	C1.3 Chemical properties of Period 3 elements and compounds	C1.3 C1.7	1. Describe reactions of Period 3 elements with oxygen, water, and chlorine. 2.Write balanced equations for Period 3 compound reactions. 3.Predict properties of Period 2/4 compounds based on Period 3 trends.	Starter (10 mins): Show a video of sodium reacting with water and ask students to predict other Period 3 reactions. Main Activity 1 (20 mins): Teacher-led demonstration (or video) of Period 3 reactions (e.g., phosphorus with oxygen). Students write equations. Main Activity 2 (20 mins): Peer teaching: Students research and present properties of one Period 3 compound (e.g., NaCl, PCl3). Plenary (10 mins): Discuss acid-base trends in Period 3 oxides (e.g., Na2O3 vs. SO4).	Science Skool videos (https://www.youtube.com/@scienceskool4734), Chemguide notes on Period 3 reactions	Research uses of one Period 3 compound and prepare a short presentation. Complete Chemguide problems on Period 3 reactions.	Support: Provide pre-written equations for analysis. Extension: Include Period 4 compounds for comparison.	Predict the reactivity of a Period 4 element with chlorine based on Period 3 trends.

17	Physical properties of Period 3 oxides	C1.4 Physical properties of Period 3 oxides	C1.4	1. Describe the physical properties (state, melting point, electrical conductivity) of Period 3 oxides (Na_2O → Cl_2O_7) and chlorides (NaCl → PCl_5). 2. Relate these properties to their bonding and structures (giant ionic, giant covalent, simple	Starter activity (10 mins): Display images.samples or virtual models of Na_2O, MgO, Al_2O_3, SiO_2, P_4O_{10}, NaCl, $MgCl_2$, $AlCl_3$, $SiCl_4$, PCl_5 Main activity (40 mins): For each sample students are to suggest state, melting/boiling point, electrical conductivity Plenary (10 mins): Discussion and peer marking of results.	Edexcel A-level Chemistry Revision - PMT https://periodic-table.rsc.org/	Periodic Table – Royal Society of Chemistry	Support: Structured table to fill in Extension: Ask students to predict temperatures for melting/boiling point	Link properties to structure and bonding types.
				molecular). 3. Compare and contrast the trends in oxides and chlorides across the period.					

18	Acid-Base behaviour of Period 3 oxides	C1.5 AcidBase behaviour of Period 3 oxides	C1.5 C1.7	1. Describe whether each Period 3 oxide behaves as a basic, acidic, or amphoteric oxide. 2. Write balanced equations for the reactions of Period 3 oxides with acids/bases where appropriate. 3. Relate acid–base behaviour to bonding and structure of oxides and chlorides.	Starter activity (10 mins): Acid, Base or Both card sort of compounds into acidic, basic, amphoteric or neutral. Main activity (40 mins): Work across the periodic table of Period 3 oxides, get students to fill in a summary table. Plenary activity (10 mins): Group work using 'reaction cards' students given reactants and products, match them up and write balanced equations.	https://www.chemguide.co.uk/inorganic/period3/chlorides.html#top https://www.chemguide.co.uk/inorganic/period3/oxidesh2o.html#top	Edexcel Chemistry A-level Topic 4: Inorganic Chemistry & The Periodic Table Revision - PMT	Support: Structured table to fill in Extension: Ask students to explain differences using bonding theory	Investigate environmental relevance (acid rain: SO_2, NO_2). Research industrial uses of amphoteric oxides (e.g. Al_2O_3 in extraction of Al)
19	Action of water with Period 3 chlorides	C1.6 Action of water with Period 3 chlorides	C1.6 C1.7	1. Describe and write equations for the reactions of NaCl, $MgCl_2$, Al_2Cl_6, $SiCl_4$, and PCl_5 with water. 2. Explain differences in behaviour using bonding and structure. 3. Predict	Starter activity (10 mins): Guess the reaction Give students a blank table with five rows (NaCl, $MgCl_2$, Al_2Cl_6, $SiCl_4$, PCl_5) and columns for: Observations when added to water, pH prediction and Reaction type. Main activity (40 mins): Demonstration of each reaction, with students annotating	https://www.chemguide.co.uk/inorganic/period3/chl	Bing Videos	Support: Provide fully balanced equations to act as model answers. Extension: Ask students to explain why PCl_5 forms H_3PO_4 rather than	Ask students to research industrial application of these reactions.

				pH changes and explain why some solutions are acidic and others neutral	their tables. Students to write equations of each reaction. Plenary activity: In groups students compare their tables and use peers to make further annotations.	orides.html#top https://www.chemguide.co.uk/inorganic/period3/oxidesh2o.html#top		H_3PO_3 on hydrolysis (link to oxidation states).	
20	Physical, chemical properties of Period 3 elements and their uses	C1.8 Physical, chemical properties of Period 3 elements and their uses	C1.8 C1.9	1. Use trends observed in Period 3 (atomic radius, electronegativity, melting point, ionisation energy) to predict properties of elements in other periods. 2. Explain how bonding and structure influence the physical/chemical behaviour of other periods' elements.	Starter activity (10 mins): Give students a partially filled Periodic Table showing atomic radius, melting points and conductivity, ask them to discuss in pairs what general trends there are. Main activity (40 mins): Guided exploration - teacher to recap trends covered across period 3. Students then to predict on period 2 and 4. Plenary activity: (10 mins) Kahoot quiz on period 3	Understanding Chemistry - Inorganic Chemistry Menu https://periodic-table.rsc.org	2-4-revision-guide-period-3-aqa.pdf		

				3. Identify key industrial and everyday uses of Period 3 elements and compounds and relate these to their properties.					
21	Knowledge Check	Content Area C	All C	1. Consolidate knowledge of content area C 2. Apply knowledge in interactive quizzes. 3. Review key concepts through peer discussion.	Individual activity: Complete quizzes on Quizlet or Kahoot (30 min). Peer review of quiz results and glossary creation (30 min).	Past paper questions Quizlet			
22	The Mole and Quantitative Chemistry	D1.1 The mole and quantitative chemistry	D1.1	1. Calculate moles, molar mass, and percentage yield. 2. Determine empirical formulae from experimental data. 3. Calculate gas volumes using molar volume.	Starter (10 mins): Quick quiz on mole definitions and Avogadro's number. Main Activity 1 (20 mins): Teacher explains mole calculations with examples (e.g., mass to moles for NaCl). Address misconception about moles formula. Main Activity 2 (20 mins): Laboratory activity: Students burn magnesium to form MgO, calculate empirical formula from mass data. Plenary (10 mins): Class compares results and discusses errors in empirical formula calculations.	Lab equipment for MgO experiment, Chemguide notes on moles (https://www.chemguide.co.uk/), LibreTexts problems 4.3.1-4.3.5	Complete Doc Brown calculation quizzes on moles. Watch RSC video on molar volume experiment.	Support: Provide a formula triangle for mole calculations. Extension: Include percentage yield calculations with limiting reagents.	Calculate the empirical formula of a hydrate (e.g., Copper Sulfate).

23	The Mole and Quantitative Chemistry	D1.1 The mole and	D1.1	1. Exam question practice on quantitative Chemistry	Starter activity (10 mins): Recall activity of quantitative chemistry equations Main activity (40 mins): Practice	Past paper questions.	Complete Doc Brown calculation	Support: Choose exam questions that are more guided	Provide more complex questions including empirical
		quantitative chemistry			examination questions on quantitative chemistry Plenary (10 mins): Use associated mark schemes to peer mark questions and provide feedback.		quizzes on moles. Watch RSC video on molar volume experiment.	Extension: Provide more complex examination questions	formula and mole calculations.
24	Chemical Kinetics	D1.2 Chemical kinetics	D1.2.1 D1.2.2 D1.2.3 D1.2.4	1. Explain factors affecting reaction rates using collision theory. 2. Interpret MaxwellBoltzmann distribution curves. 3. Determine effect of catalyst	Starter (10 mins): Marble tray demonstration to show collision frequency. Address more collisions misconception. Main Activity 1 (40 mins): Teacher presents Maxwell-Boltzmann curves and explains effects of temperature and catalysts. Plenary (10 mins): Discuss how catalysts affect activation energy on distribution curves.	RSC notes on Maxwell-Boltzmann curves (https://edu.rsc.org/), Chemguide problems on rate equations, Marbles and tray for demonstration https://puppeteer.cognitoedu.org/coursesubtopic/c3-alevel-aqa_JScZnKfp	Complete LibreTexts problems on rate laws. Watch Crash Course Chemistry video on kinetics.	Support: Provide pre-drawn MaxwellBoltzmann curves with annotations. Extension: Discussion of wider factors	Provide flashcards on Maxwell Boltzmann

25	Chemical Kinetics	D1. Chemical Kinetics	D1.2.5	1. Analyse experimental data to determine the order of reaction with respect to each reactant. 2. Write a full rate equation and calculate the rate constant (k) with units. 3. Use rate equations to predict changes in rate when	Starter (10 mins): Introduce students to the rate equation Main activity (40 mins): Use a data set and perform a teacher led worked example Plenary (10 mins): Split students into groups - give each group a different reaction/dataset, ask them to deduce the orders, write the equation, calculate the rate constant.	Kinetics 16–18 | Resource | RSC Education https://www.youtube.com/results?search_query=rate+equation+chemistry	Chemical Kinetics (rates of reaction) notes	Support: Provide step by step worked example Extension: Explore real world applications of the rate constant.	Derive the rate equation for a complex reaction (e.g., peroxodisulfateiodide).
				concentrations change.						
26	Chemical Energetics and Hess's Law	D1.3 Chemical energetics	D1.3.1 D1.3.2 D1.3.3	1. Define exothermic and endothermic reactions and their enthalpy changes. 2. Determination of standard enthalpy changes	Starter (10 mins): Show video clips of exothermic/endothermic reactions. Main Activity 1 (20 mins): Teacher reviews standard enthalpy definitions and symbols. Main Activity 2 (20 mins): Students are given blank table template to fill in to make a glossary of definitions and associated units. Plenary (10 mins): Bingo game using definitions and associated units.	Lab equipment for ethanol combustion, Chemguide notes on Hess's Law (https://www.chemguide.co.uk/), LibreTexts problems 8.3.11-8.3.13	Complete Chemguide problems on enthalpy calculations. Watch Chemistorian video on Hess cycles.	Support: Provide pre-drawn energy cycles. Extension: Include calculations for thermal decomposition.	Calculate enthalpy for a reaction using bond energies and compare with Hess's Law.

27	Chemical Energetics and Hess's Law	D1.3 Chemical energetics	D1.3.4 D1.3.5	1. Construct energy cycles using Hess's Law. 2. Calculate enthalpy changes from experimental data.	Starter (10 mins): Show video clips introducing Hess's Law and energy cycles Main Activity 1 (20 mins): Teacher explains Hess's Law with an energy cycle example. Address arrow direction misconception. Main Activity 2 (20 mins): Laboratory activity: Students measure standard enthalpy for combustion of ethanol and construct an energy cycle. Plenary (10 mins): Class compares calculated enthalpy values with theoretical values.	Thermodynamics | AP®/College Chemistry | Science | Khan Academy	Hess's law (practice) | Thermodynamics | Khan Academy	Support: Provide pre-drawn templates with arrows already drawn in and colour coded Extension: Include enthalpies which consider stoichiometry	hess law a level - YouTube
28	Chemical Equilibrium and Le Chatelier's Principle	D1.4 Chemical equilibrium	D1.4.1 D1.4.2	1. Explain dynamic equilibrium and Le Chatelier's principle. 2. Predict effects of condition changes on equilibrium position.	Starter (10 mins): Analogy of running up a downwards escalator to explain dynamic equilibrium. Main Activity 1 (20 mins): Teacher demonstrates Le Chatelier's principle with a Co/HCl equilibrium experiment. Students predict shifts. Main Activity 2 (20 mins): Individual activity: Students apply Chatelier to a known reaction, eg Haber Process. Plenary (10 mins): Discuss why Chatelier Principle may be important in industry.	RSC experiment on Le Chatelier's principle (https://edu.rsc.org/), LibreTexts problems on equilibrium constants, Lab equipment for Co demonstration	Complete LibreTexts numerical problems 1 - 3 on equilibrium. Watch Crash Course Chemistry video on equilibrium.	Support: Provide a template for Chatelier Principle Extension: Use reaction where stoichiometry must be considered.	Le Chatelier's Principle

29	Chemical Equilibrium and Le Chatelier's Principle	D1.4 Chemical equilibrium	D1.4.3 D1.4.4 D1.4.5	1. Explain equilibrium constant expressions 2. Perform calculations involving equilibrium constants 3. Interpret yield vs pressure of temperature graphs	Starter (10 mins): Think/Pair/Share where the equilibrium is in a simple gas equation. Main activity (20 mins): Kc introduction and practice worked example. Main activity (20 mins): Kp introduction and practice worked example. Plenary activity (10 mins): What does this tell us?	Equilibria 16–18 | Resource | RSC Education https://www.youtube.com/results?search_query=kc+kp+chemistry+worked+examples	an introduction to chemical equilibria	Support: Provide a step-by-step instructions to carry out calculations Extension: Introduce the concept of Van't Hoff equation	Predict the effect of a catalyst on Kc and justify using reaction profiles.
30	Green Chemistry in Industry	D1.5, D1.6 The chemical industry and green chemistry	D1.5 D1.6	1. Explain the role of kinetics, energetics, and equilibrium in industrial processes. 2. Apply green chemistry principles to evaluate industrial processes. 3. Discuss benefits and challenges of green chemistry.	Starter (10 mins): Discuss the Haber process and its environmental impact. Main Activity 1 (20 mins): Teacher presents green chemistry principles using the contact process as an example. Main Activity 2 (20 mins): Peer teaching: Students research and present one green chemistry principle (e.g., atom economy) applied to an industrial process. Plenary (10 mins): Class debates the tradeoffs between economic and environmental considerations.	Essential Chemical Industry notes (https://www.essentialchemicalindustry.org/), RSC job profile videos (https://edu.rsc.org/)	Research the environmental impact of the Haber process and suggest green improvements. Complete Chemguide problems on atom economy.	Support: Provide a template for the presentation. Extension: Include less common processes like ammonia synthesis variants.	Propose a novel green chemistry solution for a chemical industry problem.

31	Knowledge Check	Content Area D	All D	1. Consolidate knowledge of content area D 2. Apply knowledge in interactive quizzes. 3. Review key concepts through peer discussion.	Individual activity: Complete quizzes on Quizlet or Kahoot (30 min). Exam based questions (30 min).				
32	Introduction to Organic Chemistry	E1.1 Key terms in organic chemistry	E1.1 E1.2	1. Define key organic chemistry terms (hydrocarbons, homologous series, functional groups). 2. Represent organic molecules using different formulae (molecular, structural, skeletal).	Starter (10 mins): Discuss why carbon is unique in forming diverse compounds. Main Activity 1 (20 mins): Teacher presents organic chemistry terminology using alkanes and alkenes. Students draw ethane and ethene in various formulae. Main Activity 2 (20 mins): Paired activity: Students use Molymod kits to build alkanes/alkenes and name them using IUPAC rules. Plenary (10 mins): Quick naming quiz to address misconception of incorrect group priority.	Molymod kits (https://molymod.com/), Chemguide notes on organic nomenclature (https://www.chemguide.co.uk/), LibreTexts organic chemistry basics	Complete Chemguide problems on naming organic compounds. Watch Fuse School video on organic chemistry basics.	Support: Provide glossary of key terms Extension: Include branched alkanes for naming.	Name a complex molecule with multiple functional groups (e.g., 2methylbutan-1-ol).
33	Introduction to Organic Chemistry	E1.3 Naming molecules	E1.3 E1.5	1. Naming conventions IUPAC 2. Sigma and pi molecular orbitals	Starter (10 mins): Students to use whiteboards to draw organic compounds on whiteboards Main activity (40 mins): Teacher led activity on orbitals, students then model alkanes and alkenes, and have a discussion	Molymod kits (https://molymod.com/), Chemguide notes on organic nomenclature (https://www.chemguide.co.uk/), LibreTexts organic chemistry basics	an introduction to alkenes	Support: Provide IUPAC naming flowcharts. Extension: Discuss benzene and link to stability	Research sigma and pi bonds in relation to stereoisomerism

				in alkanes and alkenes	around double and single bon characteristics. Plenary (10 mins): Practice exam style questions		https://app.molvi ew.com/			

34	Isomerism and Physical Properties	E1.4, E1.6 Isomerism and physical properties	E1.4 E1.6	1. Identify and draw structural and stereoisomers. 2. Explain the effect of branching on boiling points. 3. Recognize conditions for stereoisomerism in alkenes.	Starter (10 mins): Students build isomers using Molymod kits and discuss differences. Main Activity 1 (20 mins): Teacher explains structural isomerism and stereoisomerism. Address misconception about alkenes and stereoisomerism. Main Activity 2 (20 mins): Paired activity: Students draw and name isomers and predict boiling point trends. Plenary (10 mins): Class compares isomer boiling points and discusses London dispersion forces.	Molymod kits (https://molymod.com/), Chemguide notes on isomerism (https://www.chemguide.co.uk/)	Complete Chemguide problems on structural and stereoisomerism Research boiling point trends in alkanes.	Support: Provide pre-drawn isomer structures for naming. Extension: Include cyclic compounds	Draw and name stereoisomers for a complex alkene (e.g., 2-butene derivatives).

35	Organic Reactions and Functional Group Tests	E1.7 Reactions of organic compounds	E1.7.1 E1.7.2	1. Identify types of organic reactions (addition, substitution). 2. Predict products of organic reactions under given conditions. 3. Perform simple tests to identify functional groups.	Starter (10 mins): Flash card game matching organic compounds to names Main Activity 1 (20 mins): Teacher presents reaction types (e.g., alkene addition, halogenoalkane substitution) with examples. Main Activity 2 (20 mins): Laboratory activity: Students test alkanes, alkenes, Plenary (10 mins): Discuss test results and write balanced equations	Lab equipment for functional group tests, RSC practical videos (https://edu.rsc.org/), Chemguide notes on organic reactions	Complete Chemguide problems on organic reaction equations. Watch RSC video on functional group tests.	Support: Provide reaction templates with reagents filled in. Extension: Ask students to consider reaction mechanisms	Predict the mechanism of an electrophilic addition reaction.
36	Organic Reactions and Functional Group Tests	E1.7 Reactions of organic compounds	E1.7.3 E1.7.4	1. Identify types of organic substitution reactions. 2. Predict products of organic reactions under given conditions.	Starter (10 mins): Flash card game matching organic compounds to names Main Activity 1 (20 mins): Teacher presents halogenoalkane substitution with examples. Main Activity 2 (20 mins): Laboratory activity: Students test substitution reactions with halogenoalkanes and alcohols.	Lab equipment for functional group tests, RSC practical videos (https://edu.rsc.org/), Chemguide notes on organic reactions	Complete Chemguide problems on organic reaction equations. Watch RSC video	Support: Provide reaction templates with reagents filled in. Extension: Ask students to consider	Predict the mechanism of a nucleophilic substitution reaction.

				3. Perform simple tests to identify functional groups.	Plenary (10 mins): Discuss test results and write balanced equations		on functional group tests.	reaction mechanisms	

37	Organic Reactions and Functional Group Tests	E1.7 Reactions of organic compounds	E1.7.5	1. State the conditions required for elimination reactions of halogenoalkanes. 2. Write balanced equations for elimination reactions. 3. Draw and name products (alkenes) formed from halogenoalkanes.	Starter (10 mins): Guess the reaction - put the start of 3 reactions on the board and ask students to complete them. Main Activity 1 (20 mins): Teacher presents reactions giving products and conditions. Main Activity 2 (20 mins): Students draw and name products in elimination reactions. Plenary (10 mins): Student complete a quickfire quiz reviewing the different reactions covered so far.	Lab equipment for functional group tests, RSC practical videos (https://edu.rsc.org/), Chemguide notes on organic reactions	Complete Chemguide problems on organic reaction equations. Watch RSC video on functional group tests.	Support: Provide lower-level reactions in the worksheet Extension: Ask students to predict reaction mechanisms	Students to complete a mindmap of different organic reactions and how they interlink.
38	Organic Reactions and Functional Group Tests	E1.7 Reactions of organic compounds	E1.7.6 E1.7.7	1. Describe conditions for the oxidation of primary alcohols to carboxylic acids. 2. Write balanced equations, name, and draw products from alcohol oxidation reactions. 3. Describe conditions for esterification reactions	Starter (10 mins): Show a video fo colour change reaction of ethanol and acidified potassium dichromate being heated under reflux. Students to suggest what is happening. Main Activity 1 (20 mins): Teacher presents oxidation of primary alcohols and students complete worksheet activity entering products of the reaction. Main Activity 2 (20 mins): Teacher can demonstrate esterification reaction and get students to comment on reaction and complete balanced equations.	Worksheet with alcohol examples (word, symbol, and structural equations) Mini-whiteboards and pens (Optional) Practical kit: ethanol, ethanoic acid, conc. H_2SO_4, boiling tubes, water bath	Review information on https://www.chemguide.co.uk/organicprops/alcohols/oxidation.html	Support: Provide scaffolded equations with structures predrawn Extension: Get students to think about secondary alcohol oxidation	Students to research industrial uses of esters

					Plenary (10 mins): Students to discuss ways to distinguish ethanol from ethanoic acid.				
39	Commerciall y Important Organic Reactions	E1.8 Reactions of Commerci al Importance - Part 1	E1.8.1 E1.8.2	1. Write equations for cracking and combustion. 2. Evaluate use of the equations.	Starter (10 mins): Discuss the importance of poly(ethene) in daily life. Main Activity 1 (20 mins): Teacher presents cracking and combustion with equations. Main Activity 2 (20 mins): Peer teaching: Students research and present benefits and issues of one organic compound (e.g., ethanol). Plenary (10 mins): Class discusses solutions to environmental issues (e.g., biodegradable polymers).	Essential Chemical Industry notes (https://www.essentialchemicalindustry.org/), Chemguide notes on polymerisation	Research the environmental impact of CFCs and propose alternatives. Complete Chemguide problems on polymerisation.	Support: Provide a template for presentation structure. Extension: Include less common reactions like ethanol fermentation.	Design a sustainable process for producing a polymer like PLA.
40	Commerciall y Important Organic Reactions	E1.8 Reactions of Commerci al Importance - Part 1	E1.8.3 E1.8.4	1. Write equations for polymerisation. 2. Evaluate use of the equations	Starter (10 mins): Discuss the importance of poly(ethene) in daily life. Main Activity 1 (20 mins): Teacher presents polymerisation with equations (e.g., ethene polymerisation). Main Activity 2 (20 mins): Peer teaching: Students research and present benefits and issues of one organic compound (e.g., ethanol). Plenary (10 mins): Class discusses solutions to environmental issues (e.g., biodegradable polymers).	Essential Chemical Industry notes (https://www.essentialchemicalindustry.org/), Chemguide notes on polymerisation	Research the environmental impact of CFCs and propose alternatives. Complete Chemguide problems on polymerisation.	Support: Provide a template for presentation structure. Extension: Include less common reactions like ethanol fermentation.	Design a sustainable process for producing a polymer like PLA.

41	Green Chemistry in Industry	E1.9, E1.10 Green Chemistry	E1.9 E1.10	1. Describe the benefits and drawbacks of combustion of fuels (CO_2 emissions, acid rain, energy production). 2. Explain the environmental impact of halogenoalkanes (CFCs) and ozone depletion. 3. Evaluate the pros and cons of polymers, including recycling and disposal issues.	Starter (10 mins): Headline hunt - provide a relevant headline on real world chemistry application. Allow students to discuss. Main activity (40 mins): Teacher splits students into groups and give each group a different reaction to looks at, eg, combustion, CFCs, plastics, ethanol. Each group will then research and present their reaction equations, benefits, problems, and possible solutions or alternatives. Plenary (10 mins): Each student to review all of the presentations and give a brief 2 sentence review of the one they see as most important and the best solution to the problem.	Teaching atom economy, percentage yield and green chemistry post-16 | CPD article | RSC Education	Research the Montreal Protocol	Support: Provide cards with key facts on it to help support discussion Extension: Consider equations around hydrogen fuels or carbon neutral synthetic fuels.	Use NASA to consider current status of the Ozone Hole https://ozonewatch.gsfc.nasa.gov/Scripts/big_image.php?date=2025-0904&hem=S&section=HOME

Unit 3: Principles and Applications of Physics

Learning Activities and Resources

This section offers a preview of how a scheme of work may be designed for this unit. It includes suggestions for each aspect of the specification, and suggested resources to coincide with the teaching and learning planner activities and resources. Both resources can be used alongside each other or in isolation.

Please note that the suggestions provided below are suggestions and are not mandatory, this resource is to support delivery of the qualification.

No	Lesson Title	Topic	Spec Ref	Learning Objectives	Learning Tasks & Activities	Resources	Self-Directed Study	Differentiation & Stretch/Challenge
1	Introduction to Waves	A1: Working with Waves	A1.1 A1.2 A1.4	1. Define wavelength, frequency, amplitude, period; 2. Describe transverse & longitudinal waves; 3. Use v=fλ.	Starter (10 mins): Short video clips of water & sound waves – spot differences. Main (main activity): Teacher demo with slinky for both wave types; students sketch & label diagrams; derive v=fλ; practice problems. Plenary (10 mins): Whiteboard quiz matching terms to definitions.	Slinky, projector, worksheet	Create flashcards & practice wave equation calculations.	Support: Pre-labelled diagrams & formula triangle. Extension: Research seismic waves & present in next lesson.

2	Superposition & Diffraction	A1.3 Working with Waves	A1.3.1 A1.3.2 A1.3.3	1. Define coherence, phase/path difference; 2. Explain interference; 3. Use diffraction gratings to measure λ.	Starter (10 mins): Recap quiz on v=fλ. Main (40 mins): Ripple tank demo, students sketch interference patterns; group activity: constructive vs destructive interference diagrams; practical with diffraction gratings & data collection. Plenary (10 mins): Students write short exam-style answer on use of spectra in element ID.	Ripple tank, diffraction gratings, protractors, light sources	Attempt exam practice questions - refer to mark scheme and examiner report where appropriate.	Support: Provide worked example for λ calculation. Extension: Discuss higher-order diffraction orders.
3	Diffraction grating practical	A1.3 Working with Waves	A1.3.2	1. Using practical activity to demonstrate diffraction gratings	Starter (10 mins): Glossary check - Bingo using key terms Main activity (40 mins): Practical activity on diffraction gratings Plenary activity (10 mins): Discussion around application to stars	Bingo cards, fluorescent lamp, LED, sodium lamp.	Practical write up and conclusion	Support: Provide a framework for conclusion to the experiment Extension: Apply practical activity to industrial applications
4	Working with Waves	A1.4 Using the wave equation	A1.4	1. Apply the wave equation 2. Discuss coherence and path difference	Starter (10 mins): Recap on wave equation Main activity (40 mins): Practice exam style questions on wave equation Plenary (10 mins): Discussion around coherence phase and path difference	Past exam paper questions	Review mark scheme and any associated examiner reports	Support: Choose shorter open response questions Extension: Choose extended open response questions
5	Stationary Waves & Resonance	A1.5 Working with Waves	A1.5.1 A1.5.2	1. Describe stationary wave formation; 2. Identify nodes/antinodes; calculate v=√(T/μ).	Starter: (10 mins) Guitar clip – ask students to predict effect of tension/length.	Signal generator, masses, resonance tube, worksheets	Review notes on resonance https://puppeteer.cognitoedu.org/coursesubtopic/p3-alevel-aqa_amSeXKLS	Support: Scaffolded data tables.

					Main (40 mins): Practical with Melde's apparatus/resonance tube; measure length, frequency, tension; calculate v;			Extension: Calculate theoretical frequencies
					discuss applications in music. Plenary (10 mins): Annotate stationary wave diagram.			for first 3 harmonics & compare to results.
6	Refraction & TIR	A2: Behaviour of Waves	A2.1 A2.2 A2.3	1. Calculate refractive index & critical angle; 2. Explain TIR & its uses.	Starter (10 mins): Demo laser into water tank – predict ray path. Main (40 mins): Practical measuring I and R with ray boxes & glass blocks; calculate n & critical angle; discuss optical fibre uses. Plenary (10 mins): Create a mind map linking TIR to medical and communication uses.	Ray boxes, glass blocks, protractors	Research refractive indices of common materials.	Support: Provide blank ray diagrams. Extension: Research modal dispersion & fibre optic losses.
7	Principles of Optical Fibres	A2: Behaviour of Waves	A2.2 A2.3	1. Describe the principle of total internal reflection and how optical fibres transmit signals. 2. Explain key applications of optical fibres in	Starter (10 mins): Student light in a tube demonstration (shine a laser pointer through a stream of water) Main activity: (40 mins): Split into 3 groups each group to research medical applications, communication applications and engineering or industrial applications.	Laser pointer or optical fibre demonstration kit Internet-enabled devices for research Oscilloscope traces or images (analogue vs digital)	Bending Light - Snell's Law | Refraction | Reflection - PhET Interactive Simulations	Support: Provide labelled optical fibre diagrams Extension: Introduce the concept of multiplexing and bandwidth.

				communication (internet, data transmission) and medicine (endoscopy). 3. Distinguish between analogue and digital signals and explain why digital transmission is advantageous.	Plenary (10 mins): Students to produce a 30 second 'elevator pitch' to 'sell' one of the researched applications.	Whiteboard/flipchart for mind maps		
8	EM Waves & Communication	A3: EM Spectrum	A3.1 A3.2 A3.3	1. Describe uses & risks of EM waves 2. Discuss communication applications.	Starter (10 mins): EM spectrum quick sort (order by λ or f). Main (40 mins): Students complete table: wave → wavelength range → uses →	EM spectrum charts, laptops for research	Make revision poster of EM spectrum.	Support: Provide partially completed tables.
					hazards; group research on mobile phone safety or satellite comms; mini presentations. Plenary (10 mins): Quiz on uses/hazards.			Extension: Discuss bandwidth, data transfer rates.
9	EM Waves & Communication	A3: EM Spectrum	A3.2	1. Practical investigation of light intensity	Starter (10 mins) Introduction into practical activity on light intensity Main activity (40 mins): Students perform practical activity on light intensity Plenary (10 mins): Students to write conclusions based on results from investigation	https://www.youtube.com/watch?v=US-cdZNAEhg	Explain how this practical may be applied to stars and/or a microwave.	Support: Provide scaffolded template for conclusion Extension: Provide extension suggestions for the practical and predict associated outcomes.

10	Knowledge Check	Content Area A	All A	1. Consolidate knowledge of content area A 2. Apply knowledge in interactive quizzes. 3. Review key concepts through peer discussion.	Individual activity: Complete quizzes on Quizlet or Kahoot (30 min). Exam based questions (30 min).	Past paper questions Quizlet	Revision of Content Area	
11	Forces & Motion	B1: Motion	B1.1 B1.2	1. Describe key standard units 2. Calculating speed practical 3. Calculate speed	Starter (10 mins): Matching standard units to applications. Main (40 mins): Calculate speed of trolleys down a ramp; use equations of motion. Plenary (10 mins): Solve short examstyle problem on speed/time	Trolley ramp, light gates, data logger	Practice problems online (Physics & Maths Tutor).	Support: Provide formula triangles. Extension: Derive equations from definitions.
12	Forces & Motion	B1: Motion	B1.3	1. Describe key scalar and vector quantities 2. Discuss scalars and vectors 3. Use velocity time graphs	Starter (10 mins): Matching graph shapes to motion descriptions. Main (40 mins): Plot velocity-time graph from practical trolley data; calculate acceleration; use equations of motion. Plenary: Solve short exam-style problem.	Trolley ramp, light gates, data logger	Research industrial application of accelerometers - provide a 5 min presentation	Support: Provide formula triangles Extension: Provide suggestion to extend the practical investigation.
13	Newton's Laws & Momentum	B2: Newton's Laws	B2.1	1. Apply Newton's First Law	Starter (10 mins): Concept cartoon (e.g. rocket in space) – discuss forces. Main (40 mins): Teacher led discussion on Newton's First Law Plenary (10 mins): Whiteboard law to real example.	https://www.youtube.com/watch?v=_W3VbonFNcw	Practice questions from Pearson SAMs.	Support: Step-by-step worked examples Extension: Distinguish elastic vs inelastic

								collisions mathematically.
14	Newton's Laws & Momentum	B2: Newton's Laws	B2.2	1. Define inertia and describe it as resistance to a change in motion. 2. Define gravitational field strength, g and explain its meaning. 3. Use $W=mg$ to calculate weight from mass on Earth (and compare with other planets).	Starter (10 mins): Teacher demo, place a card on top of a beaker with a coin on top, flick the card horizontally - coin drops into a beaker. Main (20 mins): Students work in groups to review instances of inertia. Main (20 mins): Students to perform exam style questions on W=mg getting progressively harder.	Beaker, playing card, coin (starter demo), Whiteboard/interactive board Data table of g on different planets (NASA website) Worksheets for W=mg calculations (differentiated)	Write a short report on why astronauts experience weightlessness in orbit despite gravity still acting on them	Support: Provide formula triangles Extension: Provide more advanced exam style questions

15	Newton's Laws & Momentum	B2: Newton's Laws	B2.3	1. Define coefficient of friction (μ) and state the equation $F=\mu N$ 2. Experimentally determine μ (static) by measuring the minimum force required to start motion. 3. Experimentally determine μ (dynamic) by measuring the force required to keep motion constant. 4. Perform calculations of μ using measured force	Starter (10 mins): Friction in Action - car braking and discussion around it. Main activity (40 mins): Practical experiment measuring friction Plenary (10 mins): Students to write an 'exit summary' drawing conclusions	Wooden block / mass block, Spring balance or force sensor / data logger, Masses (to vary normal force), Smooth surface (lab bench), Worksheets (data table for F, m, μ calculation), Video clip on friction in engineering (e.g. braking systems)	Review and making flashcards using http://hyperphysics.phy-astr.gsu.edu/hbase/frict.html	Support: Provide precalculated N for each block to reduce maths load Extension: Explore additional variables, e.g. surface area or different materials.

				and normal reaction (N = mg).				
16	Newton's Laws & Momentum	B2: Newton's Laws	B2.4	1. Define momentum as the product of mass and velocity. 2. Use the equation $p = mv$ to calculate momentum for objects. 3. Interpret momentum values in real-life contexts (safety, collisions, sports).	Starter (10 mins): Heavy vs fast - show a video clip showing a small sports car and a heavy lorry, ask which has more impact if they were to collide with a wall. Main activity (40 mins): Worked example of the equation with teacher leading demonstration, then guided practice for students. Plenary (10 mins): Quickfire quiz, teacher calls out mass and velocity and students calculate momentum on whiteboards.	Worksheets, mini whiteboards, video clips	Collision Lab - Collisions | Conservation of Energy | Conservation of Momentum - PhET Interactive Simulations	Support: Provide formula triangles and simple numbers to start Extension: Introduce vector direction.
17	Newton's Laws & Momentum	B2: Newton's Laws	B2.5	1. Apply F=ma; 2. State & use Newton's second law;	Starter (10 mins): Concept cartoon (e.g. rocket in space) – discuss forces. Main (40 mins): Practical: collisions on air track; calculate momentum before &	trolley, ramp, masses for practical activity, whiteboards	Revision Notes - Equation of motion: F = ma (Force and acceleration in the same direction) | Motion, Forces,	Support: Provide formula triangles and simple numbers
				3. Apply conservation of momentum.	after; verify conservation. Plenary (10 mins): Whiteboard Q&A linking each law to real example.		and Energy | Physics - 0625 - Supplement | Cambridge IGCSE | Sparkl	Extension: Discuss real time applications where this calculation is used.
18	Newton's		B2.6	1. Define Newton's Third Law		https://www.youtube.co	https://www.bbc.co.uk/bites	

	Laws & Momentum	B2: Newton's Laws		2. Explore applications of Newton's Third Law 3. Discuss practical applications of Newton's Third Law	Starter (10 mins): Teacher led introduction into the Third Laws of Motion Main activity (40 mins): Practical activity on Newtons Third Law of Motion, exam style questions. Plenary (10 mins): Conclusions on practical activity using Newton's Third Law of Motion.	m/watch?v=BWlEpMgaSYM https://www.youtube.com/watch?v=eU3ULRgS8Vk	ize/guides/zgv797h/revision/1	Support: Provide scaffolded practical investigation template Extension: Students to discuss real-time application of Newton's Third Law
19	Newton's Laws & Momentum	B2: Newton's Laws	B2.7	1. Define Newton's Third Law 2. Investigate applications of Drag and Air Resistance 3. Discuss practical applications of Drag and Air Resistance	Starter (10 mins): Students to recall Newton's Third Law of Motion Main activity (40 mins): Practical activity on air resistance and drag Plenary (10 mins): Conclusions on practical activity applying to industrial applications.	| Resources	https://www.youtube.com/watch?v=eYuvWQ-O_eM	Support: Provide scaffolded practical investigation template Extension: Students to apply concept to exam style questions
20	Knowledge Check	Core Content B	All B	1. Consolidate knowledge of content area A 2. Apply knowledge in interactive quizzes. 3. Review key concepts through peer discussion.	Individual activity: Complete quizzes on Quizlet or Kahoot (30 min). Exam based questions (30 min).	Past paper questions Quizlet	Revision of content area B	

21	Electrical circuits and the transfer of energy	C1: Use of electrical components	C1.1 C1.2	1. Identify common circuit symbols and draw simple series/parallel circuits. 2. Define current, potential difference, power, and energy. 3. State correct SI units for current (A), potential difference (V), power (W), and energy (J).	Starter (10 mins): Students are shown symbols and then given bingo cards to match symbols. Main activity (40 mins): Teacher led discussion on key terms. Students then to use vocabulary and set up basic circuits. Plenary (10 mins): Whiteboard quiz activity testing key symbols and definition.	Circuit symbol flashcards Printed bingo cards Whiteboard or interactive board Worksheet: definitions & unit matching Mini whiteboards for plenary Circuit set up for practical activity	Resistance - Current, voltage and resistance - 4th level Science Revision - BBC Bitesize	Support: Provide word bank and pre-drawn symbols to label Extension: Students to design circuits for different specified purposes.
22	Electricity: Current, Voltage & Resistance	C1: Use of electrical components	C1.3 C1.4	1. Define current, potential difference, resistance 2. Use V=IR.	Starter (10 mins): Circuit symbol matching game. Main (40 mins): Build series circuit; measure I & V; plot I-V graph; discuss ohmic behaviour. Plenary (10 mins): Students explain Ohm's law in own words.	Power supplies, resistors, multimeters	https://www.youtube.com/watch?v=hfj1A9T6OlA	Support: Pre-built circuits for weaker students. Extension: Test filament lamp & diode I-V curves.
23	Series & Parallel Circuits	C2: Equations	C2.1.1 C.2.1.2	1. Determine resistivity; 2. Calculate electrical power and energy.	Starter (10 mins): Recap V=IR with quick problems. Main: Build series & parallel circuits, measure currents & voltages; compare with theoretical values. Plenary: Students answer exam-style question comparing the two circuit types.	Circuit boards, meters	Practice questions on series/parallel circuits.	Support: Provide step-bystep calculation examples. Extension: Set up mixed circuit (series-parallel combination).

24	Power and Energy	C2: Equations	C2.1.3 C2.1.4	1. Define power as the rate of energy transfer. 2. Use $P = Et$ to calculate power given energy and time. 3 Use $E = VIt$ to calculate energy transferred in an electrical circuit	Starter (10 mins): Which appliance uses more? 3 appliance pictures with ratings covered, as students to rank them in terms of power. Student discussion. Main activity (40 mins): Teacher led discussion into power and electrical energy. Students work through worksheet with progressively harder problems. Plenary (10 mins): Students to complete one final challenge and discuss how cost may vary.	PowerPoint slides or board notes Mini whiteboards & markers Printed worksheet with scaffolded + challenge questions Calculator Example appliance power ratings (labels or photos)	Energy, work and power - IGCSE Physics - BBC Bitesize	Support: Provide formula triangles, scaffolded multi-step problems. Extension: Introduce the idea of wasted energy and link to national grid.
25	Electrical energy usage	C3: Electrical energy usage	C3.1 C3.2 C3.3	1. Identify typical power ratings of domestic appliances and calculate their energy usage. 2. Select appropriate fuse ratings for appliances based on current drawn. 3. Calculate energy transferred in kWh and cost of running an appliance	Starter (10 mins): Further appliances provided and students to rank in order but also suggest how power could be reduced. Main activity (20 mins): Students calculate the power of different devices and discuss appropriate fuse rating. Main activity (20 mins): Students given worksheet on calculating cost of energy and calculate daily/weekly costs. Plenary activity (10 mins): Discussion around how to reduce energy in household - link to sustainability.	Appliance power rating cards or images Worksheet (energy usage + fuse rating calculations) Calculator UK mains fuse rating chart Tariff example (£/kWh)	Circuit Construction Kit: DC - Series Circuit | Parallel Circuit | Ohm's Law - PhET Interactive Simulations	Support: Provide formula triangles, scaffolded multi-step problems. Extension: Introduce the idea of smart meters and relate to customer usage.

26	Energy transfer	C4: Energy transfer	C4.1 C4.2 C4.3	1. Define energy in joules (J), convert between joules, kilojoules, and megajoules. 2. Convert between Celsius (°C) and Kelvin (K). 3. Describe energy transfer when heating/cooling substances or during state change	Starter (10 mins): Quick conversions - write some quick-fire conversions on the board and ask students to answer on the whiteboard. Main activity (20 mins): Provide worksheet with increasingly more difficult calculations based around conversions for students to complete and then peer mark. Main activity (20 mins): Teacher led explanation of heating and state change with students annotating heating curve. Plenary activity (10 mins): Concept connections students complete a 3-2-1 activity (3 energy units, 2 key facts about Kelvin scale, 1 thing about state changes)	Conversion worksheet Heating curve diagram (blank and annotated versions)	States of Matter - Atomic Bonding | Interaction Potential | States of Matter - PhET Interactive Simulations	Support: Provide scaffolded conversion sheet Extension: Introduce concept of latent heat.
27	Energy transfer	C4: Energy transfer	C4.4	1. Perform specific heat capacity practical	Starter (10 mins): Introduction of specific heat capacity equation Main activity (40 mins): Practical activity in specific heat capacity Plenary (10 mins): Review of results and discussion around what this shows.	Practical - measuring specific heat capacity - Energy and heating - AQA - GCSE Physics (Single Science) Revision - AQA - BBC Bitesize	https://www.tes.com/teaching-resource/specific-heat-capacity-11978694	Support: Provide scaffolded practical procedure sheet Extension: Discuss applications of where calculations may be useful in industry

28	Change of state	C5: Change of state	C5.1 C5.2	1. Define specific latent heat and distinguish between fusion and vaporisation. 2. Describe experimental methods to measure specific latent heat of fusion (melting ice) and vaporisation (boiling water). 3. Use $\Delta Q=mL$ to calculate thermal energy for state changes.	Starter (10 mins): Why does the temp stay the same? Show a short clip of heating water - discussion around when temperature remains constant. Main activity (10 mins): Introduction of latent heat equation and explanation Main activity (30 mins): Practical investigation on latent heat of fusion, or latent heat of vaporisation Plenary (10 mins): Use whiteboards for quick answer questions, and one real world application of latent heat.	Immersion heater, power supply, stopwatch, ammeter, voltmeter Ice, funnels, beakers, balances Thermometers (optional for monitoring temperature stability) Worksheets with data tables and calculation practice Mini whiteboards for plenary	Research application of latent heat in appliances	Support: Provide template for practical activity, potential for some results pre-entered Extension: Potential to introduce efficiency calculations.
29	Knowledge Check	Content Area C	All C	1. Consolidate knowledge of content area A 2. Apply knowledge in interactive quizzes. 3. Review key concepts through peer discussion.	Individual activity: Complete quizzes on Quizlet or Kahoot (30 min). Exam based questions (30 min).	Past paper questions Quizlet	Revision of content area C	
30	Review & Exam Practice	Consolidation	All spec refs	Revise waves, forces, electricity; apply to exam-style problems.	Starter (10 mins): Retrieval quiz (10 Q's covering all content). Main activity (40 mins): Mock test in timed conditions; peer-mark with mark scheme; identify weak areas. Plenary (10 mins): Students write one strength and one target for improvement.	Pearson SAMs, past papers	Focused revision on weakest topics.	Support: Provide lower demand questions Extension: Attempt higher-demand questions

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