Science

Secondary: Key Stage 3, Key Stage 4

Curriculum plan 2020-21

OAK NATIONAL ACADEMY

1. Curriculum Principles

Below are a set of principles we have sought to apply in our curriculum planning within science. These are adapted for science from the generic principles guiding all Oak lessons.

Coherence and flexibility

We strive to support schools by giving them an online learning offer that can be flexible to fit alongside their existing curriculum. We need to balance this together with coherence, as complete flexibility would imply only standalone lessons, where none can build upon any other. In striking this balance, we will lean towards giving the maximum flexibility possible (where this does not compromise coherence - see point 3 below for further clarification). All units will have revision lessons at the end to consolidate knowledge, which can be standalone if only that topic has been taught, and, where disciplinary knowledge is woven into the units, there will be reminders of previously used scaffolds and prompts.

Subjects first

The science curriculum is structured into biology, chemistry and physics units, with working scientifically skills taught in context throughout. This will be made explicit to the pupils within lessons. In terms of science's relationship and overlap with other subjects (e.g. geography and maths), we will not be able to create cross-curricular coherence as the units can be taught in multiple orders. Therefore, cross curricular topics (such as Earth science) will not cohere with other subjects (e.g. geography).

Knowledge organisation

The units in the science curriculum are grouped by key stage, with a suggested route through, organised within year groups. In Key Stage 4, units are sequenced according to the AQA specification (with two exceptions, P3 Particles and B7 Ecology). In most circumstances, the units within a given year can be sequenced flexibly, but there is an assumption in the creation of the units that knowledge in any given year is building on units from previous years (i.e. that units in year 5 are planned with the assumption that units in year 4 have been taught). If following a different exam board at KS4, we will provide a suggested route through at a later date.

As stated above, the substantive knowledge (i.e. the science content) will be taught in units, and the disciplinary knowledge (i.e. working scientifically) is taught in context. Hierarchical elements of working scientifically will be reflected in the units and therefore this will be built up accordingly. While this will take account of prior learning assumptions from the previous key stage, or units, there will also be reminders of prompts and scaffolds to help pupils.

Knowledge selection

We are seeking to support schools to deliver the National Curriculum to children who cannot attend school. Our choice of what to teach will primarily be guided by the content specified in the National Curriculum, but we have also chosen to broaden this to increase challenge and build aspiration (e.g. include more physics at KS1 and 2, introduce some KS4 concepts in KS3).

Inclusive and ambitious

We want Oak to be able to support all children. Our units will be pitched so that children with different starting points can access them. Pupils need to have a large amount of subject knowledge stored in their long-term memory in order to become competent at any subject, and this is especially true of science where application is often an application of knowledge. For this reason, these lessons are designed to teach science in a clear and deliberate fashion, emphasising secure content knowledge before moving onto tasks. In this approach the teacher is the subject expert and the emphasis is on instruction and explanation, followed by deliberate practice supported by modelling, guided practice and scaffolding. Models and analogies will be used where appropriate to allow pupils to visualise or contextualise abstract ideas.

Pupil engagement

We need pupils to be thinking during science lessons - both to engage with the subject and to strengthen memory of what is being learnt. Our lessons will not be video lectures. We seek to exercise pupils' minds throughout their lessons (based on the principles described in point 5 above). This will involve questions and tasks throughout instruction, just as we would with classroom teaching.

Motivation through learning

Like all teachers, we recognise that good presentation helps pupils keep participating in our lessons. However, we are teachers, not entertainers. We seek to motivate pupils through our subjects. We believe that science is inherently interesting, and we aim to build this interest through our teaching. In science, we will provide

opportunities where possible for pupils to engage in home experimentation. We will begin each unit with a summary of the relevant careers for that unit, including those outside of science itself. Units will also include short case studies of work by current and past scientists that reflect the diversity of backgrounds of our pupils. Finally, we will try to be explicit about the real life relevance of each unit so that it is clear why this knowledge is important.

2. Subject structure overview

KS3 units and KS4 and are presented here in a suggested topic order – for further guidance, see section 3 which provides a suggested route through per year group. The codes refer to the year, subject and topic. For example, Year 7 Biology Cells is 7BC.

Key Stage 3 Science

KS3 - Biology		
Unit title	**Length of unit***	**Prior knowledge required**
7BC Cells, tissues and organs	16	KS2 Cells
7BR Reproduction and variation	15	KS2 Reproductive Cycles
8BE Ecological relationships and classification	14	KS2 Ecosystems, Adaptations, Humans and animal over time
8BD Digestion and nutrition	13	KS3 Cells, KS2 Diet and Lifestyle
9BP Plants and photosynthesis	12	KS3 Cells, KS2 Plants
9BB Biological systems and processes	15	KS3 Cells, KS2 Human anatomy
KS3 - Chemistry		
Unit title	**Length of unit***	**Prior knowledge required**
7CP Particles	16	KS2 Particles in physical and chemical changes
7CC Chemical reactions	12	KS2 Physical and Chemical Changes
8CP Atoms and the periodic table	14	None

8CM Materials and the Earth	15	KS2 Rock cycle and Sustainability
9CR Reactivity	20	KS3 Atoms and the Periodic table, Chemical reactions
9CE Energetics and rates	14	KS3 Chemical reactions
KS3 - Physics		
Unit title	**Length of unit***	**Prior knowledge required**
7PE Energy	16	KS2 Energy
7PF Forces and motion	14	KS2 Forces
8PL Light and space	16	KS2 Light and Space
8PE Electricity and magnetism	16	KS2 Electricity
9PM Matter	11	KS3 Particles
9PF Forces in action	11	KS3 Forces and motion
9PS Sound waves	11	KS2 Sound

Key Stage 4 Science

KS4 - Biology		
Unit title	**Length of unit***	**Prior knowledge required**
B1 Cell biology	Combined science: 19 Biology: 21	KS3 Cells
B2 Organisation	23	KS4 Cell biology KS3 Digestive system, Plants and photosynthesis, Biological systems and processes
B3 Infection and response	Combined science: 13	KS4 Cell biology, Organisation

	Biology: 17	
B4 Bioenergetics	15	KS4 Cell biology, Organisation KS3 Plants and photosynthesis, Biological systems and processes
B5 Homeostasis and response	Combined science (FT): 12 Combined science (HT): 14 Biology: 25	KS3 Reproduction and variation
B6 Inheritance, variation and evolution	Combined science (HT): 20 Combined science (FT): 19 Biology: 25	KS3 Reproduction and variation, Ecological relationships and classification
B7 Ecology	Combined science: 12 Biology: 17	KS3 Ecology
KS4 - Chemistry		
Unit title	**Length of unit***	**Prior knowledge required**
C1 Atomic structure and periodic table	Combined Science (FT): 18 Combined Science (HT): 19 Chemistry: 20	KS3 Atoms and the periodic table, Reactivity
C2 Bonding, structure and the properties of Matter	Combined Science: 12 Chemistry: 13	KS4 Atomic structure and the periodic table

C3 Quantitative Chemistry	Combined Science (FT): 6 Combined Science (HT): 8 Chemistry: 13	KS4 Atomic structure and the periodic table, Bonding KS3 Chemical reactions
C4 Chemical changes	Combined Science (FT): 15 Combined Science (HT): 20 Chemistry: 22	KS4 Atomic structure and the periodic table, Bonding KS3 Chemical reactions
C5 Energy changes	Combined Science (FT): 7 Combined Science (HT): 8 Chemistry: 9	KS3 Energetics and rates
C6 The rate and extent of chemical change	Combined Science (FT): 11 Combined Science (HT): 16 Chemistry: 16	KS3 Energetics and rates
C7 Organic Chemistry	Combined Science: 5 Chemistry: 13	KS4 Chemical change
C8 Chemical analysis	Combined Science: 6 Chemistry: 12	KS4 Atomic structure and the periodic table KS4 Chemical changes
C9 Chemistry of the atmosphere	8	KS3 Materials and the Earth

		There is some crossover with KS4 Ecology (B7) and KS4 Waves but only KS3 knowledge will be assumed to allow for different teaching orders
C10 Using Resources	Combined Science (FT): 9 Combined Science (HT): 10 Chemistry: 18	KS4 Chemical changes KS3 Materials and the Earth KS2 Sustainability
KS4 - Physics		
Unit title	**Length of unit***	**Prior knowledge required**
P1 Energy	Combined science (FT): 13 Combined science (HT): 14 Physics : 16	KS3 Energy
P2 Electricity	Combined science (FT): 20 Combined science (HT): 21 Physics: 23	KS4 Energy KS3 Electricity and magnetism
P3 Particle Model of Matter	Combined science (FT): 10 Combined science (HT): 11 Physics: 13	KS3 Particles and Matter
P4 Atomic Structure	Combined science: 8 Physics: 11	There is crossover content with KS4 Atomic structure and the periodic table (C1), although these lessons will only assume KS3 knowledge to allow for teaching in

		different orders - KS3 Atoms and the periodic table, Reactivity
P5 Forces	Combined science (FT): 17 Combined science (HT): 18 Physics: 25	KS3 Forces and motion, Forces in action
P6 Waves	Combined science: 9 Physics: 16	KS3 Light and space, Sound waves
P7 Magnetism	Combined science (FT): 5 Combined science (HT): 8 Physics: 13	KS3 Electricity and Magnetism
P8 Space (Physics only)	8	KS4 Forces KS4 Waves KS3 Light and Space

*all unit lengths include at least one, but usually two review lessons

3. Suggested sequence

The science curriculum has been planned on the following basis:

- Before KS3, pupils have been taught the latest KS2 National Curriculum (2014)
- After KS3, most pupils will go on to study combined science at GCSE level or GCSE single sciences - biology, chemistry and physics

As a result of this work, the science curriculum has the following features:

- It takes a year-by-year approach to teaching the curriculum.
- The content of each year's units is based on the expectation that the relevant content for each given year is taught by the end of the previous year. Schools may choose to teach a given year's topic in an earlier year, such that year 8 content is taught in year 7. In these circumstances, it is recommended that content for the previous year is taught first (for example, teaching year 8 Ecology topic at the end of year 7 once all year 7 content is taught)
- In KS4, the units are based on the AQA specification, and are ordered to ensure that paper 1 content is taught first. In the suggested sequence, they appear in the same order as the specification, except for B7 Ecology and P3 Particles. (This is to allow for teaching of Ecology when weather conditions are more likely to be favourable for outdoor sampling work, and to teach Particles as the first physics topic as it contains content foundational to other units)

- There is no expectation that any given unit in one science (e.g. physics) is taught before any given unit in another (e.g. biology), with the exception of 7CP Particles which is recommended to be the first unit taught in year 7. Any crossover material (e.g. atoms in KS4 physics and chemistry) will only assume the previous key stage's knowledge
- Many topics within any given year can be taught in a different sequence if schools wish (for example, in year 7, 7PE Energy can be taught after 7PF Forces). However, the lesson by lesson materials have been written with the suggested route through in mind, and schools will have to consider this in their decisions.
- Each year is divided into topics across biology, chemistry, and physics, but equally weighted across these three disciplines
- Working scientifically is integrated into all the topics and can be identified in the learning outcomes in the topic summaries where relevant.
- The working scientifically programme of study is covered throughout both key stages. The suggested map below is based on finishing KS3 in year 9, and starting the first three units of KS4 at the end of year 9
- The KS4 suggested topic sequence has been split below into biology, chemistry, and physics, but the precise ordering between each science (as opposed to within it) is flexible, and a matter for schools to determine. It is expected that schools will alter this according to their staffing context and curriculum time allocation in year 10 and 11.

Year group	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8
7	Particles 7CP	Cells, tissues and organs 7BC	Energy 7PE	Reproduction and variation 7BR	Chemical reactions 7CC	Forces and motion 7PF	Ecological relationships and classification 8BE	
8	Light and space 8PL	Atoms and the periodic table 8CP	Digestion and nutrition 8BD	Electricity and magnetism 8PE	Materials and the Earth 8CM	Plants and photosynthesis 9BP	Matter 9PM	
9	Forces in action 9PF	Reactivity 9CR	Energetics and rates 9CE	Sound waves 9PS	Biological systems and processes 9BB	B1 Cells	C1 Atomic Structure and the Periodic table	P3 Particle theory
Bio	B2 Organisation	B3 Infection and response	B4 Bioenergetics	B7 Ecology	B5 Homeostasis	B6 Inheritance		
Chem	C2 Bonding	C3 Quantitative Chemistry	C4 Chemical Change	C5 Energy Changes	C6 Rates of Reaction	C7 Organic Chemistry	C8 Chemical Analysis	C9 Earth and Atmosphere & C10 Using Resources
Phys	P1 Energy	P2 Electricity	P4 Atomic Structure	P7 Magnetism	P5 Forces and Motion	P6 Waves	P8 Space	

4. Unit specifics

7CP Particles

Lesson number/title	Core content
1 Solids, liquids and gases	• Describe how the movement and spacing of the particles is different in solids, liquids and gases • Draw accurate diagrams to represent the particle arrangement in solids, liquids and gases • Use the particle model to explain properties of solids, liquids and gases
2 Diffusion	• Define the term 'diffusion' • Describe diffusion in terms of particles and high and low concentration • Explain why diffusion is different in solids, liquids and gases – relate to the particle model
3 Changes of state	• Describe changes of state that occur from solid to liquid and liquid to gas in terms of particles • Interpret melting point and boiling point data
4 Investigating changes of state	• Interpret melting point and boiling point data • Plot secondary data showing changes of state
5 Gas pressure	• Describe gas pressure • Explain the effect of gas pressure on containers • Describe and explain the effect of temperature on gas pressure in terms of particles
6 Conservation of mass	• Draw a particle model for a solution • Make accurate measurements to test the conservation of mass theory • Explain the meaning of conservation of mass in terms of particles • Check for reproducibility
7 Review 1	• Review of content covered so far • Exam style questions

8 Pure and impure substances	• Define a pure substance and link this to melting and boiling points • Define a mixture • Describe simple separation techniques
9 Separating mixtures	• Identify parts of a mixture to be separated • Write a method for separating a mixture • Name key pieces of equipment and processes for separation to be successful
10 Rock salt	• Investigate the change in mass when separating this mixture • Calculate the yield of pure salt from the starting mass • Evaluate the method and suggest improvements
11 Distillation	• Explain how a simple distillation works • Identify hazards and risks and suggest how to reduce them • Identify the components of a Liebig condenser and give reasons for this being more suitable than simple distillation equipment
12 Chromatography	• Identify mixtures using chromatography • Describe how to separate a mixture using chromatography • Interpret chromatograms to describe the composition of mixtures
13 Solubility	• Define the term 'solubility' and determine the solubility of a salt in a given solvent • Use the particle model to explain solubility • Comment on reproducibility and suggest improvements to a method
14 Solubility practical	• Suggest a hypothesis from an observation • Describe the effect of temperature on solubility • Process and present data in an appropriate form • Identify anomalous results • Describe and explain patterns in solubility data using knowledge of particle theory
15 Case Study of Masataka Taketsuru	• State key facts about the life of Masataka Taketsuru • Describe his involvement with the development of distillation of whiskey
16 Review 2	• Review of content covered in second half of this topic • Exam style questions

7BC Cells tissues and organs

Lesson number/title	Core content
1 Microscopes	• Label the parts of the microscope • Describe how to use a microscope, using key terms correctly • Calculate magnification
2 Unicellular organisms	• Define the term unicellular and label common features of unicellular organisms • Name and describe the functions of some of the structures of unicellular organisms • Describe some uses and dangers of unicellular organisms
3 Diffusion Part 1	• Define diffusion • Explain factors that affect diffusion • Explain examples of diffusion in the body
4 Diffusion Part 2	• Identify variables to change, measure and control to investigate diffusion • Draw a table for results, including units • Work safely to collect and record data to test the hypothesis • Process the data to calculate a mean, accounting for anomalies • Display data appropriately • Describe and explain patterns using ideas about diffusion
5 Plant cells	• Label a typical plant cell • Describe the function of the organelles in plant cells • Describe how to use a microscope to view plant cells in focus
6 Plant as organisms	• Identify the organs of a plant and their functions • Name some of the tissues found in the leaf and describe their job • Describe ways in which the leaf is adapted to do its job
7 Animal cells	• Label an animal cell and describe what each cell part does • Prepare a slide of human cells and observe using the microscope. • Calculate magnification or image/actual size given the equation
8 Comparing animal and plant cells	• Compare plant and animal cells • Explain those differences in terms of functions of the parts • Use evidence to make a reasoned argument

9 Specialised cells	• Describe features of specialised cells, using key structures • Describe specialisation to function in a range of animal and plant cells • Explain how the specialised features enable the cell to carry out its function
10 Animals as organisms	• Identify the major organ systems of the human body and describe their main functions • Describe the organisation of multicellular organisms, in terms of cells, tissues, organs • Explain why multicellular organisms need organ systems
11 Digestive system	• Label a diagram of the organs in the digestive system • Describe the function of the digestive system • Describe and explain some of the adaptations of the digestive system and link these to diffusion
12 Respiratory system	• Label the parts of the respiratory system • Describe the path oxygen takes into the blood • Describe the adaptations of the breathing system to allow efficient diffusion
13 Inhaled and exhaled air	• Describe the composition of the air we breathe in and out • Explain the results of an experiment to prove the differences • Collect, display and process data with good resolution and process it appropriately
14 Review 1	• Review ideas about microscopes & magnification
15 Review 2	• Recall key terms, definitions and structures related to cells, tissues, organs and systems • Describe ways in which cells, tissues and organs are specialised for function • Explain adaptations in terms of diffusion
16 Case study of Betty Hay	• Understand key ideas about the life and work of Betty Hay

7PE Energy

Lesson number/title	Core content
1 Energy stores and transfers - Part A	• Name the main energy stores and give examples • Describe energy transfers, identifying pathways
2 Energy stores and transfers - Part B	• Describe energy transfers using box diagrams • Apply the conservation of energy to examples
3 Bunsen burner	• Describe how to use a Bunsen burner safely • Calculate averages • Write a conclusion from secondary data
4 Efficiency	• Calculate energy stores in different contexts • Calculate the efficiency of energy transfers • Interpret Sankey diagrams
5 Conduction	• Describe the variables and method to investigate conduction • Describe patterns in data collected, using data to back up statements • Explain how heat is transferred by conduction
6 Convection	• Describe how heat transfers occurs by convection • Explain what is meant by a convection current • Explain everyday observations using ideas on convection.
7 Radiation	• Explain how heat is transferred by radiation • Explain everyday observations using an understanding of absorption and emission of radiation • Apply knowledge of conduction, convection and radiation to questions.
8 Insulation	• Describe an insulator in terms of energy transfers • Identify methods of reducing energy transfers and explain how they work • Apply knowledge of conduction, convection and radiation
9 Mid Topic Review	Revision of key ideas covered so far in the Energy topic including: • Creating a catapult whilst identifying the energy transfers; • Comparing conduction, convection and radiation;

	• Investigating different insulations.
10 Power and energy	• Explain the relationship between energy and power. • Convert given between watts and kilowatts and hours and minutes • Use the equation p=e/t to calculate power
11 Energy in the home	• Convert between units for power and time • Calculate how much energy devices transfer from their power rating and the time of operation • Calculate the costs of running home appliances
12 Energy in food 1	• Identify variables to change, measure and control given a hypothesis • Write a method to test the hypothesis, including named equipment • Identify hazards and risks and suggest ways to reduce these with given equipment
13 Non-renewable energy resources	• Describe how fossil fuels are formed • Describe how electricity is generated in a fossil fuel power station • Explain advantages and disadvantages of fossil fuel use
14 Renewable energy resources	• Define renewable energy resources and give examples • Describe how renewable sources produce electricity using energy transfers • Describe the advantages and disadvantages of different renewable energy sources
15 Anne Easley	• Describe the work of Anne Easley • Apply knowledge of energy stores to rocketry
16 End of topic review	• Recall key terms, definitions and structures related to energy • Review key ideas from the second half of the topic

7BR Reproduction

Lesson number/title	Core content
1 Human reproductive system	• Describe adaptations of the egg and sperm cells for their job • Label diagrams of the human male and female reproductive system • Describe the function of each of the parts
2 Fertilisation	• Describe how reproduction takes place in humans • Describe the process fertilisation and implantation • Explain the role of cilia found in the oviduct • Describe the process of cell division
3 Gestation	• Describe the development of the foetus and the function of the placenta, umbilical cord and amniotic fluid • Explain how the foetus gets its nutrition and oxygen, and how waste is excreted
4 Risk Factors during Gestation	• Describe risks of smoking and alcohol during pregnancy • Use data to describe the impact of smoking on the unborn baby
5 Birth	• Describe patterns in secondary data • Describe how a baby is born • Explain differences in numbers of offspring for different animals
6 Puberty and the menstrual cycle	• Describe some of the changes in males and female bodies during puberty • Describe the main events in the menstrual cycle
7 Reproduction Revision 1	• Describe the processes that occur in the making of a baby • Describe how the chromosome number is maintained through sexual reproduction.
8 Jean Purdy and Fertility Treatment	• Describe the work of embryologist Jean Purdy • Describe her contribution to fertility treatment and the uses of her discoveries

9 Plant reproduction	• Identify and describe the function of the parts of the flower • Describe pollination and fertilization • Describe the formation of seeds and fruit
10 Seed dispersal	• Describe how seeds are adapted for specific dispersal mechanisms. • Identify variables to change, measure and control • Process data collected and use it to describe a relationship
11 Practical - Seed Dispersal	• Collect data on seed dispersal • Identifying variables that affect seed dispersal and write a method • Calculate a mean
12 Variation between species	• Explain what is meant by a 'species' • Give examples of continuous and discontinuous variation • Collect and display data on variation, explaining the choice of graph
13 Practical - Human Variation	• Collect data on variation in human height and handspan. • Plot data on a graph • Describing patterns in data
14 Why is variation important?	• Use and explain a simple model to represent sexual reproduction • Compare chromosome content in body cells and gametes • Explain why sexual reproduction leads to variation
15 Reproduction Revision 2	• Review and consolidate knowledge of reproduction • Compare reproduction in plants and humans

7CC Chemical Reactions

Lesson number/title	Core content
1 Indicators of chemical reaction	• Describe evidence for a chemical reaction • Apply conservation of mass to simple chemical change • Explain why, in terms of particles, mass stays the same in a reaction
2 Oxidation	• Describe evidence reactions with oxygen • Represent oxidation reactions using word equations and diagrams • Apply the conservation of mass theory to oxidation reactions
3 Acids and alkalis	• Identify common hazard symbols and describe appropriate safety precautions • Record observations accurately and using good language • Classify substances as acid, alkali or neutral using simple indicators
4 pH scale	• Use Universal Indicator to determine the pH of a range substances • Classify substances as strong or weak acids or alkalis based on their pH • Explain why universal indicator is better than simple indicators
5 Metal and acid reactions	• Describe evidence for the reaction of metals and acids • Write word equations to represent the reaction of metals and acids • Describe the test for hydrogen gas and the positive result
6 Review 1	• Review key ideas from the topic so far
7 Neutralisation	• Describe what happens to the pH when acids are added to alkalis or vice versa • Represent the reaction of acids and alkalis using word equations • Name the salt produced in acid alkali reactions
8 Simple Titration	• Suggest control variables needed to test a hypothesis • Make and record repeatable results and describe how these are recognized • Process repeated results appropriately and use them to write a conclusion
9 Antacid investigation	• Describe a method to find the best antacid medicine • Identify variables to change, measure and control • Design a table for results
10	• Collect accurate results and check for reproducibility

Antacid analysis	• Display the results appropriately, explaining the choice of graph • Use the results to write a conclusion saying which is the best antacid
11 Case study of Helen Sharman	• Understand key ideas about the life and work of Helen Sharman
12 Review 2	• Recall key terms, definitions and structures related to chemical reactions • Review key ideas from the second half of the topic

7PF Forces

Lesson number/title	Core content
1 What are Forces?	• Identify forces in a range of context • Give examples of contact and non-contact forces • Represent the size and direction of force using arrows • State the unit of force
2 Representing Forces	• Represent the size and direction of forces using arrows in a free body diagram • State whether opposing forces are balanced or unbalanced
3 Resultant Forces	• Describe the effect of balanced and unbalanced forces on the motion of an object • Calculate resultant forces
4 Gravity	• Measure and record the weight of known masses • Correctly plot a graph with a line of best fit • Describe the relationship between mass and weight on Earth
5 Weight	• Use an equation to calculate weight • Explain why weight changes on different planets • Use a rearranged equation to calculate mass
6 Avicenna and the story of inertia	• Describe the contribution of Avicenna to understanding motion • Describe how theories of motion have developed over time
7 Pressure	• State what is meant by pressure • Use an equation to calculate pressure • Apply knowledge to explain why pressure may be high or low in everyday situations
8 Investigating speed	• Formulate a hypothesis to investigate • Identify the variables in an investigation • Obtain a set of results, • Describe the pattern seen in the results
9	• Describe how different factors affect speed • Apply knowledge of resistive forces to explain design modifications

Factors affecting speed	
10 Calculating speed using an equation	• Use an equation to calculate speed • Give the correct units in all cases. • Calculate the relative speed of objects passing one another
11 Distance-time graphs	• Describe the features of distance time graph • Use a distance-time graph to calculate speed • Represent a journey using a distance time graph
12 Calculating speed using distance time graphs	• Compare speeds in distance time graphs • Calculate speed using the gradient of a distance-time graph
13 Revision Part 1	• Revise key forces content such as resultant force, gravity and weight.
14 Revision Part 2	• Revise key content such as pressure, calculating speed and distance-time graphs.

8BE Ecological relationships and classification

Lesson number/title	Core content
1 Food chains and webs	• Interpret food webs • Describe ways in which animals and plants are interdependent
2 Representing food chains	• Draw and interpret pyramids of number
3 Decay	• State the best conditions for decay • Explain the importance of decay. • Describe what causes decay • Explain the design features of a compost bin
4 Impacts on food webs	• Describe how changes in the environment can affect different organisms • Explain how changes in the environment can affect organisms within a food web • Explain the process of bioaccumulation
5 Random Sampling Estimating populations	• Describe how to use a quadrat to sample an ecosystem • Construct a frequency table
6 Estimating populations	• Make and record measurements to estimate the size of a population • Process the results appropriately by calculating areas and means • Apply knowledge to process secondary data
7 Classifying living organisms	• Classify organisms given appropriate information • Explain the basis of the Linnaeus classification
8 Adaptation	• Suggest things organisms may compete for • Describe ways in which organisms are adapted to be better competitors • Explain how these adaptations help them survive in given conditions
9	• Describe ways in which organisms may vary within a species

Natural selection	• Explain why some organisms within a species are better adapted to their environment • Explain why genetic variation within a species can drive natural selection
10 Evolution evidence	• Describe evidence for evolution • Explain how the evidence supports the evolution theory • Describe the changes that can lead to extinction
11 Case Study of Mary Anning	• State key facts about the life of Mary Anning
12 Biodiversity	• Describe the importance of biodiversity • Describe some of the methods being employed to maintain biodiversity • Explain how some scientific methods will support maintaining biodiversity
13 Revision 1	• Recall and apply key knowledge from the first half of the ecology topic
14 Revision 2	• Recall and apply key knowledge from the second half of the ecology topic

8PL Light and Space

Lesson number/title	Core content
1 Light waves	• Describe some properties of light waves • Describe what happens when light meets a surface • Draw accurate light ray diagrams to illustrate light travelling and meeting different surfaces
2 The electrical and chemical effects of light	• Identify variables to change, measure and control to test a hypothesis • Draw a table for repeatable results and process results appropriately • Write a conclusion for the data collected
3 Reflection	• Follow a method to test a given hypothesis • Make a conclusion from data collected • Process secondary data appropriately and use it to check for reproducibility • Draw accurate ray diagrams • Know the law of reflection
4 Reflected images	• Apply the law of reflection to different scenarios • Describe properties of reflected images • Describe and explain specular and diffuse reflections
5 Refraction	• Draw the pathway light takes through a glass block. • Measure the angle of refraction using a protractor. • Describe and explain how refraction takes place using key words and phrases.
6 Vision	• Label the parts of the eye • Use ray diagrams to show how images are formed in pinhole cameras and the eye • Describe how an image is formed and how we see
7 Correcting vision	• Safely carry out an eye dissection • Describe how the eye focuses on near and far objects • Explain the cause of long and short sightedness and how this can be corrected
8 Colours	• List the colours of the visible spectrum. • Describe how white light can be dispersed to give a range of different colours

	• Explain why we see objects as a particular colour.
9 Filters	• Describe and explain how coloured filters change white light. • Predict the colours of coloured objects in coloured light • Apply knowledge to a range of exam questions
10 Review 1	• Review key ideas about light
11 Gravity	• Describe the term 'non-contact force' and give examples • Describe the forces of attraction between the Earth & moon and the Earth and the Sun • Describe the properties that affect the sizes of gravitational forces between different objects in the Solar system
12 Weight and mass	• Describe how gravity varies in the solar system • Calculate weight, mass and gravitational field strength on Earth and other planets • Change units and express answers to a given number of significant figures
13 Case study of Maggie Aderin-Pocock	• Understand key ideas about the work of Dr Maggie Aderin-Pocock
14 Universe	• Define a light year and explain why they are used • Describe Earth's place in the universe • Describe what a star is and why it emits light
15 Seasons	• Use secondary data to describe and explain patterns in year lengths in the solar system • Describe and explain differences in day length, position of the sun and temperatures in different seasons • Explain why the Earth experiences seasons, but not every other planet in the solar system does
16 Review 2	• Recall key terms, definitions and structures related to, space and gravity • Apply knowledge to a range of questions

8CP Atoms and the periodic table

Lesson number/title	Core content
1 Elements	• Define elements, name the two types of elements and locate them on the periodic table • Recognise elements from drawings or names • Describe the rules for writing chemical symbols
2 Atoms	• Label a diagram of the atom and describe its structure • Draw and write electron configuration for any of the first 20 elements • Describe the link between electron configuration and place in the periodic table
3 Development of the periodic table	• Define 'properties' • Describe how the periodic table has developed over time • State details about the life of Dmitri Mendeleev
4 Metals and non-metals	• Describe some properties and uses of metals and non-metal elements • Describe some of the stages in the formation of the periodic table • Explain how the properties of the elements were used in early versions of the periodic table
5 Compounds	• Describe compounds and use particle diagrams to represent them • Make a simple compound and explain how it is different from the elements it is made of • Name compounds given the elements contained
6 Chemical formulae	• Name compounds given the elements or formulae • Write formula using ideas of valency • Interpret formulae in terms of number of each atom are present
7 Making compounds	• Safely make a compound and predict the change in mass during the reaction • Make accurate measurements to test the prediction made • Use data collected to check the prediction and explain observations
8 Conservation of mass	• Apply conservation of mass ideas to physical and chemical changes • Plot secondary data and draw a line of best fit • Describe and explain patterns in data • Use secondary data to check for reproducibility
9 Review 1	• Try out 2 revision techniques • Review content from the topic so far

10 Group 1	• Describe some of the properties of group 1 elements • Describe trends in physical and chemical properties of group 1 • Write word (or symbol) equations to represent their reaction with oxygen and water
11 Group 7	• Describe trends in physical properties of group 7 • Describe the trend in reactivity of group 7 • Write word equations to represent their reaction with group 1 elements
12 Group 7 displacement	• Explain the reactivity of group 7 elements • Represent displacement reactions using equations
13 Group 0	• Describe properties of group 0 elements • Describe uses of group 0 elements
14 Review 2	• Explain how an elements position in the periodic table links to its properties and reactivity (groups 1 and 7)

8BD Digestion

Lesson number/title	Core content
1 Healthy Diet Part 1	• Name the components of food and describe what each is needed for in the body • Interpret and make calculations from nutrition labels
2 Healthy Diet Part 2	• Calculate energy requirements for different activities
3 Unhealthy diet	• Describe some of the diseases linked with nutrient deficiency • Describe some of the diseases linked with imbalances in energy intake • Interpret data on the incidence of food related diseases
4 Energy release	• State uses for the energy released • Describe how energy is released from the food we eat • Evaluate a model for respiration
5 Carbohydrates	• Describe the difference between the two carbohydrates • Describe how to test for starch and sugar and their positive result • Work safely to carry out chemical tests for the presence of starch and sugar and record the results
6 Protein and fats	• Describe the chemical test for protein and fat and their positive results • Safely carry out the tests for protein and fat and record the results • Use the results collected to draw conclusions
7 Review 1	• Review key ideas from the topic so far
8 The digestive system	• Explain why digestion is necessary • Label the organs of the digestive system and describe their function • Explain the importance of gut bacteria • Describe how the intestines are adapted for their function
9 Adaptations of the small intestine	• Describe and explain adaptations of the small intestine
10	• Describe the action of the enzymes in the digestive system

Enzymes	• Explain the results of the 'model gut' experiment • Evaluate the model
11 Effect of temperature on enzymes	• Identify variables to change, measure and control to test a hypothesis • Draw a table to record results • Draw a conclusion from results obtained
12 Case Study of Rebecca Lancefield	• Understand key ideas about the life and work of Rebecca Lancefield
13 Review 2	• Review of key ideas from the second half of the topic

8PE Electricity and Magnetism

Lesson number/title	Core content
1 Circuits	• Name common circuit symbols • Make basic observations on what is needed for a circuit to work • Use a model to describe electricity
2 Current and series circuits	• Use an ammeter to make and record measurements of current at different points in a series circuit • Describe how current behaves in a series circuit • Describe and explain the effect of adding extra bulbs on current
3 Current and parallel circuits	• Recognise and draw parallel circuits • Make and record measurements of current in parallel • Describe how current behaves in parallel • Make predictions for untested circuits
4 Potential difference	• Describe potential difference using a model • Describe how to use a voltmeter to measure potential difference across components • Describe pd in series circuits
5 Potential difference in parallel circuits	• Describe pd in parallel circuits • Compare patterns of pd in series and parallel circuits
6 Resistance	• Investigate the relationship between current, pd and resistance • Use data collected to inform a conclusion • Use an equation to calculate current, pd or resistance
7 Measuring resistance	• Identify variables to change, measure and control • Collect and display results appropriately • Describe and explain the effect of length of wire on resistance
8 Lewis Howard Latimer	• Describe the contribution of Latimer to electrical lighting • Give the advantages and disadvantages of LED bulbs • Compare different types of bulbs
9	• Describe what is meant by static electricity

Static electricity	• Describe how objects can become charged • Describe how the charge can produce a force between charged objects
10 Magnetic fields	• Draw the field lines around a magnet • Describe the magnetic field around a magnet, or the Earth, using fields lines
11 Magnetic forces	• Describe the forces of attraction and repulsion between magnets • Explain attraction and repulsion of magnets using field line patterns.
12 Electromagnets	• Describe how to make a simple electromagnet • Draw the shape of the magnetic field around a straight wire • Identify key variables for an investigation of electromagnets
13 Electromagnet investigation	• Investigate the factors which affect the strength of an electromagnet • Plot a graph of data • Analyse secondary data to draw conclusions
14 Uses of Electromagnets	• To state how electromagnets are used in a variety of devices • To understand how the motor effect is caused by magnetic fields • To state the factors affecting the speed of a direct motor
15 Electricity Review	• Review of key ideas from electricity
16 Magnetism Review	• Review of key ideas from magnetism

8CM Materials and the Earth

Lesson number/title	Core content
1 Structure of the Earth	• Label a diagram showing the structure of the Earth and compare the layers in terms of composition, thickness and temperature • Explain how the continents move • Describe some of the evidence for 'continental drift'
2 Igneous rock	• Describe the formation of intrusive and extrusive igneous rocks • Explain the link between cooling rate and crystal sizes • Describe the properties of igneous rock
3 Sedimentary rock	• Describe the weathering, transportation and deposition of rocks at the Earth's surface • Describe the formation of sedimentary rocks • Describe the properties of sedimentary rocks
4 Metamorphic rock and the rock cycle	• Describe the formation of metamorphic rocks • Describe the properties of metamorphic rocks • Apply knowledge of all 3 rock type formations to questions on the rock cycle
5 Fossils	• Describe how fossils are formed • Explain how fossils move to the surface of the Earth • Interpret diagrams to identify the relative age of fossils
6 Crude oil	• Describe the composition of crude oil using keywords • Draw the first 5 alkanes • Evaluate the extraction and use of crude oil
7 Review 1	• Review key ideas from the topic so far
8 Earth's changing atmosphere	• Compare the earth's early atmosphere to the atmosphere today • Explain why carbon dioxide and oxygen levels changed in Earth's early history
9 Carbon cycle	• Describe the main processes involved in the cycling of carbon
10	• Describe the greenhouse effect

The greenhouse effect	• Explain the significance of an increased greenhouse effect
11 Climate change	• Describe some of the potential consequences of climate change • Analyse data related to climate change
12 Types of material	• Describe some of the properties of ceramics, polymers and composites
13 Recycling resources	• Explain the importance of reducing, reusing and recycling • Compare different methods of preserving natural resources
14 Mining and quarrying	• Describe the processes of mining and quarrying • Evaluate the processes of mining and quarrying
15 Review 2	• Recall key terms and definitions from the second half of the topic • Use scientific language accurately to correct statements

9BP Plants and Photosynthesis

Lesson number/title	Core content
1 Plant Roots	• Describe the function of the root and root hair cells • Compare root hair cells to 'typical' plant cells • Explain how the adaptations of the root are related to its function
2 Photosynthesis	• Identify the reactants and products of photosynthesis • Describe photosynthesis using a word equation • Interpret and draw conclusions from data
3 Uses of Sugar	• Identify hazards and risks and suggest appropriate ways to reduce the risks • Make observations and describe results • Draw conclusions from results related to photosynthesis
4 Rate of photosynthesis	• Identify factors to change, measure and control to test a hypothesis • Collect and display data appropriately • Draw conclusions from data collected
5 The leaf	• Describe how leaves are adapted for their function • Use a microscope correctly to observe stomata • Explain how features enable the leaf to do its job
6 Transport in plants	• Label the xylem and phloem • Describe the role of the xylem and phloem in transporting water and sugars • Describe the path of water and glucose around the plant
7 Mid-Topic Review	• A review of all content covered so far in this unit, including study skills, core knowledge review and extended response question practice.
8 George Washington Carver	• Describe George Washington Carver's contribution to botany • Describe what is meant by crop rotation and how it improved crop yields • Explain the advantages of crop rotation
9 Plants and the atmosphere	• Describe how carbon dioxide and oxygen levels have changed over the Earth's history • Explain how plants have affected the levels of oxygen and carbon dioxide in the atmosphere • Describe and explain recent human activities that are affecting carbon dioxide levels.

10 Plants as food	• Describe the role of plants as producers • Test for starch in common diet items • Describe the importance of insect pollination to food security
11 Application of Knowledge	• Write a conclusion from secondary data on stomata investigation • Explaining the adaptation of leaves in relation to transpiration, rate of photosynthesis and plant growth
12 Review 2	• Explain how a decline in pollinating insects could affect food supplies • Explain how slash and burn increases carbon dioxide levels • Recall key knowledge on plants and plant investigations

9PM Matter

Lesson number/title	Core content
1 Particle theory	• Describe the arrangement and motion of particles in a solid, liquid and gas • Define diffusion in terms of particle concentration and explain effect of temperature on diffusion • Explain changes of state in terms of particles
2 Change of State	• Explain why changes of state using particle theory. • Interpret heating and cooling curves.
3 Density	• Explain observations using particle model and density • Compare densities and predict if objects will float or sink • Calculate the density of regular objects
4 Diffusion	• Define diffusion and Brownian motion • Describe how diffusion affects a substance in solution or the air • Explain why diffusion is passive using Brownian motion
5 Pressure in liquids	• Describe the action of pressure in liquids and the cartesian diver • Describe how the pressure changes as you go deeper in a liquid
6 Hydraulics	• Describe what we mean by a hydraulic system • Calculate pressure and forces in hydraulic systems
7 Floating and sinking	• Describe the effect of upthrust on the weight of objects • Explain why objects float in terms of resultant forces • Explain how upthrust can vary in water
8 Atmospheric pressure	• Define atmosphere and describe how atmospheric pressure is caused • Explain how changes in atmospheric pressure can happen and what the effects are • Calculate percentage change
9 Robert Brown	• Describe the work of Robert Brown
10 Matter revision 1	• Recap aspects of the matter topic • Practice recall of key facts, skills and answering exam questions
11 Matter revision 2	• Recap aspects of the matter topic • Practice recall of key facts, skills and answering exam questions

9PF Forces in Action

Lesson number/title	Core content
1 Levers and Pivots	● Identify pivots and levers ● Calculate moments ● Explain why levers are force multipliers
2 Moments and Balance Part 1	● Explain, in terms of turning forces, how an object can be made to balance. ● Describe moments as clockwise or anticlockwise
3 Moments and Balance Part 2	● Describe how we can change the moment of a force to balance an object ● Use the moment equation to calculate force needed or distance to make turning forces balance
4 Work done Part 1	● Define and calculate work done ● Use the formula for work done to calculate work done, force or distance ● Change units for distance
5 Work done Part 2	● Define power ● Use both formulae for work done and power ● Change units where appropriate and round answers to 3 significant figures
6 Simple Machines	● Define and give examples of simple machines ● Describe how some simple machines work ● Process and describe patterns in secondary data
7 Investigating Elastic Objects	● Describe elastic deformation ● Identify variables ● Write a method for investigating the extension of a spring.
8 Hooke's law	● Recognise and explain what is meant by 'elastic limit' ● Analyse graphs for Hooke's law ● Use Hooke's Law to calculate force, extension or spring constant
9 Robert Hooke and Uses of Elastic Objects	● Describe the work of Robert Hooke ● Describe a use of an elastic object and explain the significance of Hooke's Law in context ● Describe how the spring constant effects how useful an elastic object is
10	● Review balancing moments

Moments and Work Revision	• Practice unit conversions and rounding to 3 significant figures • Carry out calculations using the work done and power equations.
11 Elastic Objects Revision	• Review key content related to elastic objects including the practical to investigate springs, graphs and Hooke's Law.

9CR Reactivity

Lesson number/title	Core content
1 Electron configuration	• Use the periodic table to work out numbers of protons, neutrons and electrons • Draw and write the electron configuration for given atoms • Explain why most atoms react but group 0 do not
2 Ions	• Draw and describe the formation of ions • Describe the formation of one type of chemical bond • Describe the link between place in the periodic table and the ion formed
3 Chemical Formulae	• Write and interpret chemical formula • Calculate relative formula mass.
4 Symbol Equations	• Write and interpret chemical formulae • Balance symbol equations
5 Acids and metals	• Write word (balanced symbol) equations for the reactions of metals and acids • Describe the test for hydrogen gas
6 Acids and Metal Oxides	• Write equations to describe the reactions of metal oxides and acids • Describe the steps in the production of a salt from a given metal oxide and an acid • Compare the reactions of metal oxides with those of metals and acids.
7 Making salts	• Define what we mean by 'salt' • Describe how to make a salt using filtration and crystallisation
8 Reactions of metal carbonates with acids	• Write word and symbol equations for the reaction of metal carbonates with acids • Describe the test for carbon dioxide and the positive result
9 Neutralisation	• Write word equations to represent the products and reactants in acid and alkali reactions • Explain what we mean by neutralisation • Describe a method of carrying out neutralisation accurately
10 Method writing	• Describe potential chemical combinations that could be used to make a particular salt • Choose appropriate chemicals and equipment to prepare a given salt • Describe how to make a salt

11 Hazard and Risk	• Describe what we mean by hazard and risk • Write a risk assessment for the chosen practical
12 Reactivity series	• Describe the reactivity series for metals • Use the reactivity series to predict a reaction • Write word and symbols equations to represent the reactions
13 Metal ores	• Explain why most metals are not found in their element form • Describe how metals can be extracted using carbon • Write word and symbol equations to represent the reactions
14 Displacement	• Use the reactivity series to predict whether a reaction will occur • Write word and symbol equations to represent reactions seen
15 Alloys	• Link properties of metals to their uses • Describe the difference between a pure metal and an alloy • Explain why alloys are more useful than pure metal
16 Producing a voltage 1	• Form a hypothesis to investigate • Identify variables to change, measure and control
17 Producing a voltage 2	• Produce a table of results to test the hypothesis • Form a conclusion based on evidence collected and back it up with data
18 Harry Brearley	• Describe the story of Harry Brearley • Describe how he made stainless steel • Compare stainless steel to other alloys
19 Review 1	• Recap electron configuration • Recap the formation of ions • Describe the reactions of acids with metal, metal oxide, metal carbonate and alkalis
20 Review 2	• Use the reactivity series to predict chemical reactions • Apply the reactivity series to extraction of metals • Compare different metals

9CE Energetics

Lesson number/title	Core content
1 What is a rate?	• Describe ways to measure the rate of a reaction • Display data recording rate of reaction appropriately
2 Reaction rate graphs	• Take readings from reaction rate curves • Describe how and explain why reaction rate changes during a reaction
3 Secondary data	• Identifying anomalies • Calculate means • Round answers to the correct number of decimal places.
4 The Effect of Concentration	• Identify variables to change, measure and control to test a hypothesis • Display data appropriately • Describe and explain the effect of concentration on the rate of reaction
5 The effect of surface area	• Identify variables to change, measure and control to test the given hypothesis • Process and display data appropriately • Describe and explain the effect of surface area on the rate of reaction
6 Catalysts	• Describe what a catalyst is and how it affects the rate of a reaction • Describe the test for oxygen and its positive result
7 Exothermic and Endothermic reactions	• Define endothermic and exothermic reactions • Recognise endothermic and exothermic reactions from temperature changes • Make and explain suggestions to changes in the equipment that would improve the data collected.
8 Combustion	• Define a combustion reaction • Explain what is meant by complete and incomplete combustion and name the products
9 Complete and Incomplete combustion	• Compare complete and incomplete combustion • Evaluate different fuels
10	• Define thermal decomposition

Thermal decomposition	• Write word and symbol equations to represent thermal decomposition reactions • Carry out a thermal decomposition reaction and explain it in terms of conservation of mass
11 Review 1	• Recall key terms, definitions and structures related to energetics and rates • Use scientific language accurately to correct statements
12 Mildred Cohn	• Describe the story of Mildred Cohn
13 Review 2	• Recap rate, the effect of surface area/concentration on rate and exothermic/endothermic reactions.

9PS Sound waves

Lesson number/title	Core content
1 Sound waves	• Label the main features of a wave diagram • Compare light and sound waves
2 Echoes and superposition	• Define what an echo is • Describe how superposition occurs and its effect on sound
3 Pitch and frequency	• Describe how the pitch of sounds is determined • Interpret oscilloscope traces
4 Amplitude and volume	• Describe how the loudness of a sound is determined • Interpret oscilloscope traces
5 Speed of sound	• Calculate the speed of sound in air • Describe how and explain why the speed of sound varies in different media in terms of particles • Rearrange equations
6 Review 1	• Review key ideas from the topic so far
7 The ear	• Identify key structures in the ear • Describe how to parts of the ear work together to allow us to hear sound
8 Hearing and Ultrasound	• Explain what is meant by 'hearing range' and how this differs with age and in different animals • Measure the loudness of common sounds using appropriate units • Describe what is meant by ultrasound • Describe uses of ultrasound
9 Sound devices	• Describe how a microphone works • Describe how a loudspeaker works

	• Explain why the frequency of the sound produced in the speaker is the same as the original sound wave
10 Case study of James West	• Understand the life and work of James West
11 Review 2	• Recall key terms and definitions • Use scientific language accurately to correct statements • Review and consolidate knowledge

9BB Biological Systems and Processes

Lesson number/title	Core content
1 Musculoskeletal system	• Describe the functions of the skeletal system • Describe the role of different parts of joints • Describe the function and give examples of antagonistic muscle pairings
2 Muscles	• Identify major muscle groups involved in common movements • Describe how some of the muscular tissue in our organs work • Measure the force of some of the skeletal muscles in the body
3 The respiratory system	• Describe the function of the structures in the respiratory system • Describe, using knowledge of diffusion, how gases are absorbed from the alveoli into the bloodstream • Explain how alveoli are adapted for their function
4 Aerobic respiration	• State the word equation for aerobic respiration • Explain the importance of respiration
5 Breathing	• Explain the process involved in breathing • Compare lung volumes in boys and girls • Calculate means and identify the range in data collected
6 Effects of exercise and respiration	• Describe the effects of exercise on the respiratory system • Explain the effects of exercise on the respiratory system
7 Anaerobic respiration	• State the word equation for anaerobic respiration • Explain the importance of this type of respiration & where it is used
8 How does exercise affect breathing rate? - an investigation	• Identify variables in an investigation • Describe a method to test a hypothesis
9	• Review key ideas from the topic so far

Review 1	
10 Effects of smoking	• Describe the effects of cigarettes on the tissues of the lungs and on gaseous exchange • Describe and explain the impacts on the health of smokers and their unborn babies • Describe trends in secondary data
11 Effects of alcohol	• Describe the effects of alcohol on the body and behaviour • Describe the effects of alcohol on health and the developing foetus • Display secondary data appropriately
12 DNA	• Define the term DNA, gene and chromosome • Describe the work of Franklin, Wilkins, Watson and Crick • Create a model of DNA
13 DNA Case Study - Franklin, Wilkins, Watson and Crick	• Understand how the work of Watson, Crick and Franklin contributed to our understanding of the structure of DNA
14 Inheritance	• Use genetic terms correctly • Draw a simple Punnett square to show inheritance • Determine the probability of offspring displaying a particular characteristic
15 Review 2	• Recall key terms, definitions and structures related to biological systems and processes • Use scientific language accurately to correct statements • Review and consolidate knowledge

B1 Cells, Year 9 (KS4) - could move to Y10

Lesson title	Combi-ned science (FT)	Combi-ned science (HT)	Biology	Core content
Prokaryotic and Eukaryotic cells	✓	✓	✓	• Describe the differences between eukaryotic and prokaryotic cells • Practice identifying eukaryotic and prokaryotic cells
Comparing cells	✓	✓	✓	• Describe functions of subcellular structures • Comparison of cell types
Order of magnitude	✓	✓	✓	• Convert mm to µm and vice versa • Expressing numbers in standard form
Microscopes	✓	✓	✓	• Describe the differences between images produced by light and electron microscopes • Explain how electron microscopes have enhanced our understanding of cell structures and processes • Explain what is meant by resolution and magnification
Viewing plant cells under the microscope and the magnification equation	✓	✓	✓	• Describe how to use a microscope to view plant cells in focus • Use the equation M=I/A to calculate any value given the other two • Change the units if necessary
Viewing animal cells under the microscope and calculating magnification	✓	✓	✓	• Find and view animal cells using a microscope • Use the magnification equation to calculate the magnification, image or actual size • Practice using scale to calculate magnification
Specialised cells	✓	✓	✓	• Describe specialised features of given cells • Explain the reason for the special features in terms of the cells function

				• Explain the importance of cell differentiation.
Diffusion	✓	✓	✓	• Describe how substances move in and out of cells by diffusion, giving examples • Describe and explain factors that can affect the rate of diffusion
Exchange surfaces and surface area to volume ratios	✓	✓	✓	• Calculate surface area to volume ratios • Explain the need for internal surfaces and circulatory systems in larger organisms • Describe and explain adaptations in plants and animals for the exchange of materials
Osmosis	✓	✓	✓	• Define the term osmosis and give some examples in living things • Explain the changes to both animal and plant cells when placed in different solutions
Osmosis Required practical part 1	✓	✓	✓	• Identify variables to change, measure and control to test a hypothesis • Practice method writing and explain reasons for given method steps • Make and record accurate mass measurements
Osmosis Required Practical part 2	✓	✓	✓	• Measure change in mass accurately and calculate percentage change • Display and interpret results appropriately • Describe and explain the patterns in the results
Active transport	✓	✓	✓	• Describe how substances are taken up by active transport • Compare diffusion, osmosis and active transport • Apply knowledge to exam questions
Cell Cycle and Mitosis	✓	✓	✓	• Identify DNA, genes, chromosomes on a diagram • Describe the main stages in the cell cycle • Use information provided to calculate time spent in different phases
Aseptic Techniques			✓	• Calculate the number of bacteria in a population given mean division time

				• Describe how to produce an uncontaminated culture of bacteria using aseptic technique • Identify variables to change, measure and control to test the action of disinfectants or antibiotics
Disinfectants and their Effectiveness			✓	• Make and record accurate measurements • Describe conclusions from the data and use data to support • Check for reproducibility in the conclusions • Calculate the area of the clear zone using πr^2
Stem cells and the use of stem cells	✓	✓	✓	• Name sources of stem cells and their uses • Describe some potential uses of stem cell technology • Evaluate different stem cell sources
Maths Skills	✓	✓	✓	• Calculating mean values • Practicing unit conversions, magnification calculation and percentage change
Review 1	✓	✓	✓	• Review of cell content
Review 2	✓	✓	✓	• Review of transport content
Exam skills and case study	✓	✓	✓	• Practice applying knowledge to exam style questions • Learn about the work of Dr Stephanie dancer

B2 Organisation, Year 10

Lesson title	Combi-ned science (FT)	Combi-ned science (HT)	Biology	Core content
Food tests	✓	✓	✓	• Describe how to test for starch, sugars, proteins and fats • Describe the positive and negative results of these tests • Describe the safety precautions needed
Digestive enzymes	✓	✓	✓	• Describe the structure and function of the digestive system • Describe the action of enzymes in digestion using the 'lock and key' model • Name the 3 main digestive enzymes, where they are produced and the substrate and products of their action
Digestion	✓	✓	✓	• Describe the organs of the digestive system and their functions • Describe the purpose and action of acid and bile in the digestive system
Absorption	✓	✓	✓	• Describe adaptations of digestive system for absorption • Explain how these adaptations aid absorption • Describe uses for the absorbed food particles
Investigating Enzymes	✓	✓	✓	• Describe ways to measure the rate of enzyme action • Identify variables to change measure and control to test the effect of temperature on enzyme action • Describe and explain the effect of temperature on the rate of enzyme action
pH and Enzymes 1	✓	✓	✓	• Identify variables to change, measure and control to test a hypothesis • Collect and record data accurately • Process and display the results appropriately • Describe and explain the effect of pH on enzyme activity

pH and Enzymes 2	✓	✓	✓	• Describe and explain the effect of pH on amylase activity • Suggest improvements to the method • Apply knowledge and understanding to secondary investigations
The lungs	✓	✓	✓	• Label the major structures in the lungs • Describe gaseous exchange • Describe and explain how the lungs are adapted for efficient gaseous exchange.
Blood and blood vessels	✓	✓	✓	• Describe the components of the blood and their function • Describe the structure and function of arteries and veins • Explain how blood components and blood vessels are adapted for their function
The Heart	✓	✓	✓	• Label the major structures in the heart • Describe the path blood takes through the heart and around the body • Calculate blood flow using appropriate equations • Describe how heart rate is controlled
Heart Rate	✓	✓	✓	• Review the structure of the heart • Describe function of pacemaker cells • Describe the role of artificial pacemakers
Heart disease	✓	✓	✓	• Describe some of the causes of heart disease • Explain how coronary heart disease can lead to a heart attack • Evaluate treatments for heart disease
Non-communicable disease	✓	✓	✓	• Describe some risk factors for diseases • Explain the impacts of lifestyle choices and disease at local, national and global levels • Analyse and interpret secondary data on disease incidence rates
Cancer	✓	✓	✓	• Describe how cancer forms in the body • Describe the risk factors associated with cancer development

				• Explain the difference between 'benign' and 'malignant' tumours • Explain how malignant cancer can spread
Plant tissues	✓	✓	✓	• Describe the job of the different types of plant tissue and how they are adapted for function • Describe the structure of a leaf and how it is adapted for gas exchange • Explain the function and location of stomata
Plant roots	✓	✓	✓	• Describe the structure of the roots • Explain how these are adapted for absorption of water and mineral ions
Transport in plants	✓	✓	✓	• Describe the movement of water around the plant by transpiration • Describe the movement of dissolved sugars around the plant by translocation • Explain the role of xylem, phloem and stomata in transport in plants
Investigating transpiration	✓	✓	✓	• Describe factors that can affect the rate at which water moves • Explain how rate of transpiration can be measured • Explain how changes in temperature, humidity, air movement and light intensity affect rates of water movement
Review 1	✓	✓	✓	• Review of digestive system, lungs and heart
Review 2	✓	✓	✓	• Review of non-communicable diseases and plant tissues
Case study: Maud L Menten	✓	✓	✓	• Introduction to the work of M Menten and her work on the Michaelis-Menten equation
Exam technique	✓	✓	✓	• Identifying the skills needed to answer describe, explain and evaluate questions • Practice answering describe, explain and evaluate questions
Maths skills	✓	✓	✓	• Describe the terms cardiac output, stroke volume and heart rate

				• Calculate cardiac output, stroke volume and heart rate • Use VESRAU to practice substitution and rearrangement (values, equation, substitute, rearrange, answer, units)

B3 Infection & Response, Year 10

Lesson title	Combined science (FT)	Combined science (HT)	Biology	Core content
Infectious disease	✓	✓	✓	• Name the cause of infectious disease and describe how they make us ill • Describe how pathogens can be spread, and how this spread can be reduced • Describe the main defence mechanisms of the body
Viral and bacterial diseases	✓	✓	✓	• Describe the symptoms, spread and prevention of the viruses measles, HIV and TMV • Describe the symptoms, spread and prevention of bacterial diseases salmonella and gonorrhoea • Explain why antibiotics can be used to treat bacterial infections but not viral ones. • Process secondary data related to infection rates
Fungal and Protist diseases	✓	✓	✓	• Describe the symptoms, spread and prevention of rose black spot • Describe the spread, symptoms and prevention of malaria • Explain what is meant by the term 'vector'
Immunity	✓	✓	✓	• Describe how white blood cells respond to destroy pathogens • Explain the difference between the primary and secondary response • Explain what is meant by immunity
Vaccines	✓	✓	✓	• Describe what is in a vaccine • Explain how vaccines prevent infection • Explain the advantages of large scale vaccination
Antibiotics	✓	✓	✓	• Explain the difference between antibiotics and over the counter medications

				• Collect data on the action of different antibiotics and process it appropriately • Use the data collected to draw conclusions
Maths skills	✓	✓	✓	• Calculate a mean, the area of clear zones and percentage changes • Draw a conclusion from data
Testing drugs 1	✓	✓	✓	• Identify the source of digitalis, penicillin and aspirin • Describe the stages in developing new drugs to treat disease • Describe the use of placebos and explain why they are needed
Testing drugs 2	✓	✓	✓	• Recap on stages of drug development • Explain the importance of carrying out a double-blind trial
Monoclonal antibodies			✓	• Describe how monoclonal antibodies are made • Describe some uses of monoclonal antibodies • Explain why monoclonal antibodies are not as widely used as first hoped
Plant defences and deficiencies Part 1			✓	• Describe physical and chemical defences in plants to prevent infectious disease • Describe the use of nitrate and magnesium ions by plants
Plant defences and deficiencies Part 2			✓	• Describe the symptoms shown by plants deficient in nitrate and magnesium ions • Review of TMV and Rose Black spot, and describe how aphids can affect a plant • Describe how to identify and diagnose plant diseases
Review 1	✓	✓	✓	• Review of pathogens
Review 2	✓	✓	✓	• Review of drug development and treating infection
Review 3 (Bio Only)			✓	• Review of monoclonal antibodies and plant diseases
Exam skills	✓	✓	✓	• Identify command verbs and respond appropriately • Apply knowledge to exam style questions
Kelly Chibale	✓	✓	✓	• Learn about the work of Kelly Chibale

B4 Bioenergetics, Year 10

Lesson title	Combi-ned science (FT)	Combi-ned science (HT)	Biology	Core content
Photosynthesis	✓	✓	✓	• Name the reactants and products needed for photosynthesis and represent it using a word and symbol equation • Describe the uses for the glucose made during photosynthesis • Carry out a test for starch and explain the results
Photosynthesis required practical	✓	✓	✓	• Identify variables to change, measure and control to test a hypothesis • Explain the steps in a given method to test a hypothesis • Collect and record data to test the hypothesis
Photosynthesis required practical results	✓	✓	✓	• Collect the data in a suitable table • Describe and explain the relationship between light intensity and rate of photosynthesis • Describe and explain the effect of carbon dioxide concentration and temperature on the rate of photosynthesis • HT - the inverse square law
Limiting factors of photosynthesis	✓	✓	✓	• Describe and explain the relationship between light intensity and rate of photosynthesis • Describe and explain the effect of carbon dioxide concentration and temperature on the rate of photosynthesis • Identify limiting factors from graphs

Manipulating factors of photosynthesis		✓	✓	• Interpret graphs of photosynthesis rate with multiple factors and decide which is limiting • Describe some ways of manipulating conditions for plant growth • Evaluate these methods
Review photosynthesis	✓	✓	✓	• Review of photosynthesis
Respiration	✓	✓	✓	• Define respiration and explain its importance in the body • Describe the changes in the body during exercise • Explain why these changes are necessary
Anaerobic respiration	✓	✓	✓	• Describe the consequences of anaerobic respiration • Explain the results of a simple experiment into anaerobic respiration using knowledge and understanding • Compare aerobic respiration with anaerobic respiration
Consequences of Anaerobic respiration		✓	✓	• Describe how an oxygen debt occurs • Explain the problems with an oxygen debt and how the body compensates and responds
Metabolism	✓	✓	✓	• Define the term metabolism • Give examples of reactions in metabolism • Describe the formation of lipids, amino acids and urea
Synoptic links	✓	✓	✓	• Explain the importance of the digestive, respiratory and circulatory systems in effective respiration
End of topic review	✓	✓	✓	• Review of respiration and metabolism
Exam skills				• Apply knowledge of bioenergetics to exam style questions
Maths skills	✓	✓	✓	• Practice calculating means including identifying anomalies • HT - calculations of inverse square law
Scientist Case study	✓	✓	✓	• Learn about the work of the botanist Ynes Mexia

B5 Homeostasis, Year 11

Lesson title	Combi-ned science (FT)	Combi-ned science (HT)	Biology	Core content
The Nervous system	✓	✓	✓	• Describe the role of receptors, neurons and effectors in responding to a stimulus • Describe an appropriate response pathway to any given stimulus
Reflex arcs	✓	✓	✓	• Describe what is meant by a reflex and give some examples • Explain the difference between a reflex and a conscious action • Label a diagram of a reflex arc, using key terms correctly • Describe how nerve cells communicate with each other in a simple reflex action
Required practical - Reaction time part 1	✓	✓	✓	• Identify the hypothesis and variables from a given method • Collect and record data accurately • Process and display data collected (including uncertainties if appropriate)
Required practical - Reaction time part 2	✓	✓	✓	• Decide on the reproducibility of class data • Evaluate the practical procedure • Describe and explain patterns in secondary data
The Brain			✓	• Name the main parts of the brain and describe their function • Describe how knowledge of the brain has developed • Evaluate the benefits and risks of procedures carried out on the brain and nervous system
The eye			✓	• Label the parts of the eye and describe their functions • Describe how the eye responds to changes in light levels • Describe how the eye focuses on near and far objects

Correcting Vision			✓	• Explain how defects of the eye can lead to short and long sightedness • Explain how treatments of long and shortsightedness work • Interpret ray diagrams that show long and short sightedness and how these are treated with lenses
Hormonal responses	✓	✓	✓	• Describe how the endocrine system brings about responses in the body • Label the main endocrine glands of the body • Compare hormonal responses with nervous responses
Negative feedback - higher		✓	✓	• Describe the role of adrenaline and thyroxine in the body • Explain how negative feedback allows homeostasis
Regulating body temperature			✓	• Describe how body temperature is monitored • Describe the responses to a rise or drop in core body temperature • Explain how these mechanisms restore body temperature
Controlling blood sugar levels - Foundation	✓			• Describe how blood glucose levels are monitored • Explain the response to an increase in blood glucose • Explain how insulin controls blood glucose levels in the body
Controlling blood sugar levels - Higher		✓	✓	• Describe how blood glucose levels are monitored • Explain the response to an increase in blood glucose • Explain how insulin controls blood glucose levels in the body • Explain the role of glucagon in blood sugar level maintenance and how negative feedback is used
Diabetes	✓	✓	✓	• Compare Type 1 and Type 2 diabetes • Describe some treatments for both types of diabetes • Interpret data from graphs on the effect of insulin on blood glucose in people with diabetes
The nervous system and homeostasis review lesson - Higher		✓	✓	• Review of nervous system and homeostasis

The nervous system and homeostasis review lesson - Foundation	✓			• Review of nervous system and homeostasis
Water balance			✓	• Describe ways in which water is gained and lost by the body • Describe how water levels are monitored • Describe the response when water levels in the body varies
The kidney			✓	• Describe the function of the kidneys in producing urine • Describe and explain the differences in blood composition before and after filtration • Explain the role of ADH in water balance
Kidney failure			✓	• Interpret secondary data on blood composition before and after filtration • Describe how dialysis works • Evaluate the treatment of kidney failure by dialysis or transplant
Osmoregulation review			✓	• A review of water balance and application to exam style questions
Hormones in reproduction - Foundation	✓			• Describe the roles of male and female reproductive hormones • Describe the menstrual cycle and the hormones involved
Hormones in reproduction - Higher		✓	✓	• Describe the roles of male and female reproductive hormones • Describe the menstrual cycle and the hormones involved • Explain the interactions of FSH, LH, oestrogen and progesterone in the menstrual cycle • Extract and use information from graphs showing hormone levels
Artificial control of fertility - Higher		✓	✓	• Describe how fertility drugs and IVF work • Interpret secondary data on fertility treatments and IVF • Evaluate fertility treatments from the perspective of doctors and patients

Contraception	✓	✓	✓	• Describe how different methods of contraception prevent pregnancy • Interpret data on the effectiveness of contraception methods • Evaluate different hormonal and non-hormonal methods
Plant hormones			✓	• Describe the responses to light and gravity by plants • Describe how growth is achieved in roots and shoots • Investigate the effect of light or gravity on seedlings. • Describe the role of gibberellins and ethene
Required practical: Plants hormones 1			✓	• Identify variables and design a hypothesis • Describe how to investigate how light and gravity affect plant growth • Display results appropriately • Draw conclusions consistent with results from the seedling practical
Required practical: Plants hormones 2			✓	• Interpret experimental data • Apply knowledge to exam style questions • Interpret secondary data on the effect of hormones
Homeostasis review lesson - Higher		✓	✓	• Review of homeostasis
Homeostasis review lesson - Foundation	✓			• Review of homeostasis
Scientist Case study: Kiran Mazumdar-Shaw	✓	✓	✓	• The work of Kiran Mazumdar-Shaw

B6 Inheritance & evolution, Year 11

Lesson title	Combi-ned science (FT)	Combi-ned science (HT)	Biology	Core content
Meiosis and fertilisation	✓	✓	✓	• Describe the main features of meiosis • Compare mitosis with meiosis • Explain the importance of meiosis in reproduction
Sexual vs asexual reproduction	✓	✓	✓	• Describe sexual and asexual reproduction in animals and plants • Explain why asexual reproduction leads to identical offspring • Explain why sexual reproduction leads to variation
Advantages and disadvantages of sexual and asexual reproduction			✓	• Describe the advantages and disadvantages of sexual and asexual reproduction • Give examples of organisms that can reproduce by both methods • Apply knowledge to novel organisms
Genes, DNA and chromosomes	✓	✓	✓	• Define and recognize diagrams of DNA, genes and chromosomes • Describe the structure and function of DNA • Describe the advantages of understanding the human genome
Case study: Nancy Chang	✓	✓	✓	• Learn about the work of Nancy Chang, who sequenced the HIV genome
Protein synthesis			✓	• Describe how DNA bases code for proteins • Describe protein synthesis • Explain how mutations can affect the protein made
Genetic inheritance - Foundation	✓			• Construct and interpret genetic diagrams.

				• Calculate the probability of inheriting particular characteristics given information about the parents • Use genetic terms to describe parents & offspring characteristics
Genetic inheritance - Higher		✓	✓	• Construct and interpret genetic diagrams. • Calculate the probability of inheriting particular characteristics given information about the parents • Use genetic terms to describe parents & offspring characteristics
Inherited disorders part 1 - Foundation	✓			• Describe the symptoms of the genetic diseases cystic fibrosis & polydactyly • Use genetic cross diagrams to calculate probability of offspring inheriting these diseases
Inherited disorders part 1 - Higher		✓	✓	• Describe the symptoms of the genetic diseases cystic fibrosis & polydactyly • Use genetic cross diagrams to calculate probability of offspring inheriting these diseases
Inherited disorders part 2	✓	✓	✓	• Interpret family trees • Calculate probability of offspring inheriting diseases from family trees • Evaluate use of embryo screening for inherited disorders
Sex determinations	✓	✓	✓	• Name and recognise the chromosomes that determine sex • Construct and interpret diagrams to show how sex is inherited • Interpret family tree diagrams to explain the pattern of inheritance
Mendel			✓	• Describe the work of Gregor Mendel • Interpret his results and describe how it furthered our understanding of genetics • Explain why Mendel's work was not accepted until after his death
Mid-topic review	✓	✓	✓	• Review of meiosis, sexual and asexual reproduction, genes and inheritance

Variation and natural selection - part 1	✓	✓	✓	• Describe reasons for extensive variation within species • Describe the effects of mutations
Variation and natural selection - part 2	✓	✓	✓	• Explain how variation can lead to evolution by natural selection
Evolution and extinction	✓	✓	✓	• Describe the theory of evolution • Interpret evolutionary trees • Explain why some organisms are now extinct
Darwin and Wallace			✓	• Compare Lamarck's model for evolution with Darwin's • Describe the work of Darwin and Wallace in the development of evolutionary theory • Explain why many of these ideas were controversial
Speciation			✓	• Define the terms species and speciation • Describe how different species can arise from a common ancestor • Describe Wallace's work on speciation
Evidence for evolution - part 1	✓	✓	✓	• Describe some of the ways fossils are produced • Explain how this and other evidence gives us information about the development of life on earth • Explain why we cannot be certain about how life on earth began
Evidence for evolution - part 2	✓	✓	✓	• Describe how bacteria have evolved to become resistant to antibiotics • Describe ways of reducing the development of antibiotic resistant bacteria • Evaluate the use of antibiotics in agriculture
Selective breeding	✓	✓	✓	• Describe the process of selective breeding in plants and animals • Explain the impact of selective breeding • Evaluate the use of selective breeding in food plants and domesticated animals

Genetic engineering	✓	✓	✓	• Describe genetic engineering • Give examples of genetically modified organisms • Explain some potential benefits and risks of genetic engineering in agriculture and medicine
Genetic engineering - part 2		✓	✓	• Describe the process of producing a genetically modified organism • Evaluate the use of genetic engineering
Cloning			✓	• Describe cloning techniques in plants and animals • Evaluate cloning methods for medicine and agriculture • Explain the ethical objections to animal cloning
Classification	✓	✓	✓	• Describe and apply the Linnaean system for classification • Explain why new models of classification have been proposed • Describe the 'three domain' classification system
End of topic review 1	✓	✓	✓	• Review of natural selection, selective breeding and genetic engineering
End of topic review 2			✓	• Review of the biology only content - protein synthesis, Mendel, evolution theories, speciation and cloning

B7 Ecology, Year 11

Lesson title	Combi-ned science (FT)	Combi-ned science (HT)	Biology	Core content
Communities	✓	✓	✓	• Identify examples of interdependence within an ecosystem • Predict the impact of changes to one species on the rest of the community • Extract and interpret information from charts, tables and graphs relating to interaction of organisms in a community
Biotic and abiotic factors	✓	✓	✓	• Identify biotic and abiotic factors within an ecosystem • Explain how a change in a biotic or abiotic factor can affect a community • Extract and interpret information from secondary data
Adaptations	✓	✓	✓	• Give examples of behavioural, structural or functional adaptations • Suggest factors that organisms are competing for given information • Identify and explain how organisms are adapted to live in their natural environment
Maths skills	✓	✓	✓	• Calculate surface area:volume ratio • Calculate averages and uncertainties
Sampling required practical 1	✓	✓	✓	• Use a quadrat to collect valid data to estimate a population size • Describe how to make the data as accurate as possible • Calculate population estimates
Sampling required practical 2	✓	✓	✓	• Calculate percentage cover of organisms • Describe how to use a transect line to test a hypothesis • Process and interpret secondary data, identifying variables
Biomass			✓	• Construct pyramids of biomass from information given

				• Explain the losses of energy at each stage • Calculate the efficiency of organisms in turning food into new biomass
Food security and farming			✓	• Describe some of the biological factors that can affect levels of food security • Describe some of the ways farming methods can increase levels of efficiency of food production • Evaluate methods to improve efficiency of food production
Cycles	✓	✓	✓	• Describe the water cycle and explain its importance to living things • Identify the processes by which carbon is cycled through biotic and abiotic parts of ecosystems • Describe the processes involved accurately
Decay			✓	• Name the causes of decay and describe conditions that can speed it up • Describe and explain the effect of temperature on the rate of decay • Interpret secondary data to describe and explain the effect of oxygen on the rate of decay • Apply knowledge to uses of decay
Decay Required practical			✓	• Identify variables to change, measure and control to test a hypothesis involving the rate of decay • Collect and record data to test the hypothesis • Process and display the data appropriately.
Global warming	✓	✓	✓	• Describe and explain ways in which humans affect ecosystems • Evaluate the data linking greenhouse gases to global warming • Describe some of the consequences of global warming
Biodiversity	✓	✓	✓	• Describe some impacts of humans on biodiversity • Explain the importance of biodiversity • Describe ways that humans have tried to restore or maintain biodiversity

Review 1	✓	✓	✓	• Review of communities, biotic and abiotic factors, adaptation and sampling
Review 2	✓	✓	✓	• Review of cycles, global warming and biodiversity
Review 3			✓	• Review of biology only content - biomass, food security and decay
Case study: Dr Beth Penrose	✓	✓	✓	• Introduction to the work of Dr Beth Penrose

C1 Atomic Structure and the periodic table, Year 9/10

Lesson title	Combi-ned science (FT)	Combi-ned science (HT)	Chemi-stry	Core content
Atoms, Elements and compounds	✓	✓	✓	• Define elements and compounds an identify them from diagrams • Name compounds from word equations and formulae • Identify reactants and products in equations
Conservation of mass in equations	✓	✓	✓	• Interpret chemical formulae • Apply conservation of mass to equations
Mixtures and separation	✓	✓	✓	• Define, identify and describe mixtures • Explain the steps in the separation of mixtures of soluble and insoluble substances • Explain how mixtures of soluble and insoluble substances are represented and recognised
Separation by distillation	✓	✓	✓	• Describe how to separate a mixture of two or more liquids, identifying key equipment • Explain the processes and equipment involved • Apply particle theory to distillation
Separation by chromatography	✓	✓	✓	• Describe the process of chromatography • Carry out the chromatography of chlorophyll, explaining key steps • Interpret chromatograms
Atomic structure	✓	✓	✓	• Describe atoms using the nuclear model • State the charges and mass of the three subatomic particles • Use the periodic table to calculate the number of protons, neutrons and electrons for any given element

Development of the atomic model	✓	✓	✓	• Describe the development of the atomic model • Compare the nuclear model with the plum pudding model • Explain how new evidence from the scattering experiment led to a change in the atomic model
Isotopes	✓	✓	✓	• State the definition of an isotope • Compare isotopes from given information • Calculate RAM of isotopes given their abundance and give answers to specified number of significant figures or decimal places
Isotopes case study lesson	✓	✓	✓	• Describe the work of Marie Curie and Frederick Soddy and explain how their work contributed to our understanding of isotopes and the atomic model
Electron configuration and the periodic table	✓	✓	✓	• Describe what keeps electrons in their orbits • Draw and write the electron configuration for any of the first 20 elements • Describe the link between outer shell electron number, number of shells and location in the periodic table
Periodic table development	✓	✓	✓	• Describe the layout of the modern periodic table • Compare the early versions of the periodic table with the modern one • Explain how the periodic table was developed as ideas changed
Why elements react	✓	✓	✓	• Explain the difference between metals and non-metals in terms of reactions and electrons • Explain why group 0 do not react in terms of electrons • Describe trends in physical properties of group 0
Group 1	✓	✓	✓	• Describe physical and chemical properties of the group 1 elements • Write equations to represent their reaction with water • Describe and explain trends in properties and reactivity of group 1
Group 7	✓	✓	✓	• Describe trends in physical properties of group 7 elements • Explain the trend in physical properties of group 7

Group 7 displacement	✓	✓	✓	• Describe trends in reactivity going down group 7 • Describe the results of a series of reactions of group 7 elements and their compounds • Write word and symbol equations to represent the reactions
Comparing the reactivities of group 1 and 7 elements	✓	✓	✓	• Use electron configuration to explain the trends in reactivity in group 1 and 7 • Compare the trends in reactivity in group 1 and 7
Displacement reactions - ionic equations		✓	✓	• Write ionic equations for the displacement reactions
Transition elements			✓	• Describe typical properties of the transition elements • Compare transition elements and their compounds with those of with group 1 • Give uses of transition metals linked to their properties
Review 1	✓	✓	✓	Review 1 - a focus on revision of atomic structure and the maths skills covered in the unit.
Review 2	✓	✓	✓	Review 2 - a focus on revision of separation techniques and the command words ‘describe’ and ‘explain’ in exam questions

C2 Structures and Bonding, Year 10

Lesson title	Combi-ned science (FT)	Combi-ned science (HT)	Chemi-stry	Core content
Ionic bonding introduction	✓	✓	✓	• Describe the formation of ions • Link the charge on ions to the place in the periodic table
Further ionic bonding	✓	✓	✓	• Describe the formation of an ionic bond • Represent ionic bonding using diagrams • Write formula for ionic compounds
Properties of ionic compounds	✓	✓	✓	• Describe some of the properties of ionic compounds • Explain some of the properties of ionic compounds using knowledge of the structure
Covalent bonding	✓	✓	✓	• Define a covalent bond • Draw and describe covalent bonds using structural, ball and stick and displayed formula • Describe the limitations of the different models
Simple covalent molecules	✓	✓	✓	• Explain why some covalent substances form molecules and others form giant structures • Describe the properties of simple covalent molecule • Explain their properties in terms of bonding
The giant covalent structures	✓	✓	✓	• Explain why some covalent substances form molecules and others form giant structures • Describe the properties of diamond and graphite • Explain the properties using knowledge of the bonding and structure • Relate properties of these carbon allotropes to their uses
Giant covalent structures: Graphene	✓	✓	✓	• Describe the structure of graphene and fullerenes • Describe and explain their properties • Describe the work of the scientists who discovered graphene

Polymers	✓	✓	✓	• Describe the structure of polymers • Explain the properties of polymers • Draw the formation of polymers given the monomer
Review 1	✓	✓	✓	• Review the content covered on ionic and covalent bonding • Compare the properties of ionic and covalent substances
Metallic bonding	✓	✓	✓	• Describe the structure and bonding in metals • Describe and explain the properties of metals • Explain why alloys are harder than pure metals
Solids, liquids and gases	✓	✓	✓	• Predict the state of substances at different temperatures, and the type of bonding present given melting and boiling point data • Describe what happens in terms of particles and forces during a change of state • (HT) Explain the limitations of the particle model in relation to changes of state
Nanoparticles (GCSE Chemistry only)			✓	• Compare dimensions of particles of different sizes • Describe some uses of nanoparticles • Evaluate the use of nanoparticles given appropriate information
Review 2	✓	✓	✓	Review 2 • Review ionic, covalent and metallic bonding • Relate properties to their bonding • Relate properties to their uses

C3 Quantitative Chemistry

Lesson title	Combi-ned science (FT)	Combi-ned science (HT)	Chemi-stry	Core content
Relative Formula Mass (FT only)	✓			• Use the periodic table and formulae to determine the relative formula mass of compounds • Work out percentage of given elements in a compound • Work out the mass of a particular element in a given mass of a compound
Relative Formula mass (HT only)		✓	✓	• Use the periodic table and formulae to determine the relative formula mass of compounds • Work out percentage of given elements in a compound • Work out the mass of a particular element in a given mass of a compound
Moles and Avogadro's Constant (HT only)		✓	✓	• Use Mass = Mr x moles to find any one value given the other two • Use Avogadro's constant to calculate number of atoms/molecules in a given mass • Calculate the mass of a given number of atoms using the Avogadro constant
Balancing equations (FT only)	✓			• Write chemical formulae using knowledge of ion charges • Balance equations using the same number of atoms rule
Balancing equations using moles (HT only)		✓	✓	• Write chemical formulae using knowledge of ion charges • Balance equations using the same number of atoms rule • Balance equations using moles
Reacting masses (FT only)	✓			• Apply conservation of mass to equations • Use a balanced equation to work out the quantity of reacting elements needed to produce a specified quantity of product • Predict the mass of product from a specified starting mass

Reacting masses (HT only)		✓		• Predict the mass of product from a specified starting mass • Use a balanced equation to work out the quantity of reacting elements needed to produce a specified quantity of product
Reacting masses and yield (GCSE chemistry)			✓	• Predict the mass of product from a specified starting mass • Use a balanced equation to work out the quantity of reacting elements needed to produce a specified quantity of product • (GCSE Chem only) Calculate the yield and suggest why the mass obtained may be less than that calculated
Atom economy			✓	• Balance equations using same number of atoms and moles • Calculate atom economy for given reactions • Choose and justify a reaction pathway
Concentration	✓	✓	✓	• Define the term 'concentration' • Calculate concentration from mass and volume • Work out the mass of a substance in a given volume of a solution of a known concentration
Titration calculations			✓	• Calculate mean volumes from experimental results • Calculate the uncertainty in the readings • Calculate the concentration of an unknown using a balanced equation and volumes of reacting solutions.
Limiting reactants		✓	✓	• Define a limiting reactant • Describe the effect of a limiting reactant on the amount of products it is possible to achieve • Calculate the limiting reactant from a balanced symbol equation
Gas volumes			✓	• Calculate the volume of a gas at room temperature and pressure from its mass and formula mass • Calculate volumes of gaseous reactants and products from a given volume of a gaseous reactant or product.
Review (FT only)	✓			Review of foundation calculations content
Review (HT only)		✓		Review of higher tier calculations content
Review (chemistry only)			✓	Review of triple only content

Practical applications of quantitative chemistry			✓	Extension review on choosing the right concentration to make a named salt, covering limiting reactant, reacting mass, yield and atom economy
Case study	✓	✓	✓	• Introduction to the work of Roger E Billings and Prof Saiful Islam

C4 Chemical Change, year 10

Lesson title	Combi-ned science (FT)	Combi-ned science (HT)	Chem-istry	Core content
Redox reactions	✓	✓	✓	• Describe oxidation and reduction in terms of oxygen • Identify where oxidation and reduction have happened given an equation • Explain how carbon can be used to extract metals from their ores using redox reactions
Investigating the reactivity of metals	✓	✓	✓	• Identify variables to change, measure and control to test the reactivity of metals • Write equations for the reactions of acids and metals, naming salts • Use observations to order metals in terms of reactivity
Displacement reactions of metals	✓	✓	✓	• Explain how the reactivity of a metal is related to forming ions • Record observations on whether or not displacement reactions occur • Write equations for displacement reactions
Redox higher tier		✓	✓	• Define redox in terms of electrons • Identify species that are oxidised or reduced in reactions • Write half equations to represent the reactions
Acid base reactions	✓	✓	✓	• Write word equations to represent the reactions of metal oxides and acids • Explain steps in a given method to produce a pure, dry sample of a soluble salt • Use ion charges to write formulae for salts
Observations from acid base reactions	✓	✓	✓	• Write equations to represent the reactions of metal carbonates and acids • Describe evidence for a chemical reaction

				• Describe the test for carbon dioxide and its positive result
Acid base ionic equations		✓	✓	• Write balanced symbol equations for acid base reaction • Write ionic equations for acid base reactions
Making salts	✓	✓	✓	• Suggest corrections to a given method to make a salt • Write a method to prepare a salt using a metal carbonate or metal oxide • Write equations for the reactions
Acids, alkalis and the pH scale	✓	✓	✓	• Describe the use of universal indicator to classify substances and measure approximate pH values • Evaluate the use of universal indicator and suggest why pH probe may be more accurate • Write equations to represent the reaction of acids and alkalis, including the ionic equation • Process secondary data, calculating means and uncertainty
Strong and weak acids		✓	✓	• Describe how to use indicator to classify substances as strong or weak acids • Explain what strong and weak acids are and concentrated and dilute • Make order of magnitude calculations to describe changes in pH
Titrations			✓	• Describe a method to find the concentration of an unknown acid or alkali • Explain the steps in the method
Processing Titration results			✓	• Calculate means and uncertainties, dealing with anomalies appropriately • Calculate the concentration of an unknown acid or alkali from data and equations provided • Suggest ways of improving accuracy
Electrolysis of a molten compound	✓	✓	✓	• Define the terms ‘electrolysis’ and ‘electrolytes’ • Describe the movement of ions during electrolysis • Explain what happens at the electrodes
Extraction of Aluminium	✓	✓	✓	• Explain the use of electrolysis to extract metals • Describe the extraction of Aluminium from its ore, including the use of a mixture and the need to continually replace the anode

				• Explain why electrolysis is so expensive and describe measures to try to reduce this
Electrolysis of solutions	✓	✓	✓	• Predict the products of the electrolysis of given solutions • Electrolyse solutions of ionic compounds and identify the products • Explain why the products are obtained
Developing an electrolysis hypothesis	✓	✓	✓	• Develop a hypothesis to test • Electrolyse given solutions, collecting and identifying the products • Apply knowledge to other related hypotheses
Electrolysis half equations		✓	✓	• Write ionic equations for the reactions at the electrodes • Identify species that are oxidised or reduced
Reactivity and acid base reactions review	✓	✓	✓	• Review of the content on reactivity, acid base reactions and making salt
Electrolysis review	✓	✓	✓	• Review of learning on electrolysis, metal extraction and electrolysis of solutions
Chemical change higher tier review		✓	✓	• Revision of higher tier content in the unit, including redox and half equations and strong and weak acids,
Humphrey Davey and Laban Roomes Applications of electrolysis	✓	✓	✓	• Describe the work of Humphrey Davey and Laban Roomes with electrolysis • Describe and explain products at the electrodes
Writing a method	✓	✓	✓	• Describe key features of method writing • Write a method to test a hypothesis and write a procedural method

C5 Energy Changes, year 10

Lesson title	Combi-ned science (FT)	Combi-ned science (HT)	Chem-istry	Core content
Exothermic and endothermic reactions	✓	✓	✓	• Define endothermic and exothermic reactions and give examples of each type • Describe some everyday uses of exothermic and endothermic reactions • Evaluate applications of exothermic and endothermic reactions
Required practical - Temperature change part 1	✓	✓	✓	• Investigate one of the variables affecting the temperature change, identifying variables to change, measure and control • Process and display results appropriately
Required practical - Temperature change part 2	✓	✓	✓	• Draw conclusions from data provided • Explain the changes in temperature during the experiment • Evaluate the equipment and method used, making and explaining suggestions for improvement
Writing a method to test a hypothesis	✓	✓	✓	• Identify variables to change, measure and control • Write a method to test a given hypothesis • Design a table to collect and record results
Energy level diagrams	✓	✓	✓	• Draw and interpret energy level diagrams to represent endothermic and exothermic reactions • Label and define activation energy • Explain why reactions are endothermic or exothermic overall
Calculating Bond energies		✓	✓	• Calculate bond energy values and use them to predict whether a reaction will be exothermic or endothermic • Relate bond energies to the correct part of energy level diagrams • Explain why bond energy calculations have a margin of error

Fuel cells			✓	• Describe how cells and batteries can be made and how the voltage can vary • Describe how a fuel cell works • Write the half equations for the electrode reactions in a fuel cell • Evaluate the use of hydrogen fuel cells in comparison with rechargeable cells and batteries
Review combined	✓	✓		Review 1 - review of the foundation and higher tier content
Review chemistry			✓	Review - review of all content in the unit, including triple science
Case study	✓	✓	✓	Case study - a look at the scientists and engineers using endothermic and exothermic reactions

C6 Rates of reaction, Year 10/11

Lesson title	Combi-ned science (FT)	Combi-ned science (HT)	Chemi-stry	Core content
Rate of reaction	✓	✓	✓	• Describe evidence for a chemical reaction • Describe how to measure rates of reactionCalculate the rate of the reaction from data or graphs
Rate of reaction using graphs and tangents		✓	✓	• Draw tangents to a curve • Use the tangent to calculate rate of reaction
Collision theory	✓	✓	✓	• Define activation energy • Describe factors that can affect the rate of reaction • Explain how these factors affect rate using collision theory
Planning an investigation to find the rate of reaction	✓	✓	✓	• Write a method to test a hypothesis • Describe patterns in data • Explain patterns using collision theory
Rate of reaction required practical 1	✓	✓	✓	• Develop a hypothesis that can be tested • Display data appropriately • Describe and explain the effect of concentration on the rate of reaction
Rate of reaction required practical 2	✓	✓	✓	• Describe how to measure the rate of reaction using a change in colour or turbidity • Process and display data appropriately, explaining choice of graph • Describe and explain the effect of concentration on the rate of reaction • Check for reproducibility in data collected

Effect of changing surface area on rate of reaction	✓	✓	✓	• Identify variables to change, measure and control to test a hypothesis • Process and display data appropriately • Use the data to describe and explain the effect of changing surface area on the rate of reaction
Effect of changing temperature on rate of reaction	✓	✓	✓	• Describe and explain the effect of temperature on rates of reaction, using particle theory. • Interpret secondary data on the effect of temperature on the rate of reaction • Explain the observations using particle theory
Effect of changing Pressure on rate of reaction	✓	✓	✓	• Recognise reactions involving gases • Describe and explain the effect of pressure on gaseous reaction • Apply knowledge to novel reactions
Catalysts	✓	✓	✓	• Describe what a catalyst is and how it affects the rate of a reaction • Explain why more than one catalyst is often needed • Describe the test for oxygen gas • Draw a reaction profile for a reaction with and without a catalyst
Reversible reactions	✓	✓	✓	• Describe what is meant by a reversible reaction and how to represent it • Explain how reversible exothermic and endothermic reactions are linked • Explain what is meant by ‘dynamic equilibrium’
Le Chatelier's principle - the effect of changing concentration and temperature		✓	✓	• State and apply Le Chatelier’s principle to any reversible reaction • Describe the effect on equilibrium of changes to temperature and concentration • Choose and explain the conditions needed to achieve a high yield

Le Chatelier's principle - the effect of changing pressure		✓	✓	• Describe the effect on equilibrium of changes to pressure • Choose and explain the conditions needed to achieve a high yield
Le Chatelier's Principle - uses in industry		✓	✓	• Describe and explain the effect of changes in pressure on the equilibrium of gaseous reactions • Describe and explain the conditions for optimum yield for a given reaction • Explain why optimum yield conditions are not always the ones chosen
The rate and extent of chemical change review 1	✓	✓	✓	Review of collision theory and rates of reaction
The rate and extent of chemical change review 2		✓	✓	Review of higher tier content in the unit : • Using tangents to calculate rates • Le Chatelier's principle

C7 Organic Chemistry, Year 11

Lesson title	Combi-ned science (FT)	Combi-ned science (HT)	Chemi-stry	Core content
Crude oil and alkanes	✓	✓	✓	• Describe the composition of crude oil • Define and recognise hydrocarbons and recall their general formula • Draw and name the first four hydrocarbons • Describe trends in physical properties of the hydrocarbons
Fractional distillation	✓	✓	✓	• Describe how crude oil is separated into fractions • Describe trends in the physical and chemical properties of the fractions of crude oil • Describe uses for the different fractions of crude oil
Cracking	✓	✓	✓	• Explain why cracking is necessary • Describe the process and products of cracking • Describe the test for alkenes and its positive result • Represent cracking using equations
Uses of hydrocarbons	✓	✓	✓	• Write equations for the complete combustion of hydrocarbons, identifying oxidation • Describe uses for the alkenes produced in cracking
Review 1	✓	✓	✓	• A review of the key ideas from the first 4 lessons of this topic
Reactions of alkenes			✓	• Draw and name alkenes • Compare the combustion of alkenes with that of alkanes • Describe and draw the reaction of alkenes with hydrogen, water and the halogens
Alcohols			✓	• Draw and name alcohols • Describe the production of alcohol from sugar • Describe the uses of alcohols and reactions with sodium, water and oxidising agents

Properties and combustion of alcohols			✓	• Describe the combustion of alcohols • Identify variables to change, measure and control to test a hypothesis • Evaluate data collected and make suggestions on how to improve it
Carboxylic acids			✓	• Name and draw carboxylic acids • Describe the properties and reactions of carboxylic acids • Explain why carboxylic acids are weak acids
Natural and addition polymers			✓	• Describe the process of addition polymerisation • Draw and name polymers • Recognise monomers from given polymers
Condensation polymers			✓	• Describe the process of condensation polymerisation • Draw and name condensation polymers & the small molecules produced • Draw and describe polymerisation of amino acids • Describe the natural polymers starch, cellulose and DNA
Review 2			✓	• Create synoptic links between this topic and other parts of GCSE chemistry
Review 3			✓	Review the separate science content from this topic

C8 Analysis, year 11

Lesson title	Combi-ned science (FT)	Combi-ned science (HT)	Chemi-stry	Core content
Pure, impure and formulations	✓	✓	✓	• Identify pure and impure substances using diagrams or data • Describe how to test for purity • Describe and give examples of formulations
Chromatography	✓	✓	✓	• Describe how to correctly use chromatography to separate mixtures • Interpret chromatograms to determine the contents of a provided mixture
Interpreting chromatograms	✓	✓	✓	• Identify mistakes in practical set up and suggest how to rectify them • Interpret chromatography data, identifying pure substances and mixtures • Calculate Rf values and using significant figures appropriately
Testing gases	✓	✓	✓	• Describe the tests for oxygen, carbon dioxide, hydrogen and chlorine and their positive results • Write and balance chemical equations to represent some of the reactions.
Review 1	✓	✓	✓	Review of the combined content
Identifying positive ions			✓	• Describe how to identify metal ions using flame tests and precipitation • Name the colours produced by given metal ions in flame tests • Write and balance chemical equations for the reactions of metal salts with sodium hydroxide
Identifying negative ions			✓	• Describe the tests for anions – carbonate, halide and sulphate • Safely carry out the tests and record the results • Describe the positive results

Review 2			✓	Review of the cation and anion tests
Identifying ions in solution			✓	• Safely carry out a series of a series of chemical tests to identify unknown solutions • Describe the tests used and the positive results • Write chemical formula for the identified compounds
Flame emission spectroscopy			✓	• Evaluate the use of instrumental methods to identify unknowns • Describe uses of flame emission spectroscopy • Interpret results from spectroscopy analysis to identify unknowns
Scientist profile Angela Lamb	✓	✓	✓	A look at the work of Angela Lamb and her work on analytical techniques
Review 3			✓	Review of the chemistry only content

C9, Atmosphere, Year 11

Lesson title	Combi-ned science (FT)	Combi-ned science (HT)	Chemi-stry	Core content
The Earth's atmosphere	✓	✓	✓	• Compare the compositions of Earth's atmosphere with the modern one • Describe and explain the changes in the composition of the atmosphere over Earth's history • Evaluate different theories about the Earth's early atmosphere • Describe and explain the formation of limestone, coal, crude oil and natural gas
The Greenhouse effect	✓	✓	✓	• Describe the greenhouse effect • Describe the reasons for and the impacts of increasing greenhouse gases on the temperature of the Earth's atmosphere • Evaluate the strength of the evidence for the link between CO_2 levels and global temperature rise
Climate change	✓	✓	✓	• Describe potential consequences of climate change • Define the carbon footprint in a range of contexts • Suggest ways of reducing carbon footprints in different contexts and why actions to reduce carbon footprints may be limited
Pollutants	✓	✓	✓	• Describe how carbon monoxide, soot, sulphur dioxide and nitrogen oxides are produced and released into the atmosphere • Predict the products of the combustion of a fuel given appropriate information • Describe the problems caused by these pollutants
Maths skills	✓	✓	✓	• Describe and explain patterns in graphs • Recap maths skills such as mean calculation
Alice Wilson	✓	✓	✓	A look at the work of geologist Alice Wilson and her contribution to the understanding of evolution of the Earth

Review 1	✓	✓	✓	Review of content in unit - changes to the atmosphere and the greenhouse effect
Review 2	✓	✓	✓	Review of global warming and the source and problems caused by named atmospheric pollutants

C10, using Resources, Year 11

Lesson title	Combi-ned science (F)	Combi-ned science (H)	Chemi-stry	Core content
Finite resources	✓	✓	✓	• State ways in which natural products are supported or replaced by man-made products • Extract and interpret information in charts, graphs and tables • Evaluate the use of finite and renewable resources
Life Cycle Assessments	✓	✓	✓	• Describe some ways of reducing our use of finite resources • Evaluate ways of reducing our use of limited resources • Carry out life cycle assessments given appropriate information
The importance of recycling	✓	✓	✓	• Describe ways of recycling • Describe the impacts of recycling in terms of environmental impact and sustainable development
Phytomining and bioleaching		✓	✓	• Describe the processes of phytomining and bioleaching to extract metals • Compare alternative methods of metal extraction using information given • Link the processes to displacement and energy change graphs
Rusting			✓	• Describe experiments to prove the need for oxygen and water for rusting to occur • Interpret results from rusting experiments • Describe methods of preventing corrosion, including sacrificial protection
Alloys			✓	• State uses of the alloys bronze, brass and steel • Interpret and evaluate the composition and uses of alloys given appropriate information • Explain why alloys are more useful than pure metals
Polymers			✓	• Give uses for different types of polymer

				• Explain how low density and high density poly(ethene) are both produced from ethene • Explain the difference between thermosoftening and thermosetting polymers in terms of their structures
Glass, ceramics and composites			✓	• Describe the production of glass • Give some uses for composites • Compare quantitatively the physical properties of glass and clay ceramics, polymers, composites and metals • Explain how the properties of materials are related to their uses and select appropriate materials.
Water safe to drink	✓	✓	✓	• Distinguish between pure and potable water • Describe and explain the steps involved in the treatment of safe drinking water • Test water for pH and dissolved solid content and calculate the concentration of dissolved solids
Required practical on potable water	✓	✓	✓	• Describe methods of producing potable water from salty water • Describe how to carry out the distillation of a water sample • Describe the differences between the water samples before and after distillation and how to test for these
Waste water treatment	✓	✓	✓	• State components of wastewater that can cause problems in the environment • Describe how wastewater is treated to make it safe to release into the environment • Compare the treatments of waste, ground and salt water in terms of ease of producing potable water
Making ammonia and the Haber process			✓	• Name the source of the reactants in the Haber process • Describe the importance of the Haber process • Describe the conditions and reactions involved in the Haber process
The economics of the Haber process			✓	• Predict the effect of temperature, concentration and pressure on yield and rate of reaction in the Haber process • Interpret graphs of reaction conditions versus rate

				• Explain why industrial conditions for the Haber process are a compromise, taking into account multiple factors
Making fertilisers in the lab and in industry			✓	• State the use and composition of NPK fertilisers • Describe the production of NPK fertilisers, naming reactants and products • Compare the industrial production of fertilisers with laboratory preparations of the same compounds given appropriate information.
Review lesson	✓	✓	✓	Review of combined content
Review lesson - chemistry content			✓	Review of chemistry content
Exam skills - compare and evaluate	✓	✓	✓	Exam skills lesson focusing on the command verbs ‘compare’ and ‘evaluate’
Case study: Kitty Hach Darrow	✓	✓	✓	A look at the work of Kitty Hach Darrow on water purification methods

P1 Energy

Lesson title	Combined science (FT)	Combined science (HT)	Physics	Core content
Energy transfers	Y	Y	Y	• Name the 8 energy stores • Describe the transfer of energy from one store to another, identifying pathways • Describe how energy is dissipated and calculate efficiency
The Kinetic energy store	Y	Y	Y	• Calculate the energy stored in a moving object • Rearrange the equation to calculate velocity or mass • Change units where necessary and express answers to given numbers of significant figures
The Gravitational Potential energy store	Y	Y	Y	• Use an equation to calculate GPE, mass or height • Use values for GPE to calculate the theoretical velocity of an object • Explain why the maximum theoretical velocity is never actually reached.
Conservation of energy	Y	Y	Y	• Define the term system • Explain the law of conservation of energy. • Apply conservation of energy to systems involving GPE and KE.
The Elastic Potential store	Y	Y	Y	• Define an elastic object • Calculate the energy stored in a stretched or compressed object • Describe the energy transfers in a bouncing object
Power	Y	Y	Y	• Describe, using examples, what is meant by power • Calculate power using energy transferred or work done • Compare the power of different appliances or machines
Efficiency and reducing	Y	Y	Y	• Calculate efficiency from numbers or a Sankey diagram • Describe ways of reducing unwanted energy transfers

unwanted energy transfers				• Explain method for reducing unwanted energy transfers
Specific heat capacity	Y	Y	Y	• Explain what is meant by specific heat capacity • Use the specific heat capacity equation to calculate unknown values
Specific heat capacity Required practical	Y	Y	Y	• Explain the method steps used to find the SHC of a substance • Plot a graph of results to determine specific heat capacity • Calculate the SHC of the blocks investigated • Write a method for an alternative SHC investigation
Insulating material required practical			Y	• Explain the steps in a given method to test a hypothesis • Collect and display data appropriately • Describe and explain patterns in results.
Insulating material required practical 2			Y	• Describe hazards, risks and safety precautions associated with a given method • Collect and display results appropriately • Calculate the rate of cooling using tangents • Draw conclusions consistent with results
Non-renewable energy resources	Y	Y	Y	• State the names of non-renewable energy resources • Interpret data to compare energy usage • Consider impact on the environment of non-renewables.
Renewable energy resources	Y	Y	Y	• Describe uses of renewable energy resources • Describe advantages and disadvantages of renewable energy resources • Evaluate the use of energy resources • Compare the use of different energy resources
Multi Step calculations for the energy topic		Y	Y	• Choose correct equations to use in calculations. • Use multiple equations to solve single problems.

Energy review	Y	Y	Y	• Correct misconceptions • Recall definitions of key terms and use them correctly • Apply understanding to exam style questions.
Case Study - Esther Takeuchi	Y	Y	Y	Understand the key contributions of Esther Takeuchi.

P2 Electricity

Lesson title	Combined science (FT)	Combined science (HT)	Physics	Core content
Drawing electrical circuits	Y	Y	Y	• Draw circuits, using correct common circuit symbols
Current and charge	Y	Y	Y	• Describe electrical current • Use the equation Q=It to calculate any value given the other two, changing units where necessary
Potential difference	Y	Y	Y	• Describe what is meant by potential difference and resistance in circuits • Recall and apply the equation linking charge, energy and potential difference
Electrical Resistance	Y	Y	Y	• Describe what happens to current when potential difference and resistance are varied • Use an equation linking potential difference, current and resistance to calculate any value given the other two
Resistance of a wire	Y	Y	Y	• Identify variables to change, measure and control to test a hypothesis • Collect and record measurements of current and potential difference for different lengths of wire • Use the readings to calculate resistance in the wire • Plot a graph of the results
Series circuits	Y	Y	Y	• Predict current and pd in series circuits • Describe the effect of adding resistors in series circuits • Use Ohm's Law to calculate current, resistance or pd
Parallel circuits	Y	Y	Y	• Describe and apply the rules for pd and current in a parallel circuit • Describe the effect of adding resistors in parallel

				• Use Ohm's law to find pd, resistance or current in parallel circuits.
Series and parallel Circuits	Y	Y	Y	• Compare series and parallel circuits. • Use Ohm's Law to find pd, current and resistance in circuits.
Properties of Resistors	Y	Y	Y	• Make and record measurements to find the pattern of resistance in a fixed resistor • Plot a graph of the data obtained • Describe and explain the relationship between current, pd and resistance in a fixed resistor
Filament lamps	Y	Y	Y	• Make and record measurements to find the pattern of resistance in a filament lamp • Plot a graph of the data obtained • Calculate resistance for the values collected • Describe and explain the relationship between current, pd and resistance in a filament lamp
Diodes	Y	Y	Y	• Recognise and draw the symbol for a diode • Process secondary data and plot a graph of the data • Describe and explain the pattern of current and pd with a diode
Light dependent Resistors	Y	Y	Y	• Identify variables to change, measure and control to test a hypothesis • Collect and display results appropriately • Explain how resistance changes with light levels in an LDR • Explain how LDRs can be used to switch lights on when it gets dark
Thermistors	Y	Y	Y	• Draw a circuit diagram to illustrate how to test the resistance of a thermistor • Process secondary data appropriately and use it to inform a conclusion • Explain the use of thermistors as a thermostat

Review of electrical circuits	Y	Y	Y	• Tackle misconceptions for electrical circuits • Recall key definitions and equations. • Apply understanding to exam style questions.
Domestic electricity	Y	Y	Y	• Describe the features of UK mains supply and three core cable • Explain the use of live, neutral and earth wires • Explain the difference between direct and alternating potential difference
Electrical power - part 1	Y	Y	Y	• Recall and apply the equation linking current, potential difference and power • Change units and the subject of equations where necessary • Recall and apply the equation to calculate power, current or resistance • Change units and the subject of equations where necessary
Electrical power - part 2	Y	Y	Y	• Recall and apply the equation linking energy, power and time • Recall and apply the equation linking charge, energy and potential difference
Multi-Step calculations		Y	Y	• HT Be able to solve problems using multi-step or multiple equations.
The National Grid	Y	Y	Y	• Describe how electricity is transmitted in the national grid, naming the components • Explain the use of transformers in the national grid • Evaluate the use of underground or overhead cables. • (HT) use a given equation to calculate current or pd given appropriate information
Domestic electricity review	Y	Y	Y	• Tackle misconceptions for domestic electricity • Recall key information and definitions • Apply understanding to exam style questions.
Static electricity			Y	• Describe the production of static electricity and sparking by rubbing surfaces • Describe evidence that charged objects exert forces of attraction or repulsion on one another when not in contact • Explain how the transfer of electrons between objects can explain static electricity

Case study: Benjamin Franklin and Sparks	Y (if wanted - makes reference to physics only content)	Y (if wanted - makes reference to physics only content)	Y	• Study the work of Benjamin Franklin and how it relates to electricity.
Electric fields			Y	• Draw the electric field pattern for isolated charged spheres • Explain the concept of an electric field • Explain how the concept of electric fields help explain non-contact forces between charged objects, sparking and other electrostatic phenomena

P3 Particle model of matter

Lesson title	Combined science (FT)	Combined science (HT)	Physics	Core content
Particle models	Y	Y	Y	• Describe the arrangement of particles in solids, liquids and gases and represent them with accurate drawings • Use the particle model to explain differences in properties of solids, liquids and gases • Evaluate the particle models
Density of solids	Y	Y	Y	• Use an equation to calculate density, mass or volume of an object • Unit conversion (mass and volume)
Density required practical	Y	Y	Y	• Describe how to measure the density of regular and irregular solids • Make and record accurate measurements
Density of liquids	Y	Y	Y	• Describe how to measure the density of liquids • Make and record accurate measurements • Suggest possible sources of error and how to correct them
Internal Energy	Y	Y	Y	• Define internal energy • Describe the two results of changing the internal energy of a system and recognize them on heating/cooling graphs • Plot secondary data for heating a substance • Describe heating and changes of state in terms of kinetic and potential energy stores
Heating and cooling substances	Y	Y	Y	• Describe heating and changes of state in terms of kinetic and potential energy stores • Use the specific heat capacity equation to calculate any value given the others
Latent heat	Y	Y	Y	• Describe changes to particle arrangement and movement during a change of state

				• Describe latent heat of vaporisation and fusion and recognize them on a graph • Use an equation to calculate energy, mass or latent heat values
Multi-step energy calculations		Y	Y	• Use an equation to calculate energy, mass or latent heat values • Multi Step calculations
Gas pressure	Y	Y	Y	• Use the particle model to explain gas pressure • Plot data to show the effect of temperature on gas pressure and describe the pattern shown • Explain why changing the temperature of a gas affects the pressure
Pressure and volume 1			Y	• Describe how volume changes affect pressure • Use the particle model to explain how changes in volume can result in changes in pressure
Pressure and volume 2			Y	• Calculate the resulting pressure or volume when one is changed using an equation • Explain how work done affects the internal energy of a gas
Review 1	Y	Y	Y	Review 1 • Recall definitions of key terms and use them correctly • Application of knowledge to exam questions • Correct key misconceptions on this topic
Case study - Joseph Black	Y	Y	Y	Studying the life and work of Joseph Black

P4 Atomic Structure

Lesson title	Combined science (FT)	Combined science (HT)	Physics	Core content
Exploring Inside Atom	Y	Y	Y	• Describe the current atomic model
Isotopes and Ionisation	Y	Y	Y	• Explain how EM radiation can cause changes in electron arrangement or ionisation • Compare isotopes in terms of their subatomic particles
History of atomic models	Y	Y	Y	• Compare the nuclear model of the atoms with the plum pudding model • Describe how evidence led to changes in the atomic model • Explain why Rutherford's atomic model was readily accepted
Radioactivity	Y	Y	Y	• Describe the effect of alpha, beta and gamma radiation on the nucleus • Describe properties of alpha beta and gamma radiation
Decay Equations	Y	Y	Y	• Write nuclear equations to represent decay
Activity and Half-life (FT)	Y			• Describe what is meant by the radioactive half life of a sample. • Plot a graph representing the number of decays in a sample. • Determine half lives from information given
Activity and Half-life (HT)		Y	Y	• Describe what is meant by the radioactive half life of a sample. • Plot a graph representing the number of decays in a sample. • Determine half lives from information given • Calculate net decline and express as a ratio
Uses and Hazards of Radiation (Combined	Y	Y		• Describe some uses and dangers of radioactive sources • Explain the relative dangers in terms of properties and half lives • Evaluate the use of radioactive sources for given situations

Science only)				• Describe and identify examples of radioactive contamination and irradiation • Compare the hazards associated with contamination and irradiation • Explain how the risk changes over time and distance from the source
Hazards of Radiation (Physics only)			Y	• Describe and identify examples of radioactive contamination and irradiation • Compare the hazards associated with contamination and irradiation • Explain how the risk changes over time and distance from the source • Describe sources of background radiation.
Uses of Radiation (Physics only)			Y	• Explain why the hazards of a radioactive source varies according to half life • Describe uses of radioactive isotopes in relation to the exploration of body organs and destruction of unwanted tissue • Evaluate uses of radioactive isotopes for exploration of body organs
Fission and fusion			Y	• Describe the process of nuclear fusion and nuclear fission • Draw and interpret diagrams representing nuclear fission • Explain what is meant by a chain reaction
P4 Atomic structure Review 1	Y	Y	Y	• Identify key misconceptions • Apply understanding to exam questions
P4 Atomic structure Review 2			Y	• Identify key misconceptions appropriate to GCSE physics course only • Apply understanding to exam questions

P5 Forces and Motion

Lesson title	Combined science (FT)	Combined science (HT)	Physics	Core content
Forces an introduction	Y	Y	Y	• Describe the difference between scalar and vector quantities • Describe forces as contact or non-contact and give examples • Describe the interaction between forces between pairs of objects
Weight, mass and gravity	Y	Y	Y	• Describe how to find and represent the centre of mass of an object • Describe the relationship between mass, weight and gravity • Use the mathematical relationship to calculate any value, given the other two
Resultant forces	Y			• Calculate resultant forces of forces acting in a straight line • Describe the effect of resultant forces on objects • Describe scalar and vector quantities and give examples
Resolving forces (HT)		Y	Y	• Calculate resultant forces of forces acting in a straight line • Describe the effect of resultant forces on objects • Describe scalar and vector quantities and give examples • Represent and interpret vector quantities using scale diagrams • Draw and interpret vector diagrams representing multiple forces
Forces and work	Y	Y	Y	• Describe energy transfers when work is done, including the effect of work done against frictional forces • Calculate work done, force or distance given appropriate information • Convert units where needed.
Forces and elasticity 1	Y	Y	Y	• Identify variables to change, measure and control in a given hypothesis

				• Construct a table for result, including units • Explain the steps in the method to test a given hypothesis • Collect and display data appropriately.
Forces and elasticity 2	Y	Y	Y	• Recall and use a formula to calculate extension, force or spring constant • Process secondary data • Plot a graph of the data and use it to explain the limit of proportionality • Relate stretching and compression to work done and calculate this.
Moments and levers			Y	• Describe examples in which forces cause rotation. • Calculate the size of a force, or its distance from a pivot, acting on an object that is balanced. • Explain how levers help in everyday life
Moments and Gears			Y	• Explain how levers and gears transmit the rotational effects of forces
Pressure			Y	• Define pressure • Calculate pressure exerted on a surface
Pressure in fluids			Y	• Explain why, in a liquid, pressure at a point increases with the height of the column of liquid above that point and with the density of the liquid. • Calculate the differences in pressure at different depths in a liquid. • Describe the factors which influence floating and sinking.
Atmospheric pressure			Y	• Describe a simple model of the Earth's atmosphere and of atmospheric pressure • Explain why atmospheric pressure varies with height above a surface.
Speed	Y	Y	Y	• Explain what is meant by the term 'average speed' • Recall and apply a formula to calculate average speed, distance or time.

Distance-time graphs	Y	Y	Y	• Interpret distance time graphs and use them to calculate speed • (HT) Explain qualitatively that motion in a circle involves constant speed but changing velocity.
Acceleration	Y	Y	Y	• Calculate resultant forces • Describe the effect of resultant forces on stationary and moving objects • Calculate acceleration and use the correct units • Use and manipulate the equation for uniform acceleration
Velocity-time graphs	Y	Y	Y	• Draw velocity–time graphs from measurements • Interpret lines and slopes to determine acceleration • (HT) Determine distance travelled by an object (or displacement of an object) from a velocity–time graph
Terminal Velocity	Y	Y	Y	• Describe and recognise terminal velocity • Explain why falling objects have different terminal velocities • (Physics only) Draw and interpret velocity–time graphs for objects reaching terminal velocity • (Physics only) Interpret the changing motion in terms of the forces acting.
Newton's laws	Y	Y	Y	• Use Newton's second law to calculate force, mass or acceleration • Estimate the speed, accelerations and forces involved in large accelerations for everyday road transport. • Recognise and use the symbol that indicates an approximate value • (HT) Define and explain that what we mean by inertial mass
Acceleration RPA 1	Y	Y	Y	• Describe a method for investigating how force or mass affects acceleration • Select appropriate apparatus for determining the acceleration of an object. • Describe how to manage the risks associated with the practical • Correctly calculate means

Acceleration RPA 2	Y	Y	Y	• Interpret graphs to make conclusions • Use the equation F=ma to calculate theoretical acceleration. • Explain differences between experiment data and theoretical values • Calculate acceleration using speed and distance measurements
Stopping distance	Y	Y	Y	• Identify and sort factors which could affect thinking and/or braking distance. • Calculate the stopping distance of a vehicle using an equation. • Write a conclusion with values quoted. • Rearrange the equation for stopping distance to calculate braking or thinking distance.
Momentum		Y	Y	• State what is meant by momentum. • Calculate the momentum of objects. • Apply the conservation of momentum to collisions and explosions.
Car safety			Y	• Explain how certain car safety features work. • Calculate quantities from an equation related to car safety features. • Rearrange an equation to calculate other values.
Combined science review	Y	Y	Y	• Identify key misconceptions from the sections of forces common to combined science and GCSE Physics courses • Apply understanding to exam questions
Physics only review			Y	• Identify key misconceptions from the Physics only section of forces • Apply understanding to exam questions
Case study - Sir Isaac Newton	Y	Y	Y	A look into the life and work of Sir Isaac Newton

P6 Waves

Lesson title	Combined science (FT)	Combined science (HT)	Physics	Core content
Wave properties	Y	Y	Y	• Identify the features of a longitudinal and transverse waves • Describe the production of longitudinal and transverse waves • Compare light and sound waves
Calculations with waves	Y	Y	Y	• Calculate frequency from diagrams or information • Make and record measurements to calculate the speed of sound in air • Use the wave equation to calculate speed, frequency or wavelength
Measuring the speed of waves in water	Y	Y	Y	• Explain the steps taken in measuring the speed of waves in water • Process results appropriately • Describe how to minimise error in the readings
Measuring the speed of waves in solids	Y	Y	Y	• Explain the steps taken in measuring the speed of waves in solids • Process results appropriately • Describe how to minimise error in the readings
Reflection			Y	• Construct ray diagrams to illustrate the reflection of a wave at a surface • Describe the effects of reflection, transmission and absorption of waves at material interfaces. • Investigate the reflection of light by different types of surface and the refraction of light by different substances
Refraction	Y	Y	Y	• Describe the effect of refraction at material interfaces • Explain the process of process of refraction
Sound			Y	• Describe the range of normal human hearing

				• Describe processes which convert wave disturbances between sound waves and vibrations in solids. • Explain why such processes only work over a limited frequency range and the relevance of this to human hearing
Ultrasound and seismic waves			Y	• Explain how ultrasound waves are used for both medical and industrial imaging • Describe how high frequency sound waves are used to detect objects in deep water and measure water depth. • Explain how seismic waves provide evidence for the structure of the Earth
Electromag-netic spectrum part 1	Y	Y	Y	• Describe properties of the EM spectrum waves • Describe uses of each type of wave
Electromag-netic Spectrum part 2	Y	Y	Y	• (HT) explain why each wave is suitable for the application • Describe the effect of different substances on EM waves • Describe some of the dangers of EM waves • Draw conclusions from secondary data on the risks and consequences of exposure to radiation
Infra-red	Y	Y	Y	• Identify variables to change, measure and control to test a hypothesis • Collect and record data • Process data collected and use it to inform a conclusion
Combined science review	Y	Y	Y	• Identifying key misconceptions across the combined science and physics only aspect of the topic. • Apply understanding to exam questions
Lenses			Y	• Pupils should be able to construct ray diagrams to illustrate the similarities and differences between convex and concave lenses. • Describe the image formed by lenses • Calculate the magnification of an image formed by a lens
Colour			Y	• Explain how the colour is related to absorption, transmission and reflection of different wavelengths of light

				• Explain the effect of viewing objects through filters or the effect on light of passing through filters • Explain why an opaque object has a particular colour
Black body radiation			Y	• Explain the intensity and wavelength distribution of radiation emitted by all bodies • Explain how the temperature of a body is related to the balance between incoming radiation • Draw/interpret diagrams to show how radiation affects the temperature of the Earth's surface and atmosphere.
Physics review			Y	• Identify key misconceptions from the physics only part of the topic • Apply understanding to exam questions

P7 Magnetism and Electromagnetism

Lesson title	Combined science (FT)	Combined science (HT)	Physics	Core content
Magnetism	Y	Y	Y	• Describe what happens when poles of a magnet are brought together • Describe how to test to see if a material is magnetic or a magnet • Interpret secondary data on an experiment to test the variation in magnetic field Describe how the strength of a magnetic field varies
Magnetic fields	Y	Y	Y	• Describe and draw the direction of the magnetic field around a bar magnet • Describe how to plot the magnetic field pattern of a magnet using a compass • Explain how the behaviour of a magnetic compass is related to evidence that the core of the Earth must be magnetic
Electromag-netism	Y	Y	Y	• Describe and draw the magnetic field around a wire carrying a current • Describe the magnetic field in and around a solenoid • Explain how the strength of the magnetic field can be varied
The motor effect and Left Hand Rule		Y	Y	• Describe the motor effect and the factors that affect the size of the force on the conductor • Use Fleming's left hand rule to predict the direction of movement of a wire in a field • Use the equation linking force, magnetic flux density, current and length to calculate any value, changing units where appropriate

F = B × I × l		Y	Y	• Use the equation linking force, magnetic flux density, current and length to calculate any value, changing units where appropriate • Combine equations to calculate missing values
DC Motors		Y	Y	• Explain how a DC motor works, using Fleming's left hand rule to predict direction of rotation • Explain the role of a commutator
Electromag-netic Induction and Generators			Y	• Describe the factors affecting size and direction of induced pd/current • Explain how the generator effect is used in an alternators (ac)
Electromag-netic devices			Y	• Explain how the generator effect is used in dynamos (dc) • Draw/interpret graphs of potential difference generated in the coil against time for generators and dynamos • Explain how a moving-coil loudspeaker and headphones work • Explain how a moving-coil microphone works.
Transformer s			Y	• Describe the structure of a transformer • Explain how transformers are used in the National Grid • Explain how an alternating current in one coil induces a current in another
Transformer Equations			Y	• Explain how the ratio of potential differences across the two coils depends on the ratio of turns • Carry out calculations linking both transformer equations and relate to advantages of power transmission at high potential differences
Case study: Nikola Tesla	Y	Y	Y	A study of the life and work of Nikola Tesla
P7 Magnetism Revision 1	Y	Y	Y	• Identify misconceptions • Apply understanding to exam questions

P7 Magnetism Revision 2			Y	• Identify misconceptions specific to the physics only part of the course • Apply understanding to exam questions

P8 Space (Physics GCSE only)

Lesson title	Core content
Solar System	• Calculate distances in space • Describe the solar system and how the sun was formed • Describe the process of nuclear fusion
Orbits	• Describe the process of circular motion • Describe similarities and differences between planets, moons and artificial satellites. • Explain how the force of gravity can lead to changing velocity but unchanging speed • Explain how the radius of an orbit must change if speed changes.
Life Cycle of a Star	• Describe the life cycle of stars similar to our sun and larger • Describe the role supernovae play in the formation of elements heavier than iron • Explain how fusion processes lead to the formation of new elements
Element synthesis	• Describe nuclear fusion of hydrogen into helium • Explain how elements heavier than iron are made
Origins of universe	• Qualitatively explain the red-shift of light from galaxies that are receding • Explain that the change of each galaxy's speed with distance is evidence of an expanding universe • Explain how red-shift provides evidence for the Big Bang model
CMBR	• Explain how CMBR provides evidence for the big bang theory • Describe how the CMBR was discovered and led to the acceptance of the Big Bang Theory • Describe what is not understood about the universe (eg dark mass and dark energy)
Review - Space	• Identify key misconceptions • Apply understanding to exam questions.
Case study - S.Chandrasekhar	A look at the life and work of S.Chandrasekhar