Science
Key Stage 3

Curriculum map

OAK NATIONAL ACADEMY

1. Philosophy

Six underlying attributes at the heart of Oak's curriculum and lessons.

Lessons and units are **knowledge and vocabulary rich** so that pupils build on what they already know to develop powerful knowledge.

Knowledge is **sequenced** and mapped in a **coherent** format so that pupils make meaningful connections.

Our **flexible** curriculum enables schools to tailor Oak's content to their curriculum and context.

Our curriculum is **evidence informed** through rigorous application of best practice and the science of learning.

We prioritise creating a **diverse** curriculum by committing to diversity in teaching and teachers, and the language, texts and media we use, so all pupils feel positively represented.

Creating an **accessible** curriculum that addresses the needs of all pupils is achieved to accessibility guidelines and requirements.

2. Units

KS3 Science is formed of 19 units and this is the recommended sequence:

Unit Title	Recommended year group	Number of lessons
1 Particles	Year 7	16
2 Cells, tissues and organs	Year 7	16
3 Energy	Year 7	16
4 Reproduction and variation	Year 7	15
5 Chemical reactions	Year 7	12
6 Forces and motion	Year 7	14
7 Ecological relationships and classification	Year 7	14
8 Light and space	Year 8	16
9 Atoms and the periodic table	Year 8	14

3. Lessons

Unit 1 Particles

16 Lessons

Lesson number	Lesson question	Pupils will learn
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 or low concentration • Use the particle model to explain why diffusion is different in solids, liquids and gases
3.	**Changes of State**	• Describe changes of state that occur from solid to liquid and liquid to gas in terms of particles

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.	**Solutions**	• 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
7.	**Review 1**	• Review the particles unit content covered so far and practice 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 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 whiskey distillation
16.	**Review 2**	• Review the particles unit content covered from lessons 8-15 and practice exam-style questions

Unit 2 Cells, tissues and organs

16 Lessons

Lesson number	Lesson question	Pupils will learn
1.	**Microscopes**	• Label the parts of a 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 • Work safely to collect and record data to test the hypothesis • Process the data to calculate a mean, accounting for anomalies • Display data appropriately, including a table for results with units • 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.	**Plants 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, image or actual size using an 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 animal and plant cells, using key structures • 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 and 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 for 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 appropriately
14.	**Review (Part 1)**	• Review content about microscopes & magnification

15.	**Review (Part 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

Unit 3 Energy

16 Lessons

Lesson number	Lesson question	Pupils will learn
1.	**Energy stores and transfers (Part 1)**	• Name the main energy stores and give examples • Describe energy transfers, identifying pathways
2.	**Energy stores and transfers (Part 2)**	• Describe energy transfers using box diagrams • Apply the conservation of energy to examples
3.	**Investigating energy transfers**	• Describe how to use a Bunsen burner safely • Calculate averages • Write a conclusion based on 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 of convection.
7.	**Radiation**	• Explain how heat is transferred by radiation • Explain everyday observations using an understanding of absorption and emission of radiation
8.	**Insulation**	• Describe an insulator in terms of energy transfers • Describe an insulator in terms of energy transfers • Apply knowledge of conduction, convection and radiation to solve problems

9.	**Mid topic review**	• Creating a catapult whilst identifying the energy transfers • Revision of conduction, convection and radiation • Investigating different insulators
10.	**Power and energy**	• Explain the relationship between energy and power. • Convert 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 based on their power rating and the time of operation • Calculate the costs of running home appliances
12.	**Energy in food**	• 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**	• Understand key ideas about the life and 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 lessons 10-15 of the Energy unit.

Unit 4 Reproduction and variation

15 Lessons

Lesson number	Lesson question	Pupils will learn
1.	**Human Reproductive System**	• Describe adaptations of the egg and sperm cells to their function • Label diagrams of the human male and female reproductive systems • Describe the function of each of the parts of the reproductive systems
2.	**Fertilisation**	• Describe how reproduction takes place in humans • Describe the processes of 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 nutrients and oxygen, and how waste its is excreted

4.	**Risk Factors during Gestation**	• Describe risks of smoking and alcohol during pregnancy • Use data to describe the impact of smoking on an unborn baby
5.	**Birth**	• Describe patterns in secondary data • Describe how a baby is born • Explain differences in the 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 human reproduction • Describe how the chromosome number is maintained through sexual reproduction.
8.	**Jean Purdy and Fertility Treatment**	• Describe key ideas about the life and 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 Formation and Dispersal**	• Describe how seeds are adapted for specific dispersal mechanisms. • Identify variables to change, measure and control in an investigation • Process data collected and use it to describe a relationship between variables
11.	**Practical: Seed Dispersal**	• Collect data on seed dispersal • Identifying variables that affect seed dispersal and write a method • Calculate the mean of a set of values
12.	**Variation**	• 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 (Part 2)**	• Review and consolidate knowledge of reproduction • Compare reproduction in plants and humans

Unit 5 Chemical reactions

12 Lessons

Lesson number	Lesson question	Pupils will learn
1.	**Indicators of a 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 for 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 appropriate 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.	**Metals and acids**	• 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
6.	**Revision 1**	• Review and consolidate knowledge from the chemical reactions unit 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 Titrations**	• Suggest control variables needed to test a hypothesis • Make and record repeatable results and describe how these are recognized • Process data appropriately and use them to write a conclusion
9.	**Antacid Investigation: Planning**	• Describe a method to find the best antacid medicine • Identify appropriate variables to change, measure and control • Design a table for results
10.	**Antacid Investigation: Analysis & Conclusion**	• Collect accurate results and check for reproducibility • Display the results appropriately, explaining the choice of graph • Analyse 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. Revision (Part 2)

- Recall key terms, definitions and structures related to chemical reactions
- Review key ideas from lessons 7-11 of this unit

Unit 6 Forces and motion

14 Lessons

Lesson number	Lesson question	Pupils will learn
1.	**What are Forces?**	• Identify forces in a range of contexts • 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 • Plot an accurate 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 for an investigation • Identify the variables in an investigation • Obtain a set of results and describe the pattern in the results
9.	**Factors that affect speed**	• Describe how different factors affect speed • Apply knowledge of resistive forces to explain design modifications
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 content such as resultant force, gravity and weight
14.	**Revision (Part 2)**	• Revise key content such as pressure, calculating speed and distance-time graphs.

Unit 7 Ecological relationships and classification

14 Lessons

Lesson number	Lesson question	Pupils will learn
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**	• 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 system
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.	**Natural Selection**	• Describe ways in which organisms may vary within a species • 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**	• Understand key ideas about the life and work 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 (Part 1)**	• Recall and apply key knowledge from the first half of the ecology topic

14. Revision (Part 2)

- Recall and apply key knowledge from the second half of the ecology topic

Unit 8 Light and space

16 Lessons

Lesson number	Lesson question	Pupils will learn
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**	• State the law of reflection • Process secondary data appropriately and use it to check for reproducibility • Draw accurate ray diagrams

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.	**Colour**	• 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-style questions
10.	**Review of light**	• Recall key terms, definitions and structures related to light • Apply knowledge to a range of exam-style questions
11.	**Gravity**	• Describe the term 'non-contact force' and give examples • Describe the forces of attraction between the Earth and moon, and the Earth and 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 life and work of Dr Maggie Aderin-Pocock
14.	**Universe**	• Define a light year and explain why they are used in astronomy • 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 of space

- Recall key terms, definitions and structures related to, space and gravity
- Apply knowledge to a range of exam-style questions

Unit 9 Atoms and the periodic table

14 Lessons

Lesson number	Lesson question	Pupils will learn
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 configurations 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 formulae using ideas of valency • Interpret formulae in terms of the number of each atom 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 (Part 1)**	• Practice 2 revision techniques • Recall key content from the unit so far
10.	**Group 1**	• Describe some of the properties of group 1 elements • Describe trends in physical and chemical properties of group 1 elements • Write word (or symbol) equations to represent group 1 element reactions with oxygen and water

11.	**Group 7**	• Describe trends in physical and chemical properties of group 7 elements • Write word equations to represent group 7 element reactions 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 (Part 2)**	• Explain how an element's position in the periodic table links to its properties and reactivity (groups 1 and 7)

Unit 10 Digestion and nutrition

13 Lessons

Lesson number	Lesson question	Pupils will learn
1.	**Healthy diet (Part 1)**	• Name the components of food and describe what each component 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 from food • Describe how energy is released from the food we eat • Evaluate a model for respiration

5.	**Carbohydrates**	• Describe the difference between two types of carbohydrate • Describe how to test for starch and sugar • 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 tests for protein and fat • Safely carry out the tests for protein and fat and record the results • Use the results collected to draw conclusions
7.	**Review (Part 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
9.	**Adaptations of the small intestine**	• Describe and explain adaptations of the small intestine

10.	**Enzymes**	• Describe the action of enzymes in the digestive system • Explain the results of the 'model gut' experiment • Evaluate the model gut
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 (Part 2)**	• Review some of the key ideas from lessons 8-12 of the digestion and nutrition unit

Unit 11 Electricity and magnetism

16 Lessons

Lesson number	Lesson question	Pupils will learn
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 & series circuits**	• Use an ammeter to 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 & 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 potential difference in series circuits
5.	**Potential difference in parallel circuits**	• Describe potential difference in parallel circuits • Compare patterns of potential difference in series and parallel circuits
6.	**Resistance**	• Investigate the relationship between current, potential difference and resistance • Use data collected to inform a conclusion • Use an equation to calculate current, potential difference 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.	**Static electricity**	• Describe what is meant by 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 • Identify key variables for an investigation of electromagnets

13.	**Uses of electromagnets**	• State how electromagnets are used in a variety of devices • Draw the shape of the magnetic field around a straight wire
14.	**Electric motors**	• Understand how the motor effect is caused by magnetic fields • State the factors affecting the speed of a direct motor
15.	**Electricity review**	• Review of key ideas from lessons 1-9 of the electricity and magnetism unit
16.	**Magnetism review**	• Review of key ideas from lessons 10-14 of the electricity and magnetism unit

Unit 12 Materials and the Earth

15 Lessons

Lesson number	Lesson question	Pupils will learn
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 rocks**	• 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 rocks**	• Describe the weathering, transportation and deposition of rocks at the Earth's surface • Describe the formation and properties of sedimentary rocks

4.	**Metamorphic rocks**	• Describe the formation and 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 molecular diagrams of the first 5 alkanes • Evaluate the extraction and use of crude oil
7.	**Review (Part 1)**	• Review of key ideas from lessons 1-6 of the materials and the Earth unit
8.	**The Earth's 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.	**The carbon cycle**	• Describe the main processes involved in the cycling of carbon
10.	**The greenhouse effect**	• Describe the greenhouse effect • Explain the significance of an increased greenhouse effect
11.	**Evidence for 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 and evaluate the processes of mining and quarrying

15. Review (Part 2)

- Review of key ideas from lessons 7-14 of the materials and the Earth unit

Unit 13 Plants and photosynthesis

12 Lessons

Lesson number	Lesson question	Pupils will learn
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 glucose**	• 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 in a plant stem • 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 & 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 components of our diet • Describe the importance of insect pollination to food security
11.	**Application of knowledge**	• Write a conclusion from secondary data on a stomata investigation • Explaining the adaptation of leaves in relation to transpiration, rate of photosynthesis and plant growth

12. Review (Part 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

Unit 14 Matter

11 Lessons

Lesson number	Lesson question	Pupils will learn
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
2.	**Change of state**	• Explain 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 & 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 (Part 1)**	• Recap key aspects of the matter unit • Practice recall of key facts, skills and answer exam-style questions
11.	**Matter revision (Part 2)**	• Continue to recap key aspects of the matter unit • Practice recall of key facts, skills and answer exam-style questions

Unit 15 Forces in action

11 Lessons

Lesson number	Lesson question	Pupils will learn
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 or distance required 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 • Convert units for distance

5.	**Work done (Part 2)**	• Define power • Use both formulae for work done and power • Convert 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.	**Moments and work revision**	• Review balancing moments • 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

Unit 16 Reactivity

20 Lessons

Lesson number	Lesson question	Pupils will learn
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 formulae • Calculate relative formula mass
4.	**Symbol equations**	• Continue to write and interpret chemical formulae • Balance symbol equations

5.	**Acids and metals**	• Write word and 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 a salt**	• Define what we mean by 'salt' • Describe how to make a salt using filtration and crystallisation
8.	**Acids and metal carbonates**	• 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 often more useful than pure metals
16.	**Producing a voltage (Part 1)**	• Form a hypothesis to investigate • Identify variables to change, measure and control

17.	**Producing a voltage (Part 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 and how he made stainless steel • Compare stainless steel to other alloys
19.	**Review (Part 1)**	• Recap electron configuration and the formation of ions • Describe the reactions of acids with metal, metal oxide, metal carbonate and alkalis
20.	**Review (Part 2)**	• Use the reactivity series to predict chemical reactions • Apply the reactivity series to the extraction of metals • Compare the properties of different metals

Unit 17 Energetics and rates

14 Lessons

Lesson number	Lesson question	Pupils will learn
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 and explain reaction rate changes during a reaction
3.	**Secondary data**	• Identifying anomalies in data • Calculate means, rounding 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
7.	**Exothermic and endothermic reactions**	• Define endothermic and exothermic reactions • Recognise endothermic and exothermic reactions from temperature changes • Make and explain changes in the equipment that would improve the quality of 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.	**Thermal decomposition**	• Define 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 (Part 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 (Part 2)**	• Recap the effect of surface area/concentration on rate and exothermic/endothermic reactions
14.	**Investigation: Exo vs. Endo**	• Plan an investigation looking into exothermic vs endothermic reactions

Unit 18 Sound waves

11 Lessons

Lesson number	Lesson question	Pupils will learn
1.	**Sound waves**	• Label the main features of a wave diagram • Compare light and sound waves
2.	**Echoes and superposition**	• Define an echo • Describe how superposition occurs and its effect on sound
3.	**Pitch and frequency**	• Describe how the pitch of sounds is determined • Interpret oscilloscope traces for frequency
4.	**Amplitude and volume**	• Describe how the loudness of a sound is determined • Interpret oscilloscope traces for amplitude
5.	**Speed of sound**	• Calculate the speed of sound in air • Describe and explain how the speed of sound varies in different media in terms of particles

6.	**Review (Part 1)**	• Review key ideas from lessons 1-5 of the sound waves unit
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 ranges 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 and state some uses of it
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 (Part 2)

- Recall key terms and definitions from the sound waves unit
- Use scientific language accurately to correct statements
- Review and consolidate knowledge

Unit 19 Biological systems and processes

15 Lessons

Lesson number	Lesson question	Pupils will learn
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.	**The effects of exercise on respiration**	• Describe and 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 the intensity of exercise affect breathing rate? An investigation**	• Identify variables in an investigation • Describe a method to test a hypothesis
9.	**Review One**	• Review key ideas from lessons 1-8 of the biological systems and processes unit so far

10.	**Smoking**	• Describe the effects of cigarettes on the tissues of the lungs and on gaseous exchange • Describe and explain the impact on the health of smokers and their unborn babies • Describe trends in secondary data
11.	**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 terms DNA, gene and chromosome • 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 Two**	• Recall key terms, definitions and structures related to biological systems and processes • Use scientific language accurately to correct statements • Review and consolidate knowledge from the biological systems and processes unit

4. Learn More

Contents

1. 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. 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.

2. 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).

3. Knowledge organisation

The units in the science curriculum are grouped by key stage, with a suggested route through, organised within year groups. 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 8 are planned with the assumption that units in year 7 have been taught).

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.

4. 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. introduce some KS4 concepts in KS3).

5. Subject structure overview

KS3 units are presented here in a suggested topic order. The codes refer to the year, subject and topic. For example, Year 7 Biology Cells is 7BC.

All unit lengths include at least one, but usually two review lessons.

KS3 Biology

Unit title	Prior knowledge required
7BC Cells, tissues and organs	KS2 Cells
7BR Reproduction and variation	KS2 Reproductive Cycles
8BE Ecological relationships and classification	KS2 Ecosystems, Adaptations, Humans and animal over time
8BD Digestion and nutrition	KS3 Cells, KS2 Diet and Lifestyle
9BP Plants and photosynthesis	KS3 Cells, KS2 Plants
9BB Biological systems and processes	KS3 Cells, KS2 Human anatomy

KS3 Chemistry

Unit title	**Prior knowledge required**
7CP Particles	KS2 Particles in physical and chemical changes
7CC Chemical reactions	KS2 Physical and Chemical Changes

8CP Atoms and the periodic table	None
8CM Materials and the Earth	KS2 Rock cycle and Sustainability
9CR Reactivity	KS3 Atoms and the Periodic table, Chemical reactions
9CE Energetics and rates	KS3 Chemical reactions

KS3 Physics

Unit title	Prior knowledge required
7PE Energy	KS2 Energy
7PF Forces and motion	KS2 Forces
8PL Light and space	KS2 Light and Space
8PE Electricity and magnetism	KS2 Electricity
9PM Matter	KS3 Particles
9PF Forces in action	KS3 Forces and motion
9PS Sound waves	KS2 Sound

6. 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)
- 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 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
- Three KS4 units have been included at the end of year 9 (one physics, one biology and one chemistry unit). This is to support schools which wish to start teaching GCSE content at the end of year 9. Some schools might not wish to start GCSE content until the beginning of year 10.
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7. 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.

8. 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. This will involve questions and tasks throughout instruction, just as we would with classroom teaching.

9. 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.