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| Skills sheets are all located under ‘Additional support’ on Kerboodle as these resources are applicable to multiple topics. AQA Activate 1 > Additional support |
| **Enquiry processes** |
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| EP1 Asking scientific questions | **Enquiry processes**● 2.10 Identify an observation that could be recorded or measured over time.● 2.10 Identify a dependent variable, an independent variable, or two variables which may show a correlation.● 2.10 Write an observation, fair test, or pattern seeking enquiry question.● 2.12 Think up a hypothesis, and make an experimental prediction.● 2.12 Identify and record key features of an observation.● 2.12 Conclude if hypothesis is correct. | **Know**- State some questions that can be investigated.- Name variables that can vary in an investigation.- Name some types of enquiry question.**Apply**- Describe how scientists develop an idea into a question that can be investigated.- Identify independent, dependent, and control variables.- Suggest ways to investigate different types of enquiry question.**Extend**- Explain how and why some questions can be investigated and why some cannot.- Suggest examples of independent, dependent, and control variables in an unfamiliar situation.- Explain in detail why a specific question cannot be investigated, suggesting alternative questions that can be investigated. | To start, students make a list of things that could change in an investigation and questions they could ask if they were given something to investigate. **Support**: Provide a list of different things connected with an investigation for students to choose from.For the main lesson activity, introduce different types of enquiry question and discuss the different methods that you can use to answer these types of question.Work through the activity sheet. They should describe how controlling variables is important if you are to obtain evidence to answer your question.Students categorise variables in a hypothetical investigation as independent, dependent, and control using the interactive resource.For homework, students write down variables linked to things they can investigate in everyday life. | **Activity**:Askingscientificquestions**Interactive**:Identifyingvariables |
| EP2 Planning investigations | **Enquiry processes**● 2.9 Choose a suitable range and interval for the independent variable.● 2.9 Test suitability of measuring instrument, and use it correctly.● 2.9 Carry out the method carefully and consistently.● 2.11 Decide how to vary the independent variable and to measure the dependent variable.● 2.11 Identify and control the control variables.● 2.13 Identify risks and hazards, and control measures.● 2.13 Suggest how the question being investigated can be safely explored in a school science laboratory. | **Know** - State what should be included in the plan for an investigation. - Identify different types of variable and experimental errors. - State what is meant by a risk assessment.**Apply**- Describe how to write a plan for an investigation. - Describe how to produce accurate and precise data, and reduce experimental error. - Describe a risk assessment.**Extend**- Write a detailed plan for a hypothetical investigation.- Explain the effect of experimental error, and of not controlling all the variables adequately. - Identify risks in an experiment and write an appropriate risk assessment for an investigation and explain why the experiment can, or cannot, be conducted in a science laboratory. | To start, students state occasions when they had to plan, consequences of not planning, and how they can tell their plan was good enough.Students state different risks they took that day, and classify the consequences as minor and severe, and the likelihood as likely or unlikely. Discuss things that they did that could reduce the risk (control measures). Discuss whether a severe but unlikely risk is worth taking.For the main lesson activity, the activity sheet leads students through structured questions. Students are presented with four sets of data on the interactive resource and must decide whether each set of data is accurate, precise, or neither. Students can then suggest why errors have occurred improvements to data collection. For homework, students write a plan including a risk assessment for a simple activity. | **Activity**: Planninginvestigations**Skill sheet**:Accuracy andprecision**Skill sheet**:Recording results**Interactive**:Accurate or precise? |
| EP3 Collecting, recording, and presenting data | **Enquiry processes**● 2.1 Calculate means from data.● 2.4 Decide the type of chart or graph to draw based on its purpose or type of data.● 2.4 Design a table for the data being gathered.● 2.4 Draw line graphs to display relationships.● 2.6 Record observations you want to explain.● 2.9 Remove outliers and calculate mean of repeats.● 2.11 Control the variables. | **Know**- State an example of how data can be recorded. - With help, calculate a mean of two values. - Add data to a graph or chart.**Apply**- Describe how to make and record observations and measurements. - Calculate a mean from three repeat measurements. - Present data appropriately as tables and graphs.**Extend**- Explain how to collect and record accurate and precise data. - Calculate a mean for repeat readings in a range of situations. - Explain the choice of graph or chart for different types of data, and plot them. | To start, students describe how to use equipment to collect precise and accurate data. Draw a table showing results from a mock investigation including incomplete headings, which students identify.For the main lesson activity, remind students of the terminology (independent, dependent, and control variables). Introduce ways to display data – line graphs or pie charts. Students carry out an experiment measuring how high balls bounce and prepare a table and graph of results.Use examples from real-life to discuss issues raised by ‘bad’ use of data. The website Bad Science is a rich source of examples of misused data.Example data sets are provided in the interactive resource for students to calculate arithmetic means.For homework, students collect data at home in a suitable table. | **Practical**:Collecting andpresenting data**Skill sheet**:Calculating means**Skill sheet**:Choosing scales**Skill sheet**:Recording results**Skill sheet**:Drawing graphs**Interactive**:Calculating means |
| EP4 Analysing patterns in data | **Enquiry processes**● 2.1 Identify a pattern in data from a results table or bar chart.● 2.1 Interpret a sloping line on a graph to suggest the relationship between variables.● 2.2 Suggest reasons for differences in repeat readings.● 2.2 Comment on whether your findings fit with known scientific explanations.● 2.3 Make conclusion and explain it.● 2.3 Judge whether the conclusion is supported by the data.● 2.3 Suggest other possible conclusions that could be drawn from your data.● 2.6 Develop explanations.● 2.12 Discuss whether the data support your hypothesis. | **Know**- State what is meant by a line of best fit. - List what should be included in a conclusion.**Apply** - Find a pattern in data using a graph or chart, and draw a line of best fit on a line graph. - Interpret data to draw conclusions using scientific explanations.**Extend**- Plot data on a graph and draw the line of best fit. - Analyse data from an investigation to draw up a detailed conclusion, describe relationships, and suggest alternative explanations where appropriate. | To start, students decide if statements on interactive resource are likely or unlikely.Show students data from a previous experiment. Students will find it hard to state a relationship simply. Ask students to suggest the missing stages needed to analyse data.For the main lesson activity, use the activity sheet to plot graphs showing different relationships. Students could use results from their own experiments or draw graphs on the floor to walk across.Students use data/graphs from the previous activity to write a conclusion and peer assess them.Draw a graph with data plotted on it and ask one student to draw a line of best fit, while other students decide if it is suitable. Show graphs using ideas that the students will have met in KS2 (e.g., the temperature of water and the time it takes to dissolve a sugar lump) and ask them to write a conclusion, including a scientific explanation.For homework, provide students with further data to practise drawing graphs and ask students to describe different relationships and write conclusions. | **Interactive**: Is therea relationship?**Activity**: Analysingdata**Skill sheet**:Choosing scales**Skill sheet**:Drawing graphs |
| EP5Evaluating data and methods | **Enquiry processes**● 2.2 Analyse strengths and weaknesses in your inquiry.● 2.3 Comment on whether there is a real difference between data.2.2 Identify potential sources of random and systematic error.● 2.2 Suggest ways to improve the method, and to reduce measurement errors.● 2.11 Explain why some variables are difficult to control.● 2.3 Justify whether anomalous results can be explained or ignored.● 2.2 Describe how the size of the error in an investigation affects the strength of the evidence.● 2.2 Explain why having someone else repeat the experiment could increase confidence in the conclusion. | **Know** - State how to evaluate data. - Suggest one improvement to an investigation.**Apply**- Describe the stages in evaluating the data. - Suggest ways of improving a practical investigation.**Extend**- Compare and contrast data, suggesting reasons why the data may be different.- Explain ways of improving data in a practical investigation. | To start, students are provided with examples of statistics and encouraged to ask questions to judge whether to believe the data or not. Alternatively, students complete the interactive resource to select what information is needed to believe a claim.Students look at data from previous experiments and suggest ways to improve the data. For the main lesson activity, students consider the collected data when they all measure one event. Then complete the activity sheet to compare two different experiments and identify differences that make one experiment better than another. Suggest how to evaluate data. Discuss the effect of control variables and the difference between evaluating the data and method. Display a range of measuring instruments that students regularly use and discuss/display/show images or video of alternative measuring instruments.Give out two sets of data for the same experiment, and get students to suggest as many reasons as possible why they are different when the data is from the same experiment. Students watch you doing an experiment containing lots of mistakes and make a list of improvements that you need to make.For homework, students write about measuring instruments they find at home and potential experimental errors. | **Interactive:**Patrick’s claim**Activity**: Evaluatingdata and methods |

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| **1 Forces** |
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| 1.1.1 Introduction to forces | **Securing Mastery Goals**● 3.1.2 Draw a force diagram for a problem involving gravity.**Extending Mastery Goals**● 3.1.2 Compare and contrast gravity with other forces.**Enquiry processes**● 2.9 Use the measuring instrument correctly.● 2.12 Make an experimental prediction. | **Know**- Describe what forces do.- Identify a 'contact force', 'non-contact force', and 'newton'.- Use a newtonmeter to make predictions about sizes of forces.**Apply**- Categorise everyday forces as 'contact' and 'non-contact' forces.- Identify interaction pairs in a simple situation.- Interpret force diagrams used to illustrate problems involving gravity.- Describe what 'interaction pair' means.- Make predictions about forces in familiar situations.**Extend**- Identify interaction pairs in complex situations.- Explain the link between non-contact forces, contact forces, and interaction pairs.- Make predictions about pairs of forces acting in unfamiliar situations. | To start, students recap on what forces are and what they do, and individually name as many forces as possible. They then sort the forces into contact and non-contact forces.Give groups of students a pair of newtonmeters, linking the hooks together. Ask them to predict the readings on each newtonmeter if one student holds their newtonmeter and the other student pulls theirs away.In the main lesson activity, introduce newtons and newtonmeters. Students measure the force needed to carry out different activities and record these in a table. Introduce students to force diagrams and force arrows. Give students three arrows of different lengths to put on objects in a forces circus and describe them as ‘the force of the ... on the’Either interactively or on the board, students list situations involving forces and put these in order, ranked by size. If students have measured the same thing during the practical ask them to compare results. Students discuss the types of forces in the forces circus (contact or noncontact) and identify some interaction pairs.For homework, students measure forces at home using cardboard and rubber band device. | **Practical**:Measuring forces**Interactive**:Comparing the size of forces |
| 1.1.2 Balanced and unbalanced forces | **Securing Mastery Goals**● 3.1.2 Draw a force diagram for a problem involving gravity.**Exceeding Mastery Goals**● 3.1.2 Predict changes in an object’s speed when the forces on it change.**Enquiry processes**● 2.9 Gather sufficient data for the investigation and repeat if appropriate.● 2.4 Select a good way to display data. | **Know**- Identify familiar situations of balanced and unbalanced forces. - Recognise equilibrium. - Identify a resultant force. - Identify when the speed or direction of motion of an object changes. - Present observations in a table with help.**Apply**- Draw a force diagram for a problem involving gravity. - Describe the difference between balanced and unbalanced forces. - Describe situations that are in equilibrium. - Calculate resultant forces. - Explain why the speed or direction of motion of objects can change. - Present observations in a table including force arrow drawings.**Extend**- Explain the difference between balanced and unbalanced forces. - Describe a range of situations that are in equilibrium. - Describe the link between the resultant force and the motion of an object. - Explain why the speed or direction of motion of objects can change using force arrows. - Predict and present changes in observations for unfamiliar situations. | To start, show a short video of a sports activity.Students list what happens as the motion of a person or object changes.Students describe their motion on a short car/bus journey.In the main lesson activity, students identify forces acting on experiments in a circus and decide if they are balanced. As part of the practical sheet, students sketch the force diagram for each experiment and identify situations where the resultant force is zero, and when it is not zero.Students describe and act out how to change motion when you ride a bicycle, linking the ideas to the forces.Interactive resource where students sort statements describing the motion of a football being kicked into balanced or unbalanced forces.For homework, students list different situations at home where forces are balanced or unbalanced.  | **Practical**: Force circus**Skill sheet**:Scientific apparatus**Interactive**:Balanced andunbalanced forces**Animation:** Balanced and unbalanced forces |
| 1.1.3 Speed | **Securing Mastery Goals**● 3.1.1 Use the formula: speed = distance (m) ÷ time (s) or distance–time graphs, to calculate speed. ● 3.1.1 The higher the speed of an object, the shorter the time taken for a journey.● 3.1.1 Describe how the speed of an object varies when measured by observers who are not moving, or moving relative to the object.**Exceeding Mastery Goals**● 3.1.1 Suggest how the motion of two objects moving at different speeds in the same direction would appear to the other.**Enquiry processes**● 2.12 Make an experimental prediction. ● 2.11 Identify how to control each control variable.● 2.9 Gather sufficient data for the investigation and repeat if appropriate.● 2.12 Decide whether the conclusion of the experiment agrees with your prediction.● 2.13 Identify risks and hazards. ● 2.13 Identify control measures.**Enquiry processes activity**● 3.1.1 Investigate variables that affect the speed of a toy car rolling down a slope.**Band Outcome Checkpoint** | **Know**- State the equation for speed and use it to calculate speed, with support. - Recognise relative motion. - Use appropriate techniques and equipment to measure times and distances.**Apply**- Calculate speed using the speed equation. - Describe relative motion. - Choose equipment to make appropriate measurements for time and distance to calculate speed.**Extend**- Use the speed equation to explain unfamiliar situations. - Describe and explain how a moving object appears to a stationary observer and to a moving observer.- Choose equipment to obtain data for speed calculations, justifying their choice based on accuracy and precision. | To start, students estimate speeds in different situations using tangible examples. Students measure the time taken for a ball to fall from a height of one metre. Discuss where the ball travelled slowest and fastest and introduce the speed equation.For the main lesson activity, students investigate the effects of a selected variable on the average speed of a toy car as it rolls down a ramp. Students will have to calculate the speed of the car, as they vary the independent variable. Students choose the correct words on the interactive resource to summarise relative motion. Students discuss who had the quickest reaction time, factors that affect it, and benefits of quick reaction time. For homework, produce a safety leaflet explaining when drivers should slow down and explain the physics behind this.  | **Practical**: Rolling, rolling**AT practical:** Investigating the average speed of a trolley**Skill sheet:**Recording results**Interactive**:Talking aboutrelative speed |
| 1.1.4Distance-time graphs | **Securing Mastery Goals**● 3.1.1 Use the formula: speed = distance (m) ÷ time (s) or distance–time graphs, to calculate speed.● 3.1.1 A straight line on a distance–time graph shows constant speed, a curving line shows acceleration.● 3.1.1 Illustrate a journey with changing speed on a distance– time graph, and label changes in motion.**Enquiry processes**● 2.1 Read values from a line graph.● 2.4 Draw line graphs to display relationships. | **Know**- Describe simply what a distance–time graph shows. - Use a distance–time graph to describe a journey qualitatively. - Present data given on a distance–time graph, with support. - Calculate speed from a distance–time graph, with support.**Apply**- Interpret distance–time graphs. - Calculate speed from a distance–time graph and convert between units. - Plot data on a distance–time graph accurately.**Extend**- Draw distance–time graphs for a range of journeys. - Analyse journeys using distance–time graphs. - Manipulate data appropriately to present in a distance–time graph. | To start, sketch and explain a labelled distance–time graph.List typical speeds for different activities, students work out how long it will take to travel 10 m. Explain uses of distance–time graphs.For the main lesson activity, introduce the idea of distance–time graphs in interpreting movement in detail.Demonstrate how the slope of the graph shows speed.Students then interpret data on the activity sheet to plot a distance–time graph for a migrating bird, the Tour de France, or a sled dog race.Students match halves of sentences using the interactive resource to explain distance– time graphs.Each pair of students should draw a distance–time graph on a mini-whiteboard. Allow students to walk around the classroom to find other whiteboards, giving descriptions of graphs shown, or imagining the shape of a graph if the description is shown.For homework, students note down typical times and distances for a journey they make and produce a labelled distance–time graph. | **Activity**: Usingdistance–timegraphs**Interactive**: What can you tell from a distance–timegraph?**Animation:** Distance–timegraphs**Maths skills**: link to MyMaths activity to support distance–time graphs. |
| 1.2.1Gravity | **Securing Mastery Goals**● 3.1.2 Use the formula: weight (N) = mass (kg) × gravitational field strength (N/kg).● 3.1.2 g on Earth = 10 N/kg. On the moon it is 1.6 N/kg.● 3.1.2 Explain unfamiliar observations where weight changes.● 3.1.2 Deduce how gravity varies for different masses and distances.● 3.1.2 Compare your weight on Earth with your weight on different planets using the formula.**Exceeding Mastery Goals**● 3.1.2 Draw conclusions from data about orbits, based on how gravity varies with mass and distance.● 3.1.2 Suggest implications of how gravity varies for a space mission.**Enquiry processes**● 2.9 Prepare a table with space to record all measurements. ● 2.9 Gather data, minimising errors.**Enquiry processes activity**● 3.1.2 Explain the way in which an astronaut’s weight varies on a journey to the moon. | **Know**- Describe the difference between mass and weight.- Describe simply how gravity varies with mass and distance. - State the force that holds planets and moons in orbit around larger bodies. - State *g* on the Earth and the moon. - Use the formula weight = mass × *g*, with support.**Apply**- Describe how gravity due to an object changes if the mass or the distance from the object changes.- Use a formula (weight = mass × *g*) to work out your weight on different planets, and compare it to your weight on Earth.- Explain why your weight changes in unfamiliar circumstances.**Extend**- Compare and contrast gravity with other forces. - Explain how the effect of gravity changes moving away from Earth, and in keeping objects in orbit.- Analyse data about orbits in terms of the variation of gravity with mass and distance. - Present results in a table, ensuring they are reliable. | To start, show students a video of astronauts on the Moon, and compare mass and weight.Students group forces given on the interactive resource into contact and non-contact forces.For the main lesson activity, prepare sealed containers containing different masses of sand representing celestial bodies. Students weigh the containers, and use *W = mg*.Students describe how their weight changes on a journey to the Moon.Demonstrate orbiting by rolling a football on the floor and provide a list of objects that orbit other objects.They draw diagrams to show the force of gravity on each one keeping it in orbit. Students link list of five masses (and five equivalent weights) on the Earth and on the Moon. Ask students to compare an astronaut doing sport on the Earth and on the Moon.For homework, write a holiday brochure for a trip to another planet, explaining conditions and how to prepare. | **Interactive**:Contact andnon-contact forces**Practical**: Gravity cups**WebQuest:** International space station |

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| **2 Electromagnets** |
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| 2.1.1 Potential difference | **Securing Mastery Goals**● 3.2.1 Draw a circuit diagram to show how potential difference can be measured in a simple circuit.● 3.2.1 Use the idea of energy to explain how potential difference and resistance affect the way components work. ● 3.2.2 Turn circuit diagrams into real series and parallel circuits, and vice versa. **Exceeding Mastery Goals**● 3.2.1 Justify the sizes of potential differences in a circuit, using arguments based on energy.● 3.2.1 Draw conclusions about safety risks, from data on potential difference, resistance and current. **Enquiry processes**● 2.9 Use the measuring instrument correctly.● 2.9 Carry out the method carefully and consistently.● 2.13 Identify features of an investigation which are hazardous. | **Know**- State the unit of potential difference. - Name the equipment used to measure potential difference. - Describe the effect of a larger potential difference. - Use appropriate equipment to measure potential difference.**Apply**- Describe what is meant by potential difference. - Describe how to measure potential difference. - Describe what is meant by the rating of a battery or bulb. - Set up a simple circuit and use appropriate equipment to measure potential difference.**Extend**- Explain why potential difference is measured in parallel. - Predict the effect of changing the rating of a battery or bulb in a circuit. - Set up and measure potential difference across various components in a circuit.- Explain the difference between potential difference and current. | To start, show battery-powered items and their operating potential difference (p.d.). Discuss the ratings of different appliances or components and explain p.d. Group items as battery or mains operated, and rank all items from the lowest to the highest p.d. Introduce sources of p.d. and complete interactive resource to link the operating p.d. with objects.For the main lesson activity, set up a simple circuit to demonstrate the position of the voltmeter.Students set up simple circuits to investigate p.d. and answer the questions on their activity sheet. Discuss the rope model for p.d. Students list similarities and differences between current and potential difference.For homework, students prepare a list of pieces of electrical equipment used at home and the potential difference supplied, either from batteries or the mains (230 V). (Students should get parental permission to move/unplug equipment.) | **Interactive**:Looking at potentialdifference**Activity**:Investigatingpotential difference**Skill sheet**:Recording results |

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| 2.1.2 Resistance | **Securing Mastery Goals**● 3.2.1 Calculate resistance using the formula: resistance (Ω) = potential difference (V) ⁺ current (A).● 3.2.1 Use the idea of energy to explain how potential difference and resistance affect the way components work. ● 3.2.1 Given a table of potential difference against current.Use the ratio of potential difference to current to determine the resistance.● 3.2.1 Use an analogy like water in pipes to explain why part of a circuit has higher resistance.● 3.2.1 Turn circuit diagrams into real series and parallel circuits, and vice versa. **Enquiry processes**● 2.10 Identify a dependent variable.● 2.10 Write a question linking variables in the form ‘How does... affect...?’.● 2.12 Suggest a hypothesis for the observation.● 2.10 Identify an independent variable.● 2.10 Explain which type of enquiry is best for answering a given scientific question. | **Know**- Calculate the resistance from values of p.d. and current with support. - Compare simply the resistance of conductors and insulators. - List examples of conductors and insulators. - Identify some of the variables in the investigation.**Apply**- Describe what is meant by resistance.- Calculate resistance of a circuit. - Describe the difference between conductors and insulators in terms of resistance. - Identify independent, dependent, and control variables.**Extend**- Explain the causes of resistance. - Explain what factors affect the resistance of a resistor. - Compare the effect of resistance in different materials. - Independently select and control all the variables in the investigation, considering accuracy and precision. | To start, students complete interactive resource.Explain what resistance and current are.Discuss changes you could make in a circuit to increase resistance. For the main lesson activity, introduce electrical resistance.Students will investigate how changes in a wire affect its resistance. Students will then carry out an experiment to investigate the relationship between resistance and the length of a wire.Draw a circuit diagram including an ammeter and voltmeter. Add sample readings for students to calculate the correct value of resistance. Students individually list things that went well, and things they would change if they repeated their experiment.For homework, provide students with further examples of resistance calculations for them to complete at home. | **Interactive**: What do you know already?**Practical**:Investigating the resistance of a wire**AT practical:** Investigating the resistance of conducting dough**Maths skills:** worked solution on resistance**MyMaths:** link to MyMaths activity to support resistance **Skill sheet**:Recording results**Skill sheet**:Choosing scales**Skill sheet**:Evaluation |
| 2.1.3 Series and parallel circuits | **Securing Mastery Goals**● 3.2.2 Turn circuit diagrams into real series and parallel circuits, and vice versa. **Exceeding Mastery Goals**● 3.2.1 Predict the effect of changing the rating of a battery or a bulb on other components in a series or parallel circuit.● 3.2.1 Draw conclusions about safety risks, from data on potential difference, resistance and current. ● 3.2.2 Compare the advantages of series and parallel circuits for particular uses.**Enquiry processes**● 2.1 Identify patterns in data.● 2.3 Incorporate the pattern you found into an answer to the enquiry question.● 2.3 Make a conclusion and explain it.**Enquiry processes activity:**● 3.2.1 Compare the potential difference drop across resistors connected in series in a circuit. | **Know**- State one difference between series and parallel circuits. - State how potential difference varies in series and parallel circuits.**Apply**- Describe the difference between series and parallel circuits. - Describe how potential difference varies in series and parallel circuits- Identify the pattern of potential difference in series and parallel circuits.**Extend**- Predict the effect of changing the resistance of a circuit component on the overall (net) resistance of the circuit.- Explain why p.d. varies in series and parallel circuits. - Explain the pattern in potential difference readings for series and parallel circuits, drawing conclusions. | To start, students write down and share what they already know about circuits.Ask students to list circuits where equipment or components can be controlled separately or together. Explain how this can be done using series and parallel circuits. Students then group items into two categories: those that use series circuits, and parallel circuits.For the main lesson activity explain to students that the circuits they have been working with so far are series circuits, and introduce the idea of parallel circuits. Large diagrams of each type of circuit can be used to highlight similarities and differences.Students then investigate circuit rules by carrying out mini-experiments as part of an activity circus. Students note down their observations at each station and answer the questions that follow using their results.Students must complete the missing value for p.d. in partially filled circuit diagrams.Revisit the rope model to demonstrate p.d. in a series circuit. Ask students to contribute ideas as to how this model can be used to demonstrate parallel circuits. For homework, students draw a circuit for lighting in the home. This can be for several rooms in the home or for a staircase, for which the set-up for (two-way) switches should also be included. | **Interactive**: Series or parallel?**Practical**: Series and parallel circuits |
| 2.2.1Current | **Securing Mastery Goals**● 3.2.2 Describe how current changes in series and parallel circuits when components are changed.● 3.2.2 Turn circuit diagrams into real series and parallel circuits, and vice versa. **Exceeding Mastery Goals**● Evaluate a model of current as electrons moving from the negative to the positive terminal of a battery, through the circuit.**Enquiry processes**● 2.9 Use the measuring instrument correctly.● 2.9 Carry out the method carefully and consistently.● 2.13 Identify features of an investigation which are hazardous.**Enquiry processes activity**● 3.2.2 Compare and explain current flow in different parts of a parallel circuit. | **Know**- State what current is. - Use an ammeter to measure current. - Identify the pattern of current in series and parallel circuits.**Apply**- Describe how current changes in series and parallel circuits when components are changed.- Describe how to measure current. - Set up a circuit including an ammeter to measure current.**Extend**- Use a model to explain how current flows in a circuit. - Predict the current in different circuits. - Measure current accurately in a number of places in a series circuit. - Explain the pattern in current readings for series and parallel circuits, drawing conclusions. | To start, recap current and that some appliances use larger currents than others. Students to rank appliances that plug into the mains in order of the current they use. If a current meter is available, the current drawn by different appliances can be demonstrated.For the main lesson activity use the water pipe analogy to introduce students to current as a flow of charge. Students carry out a practical to measure current using simple series and parallel circuits and answer the questions that follow on the practical sheet.Use the rope model to show that charge is spread throughout the circuit. Students should discuss what each part of the model represents in a circuit.Model a parallel circuit with two separate loops. In this interactive students predict the change to the reading on an ammeter when changes are made to a circuit.For homework, students draw the circuit diagrams for simple pieces of equipment. | **Practical**:Investigatingcurrent**Interactive**:Bigger or smaller?**Animation:** Electric current |
| 2.2.2Charging up | **Securing Mastery Goals**● 3.2.2 Two similarly charged objects repel, two differently charged objects attract.● 3.2.2 Describe what happens when charged objects are placed near to each other or touching.● 3.2.2 Use a sketch to describe how an object charged positively or negatively became charged up.**Exceeding Mastery Goals**3.2.2 Suggest ways to reduce the risk of getting electrostatic shocks.**Enquiry processes**● 2.1 Identify patterns in data.● 2.3 Incorporate the pattern you found into an answer to the enquiry question.● 2.3 Make a conclusion and explain it. | **Know**- Describe how to charge insulators. - State the two types of charge. - State what surrounds charged objects. - Describe what happens when you bring similarly charged objects together, and when you bring differently charged objects together.**Apply**- Use a sketch to explain how objects can become charged. - Describe how charged objects interact. - Describe what is meant by an electric field. - Interpret observations, identifying patterns linked to charge.**Extend**- Explain, in terms of electrons, why something becomes charged.- Predict how charged objects will interact. - Suggest ways to reduce the risk of getting electrostatic shocks. - Use observations to make predictions. | To start, demonstrate static using balloon.Students list and discuss as many non-contact forces as possible. For the main lesson activity, demonstrate several effects of electrostatics. Students should see that a noncontact force exists between charged objects. Explain why the balloon becomes charged and use the idea of an electric field creating forces to explain each demonstration. Ask students for their own suggestions of effects they have already seen. Students then complete the tasks on the activity sheet.Students use the interactive resource to re-order sentences to explain the effect of a charged balloon on hair.Students make labelled drawings showing what they think happens when something is charged. For homework, students write a short summary paragraph on the uses of static electricity. | **Activity**:Electrostatics**Skill sheet**:Recording results**Interactive**: What happens with the balloon? |

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| **3 Energy** |
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| 3.1.1Food and fuels | **Securing Mastery Goals**● 3.3.1 Food labels list the energy content of food in kilojoules (kJ).● 3.3.1 Compare the amounts of energy transferred by different foods and activities.**Enquiry processes**● 2.6 Describe the evidence for your idea.● 2.6 Explain why the evidence supports your idea.● 2.12 Suggest a hypothesis for the observation.● 2.12 Conclude if hypothesis is correct. | **Know**- Identify energy values for food and fuels. - Describe energy requirements in different situations. - Interpret data on food intake for some activities.**Apply**- Compare the energy values of food and fuels. - Compare the energy in food and fuels with the energy needed for different activities.- Explain data on food intake and energy requirements for a range of activities.**Extend**- Calculate energy requirements for various situations, considering diet and exercise.- Suggest different foods needed in unusual situations, for example, training for the Olympics.- Explain why an athlete needs more energy from food using data provided. | To start, students categorise statements about energy from the interactive resource as true or false.Students consider how the food requirements change for different people engaged in different activities. The main lesson activity uses props to demonstrate the size of a joule to students. Students extract information from food labels about energy intake per portion, suggest foods that could be eaten to provide their daily amount of energy, and rank energy requirements for carrying out different activities in order.Students decide and justify which of the activities they do during a typical school day has the greatest energy requirement, and compare their choices. Ask students ‘Do you adjust your food intake to allow for an active school day?’Provide students with information about the energy supplied by burning fuels. Students compare the amount of energy supplied by fuel with the amount of energy supplied by food. For homework, students keep track of what they do during a 24-hour period and estimate energy requirements. | **Interactive**: Energy stored in foods**Activity**: Food and fuels**Access:** Food and fuels**Skill sheet:**Converting units |
| 3.1.2Energy resources | **Securing Mastery Goals**● 3.3.1 Explain the advantages and disadvantages of different energy resources.● 3.3.1 Represent the energy transfers from a renewable or non-renewable resource to an electrical device in the home. **Exceeding Mastery Goals**● 3.3.1 Evaluate the social, economic and environmental consequences of using a resource to generate electricity, from data.● 3.3.1 Suggest actions a government or communities could take in response to rising energy demand. **Enquiry processes**● 2.1 Select relevant data and do calculations. 2.1 Identify patterns in data.● 2.3 Judge whether the conclusion is supported by the data.● 2.7 Identify the claim; check the claim; check the evidence; check the reasoning.● 2.8 List all the facts, scientific ideas, data, or conclusions that support your opinion.● 2.14 Consider people; consider the environment; consider money.● 2.14 Describe how each group could benefit or be harmed. | **Know**- Name renewable and non-renewable energy resources. - State one advantage and one disadvantage of fossil fuels. - Use one source of information. - Name a renewable resource used to generate electricity.**Apply**- Describe the difference between a renewable and a non-renewable energy resource.- Describe how electricity is generated using a fossil fuel or a renewable resource. - Choose an appropriate source of secondary information. - Explain the advantages and disadvantages of different energy resources.**Extend**- Compare renewable and non-renewable resources. - Explain how a range of resources generate electricity, drawing on scientific concepts. - Justify the choice of secondary information. - Suggest actions a government or communities could take in response to rising energy demand. | To start, provide samples of fuels for students to put into two groups, providing justification. Introduce the idea of energy release during combustion of fuels, and the difference between renewable and non-renewable energy resources.Students describe how their lives would be different without electricity.For the main lesson activity, provide a range of research stations for students to carry out research on the topics posed in the research activity regarding the generation of electricity. Students produce a poster or leaflet to answer these questions.Compare videos of a thermal power station and renewable energy.Students complete the gaps on the interactive resource on fossil fuels.Students should then produce a similar summary for renewable energy sources.List different methods of electricity generation on the board. Students should diamond rank these ways in order of importance.For homework, students write a short newspaper article explaining the opening of a fossil fuel power station in their neighbourhood.  | **Activity**: Energyresources**Interactive**: Fossil fuels**Video:** Energy resources |
| 3.1.3Energy and power | **Securing Mastery Goals**● 3.3.1 Compare the energy usage and cost of running different home devices.**Exceeding Mastery Goals**● 3.3.1 Suggest actions a government or communities could take in response to rising energy demand. ● 3.3.1 Suggest ways to reduce costs, by examining data on a home energy bill.**Enquiry processes**● 2.1.2 Make an experimental prediction.**Enquiry processes activity:**● 3.3.1 Compare the running costs of fluorescent and filament light bulbs. | **Know**- State the definitions of energy and power. - State that power, fuel used, and cost are linked.- Predict which equipment is more powerful when given a selection of appliances.**Apply**- Explain the difference between energy and power. - Describe the link between power, fuel use, and cost of using domestic appliances.- Predict the power requirements of different home devices, and compare their energy usage and how much they cost to run.**Extend**- Compare the power consumption of different appliances. - Calculate and compare energy costs in different scenarios. - Predict the effect on energy bills of changing the power of equipment. | To start, show students a range of light bulbs of different power ratings and ask students to choose the bulb that will produce the brightest light, before offering the definition of power.Explain what is meant by power. Students list10 appliances they used yesterday, and rank these according to power. For the main lesson activity introduce the difference between energy and power, and check students know the units for each.Demonstrate an energy monitor or joulemeter.Compare the power and temperature of two light bulbs (an energy-saving and an incandescent light bulb).Students carry out the task on the activity sheet, examining different items found around the home, and answer the questions that follow.Students use summarise ways to reduce energy bills. They choose the correct words to complete sentences in the interactive resource.Students check their order of the 10 appliances from the start of the lesson, and decide if they still agree with their original ranking. For homework, students find out the power rating of appliances at home and list them in order of power, and state the relevance power rating has on an energy bill.Students mustcheck with their parents before unplugging or moving appliances, or else carry out this task under adult supervision.  | **Activity**: Power**Skill sheet**:Converting units**Interactive**:Reducingenergy bills**Maths skills:** worked solution on cost of electricity**MyMaths:** link to MyMaths activity to support energy and power |
| 3.2.1Energy adds up | **Securing Mastery Goals**● 3.3.2 Describe how the energy of an object depends on its speed, temperature, height or whether it is stretched or compressed.● 3.3.1 Show how energy is transferred between energy stores in a range of real-life examples.**Exceeding Mastery Goals**● 3.3.2 Explain why processes such as swinging pendulums or bouncing balls cannot go on forever, in terms of energy. ● 3.3.2 Evaluate analogies and explanations for the transfer of energy. **Enquiry processes**● 2.9 Choose range, interval, readings. ● 2.9 Test suitability of measuring instrument.● 2.9 Gather data, minimising errors.**Enquiry processes activity**● 3.3.2 Explain the energy transfers in a hand-crank torch. | **Know**- State the definition of the conservation of energy. - State how energy is transferred. - Present simple observations of energy transfers.**Apply**- Describe energy stores before and after a change, including stores relating to an object’s speed, temperature, height or shape.- Explain what brings about transfers in energy between stores. - Present observations of energy transfers in a table.**Extend**- Apply ideas about stores and transfers to a range of unfamiliar situations. - Compare energy transfers to energy conservation. - Present detailed observations of energy transfers in a table, explaining changes to the physical system, and how that relates to the ways in which energy is stored. | To start, introduce energy stores and give examples of each type. Students suggest examples in the room.Show some examples of energy changes and ask students to describe in words what is happening. Introduce the idea of energy stores and that energy is transferred from a store when anything happens. Explain that all energy must be accounted for (law of conservation of energy).For the main lesson activity introduce/recap the types of energy store and transfer, as well as the law of conservation of energy.Students will then carry out a circus activity where they identify energy stores before and after an energy transfer, in addition to the energy transfers taking place during the experiment. The circus should include the energy transfers in a hand-crank torch. Students then answer questions that follow.Students sort a list of items and scenarios into energy stores or energy transfers using the interactive resource.Ask students to write the law of conservation of energy on their mini-whiteboards. Students should then use an example from the practical and account for all the energy during the transfer. Demonstrate how you can model a change in energy in stores using liquid in beakers (beaker = store, liquid = energy), or with money (money = energy).For homework, students describe five energy changes that take place during a normal school day. | **Practical**: The conservation of energy**Interactive**: Energy stores and transfers**Animation:** Energy |
| 3.2.2 Energy dissipation | **Securing Mastery Goals**● 3.3.2 Calculate the useful energy and the amount dissipated, given values of input and output energy.● 3.3.2 Explain how energy is dissipated in a range of situations.**Exceeding Mastery Goals**● 3.3.2 Explain why processes such as swinging pendulums or bouncing balls cannot go on forever, in terms of energy. ● 3.3.2 Compare the percentages of energy wasted by renewable energy sources.● 3.3.2 Evaluate analogies and explanations for the transfer of energy. **Enquiry processes**● 2.4 Present findings of research into cost and efficiency.● 2.9 Prepare a table with space to record all measurements.● 2.9 Gather data, minimising errors. | **Know**- State what dissipation means. - Do simple calculations of wasted energy from input and useful energies. - State what lubrication and streamlining mean.**Apply**- Explain how energy is dissipated in a range of situations. - Calculate useful energy and wasted energy from input and output energies. - Describe how dissipated energy can be reduced.**Extend**- Account for all energy transfers in a range of situations. - Calculated a useful energy and wasted energy, and efficiency. - Evaluate methods of reducing energy dissipation. | To start, discuss different appearances of three types of light bulb of the same output power (incandescent, CFL, and LED). Use an energy meter to show that the power being transferred electrically is different. Students rank the bulbs in terms of least to most wasted energy and discuss what is happening in terms of energy stores.Show thermal images of houses/cars, and discuss what we mean by ‘dissipation’. Students discuss ways to reduce dissipation in each case. Alternatively, students complete the statements about energy dissipation in the interactive activity.For the main lesson activity, introduce lubrication as a way of reducing dissipation due to friction. Show close up photos of smooth surfaces, demonstrating that they are not really smooth.Students complete practical investigating the efficiency of lightbulbs.Revisit the comparison of light bulbs from 3.1.3Energy and power. Give out data for input and useful energy and get students to calculate the wasted energy. Introduce ‘efficiency’ and ask students to rank bulbs in terms of efficiency.Students rank the lubricants in order of best to worse. Discuss any differences in methods and results, and situations where the choice of lubricant is important.Show a range of situations that involve energy dissipation (bouncing ball, pendulum), and ask the same two questions about each for students to answer on whiteboards:● How is the energy dissipated?● How do you reduce energy dissipation?For homework, students research the history of efficiency labels on appliances and what they mean.  | **Interactive:**Efficiencystatements**Activity**:Investigatingthe efficiency of lightbulbs |

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| **4 Waves** |
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| 4.1.1Sound waves and speed | **Securing Mastery Goals**● 3.4.1 Sound does not travel through a vacuum.● 3.4.1 The speed of sound in air is 330 m/s, a million times slower than light.● 3.4.1 Explain observations where sound is reflected, transmitted or absorbed by different media. **Enquiry processes**● 2.6 Develop an explanation.● 2.6 Decide if a diagram might help the explanation.● 2.6 Suggest a scientific idea that might explain the observation.● 2.6 Communicate your idea, evidence and reasoning. | **Know**- Name some sources of sound. - Name materials that sound can travel through. - State that sound travels at 330 m/s in air, a million times more slowly than light.- Use data to compare the speed of sound in different materials.**Apply**- Describe how sound is produced and travels. - Explain observations where sound is transmitted by different media. - Contrast the speed of sound and the speed of light. - Compare the time for sound to travel in different materials using data given.**Extend**- Explain what is meant by supersonic travel. - Describe sound as the transfer of energy through vibrations and explain why sound cannot travel through a vacuum.- Compare the time taken for sound and light to travel the same distance. - Explain whether sound waves from the Sun can reach the Earth. | To start, students list sounds and how they are caused. Students hum with their hand resting on their throat to feel the larynx vibrating. Hit a tuning fork on the bench so it vibrates and produces a sound, then dip it in water to show it is vibrating. For the main lesson activity, explain that sound travels at different speeds in different materials. Review the particle arrangement in solids, liquids, and gases. Students predict which material sound travels fastest in, then complete the questions on the activity sheet.Explain definition of supersonic and show video clips of supersonic objects and remind students how fast these objects are travelling.The interactive resource involves students linking up sentences to consolidate the ideas of the lesson.For homework, students research supersonic travel. | **Question-led lesson:** The speed of sound**Activity**: The speedof sound**Interactive**:Vibrations and energy |
| 4.1.2 Loudness and amplitude | **Securing Mastery Goals**● 3.4.1 Explain observations of how sound travels using the idea of a longitudinal wave.● 3.4.1 Explain observations where sound is reflected, transmitted or absorbed by different media. ● 3.4.1 Describe the amplitude and frequency of a wave from a diagram or oscilloscope picture. ● 3.4.1 Use drawings of waves to describe how sound waves change with volume or pitch. **Exceeding Mastery Goals**● 3.4.1 Evaluate the data behind a claim for a sound creation or blocking device, using the properties of sound waves. **Enquiry processes**● 2.9 Choose range, interval, readings. ● 2.9 Carry out the method carefully and consistently.● 2.9 Use the measuring instrument correctly. ● 2.9 Gather data, minimising errors. | **Know**- Define amplitude, frequency, and wavelength. - State the link between loudness and amplitude. - State two things that can happen when sound goes through matter or hits a boundary.- Label amplitude on a diagram of an oscilloscope trace of a wave.**Apply**- Explain observations of how sound travels using the idea of a longitudinal wave.- Describe the link between loudness and amplitude, using diagrams. - Explain what happens when sound goes through matter or hits a boundary.- Describe how to find the amplitude of a wave from an oscilloscope trace.**Extend**- Explain how you can make measurements of the amplitude of a sound wave.- Compare and contrast waves of different loudness using a diagram. - Describe in detail the behaviour of sound as it travels in matter or hits a boundary.- Use an oscilloscope on a variety of settings of p.d./division to find the amplitude of a sound wave. | To start, the interactive resource asks students to categorise ways to change the loudness of sounds based on everyday observations and musical instruments. **Extension**: Students supply their own suggestions to add to the lists.Introduce the idea of longitudinal waves, showing an appropriate video. For the main lesson activity, students practice drawing wave diagrams using simple examples. Connect the signal generator and loudspeaker to the output of an oscilloscope. Students then complete the activity sheet.**Support**: A support sheet is available as a reference for key terms used during this activity.When students have worked with the oscilloscope traces qualitatively, introduce the idea of measuring the amplitude using the oscilloscope.Explain that the oscilloscope is showing a p.d. vs time graph. Show waves of two different amplitudes and ask the students to calculate the amplitude of each wave in volts.Students sketch a wave on a mini-whiteboard and then draw a louder wave. Show diagrams of waves from an oscilloscope screen with the V/div for each and the amplitude stated.**Support**: Present a choice of waves for students to choose the loudest.Students write down three things they have learned this lesson. For homework, students write about methods for reducing the volume of sound. | **Interactive**:Loudness**Activity**: Wavediagrams |
| 4.1.3Frequency and pitch | **Securing Mastery Goals**● 3.4.1 Use drawings of waves to describe how sound waves change with volume or pitch. ● 3.4.1 Describe the amplitude and frequency of a wave from a diagram or oscilloscope picture. **Exceeding Mastery Goals**● 3.4.1 Use diagrams to compare the waveforms a musical instrument makes when playing different pitches or volumes.**Enquiry process activity**● 3.4.1 Relate changes in the shape of an oscilloscope trace to changes in pitch and volume. | **Know**- Define auditory range. - State the difference between frequency and pitch. - Label time period on a diagram of a sound wave on an oscilloscope.**Apply**- Describe the auditory range of humans. - Describe the link between frequency and pitch. - Describe how to find the frequency of a wave from an oscilloscope trace.**Extend**- Present a reasoned prediction using data of how sounds will be differently heard by different animals.- Compare and contrast waves of different frequency using a diagram. - Use an oscilloscope on a variety of settings of s/div to find the period and frequency of a sound wave. | To start, show images of different animals and ask what is different about their hearing.The interactive resource asks students to categorise ways to change the pitch or loudness of sounds based on everyday observations and musical instruments.For the main lesson activity use a signal generator, loudspeaker, and oscilloscope to display a trace on the screen at the same time as listening to the sound. Ask students to note the difference between high and low pitched sounds, and draw waveforms. Explain that the trace on the screen shows how the displacement of air molecules changes with time. Define period and amplitude.The activity sheet contains a diagram of the screen. Students label the axes and sketch a particular waveform. The sheet takes them throughthe process of:- finding the period from the time between two peaks- finding the frequency using f = 1 ÷ T.Care will need to be taken with the units of period, which will be in milliseconds. Show waveforms of the same note played on different musical instruments and discuss the differences. Show soft and loud sound, and high and low frequencies. Students match waveform descriptions to the wave.A volunteer, or you, can try whistling the highest note possible. Another student takes a measurement of the number of waves in a certain number of divisions and students work out the frequency of the note.For homework, students explain uses of high-pitched ‘mosquito’ alarms. | **Interactive:**Loudness and pitch**Activity:** What’s the frequency? |
| 4.1.4 The ear and hearing | **Exceeding Mastery Goals**● 3.4.1 Suggest the effects of particular ear problems on a person’s hearing.● 3.4.1 Evaluate the data behind a claim for a sound creation or blocking device, using the properties of sound waves.**Enquiry processes**● 2.13 Identify risks and hazards.● 2.13 Identify ways of reducing the risk. | **Know**- Name some parts of the ear. - State some ways that hearing can be damaged. - Describe some risks of loud music.**Apply**- Describe how the ear works. - Describe how your hearing can be damaged. - Explain some risks of loud music.**Extend**- Evaluate the data behind a claim for a sound creation or blocking device, using the properties of sound waves.- Suggest the effects of particular ear problems on a person’s hearing. - Explain, in detail, risks of hearing damage linked to sound level and time of exposure. | To start, discuss how loudness is measured in decibels and suggest ways to reduce harm.As a class, play hangman using the names of the different parts of the ear. For the main lesson activity, connect the microphone to the input of the oscilloscope and demonstrate sound waves produced when a noise is made. If a sound level meter is available, measure sound levels during the lesson. Students complete the activity sheet identifying parts of the ear and ways the ear can be damaged. Students rearrange sentences to explain how sounds travel from the pinna to the brain in the interactive resource.Display sound levels during the lesson against a decibel scale and discuss implications. Depending on the location of the school, also give out a table showing sound levels in the neighbourhood.For homework, students write a leaflet for primary students on the dangers of loud music and reducing harm.An alternative WebQuest homework activity is also available on Kerboodle where students research the science of music. | **Activity**: Hearing and how it isdamaged**Interactive**:Hearing**WebQuest**: The science of music |
| 4.2.1Light | **Securing Mastery Goals**● 3.4.2 Light travels at 300 million metres per second in a vacuum.● 3.4.2 ray diagrams of eclipses to describe what is seen by observers in different places.**Enquiry processes**● 2.2 Analyse strengths and weaknesses in your inquiry. | **Know**- Describe some ways that light interacts with materials. - State the speed of light. - State the positions of the Earth, Moon, and Sun during a solar eclipse.**Apply**- Describe what happens when light interacts with materials. - Explain how ray diagrams can explain the formation of shadows. - Use ray diagrams to describe what observers see during an eclipse.**Extend**- Predict how light will interact with different materials. - Use ray diagrams to explain what observers see during an eclipse. | To start, discuss how the Sun’s light travels into the classroom and how we see it. Remind students of the speed of light (300 million km/s).Students use the interactive resource to classify different objects using the terms translucent, opaque, and transparent.For the main lesson activity, students model a solar eclipse using the instructions on the practical sheet and then answer the questions on the practical sheet.**Support**: Clarify these concepts using animations and diagrams. A support sheet is available with partially drawn diagrams for students to complete.Measure the light transmitted through different materials using a light dependent resistor (LDR) and multimeter to measure resistance, or a light meter. Set the multimeter to read resistance and aim the LDR towards the light source. Students check equipment by seeing how light levels vary in the room first. Test and rank different materials on a scale from transparent to opaque.Students draw and compare diagrams to explain a solar eclipse. They repeat this for lunar eclipses.Students compare materials that light or sound travels easily through. For homework, students list materials used at home as opaque, transparent, and translucent and how this suits their role.  | **Interactive**: Types of material**Practical:** How bright is the light?**Practical**: The Moon and eclipses |
| 4.2.2 Reflection | **Securing Mastery Goals**● 3.4.2 Construct ray diagrams to show how light reflects off mirrors, forms images and refracts. ● 3.4.2 Use ray diagrams to describe how light passes through lenses and transparent materials. **Exceeding Mastery Goals**● 3.4.2 Use a ray diagram to predict how an image will change in different situations. ● 3.4.2 Predict whether light will reflect, refract or scatter when it hits the surface of a given material. ● 3.4.2 Use ray diagrams to explain how a device with multiple mirrors works.**Enquiry processes**● 2.9 Use the measuring instrument correctly.● 2.9 Carry out the method carefully and consistently.● 2.13 Identify features of an investigation which are hazardous. | **Know**- With guidance, construct ray diagrams to show how light reflects off mirrors and forms images.- Identify examples of specular and diffuse reflection. - Use appropriate equipment safely with guidance.**Apply**- Explain how images are formed in a plane mirror using a ray diagram. - Explain the difference between specular and diffuse reflection. - Use appropriate equipment and take readings safely without help.**Extend**- Use a ray diagram to explain how an image in a mirror changes as you move the mirror/object, or to explain the formation of images in multiple mirrors.- Predict how light will reflect from different types of surface. - Take accurate readings using appropriate equipment and working safely. | To start, students use mirrors to describe the image of an object.Explain the difference between specular and diffuse reflection, students classify examples.For the main lesson activity, students investigate reflection by shining a torch onto different flat surfaces and observe the reflected light on a nearby white surface. Students predict and explain results.Interactive resource where student choose words to complete a paragraph on the reflection experiment.Demonstrate how mirror images are formed, using a triangle drawn on an OHP sheet.For homework, set questions showing the position of an object and the position of a mirror. | **Practical**:Investigatingreflection**Interactive**:Reflectionexperiment |
| 4.2.3 Refraction | **Securing Mastery Goals**● 3.4.2 Construct ray diagrams to show how light reflects off mirrors, forms images and refracts. ● 3.4.2 Use ray diagrams to describe how light passes through lenses and transparent materials. **Exceeding Mastery Goals**● 3.4.2 Use a ray diagram to predict how an image will change in different situations. ● 3.4.2 Predict whether light will reflect, refract or scatter when it hits the surface of a given material. **Enquiry processes**● 2.4 Decide the type of chart or graph to draw based on its purpose or type of data. | **Know**- Describe what happens when light is refracted. - State a difference between what happens to light when it goes through a convex lens and a concave lens.- Record some observations as a diagram with help.**Apply**- Use a ray diagram to describe how light travels through a transparent block. - Use a ray diagram to describe what happens when light travels through a convex or concave lens.- Record observations using a labelled diagram.**Extend**- Predict whether light will refract when it hits a surface. - Draw ray diagrams to show what happens when light goes through a convex or concave lens.- Record observations using labelled diagrams, and apply this to other situations. | To start, place a test tube in a beaker and pour glycerol in the beaker. Then pour glycerol inside the test tube – the test tube becomes invisible. Explain light doesn’t refract (change direction) when it travels between the test tube and the glycerol, so we cannot detect the test tube. Students complete the interactive activity.Students look at the physical difference between concave and convex lenses, and how writing on a page appears when you look through the lens.For the main lesson activity, students investigate refraction using a glass or perspex block, changing the angle of incidence. Students then complete the practical sheet questions. Students use cylindrical convex and concave lenses to look at what happens to light as it travels through each lens. Discuss how the refraction of light explains the path of the light through the lens.Place a drop of water on an image drawn on a shiny and the water magnifies the image due to refraction through the lens. Additionally, draw three parallel arrows on a piece of paper and ask students to view them through a beaker of water (they change direction). Discuss what happens to light.For homework, students identify and write about items that use lenses (or refraction) at home.  | **Interactive**: Key words in light**Access:** Investigating refraction**Practical**:Investigatingrefraction |
| 4.2.4The eye and vision | **Securing Mastery Goals**● 3.4.2 Use ray diagrams to describe how light passes through lenses and transparent materials. (Further examples)● 3.4.2 Describe how lenses may be used to correct vision.**Enquiry processes**● 2.5 Use scientific vocabulary accurately, showing that you know its meaning and use appropriate units and correct chemical nomenclature.**Enquiry processes activity**● 3.4.2 Use ray diagrams to model how light passes through lenses and transparent materials. | **Know**- Name parts of the eye. - Name two problems that people can have with their vision. - Describe problems people have with their eyesight.**Apply**- Describe how the eye works. - Name the lens used to correct short sight, and the lens used to correct long sight.- Describe how lenses correct short-sight and long-sight.**Extend**- Explain how the eye forms an image. - Explain how lenses correct vision. - Use ideas about refraction to explain the action of lenses in glasses and contact lenses. | To start, students look through convex lenses and describe the images seen when objects are varying distances away. Students list as many parts of the eye as they can, and what that part does. In the interactive activity, students match the parts of the eye to their functions.For the main lesson activity show an opticians chart and discuss problems with the vision.Demonstrate what happens in the eye with short and long-sight using a model eye. Demonstrate how to correct the problems with convex and concave lenses. Students complete the ray diagrams on a worksheet and answer questions about short-sight and long-sight.Students describe how light travels from an object to the retina using scientific terminology. The description should be for short sight or for long sight. They swap stories with a partner who guesses whether the story describes short sight or long sight.Students view an object across the room using each eye in turn, then both eyes. Discuss how the image seemed to change and why we need two eyes.For homework, students research eyes of another animal to write a short article with a labelled ray diagram.  | **Question-led****lesson:** Modelling the eye and the camera**Interactive:** What’s in your eye?**Activity**: Correcting vision**Animation:** The eye and the camera |
| 4.2.5Colour | **Securing Mastery Goals**● 3.4.1 Different colours of light have different frequencies.● 3.4.2 Explain observations where coloured lights are mixed or objects are viewed in different lights.**Enquiry processes**● 2.12 Make an experimental prediction.● 2.12 Decide whether the conclusion of the experiment agrees with your prediction. | **Know**- State what happens to light when it passes through a prism.- State the difference between colours of light in terms of frequency. - State the effect of coloured filters on light. - Predict how red light will appear on a white surface.**Apply**- Explain what happens when light passes through a prism. - Describe how primary colours add to make secondary colours. - Explain how filters and coloured materials subtract light. - Predict the colour of objects in red light and the colour of light through different filters.**Extend**- Explain why a prism forms a spectrum. - Explain the formation of secondary colours. - Predict how coloured objects will appear given different coloured lights and filters.- Predict the colour of objects in lights of secondary colours, giving a reason for the prediction. | To start, use a very bright light source to project a spectrum using a prism (dispersion). Ask why the colours appeared and explain that different colours have different frequencies.Class discussion about rainbows leading into refraction and dispersion.For the main lesson activity, introduce the concept by asking students to look around the room using coloured filters. Students then carry out the experiment on the practical sheet. Students predict the colour of a red object in different coloured light and predict the colour of light through two coloured filters. They then test their predictions. Students then move on to testing colours of objects by shining different coloured lights onto them, against a black background.Students suggest ways to make an object appear red.Interactive resource where students sort colours into primary, secondary, or neither.For homework, students write a guide telling police how to collect accurate witness statements for crimes committed in yellow street light.An alternative WebQuest homework activity is also available on Kerboodle where students research how lights can be used during concerts on stage. | **Practical**: Colour mixing**Interactive**: Types of colours**WebQuest**: Stage lighting |

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| **5 Matter** |
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| 5.1.1The particle model | **Securing Mastery Goals**● 3.5.1 Explain the properties of solids, liquids and gases based on the arrangement and movement of their particles. **Enquiry processes**● 2.6 Suggest a scientific idea that might explain an observation.**Enquiry processes activity**● 3.5.1 Relate the features of the particle model to the properties of materials in different states. | **Know**- State that materials are made up of particles. - State that the properties of substances can be described in terms of particles in motion.- State what toy building bricks are representing when they are used to model substances.**Apply**- Explain, in terms of particles, why different substances have different properties. - Explain properties, such as density, based on the arrangement and mass of particles.- Use models to investigate the relationship between the properties of a material and the arrangement of its particles.**Extend**- Evaluate particle models that explain the properties of substances. - Use data about particles to predict and explain differences in properties such as density.- Design and explain a new representation for the particle model. | To start, ask students for the meaning of words in the corresponding student-book spread to gauge prior knowledge.Ask students to make a list of all the different materials they can see in the classroom.For the main lesson activity, use toy building bricks to demonstrate individual particles within a larger amount of substance, and different coloured bricks to demonstrate different substances.Students complete the activity sheet on the particle model and complete a written section about particles and discuss the particle model.Students should complete the questions provided in the corresponding student-book spread.In pairs, students discuss how the toy building bricks model could be used to show the relationship between the properties of a material and the arrangement of its particles. Students think about how a picture represents particles within a material. They must then decide if the reasons given in the resource make the model a good or a bad one.Ask students to use the key words from the student book to write sentences that summarise what they have learnt about materials and particles.For homework, students write about the properties of a material of their choice. | **Activity**:Introducing the particle model**Interactive**:Considering models |

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| 5.1.2States of matter | **Securing Mastery Goals**● 3.5.1 Explain the properties of solids, liquids and gases based on the arrangement and movement of their particles. **Exceeding Mastery Goals**● 3.5.1 Argue for how to classify substances which behave unusually as solids, liquids or gases.**Enquiry processes**● 2.3 Make a conclusion and explain it. | **Know**- Describe the properties of a substance in its three states.- State that the properties of substances can be described in terms of the arrangement and movement of its particles.- Make relevant observations in order to decide is a substance is in its solid, liquid or gas state.**Apply**- Compare the properties of a substance in its three states.- Explain the properties of solids, liquids, and gases based on the arrangement and movement of their particles.- Use observations to decide if a substance is in its solid, liquid or gas state.**Extend**- Argue for how to classify substances which behave unusually as solids, liquids, or gases. - Justify whether a given property of a substance in a given state can be explained by the arrangement, or by the movement, of its particles.- Evaluate a representation of the particle model. | To start, display interactive activity of objects that students drag into the correct columns for solids, liquids, or gases. Discussion about how small particles are. Provide students with an array of simple objects and substances to classify as solids, liquids, or gases.**Support**: Students will often prefer to touch/see objects to aid their decision making.For the main lesson activity, display interactive particle model animations (found on the Internet) for solids, liquids, and gases. Draw up and explain a table of properties for each state.Use a group of students to represent particles and arrange them as a solid, liquid, and gas. Discuss the arrangement and movement of the particles in each state. Students complete the practical allowing them to make observations on the properties of materials, and conclude whether they are in the solid, liquid, gas, or more than one of these states.Call out properties of solids, liquids, and gases for students to identify on mini-whiteboards. One student describes a material in terms of its properties, and another student tries to identify what it is and its state of matter.For homework, students design a detailed poster on the three states of matter. | **Question-led****lesson**: States of matter**Interactive**: Solid, liquid, or gas?**Practical**:Properties of solids, liquids, and gases**Skill sheet**:Recording results |
| 5.1.3 Melting and freezing | **Securing Mastery Goals**● 3.5.1 A substance is a solid below its melting point, a liquid between its melting and boiling points, and a gas above its boiling point.● 3.5.1 Explain changes in states in terms of changes to the energy of particles. ● Draw before and after diagrams of particles to explain observations about changes of state, gas pressure, and diffusion. **Enquiry processes**● 2.4 Select a good way to display data.● 2.4 Draw line graphs to display relationships. | **Know**- Describe how the properties of a substance change as it melts or freezes. - Recognise an energy transfer during a change of state. - Describe the observations as stearic acid cools in terms of states of matter.**Apply**- Draw annotated before and after diagrams of particles, and use words, to explain observations about melting and freezing.- Explain melting and freezing in terms of changes to the energy of particles. - Use cooling data to identify the melting point of stearic acid.**Extend**- Explain why there is a period of constant temperature during melting and freezing based on the arrangement and movement of particles, and energy transfers.- Explain in detail the differences between melting and freezing. - Suggest reasons for the different melting points of different substances based on the arrangement, movement, and energy of their particles. | To start, ask students to name the processes of melting and freezing using water examples. Introduce the terms reversible and irreversible.Students reorder the descriptions of freezing on the interactive resource.For the main lesson activity, students make predictions before they observe the stearic acid practical and then plot their data to produce a cooling curve.**Support**: Students should be provided with pre-drawn axes.Introduce students to the use of cooling curves to find melting point.In groups, students should plan a two-minute presentation to the class to explain their results.As a class, discuss where the melting point would be found on the graph and how melting points can be used to identify substances.Ask students to sketch the cooling curve for stearic acid on a mini-whiteboard. Then ask students to draw particle diagrams for each stage in the curve and name the state for each significant section of the graph.Ask students to refer to the table of melting points on the corresponding student-book spread. Name a temperature and ask students which state each substance would be in.For homework, give students the melting point of iron (1538 °C) and ask them to suggest why steel does not have one specific melting temperature.An alternative WebQuest homework activity is also available on Kerboodle where students research how roads are made safer in adverse weather conditions. | **Interactive**: What happens as water freezes?**Practical**:Observing thecooling of stearic acid**Skill sheet**:Choosing scales**Skill sheet**:Recording results**Skill sheet**:Drawing graphs**WebQuest**: Safer roads |
| 5.1.4Boiling | **Securing Mastery Goals**● 3.5.1 A substance is a solid below its melting point, a liquid between its melting and boiling points, and a gas above its boiling point.● 3.5.2 Liquids have different boiling points.● 3.5.1 Explain changes in states in terms of changes to the energy of particles. ● 3.5.1 Draw before and after diagrams of particles to explain observations about changes of state, gas pressure, and diffusion. **Enquiry processes**● 2.4 Draw line graphs to display relationships.● 2.6 Suggest a scientific idea that might explain the observation. | **Know**- Describe how the properties of a substance change as it boils. - Recognise an energy transfer during a change of state. - Draw straightforward conclusions from boiling point data presented in tables and graphs.**Apply**- Draw annotated before and after diagrams of particles, and use words, to explain observations about boiling.- Explain why different substances boil at different temperatures in terms of changes to the energy of particles.- Select data and information about boiling points and use them to contribute to conclusions.**Extend** - Explain why there is a period of constant temperature during boiling based on the arrangement and movement of particles, and energy transfers.- Suggest reasons for the different boiling points of different substances based on the arrangement, movement, and energy transfers of their particles.- Assess the strength of evidence from boiling point data, deciding whether it is sufficient to support a conclusion. | To start, ask students why there are bubbles in boiling water, and where the energy is transferred from.Students use the interactive resource to reorder descriptions of boiling.For the main lesson activity, students use the supplied data to plot a heating curve for water. Students then need to consider what is happening to the particles at each stage of the process, together with the energy transfers that occur.Discuss where the boiling point is found on the curve, and why there are periods with constant temperatures. Students then write a few sentences to summarise the discussion.Students should discuss the reversibility of boiling at this stage.Students should complete the questions provided on the corresponding student-book spread.Students match substances on the board a jumbled up list of their boiling points. Students write a paragraph to explain how to do an experiment to use boiling point data to identify a substance.For homework, students prepare a fact sheet on different ways the boiling point of water can be changed and why this is useful.  | **Interactive**: What happens when water boils?**Activity**: Heating water**Skill sheet**:Choosing scales**Skill sheet**:Drawing graphs |
| 5.1.5More changes of state | **Securing Mastery Goals**● 3.5.1 Explain changes in states in terms of changes to the energy of particles. ● 3.5.1 Draw before and after diagrams of particles to explain observations about changes of state, gas pressure and diffusion. **Exceeding Mastery Goals**● 3.5.1 Make predictions about what will happen during unfamiliar physical processes, in terms of particles and their energy.**Enquiry processes**● 2.9 Prepare a table with space to record all measurements. ● 2.10 Write a fair test enquiry question.● 2.11 Identify control variables. ● 2.11 Control the variables.● 2.11 Describe how controlling variables is important in providing evidence for a conclusion. | **Know**- State the names of changes of state involving gases. - Describe one difference between evaporation and boiling. - Write a fair test enquiry question on evaporation, and plan the method and how to control the variables.**Apply**- Draw annotated before and after diagrams of particles, and use words, to explain observations about evaporating, condensing and subliming.- Explain differences between evaporation, sublimation and boiling based on the arrangement and movement of particles.- Explain why it is important to control variables to provide evidence for a conclusion in an evaporation investigation.**Extend**- Make predictions about what will happen during an unfamiliar physical process – deposition – in terms of particles and their energy.- Compare evaporation, boiling and sublimation based on the arrangement, movement, and energy transfers of particles.- Justify the procedure and evaluate the results in an evaporation investigation. | To start, demonstrate the sublimation of iodine (and solid CO2 if available) in a fume cupboard. Demonstrate how the solid that has sublimed can be recollected (see RSC Practical Chemistry) as a solid again without the liquid being seen. Students should consider the energy transfers involved in sublimation and condensation, and discuss the reversibility of this change.Ask students to demonstrate condensation by breathing on a cold surface such as a mirror. Discuss what is happening to the particles and whether this change is reversible or irreversible.In the main lesson practical, explain to students that copper sulfate crystals will form from copper sulfate solution as the solution evaporates, and that the speed of evaporation affects crystal size. Students plan and carry out the investigation.Students should read the corresponding student-book spread and answer the summary questions.**Support**: Issue students with the access sheet, which gives instructions for making copper sulfate crystals.An interactive resource where students match state changes to pictures of evaporation, condensation, and sublimation.Ask students to explain the differences between evaporation, boiling and sublimation based on the arrangement and movement of particles.For homework, students prepare a leaflet for householders on how they can dry their washing most efficiently. | **Practical**:Who can make the biggest crystals?**Access:** Who can make the biggest crystals?**Interactive**:Identifyingevaporation,condensation,and sublimation |
| 5.1.6Diffusion | **Securing Mastery Goals**● 3.5.1 Draw before and after diagrams of particles to explain observations about changes of state, gas pressure, and diffusion. **Exceeding Mastery Goals**● 3.5.1 Evaluate observations that provide evidence for the existence of particles.**Enquiry processes**● 2.9 Prepare a table with space to record all measurements.● 2.10 Write a fair test enquiry question.● 2.11 Decide how to vary the independent variable between planned values.● 2.11 Decide how to measure the dependent variable. ● 2.11 Identify control variables.● 2.11 Control the variables.● 2.11 Describe how controlling variables is important in providing evidence for a conclusion. | **Know**- Describe examples of diffusion. - State that observations about diffusion can be explained in terms of particles in motion. - Write a fair test enquiry question on diffusion, identify the independent and dependent variables, and plan the method and how to control the variables.**Apply**- Describe evidence for diffusion. - Draw annotated before and after diagrams of particles, and use words, to explain diffusion. - Explain why it is important to control variables to provide evidence for a conclusion in a diffusion investigation.**Extend**- Evaluate observations that provide evidence for the existence of particles. - Draw annotated before and after diagrams of particles, and use words, to predict the relative speed of diffusion when the value of a given independent variable is changed.- Justify the procedure and evaluate the results in a diffusion investigation. | To start, complete bromine diffusion practical. Use the particle model to explain observations, and identify diffusion.Ask students to make their way across the room with more and more other students in their way to demonstrate diffusion through the different states, and hence the relative speeds. Asking students to travel in pairs with arms interlinked will allow modelling of how greater particle mass affects diffusion speed.For the main lesson activity, students plan and carry out an investigation into the effect of temperature on diffusion using potassium magnate.Students should complete the questions provided in the corresponding student-book spread.**Support**: The support sheet contains a table of results for students to fill in. Support students in order to make their investigations as fair as possible.Students complete a passage on diffusion from the interactive resource.Call out statements about diffusion, and students move to ‘true’ or ‘false’ corner of the room.For homework, students write a short paragraph explaining why hot water is best for making cups of tea. | **AT Practical:** Testing a prediction about diffusion**AT Practical:** What is the best temperature to make tea?**Practical**: Which factors affect the rate of diffusion?**Interactive**:Describing diffusion**Skill sheet**:Choosing scales**Skill sheet**:Recording results**Skill sheet**:Drawing graphs |
| 5.1.7Gas pressure | **Securing Mastery Goals**● 3.5.1 Explain unfamiliar observations about gas pressure in terms of particles.● 3.5.1 Draw before and after diagrams of particles to explain observations about changes of state, gas pressure, and diffusion. ● 3.5.1 Make predictions about what will happen during unfamiliar physical processes, in terms of particles and their energy.**Enquiry processes**● 2.3 Make a conclusion and explain it.● 2.3 Judge whether the conclusion is supported by the data. | **Know**- Describe examples of gas pressure. - Use words to explain gas pressure simply. - Collect and interpret simple primary data to provide evidence for gas pressure.**Apply**- Draw annotated particle diagrams, and use words, to explain gas pressure. - Explain unfamiliar observations about gas pressure in terms of particles. - Collect, analyse and draw a conclusion from primary data providing evidence for gas pressure.**Extend**- Draw annotated before and after particle diagrams, and use words, to explain what happens to gas pressure as conditions are changed.- Predict what will happen to gas pressure as conditions are changed in terms of particles and their energy.- Evaluate the extent to which a conclusion made from primary data about gas pressure is justified by the evidence collected. | To start, demonstrate gas pressure using a small amount of water and an effervescent indigestion tablet.Discuss the statements with students to ensure that they all have a good recall of the behaviour of gases. The interactive resource will allow you to find out how confident students are with the behaviour of gases. For the main lesson activity, students carry out a practical in which they consider the factors that affect how much gas pressure is generated.Students then draw annotated particle diagrams, and use words to explain their observations.Ask students to draw a storyboard with explanations of particle diagrams to show what happens as you blow a balloon up.**Support**: Provide key words and phrases on which to base drawings.Without referring to their books or class notes, students should explain to a partner what causes gas pressure.Ask students to come up with situations where pressure is helpful and unhelpful.For homework, students use their knowledge of gas pressure to explain why fizzy drinks sometimes spray out when they are opened. | **Interactive**: What are gases like?**Practical**: What affects gas pressure?**Animation:** Gas pressure |
| 5.1.8Inside particles | ● This lesson covers prerequisite knowledge, key words, and facts for AQA KS3 science Topic 6.1 Metals and non-metals and Topic 6.2 Acids and alkalis. | **Know**- State definitions of atoms, elements, molecules and compounds - Name one element and one compound.**Apply**- Represent atoms, molecules and elements using models. - Use diagrams to represent atoms and molecules of elements and compounds.**Extend**- Compare atoms, molecules and elements using models. - Use diagrams to compare molecules of an element and a compound. | To start, pour water through a copper water pipe (or similar). Elicit differences in properties between the two substances, and ask student pairs to use the particle model to discuss reasons for these differences. Ask if it is possible to use the particle model to explain the differences in properties between copper and ice – it is not. Point out that the differences in properties must be because ice and copper particles are different from each other.Students remind themselves of the arrangements of particles in liquid and solid water by drawing these on mini-whiteboards and peer assessing.For the main lesson activity, tell students that pure substances can be classified as elements or compounds. Students use plasticine to make a few 2 cm diameter spheres to represent copper atoms, and a few 1 cm diameter spheres to represent oxygen atoms. Use them to show the arrangement of atoms in solid copper. Students then join their oxygen atoms in pairs to represent oxygen molecules.Show a video clip of a hydrogen-oxygen explosion, and point out the differences in properties between this mixture and water, a compound made from atoms of the same elements. Students use modelling clay or other materials to make model water molecules for classroom display.On mini-whiteboards, ask students to draw the following: an element that exists as single atoms, molecules made up of three atoms of the same element, and so on.Students write definitions of the key words in their books, and peer assess. Alternatively, use the interactive resource on key words from this section.For homework, make an illustrated A4 poster explaining the meanings of the key words element, atom, molecule, compound. | **Activity:** Finding out about atoms and molecules |
| 5.2.1Pure substances and mixtures | **Securing Mastery Goals**● 3.5.2 Air, fruit juice, sea water and milk are mixtures.● 3.5.2 Choose the most suitable technique to separate out a mixture of substances. **Enquiry processes**● 2.9 Carry out the method carefully and consistently.**Enquiry processes activity**● 3.5.2 Devise ways to separate mixtures, based on their properties. | **Know**- State what a mixture is and give examples of mixtures. - State that a mixture can be separated as a result of the different melting points of its components.- With help, choose a simple technique to separate the substances in a mixture.**Apply**- Explain what a mixture is using the particle model. - Explain how to use melting temperatures to distinguish mixtures from pure substances.- Devise suitable techniques to separate mixtures, based on their properties.**Extend**- Use particle models to compare mixtures and pure substances. - Comment on the purity of a substance by interpreting temperature change data.- Justify the suitability of separation techniques in terms of the properties of constituent substances. | To start, students describe what they think a mixture is and give examples of any everyday mixtures they can think of. Students sort a list of common substances according to whether they are mixtures or not using the interactive resource, justifying their suggestions. For the main lesson activity, discuss the definition of a mixture, and impure and pure substances. Students answer questions C, 2 and 3 in the student-book.Students devise ways to separate different mixtures using appropriate techniques, justifying their choice of techniques, and answer the questions that follow. **Support**: The accompanying support sheet lists possible separation techniques and how they work.Draw particle diagrams of pure substances and mixtures on the board. Students decide on the category and use mini-whiteboards to display their answer.Draw sketch graphs for phase changes of hypothetical substances. Students use mini-whiteboards to say whether the graph shows a pure or impure substance. For homework, students write a list of mixtures from around the home and local environment. | **Question-led****lesson**: Puresubstances and mixtures**Interactive**: Spotthe mixtures**Practical:**Separating mixtures**Skill sheet:**Scientific apparatus |
| 5.2.2Solutions | **Securing Mastery Goals**● 3.5.2 Air, fruit juice, sea water and milk are mixtures.● 3.5.2 Explain how substances dissolve using the particle model.**Enquiry processes**● 2.3 Make a conclusion and explain it.● 2.3 Judge whether the conclusion is supported by the data. | **Know**- When provided with key words, describe solutions using key words. - Describe observations when a substance dissolves. - Use observations or data to draw a conclusion to distinguish a solution from a pure liquid.**Apply**- Explain how substances dissolve using the particle model. - Draw annotated before and after particle diagrams to represent dissolving. - Use data to draw a conclusion about the mass of solute dissolved in a solution.**Extend**- Explain the relationship between solutes, solvents, and solutions. - Justify whether a given particle diagram represents a solution or a pure substance.- Explain the applications of solution chemistry to different contexts. | To start, ask students to make a list of times when they dissolve something, and to describe in their own words what happens when substances are dissolved. Demonstrate salt dissolving in water in a beaker and ask the question ‘Has the salt gone away?’ For the main lesson activity, using an everyday example such as adding coffee powder to water, define solute, solvent, and the resulting mixture as the solution (coffee). Demonstrate the conservation of mass by dissolving a known mass of coffee powder in a known mass of water. Ask students to suggest possible applications of the conservation of mass (to distinguish pure solvents from solutions). Students draw annotated before and after particle diagrams to represent dissolving.Students watch a demonstration on whether or not different solutes dissolve in a range of solvents, recording observations in a results table. Students then carry out a short task about the conservation of mass, plotting a graph, and identifying unknown substances as solvents or solutions given their volumes and masses.Students match key words to images on the interactive resource and explain how they relate to one another. Students design and perform role plays to describe what happens to particles when a solute dissolves. Students should ensure that their role plays illustrate the difference between solutes, solvents, and solutions.For homework, students identify and explain one example of dissolving that happens in the home. | **Practical**: Solution or not?**Interactive**:Solutes, solvents,and solutions**Skill sheet**:Recording results**Skill sheet**:Drawing graphs |
| 5.2.3Solubility | **Securing Mastery Goals**● 3.5.2 Use the solubility curve of a solute to explain observations about solutions.**Exceeding Mastery Goals**● 3.5.2 Analyse and interpret solubility curves.**Enquiry processes**● 2.9 Prepare a table with space to record all measurements.● 2.9 Identify the independent variable. ● 2.9 Decide how to measure the dependent variable.● 2.9 Identify control variables. ● 2.9 Control the variables.● 2.9 Describe how controlling variables is important in providing evidence for a conclusion.● 2.10 Write a fair test enquiry question. ● 2.10 Make a conclusion and explain it.  | **Know**- Use key words about dissolving. - Interpret solubility data shown on a bar chart. - Write a fair test enquiry question on solubility, and plan the method and how to control the variables.**Apply**- Explain observations about dissolving. - Use the solubility curve of a solute to describe and explain simply observations about solutions. - Explain why it is important to control variables to provide evidence for a conclusion in a solubility investigation.**Extend**- Suggest a reason for the effect of temperature on solubility for a given solute. - Analyse and interpret solubility curves. - Justify the procedure and evaluate the results in a solubility investigation. | To start, ask students to write a simple description of what happens when sugar dissolves in water. Demonstrate the differences in solubility in 20 cm3 of water for salt, calcium carbonate, and potassium manganate(VII). Explain saturated solution and that different substances have different solubility values.For the main lesson activity, introduce the term solubility, and how this relates to saturated solutions. Explain solubility graphs and discuss the solubility graphs on the corresponding student book. Students will plan and carry out a practical investigation to find out whether the solubility of salt in seawater differs according to the temperature of the region. Students fill in the gaps in a short paragraph summarising solubility using the interactive resource.Discuss the solubility graphs shown in the corresponding student-book spread and the trends shown. Students should then use the graphs to state the solubility of particular solutes at given temperatures.For homework, students complete the questions on the practical sheet, and write a short paragraph to explain why sugar crystals can sometimes be found at the bottom of a teacup after the tea has been drunk. | **Practical**: Seawatersolubility**Interactive**:Understandingsolubility**Skill sheet**: Planninginvestigations**Skill sheet**:Recording results**Skill sheet**: Scientificapparatus |
| 5.2.4Filtration | **Securing Mastery Goals**● 3.5.2 Use techniques to separate mixtures. ● 3.5.2 Choose the most suitable technique to separate out a mixture of substances. **Exceeding Mastery Goals**● 3.5.2 Suggest a combination of methods to separate a complex mixture and justify the choices. **Enquiry processes**● 2.9 Carry out the method carefully and consistently. | **Know**- State that mixtures may be separated due to differences in their physical properties. - State that the method chosen to separate a mixture depends on which physical properties of the individual substances are different.- With support, use the correct techniques to filter a mixture.**Apply**- Identify a physical property that must be different in order for given separation technique to work.- Choose the most suitable technique(s) to separate a mixture of substances. - Use annotated before and after particle diagrams, and words, to explain how filtration works.**Extend**- Explain why a stated physical property must be different in order for a given separation technique to work.- Justify a chosen technique for separating a mixture of substances. - Design a model to explain filtering, and identify advantages and disadvantages of the model. | To start, demonstrate the filtration of a mixture of sand and water, explaining how filter paper works. Identify the apparatus names and introduce the terms filtrate and residue. Point out that this method of separation (filtration) relies on a difference in physical properties between the two substances in the mixture.Introduce filtration apparatus. Stretch a badminton net across the classroom, or arrange chairs with tiny gaps between them. Ask students to approach the net (or chairs) and to pass coloured balls through the gaps. Ask students to explain this model of filtration (students = residue, coloured balls = filtrate).Students work in pairs or small groups to gather as many ideas as possible on what filtration may be used for. Students share these ideas as a class, noting down important uses of filtration in society.Students solve a problem of separating salt from a mixture of rock and salt by filtration and evaporation. Students start by planning the investigation, using the particle model and drawing a particle diagram to explain why their plan works. They then answer the questions that follow about filtration.**Support**: The support sheet includes diagrams of apparatus that can be used during filtration to help students draw their own labelled diagrams.Students summarise key concepts and terminology from this lesson using a gap-fill exercise on the interactive resource.Students draw a labelled diagram showing the apparatus for filtering on mini-whiteboards and define what the residue and filtrate are. Students should also give a brief description about how filter paper works.For homework, students research six uses of filtration. An explanation of how filtration works is required. | **Practical**:Investigatingfiltration**Interactive**: How does filtering work?**Skill sheet**:Planninginvestigations**Skill sheet**:Scientific apparatus |
| 5.2.5Evaporation and distillation | **Securing Mastery Goals**● 3.5.2 Use techniques to separate mixtures.● 3.5.2 Choose the most suitable technique to separate out a mixture of substances. **Exceeding Mastery Goals**● 3.5.2 Suggest a combination of methods to separate a complex mixture and justify the choices. **Enquiry processes**● 2.9 Carry out the method carefully and consistently. | **Know**- State that mixtures may be separated owing to differences in their physical properties.- State that the method chosen to separate a mixture depends on which physical properties of the individual substances are different- Label distillation apparatus and describe what happens in distillation.**Apply**- Identify the physical property that must be different in order to separate a mixture by evaporation or distillation.- Draw annotated before and after particle diagrams, and use words, to explain how evaporation and distillation work.- Use the particle model to explain observations made during the distillation of inky water.**Extend**- Compare evaporation and distillation.- Justify whether evaporation or distillation would be suitable for obtaining given substances from solution.- Suggest a combination of methods to separate a complex mixture and justify the choices made. | To start, ask students to suggest how salt can be obtained from seawater and why this may be useful.Show students the apparatus used for evaporation. Ask students what this is used for before demonstrating the evaporation of salty water. On mini-whiteboards, students draw annotated particle diagrams to explain how evaporation separates salt from its solution. For the main lesson practical, students carry out (or observe as a demonstration) how pure water is extracted from inky water. Students draw a labelled diagram and answer the questions that follow. They also draw annotated before and after particle diagrams to explain how distillation works.**Support**: The accompanying support sheet contains labels students can use for their distillation diagram, as well as a suggested results table for their observations.Students summarise the key stages in distillation using the gap-fill exercise on the interactive resource. Call out mixtures or solutions and ask students to decide and justify if they would be suitable for separation by evaporation, distillation, or both. Students display their answers using mini-whiteboards.For homework, students write an article for a science magazine about why salt flats arise.  | **AT Practical:** Separating sea water**Practical**:Distillation of inky water**Animation:** Dry-cleaning**Interactive**:Describingevaporation and distillation**Skill sheet**:Scientific apparatus**Skill sheet**:Recording results |
| 5.2.6Chromatography | **Securing Mastery Goals**● 3.5.2 Use evidence from chromatography to identify unknown substances in mixtures.**Enquiry processes**● 2.9 Gather data, minimising errors.● 2.9 Decide whether the conclusion of the experiment agrees with your prediction. | **Know**- Describe what happens to a mixture when it undergoes chromatography.- Describe what a chromatogram looks like.- Use evidence from chromatography to identify unknown substances in mixtures, and to identify the pen or plant a sample is from.**Apply**- Explain how chromatography separates mixtures.- Identify one physical property which must be different, and one physical property which must be the same, in order to separate a mixture by chromatography.- Use evidence from chromatography to explain how to identify unknown substances in mixtures, and to identify the pen or plant a sample is from.**Extend**- Justify the use of chromatography in different scenarios.- Consider how chromatography can be used to monitor the progress of reactions. - Suggest possible issues to consider when using chromatography to identify unknown substances. | To start, discuss how coloured felt-tip pens are made from a combination of dyes, and ask students to suggest ways in which we can separate the different coloured dyes.Place one drop of water on a coloured sugar-coated chocolate in the middle of a piece of filter paper. Show students how the dyes in the sugar coating separate out and discuss that the shell contains a mixture of colours and they dissolve in the water and travel outwards with the water. For the main lesson activity, students carry out a short investigation using chromatography to solve a mystery involving a fraudulent cheque, before answering questions that follow.Give each student a different coloured ball or piece of paper. Working in small groups, ask students to make a role play to model chromatography, which they will perform and explain to the rest of the class.Students explain chromatography in terms of what they saw with the sugar-coated chocolate, using key ideas and scientific terminology from this lesson. This can be done as a game of pair-share consequences, where each pair adds the next step in the chromatography procedure or explanation.Students re-order sentences on the interactive resource to explain what happens during chromatography.For homework, students prepare a newspaper article on how chromatography was used to catch the practical fraudster.An alternative WebQuest homework activity is also available on Kerboodle where students research the use of chromatography in forensic science. | **Practical**: Who stole the money?**Interactive**:Describingchromatography**WebQuest**:Chromatographyand crime |

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| **Section** | **AQA syllabus statement** | **Outcomes** | **Lesson overview** | **Kerboodle Resources and Assessment** |
| **6 Reactions** |
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| 6.1.1 Chemical reactions  | **Enquiry processes**● 2.6 Suggest a scientific idea that might explain the observation.● 2.6 Describe the evidence for your idea.● 2.6 Explain why the evidence supports your idea. | **Know**- Describe some features of chemical reactions. - Give examples of chemical reactions and physical changes. - Record simple observations from practical work.**Apply**- Explain what a chemical reaction is, giving examples. - Deduce whether described change is a physical change or a chemical reaction.- Record detailed observations from practical work.**Extend** - Justify the use of specific metals and non-metals for different applications.- Compare chemical reactions to physical changes. - Deduce whether an observed or described change is a physical change or a chemical reaction. | An alternative question-led lesson is also available.To start, ask students to discuss what they think a reaction is, and to give some examples of reactions they know about.Use a Bunsen burner to boil a beaker of water, add a teabag and then, using tongs, toast a piece of bread. Ask students to guess why you may be doing this, and how it relates to the lesson.For the main lesson activity, students carry out a series of reactions to observe what happens and find the signs that can be used to show reactions are occurring. Students then use their observations to answer questions based on chemical reactions and physical changes.Ask groups of students to feed back what they observed during the practical and discuss differences between chemical and physical changes. Students complete questions in the student book.**Support**: The support sheet allows students to record their observations in a suggested table of results.Ask students to write down on a mini-whiteboard the signs of a chemical reaction, and explain the differences between a physical and a chemical change.Students use the clues given on the interactive resource to complete a crossword of key words in this topic.For homework, students make a poster showing the signs of a chemical reaction. | **Question-led****lesson**: Chemicalreactions**Practical**: Finding out about reactions**Interactive**:Reactionscrossword**Video:** The signs of a chemical reaction**Skill sheet**:Recording results**WebQuest**: Kitchen chemistry |
| 6.1.2 Acids and alkalis | **Securing Mastery Goals**● 3.6.2 Acids and alkalis can be corrosive or irritant and require safe handling.**Enquiry processes**● 2.13 Identify risks and hazards.● 2.13 Identify control measures. | **Know**- Name some common properties of acids and alkalis. - Describe, in simple terms, what the key words ‘concentrated’ and ‘dilute’ mean. - Label hazard symbols and describe the hazards relating to them.**Apply**- Compare the properties of acids and alkalis. - Describe differences between concentrated and dilute solutions of an acid. - Identify and describe the meaning of hazard symbols and offer suitable safety precautions.**Extend**- Compare the different particles found in acids and alkalis. - Explain what ‘concentrated’ and ‘dilute’ mean, in terms of the numbers of particles present.- Offer suitable safety precautions when given a hazard symbol, and give a reason for the suggestion. | To start, display a selection of acids and alkalis around the classroom, including household substances such as soap, vinegar, and drain cleaner. Ask students to make a list of the precautions noted on each item and the types of uses seen.The interactive resource contains a word search with the chemical names of common acids and alkalis.For the main lesson, discuss the chemical nature of acids and alkalis and the properties they each have. Discuss that acids and alkalis can have different concentrations. In this activity students are required to match each hazard symbol to its name and description, and to apply this to a laboratory situation. Students often think that acids and alkalis react together to make an explosion. Demonstrate to them that this is not the case. Then give students 15 minutes to design a poster to summarise the properties of acids and alkalis.Go through a list of common acids and alkalis on the board. Students must decide on their mini-whiteboards if the substance concerned is an acid or an alkali. Remove the list and ask students to recall from memory as many acids and alkalis as possible.Call out the hazard names associated with most acids and alkalis (corrosive and irritant) and ask students to sketch the symbol from memory on a mini-whiteboard.For homework, students write a short report on the hazard symbols that can be found around the home.  | **Interactive**:Common acids and alkalis**Activity**: Acids and alkalis |
| 6.1.3 Indicators and pH | **Securing Mastery Goals**● 3.6.2 Acids have a pH below 7, neutral solutions have a pH of 7, alkalis have a pH above 7.● 3.6.2 Identify the best indicator to distinguish between solutions of different pH, using data provided.● 3.6.2 Use data and observations to determine the pH of a solution and explain what this shows.**Enquiry processes**● 2.12 Make an experimental prediction.● 2.9 Gather data, minimising errors.● 2.12 Decide whether the conclusion of the experiment agrees with your prediction.● 2.12 State whether or not the hypothesis is correct. | **Know**- State that acids have a pH below 7, neutral solutions have a pH of 7, alkalis have a pH above 7.- State that indicators will be different colours in acids, alkalis, and neutral solutions.- Identify the pH of a solution using experimental observations.**Apply**- Use the pH scale to measure acidity and alkalinity. - Describe how indicators categorise solutions as acidic, alkaline, or neutral. - Identify the best indicator to distinguish between solutions of different pH, using data provided.**Extend**- Compare the use of a variety of indicators and a pH probe to measure acidity and alkalinity.- Deduce the hazards of different acids and alkalis using data about their pH. - Evaluate the accuracy of the pH values chosen through the experimental observations. | To start, ask students to list as many properties of acids and alkalis on mini-whiteboards as they can recall. Discuss with students the uses of indicators in everyday life, and that chemical indicators such as litmus paper can be used to identify acids and alkalis. Discuss the term ‘indicator’ and why these substances are useful to chemists.**Support**: Although the use of red and blue litmus paper is useful to see the colour change between acids and alkalis, it may be useful to keep to one type of litmus paper to avoid confusing students.For the main lesson activity, students carry out a simple practical using universal indicator (in both paper and solution form) to find the pH of mystery solutions. They then answer questions that follow.Discuss applications of pH testing. Show students a pH probe and explain why these can provide a more accurate pH value for solutions.Explain that pH shows how corrosive a solution is likely to be. Read out pairs of pH values of solutions and ask students to predict which solution in each pair is more corrosive.Call out pH values and ask students to display acid, alkali, or neutral on a mini-whiteboard. Then ask students to call out the colours of universal indicator expected for these pH values.The interactive resource includes pictures of solutions after universal indicator has been added. Students must match the correct pH value to each picture.For homework, students produce leaflets explaining why pH testing is important for farmers. | **AT Practical:** Measuring pH changes**Practical**: Using universal indicator**Interactive**:Indicator colours**Skill sheet**:Recording results |
| 6.1.4 Acid strength | **Securing Mastery Goals**● 3.6.2 Hydrochloric, sulfuric and nitric acid are strong acids.● 3.6.2 Ethanoic (acetic) and citric acid are weak acids.**Exceeding Mastery Goals**● 3.6.2 Deduce the hazards of different alkalis and acids using data about their concentration and pH.**Enquiry processes**● 2.3 Make a conclusion and explain it. | **Know**- State examples of strong and weak acids. - State the pH range for acidic solutions.**Apply**- Explain the difference between a strong acid and a weak acid. - Compare pH values of concentrated and dilute solutions of the same acid. - Use models to show the difference between a strong acid and a weak acid.**Extend**- Explain the difference between acid strength and acid concentration. - Deduce the hazards of different acids using data about their concentration and pH.- Evaluate models for strong and weak acids, and suggest improvements. | To start, show students some citric acid in a packet, an orange, and a bottle of hydrochloric acid. Point out that citric acid is used to make drinks taste sour, and is the natural acid in citrus fruits, but that hydrochloric acid is not used in food or drink. Ask students to suggest why.Read out pairs of pH values for acidic solutions, students identify the more acidic solution on mini-whiteboards. For the main lesson activity, students carry out an investigation on strong and weak acids using magnesium ribbon. During this activity, remind students about dilute and concentrated solutions.Students use a molecular model kit to model hydrochloric acid particles which are then added to beans representing water in a beaker, breaking up the hydrochloric acid particles as they enter the ‘water’. This represents a strong acid. Weak acids are also built, with only some breaking up when added to the beans representing water. Students then write about the difference between a strong and weak acid.Students identify terms when read out definitions of: strong acid, weak acid, dilute acid solution, concentrated acid solution. Alternatively, students use the interactive activity to check their understanding of the key terms.Ask students to identify the stronger acid when given the pH values of solutions of two different acids, each of the same concentration. For homework, students use the Internet to research the properties and uses of a weak acid. | **Practical**:Finding out about strong and weak acids**Interactive**:Definitions |
| 6.1.5 Neutralisation | **Securing Mastery Goals**● 3.6.2 Explain how neutralisation reactions are used in a range of situations.● 3.6.2 Describe a method for how to make a neutral solution from an acid and alkali.**Enquiry processes**● 2.3 Make a conclusion and explain it.● 2.10 Write a fair test enquiry question.● 2.11 Identify control variables.**Enquiry processes activity**● 3.6.2 Devise an enquiry to compare how well indigestion remedies work. | **Know**- State simply what happens during a neutralisation reaction.- Give one example of a neutralisation reaction. - Identify independent, dependent, and control variables in an investigation.**Apply**- Describe a method for making a neutral solution from an acid and an alkali. - Explain how neutralisation reactions are used in a range of situations.- Design an investigation to find out which indigestion remedy is ‘better’.**Extend**- Interpret a graph of pH changes during a neutralisation reaction. - Justify the method chosen to investigate which indigestion remedy is ‘better’. | To start, add universal indicator to a beaker of dilute NaHCO3 and a beaker of dilute HCl. Pour the bicarbonate solution into a clamped burette.Slowly add acid into the burette, and point out the colour changes that occur where the two solutions meet. Dissolve an indigestion remedy in a beaker of water and use red litmus paper to show the solution is alkaline. Ask students to consider what happens when this is taken for indigestion.In the main lesson activity, students decide what is meant by a ‘better’ indigestion remedy.They follow tips provided to plan an experiment to test two indigestion remedies. They then carry out their investigation and use their results to draw conclusions. Students then answer the questions that follow.**Support**: An access sheet is available where students are not required to plan the method for this investigation.Ask students to explain which indigestion remedy they decided would be ‘better’ at neutralising stomach acid. The interactive resource asks students to type in key words and figures.For homework, students make an A4 poster to describe and explain some uses of neutralisation reactions.An alternative WebQuest homework activity is also available on Kerboodle where students research soil pH. | **Access:** Neutralisation**Practical**:Neutralisation**Animation:** Acidic lakes**Interactive**:Neutralisationreactions**WebQuest**: Soil pH**Skill sheet**: Planninginvestigations**Skill sheet**:Recording results |
| 6.1.6 Making salts | **Exceeding Mastery Goals**● 3.6.2 Estimate the pH of an acid based on information from reactions.● 3.6.2 Given the names of an acid and an alkali, work out the name of the salt produced when they react.*Know and Apply students need to know that neutralisation reactions produce a salt and water.***Enquiry processes**● 2.12 Identify and record key features of an observation. | **Know**- State the type of substances made when an acid and alkali react. - Match the type of salt that will form from the type of acid used. - Describe observations during an experiment.**Apply**- Describe what a salt is. - Choose the correct name of the salt formed in a neutralisation reaction from a list of possible salts.- Describe the steps in making a salt in a neutralisation reaction.**Extend**- Explain what salt formation displaces from the acid. - Predict the names of salts formed when acids react with metals or bases and write word equations to represent the reactions.- Describe and explain the steps involved in making a salt in a neutralisation reaction.- Estimate the pH value of an acid based on information about its reactions. | To start, ask students to list facts they know about the everyday usage of the word ‘salt’.Discuss why, in particular, table salt is of huge importance globally and biologically. Show students some hydrochloric acid and sodium hydroxide and discuss the hazards of each and if it would be safe to consume these. Then display sodium chloride (from a table salt container). Ask students to consider why it is safe to consume in small quantities.For the main lesson activity, discuss with students the reaction between an acid and a base, and the reaction between an acid and a metal. Students should write down the definition of a salt. Show examples of word equations.Discuss the names of salts – the metal involved followed by the name derived from the type of acid used.Students carry out the reaction between HCl and NaOH to make table salt crystals, noting observations and answering the questions that follow.Ask students to write the definition of a salt on their mini-whiteboard.Interactive resource in which students complete word equations of reactions between acids and metals.For homework, students find out the name of a base that can be used to neutralise acids in soils. Then they find out names of acids present in soils and predict the names of the salts that would form during these reactions, as well as the secondary products of the reactions. | **Question-led****lesson**: Making salts**Practical**:Making salts**Interactive**: Name the substances |
| 6.2.1More about elements | **Securing Mastery Goals**● 3.6.1 Iron, nickel and cobalt are magnetic elements.● 3.6.1 Mercury is a metal that is liquid at room temperature.● 3.6.1 Bromine is a non-metal that is liquid at room temperature.● 3.6.1 Identify an unknown element from its physical and chemical properties. **Exceeding Mastery Goals**● 3.6.1 Justify the use of specific metals and non-metals for different applications, using data provided.**Enquiry processes**● 2.4 Select a good way to display data. | **Know**- State what an element is.- State examples of elements. - Present some simple facts about an element.**Apply**- Identify an unknown element from its physical and chemical properties. - Compare the properties of typical metals and non-metals. - Record observations and data on elements.**Extend**- Justify the use of specific metals and non-metals for different applications, using data provided.- Deduce the relationship between the position of an element in the periodic table and its properties.- Use observations and data obtained to form conclusions about given elements. | To start, complete interactive elements wordsearch.Ask students to compare displayed element samples, pointing out that an element cannot be broken down.For the main lesson activity, students work in small groups to research several elements assigned to them, and then produce small (A5) information posters that make up a class periodic table. Indicate the metals and non-metals.Students work in pairs to reflect on the previous activity, and to list properties that are typical of metal and non-metal elements.Read out a list of properties, students indicate whether it is typical of a metal or non-metal element.Ask students to write five sentences with ‘but’ in the middle, to compare metals and non-metals.For homework, students make a ‘dating profile’ for a particular element, imagining it is a person.  | **Interactive**:Elementswordsearch**Activity**:The elements**Skill sheet**:Calculatingpercentages |
| 6.2.2Chemical reactions of metals and non-metals | **Securing Mastery Goals**● 3.6.1 Describe an oxidation, displacement, or metal–acid reaction with a word equation. ● 3.6.1 Use particle diagrams to represent oxidation, displacement and metal-acid reactions. ● 3.6.1 Identify an unknown element from its physical and chemical properties. **Exceeding Mastery Goals**● 3.6.1 Deduce the physical or chemical changes a metal has undergone from its appearance. **Enquiry processes**● 2.4 Design a table for the data being gathered.● 2.9 Gather sufficient data for the investigation. | **Know**- State that many elements react with oxygen to form oxides. - State what the arrow means in a word equation. - Describe a difference in physical properties between typical metal and non-metal oxides.**Apply**- Use particle diagrams to represent oxidation reactions. - Describe an oxidation reaction with a word equation. - Classify the products obtained when typical metal and non-metal elements react with oxygen.**Extend**- Decide whether a word equation represents an oxidation reaction. - Interpret a word equation to name reactants and products. - Deduce the physical or chemical changes a metal has undergone from its appearance. | To start, sprinkle iron filings into a Bunsen burner to demonstrate iron reacting with oxygen from the air to make iron oxide. Then demonstrate cutting a sample of sodium, and point out that the cut face quickly goes dull as a result of its reaction with oxygen to form sodium oxide.Students list as many metal and non-metal properties as possible.For the main lesson activity, students carry out oxides practical, burning charcoal to produce carbon dioxide and magnesium to produce magnesium oxide. The oxide products are tested using litmus. Students complete word equations for oxidation reactions. Emphasise the meaning of the arrow in an equation in chemistry.Alternatively, set the interactive activity in which students complete word equations, paying particular attention to correct spelling.Students use mini-whiteboards to write the key word when you give them a definition based on the work in this lesson.For homework, students research how different elements produce different coloured flames when burned in oxygen, and how this is useful for making fireworks. | **Practical:**Examining oxides**Interactive**:Completingequations |

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| 6.2.3Metals and acids | **Securing Mastery Goals**● 3.6.1 Describe an oxidation, displacement, or metal–acid reaction with a word equation. ● 3.6.1 Use particle diagrams to represent oxidation, displacement and metal–acid reactions. **Enquiry processes**● 2.3 Make a conclusion and explain it. | **Know**- Describe what happens when metals react with acids. - State that when a metal reacts with an acid the products are a salt and hydrogen gas.- State which metals produce bubbles when reacting with acid.**Apply**- Compare the reactions of different metals with dilute acids. - Predict the names of the products formed in a metal-acid reaction, and describe the reaction with a word equation or represent it with a particle diagram.- Decide which metals react more vigorously from practical observations.**Extend**- Suggest how temperature changes may be linked with differences in reactivity between metals with acid. | To start, show a strip of magnesium ribbon and a test tube of dilute hydrochloric acid. Students predict if the two will react and recall the signs of a chemical reaction. Discuss the observations.Demonstrate the reaction between magnesium and hydrochloric acid, collecting the hydrogen gas produced. Hold a lit splint to the collected gas to demonstrate the characteristic squeaky pop as a test for hydrogen gas.**Support**: Recap the differences between physical and chemical reactions.For the main lesson activity, students add four different metals (zinc, lead, iron, magnesium) to dilute hydrochloric acid, one at a time, and test the gas produced with a lighted splint to show that it is hydrogen. Based on reactions that occur, students list the metals in order of increasing reactivity. They then write word equations for the reactions.Students match reactants to products using the interactive resource. Ask students for the other product formed in all these reactions (hydrogen).Students write the general equation for the metal–acid reaction on mini-whiteboards. Students then write down the signs of chemical reactions that would show the metal was reacting, and explain the test for hydrogen gas.For homework, students produce a tutorial sheet that teaches other students how to name the salts made when metals react with acids. | **Practical:** Reacting metals with acids**Interactive**: Spot the salt |
| 6.2.4 Metals and oxygen | **Securing Mastery Goals**● 3.6.1 Describe an oxidation, displacement, or metal–acid reaction with a word equation. **Exceeding Mastery Goals**● 3.6.1 Deduce the physical or chemical changes a metal has undergone from its appearance. ● 3.6.1 Justify the use of specific metals and non-metals for different applications, using data provided. **Enquiry processes**● 2.3 Make a conclusion and explain it. | **Know**- State the product of a reaction between a metal and oxygen.- Name one metal that reacts vigorously with oxygen and one metal that does not react with oxygen.- Make observations about how different metals react with oxygen.**Apply**- Compare the reactions of different metals with oxygen. - Describe an oxidation reaction with a word equation. - Rank metals in order of how vigorously they react with oxygen.**Extend**- Explain the reactivity of metals according to how they react with oxygen. - Justify the use of specific metals for different applications, using data provided. - Deduce the physical or chemical changes a metal has undergone from its appearance. | To start, cut a piece of lithium on a white tile showing the shiny surface rapidly becoming dull.Also show a new iron nail and a rusty iron nail. Discuss and lead to metals reacting with oxygen to produce metal oxides. Give the names of metal oxides and ask students to identify which elements the compounds are made from.For the main lesson activity, students carry out the reactions of four different metals with oxygen using a Bunsen flame, record their observations in a suitable results table, and write a word equation to represent each reaction. Students then answer the questions that follow based on reactivity.Discuss how the uses of metals depend on their properties. Students answer the questions in the student book to check their understanding.Interactive resource where students categorise statements on metal and oxygen reactions as true or false.Revisit the starter demonstration involving the oxidation of lithium and iron. Students should now be able to explain what has happened to both metals and write word equations on mini-whiteboards.For homework, students write a paragraph to explain why some metals lose their shine over time but why gold does not.  | **Practical:** How do metals react with oxygen?**Interactive**: Can this be true?**Skill sheet**:Recording results |
| 6.2.5Metals and water | **Securing Mastery Goals**● 3.6.1 Place an unfamiliar metal into the reactivity series based on information about its reactions.**Exceeding Mastery Goals**● 3.6.1 Deduce a rule from data about which reactions will occur or not, based on the reactivity series.**Enquiry processes**● 2.10 Write a fair test enquiry question.● 2.11 Identify control variables.**Enquiry processes activity**● 3.6.1 Use experimental results to suggest an order of reactivity of various metals. | **Know**- State the products of the reaction between metals and water. - State whether a metal is more or less reactive than another metal. - Write a simple method to find out how easily metals react with acids or water.**Apply**- Compare the reactions of different metals with water. - Use the reactivity series to predict reactions, and place an unfamiliar metal into the reactivity series based on information about its reactions.- Plan a practical to compare the reactivity of three metals, including identifying control variables and planning how to control them.**Extend**- Link a metal’s reactions with its place in the reactivity series. - Deduce a rule from data about which reactions will occur or not, based on the reactivity series.- Write a suitable fair test question and plan in detail which variables to control and how to control them. | To start, remind students that some metals react with water to produce metal hydroxides and hydrogen gas. By demonstrating the reactions of Group 1 metals in water, the vigour of the reaction can be linked to reactivity. Show what happens when magnesium is placed in water, to show that some metals (less reactive than calcium) react only very slowly with cold water. Magnesium and zinc, though, do react with steam.Ask students to predict the relative reactivity of gold compared to iron based on daily observations**Support**: Students may require hints, for example, why is jewellery made from gold, or why do we need to oil bike chains?For the main lesson practical, students plan and carry out an investigation to test the reactivity of three metals (sodium, magnesium, and copper) in water and in acid. There should be a class discussion after the experiment to go through methodology, observations and conclusions regarding the order of reactivity.Students explain what the reactivity series is and re-order the metals given on the interactive resource according to their position in the reactivity series.Students make up a ‘Guess Who’-style game about the identity of different metals.For homework, students write a mnemonic to help them remember the order of metals in the reactivity series. | **Practical**:Comparing thereactivity of metals**Interactive**:Ordering metals**Skill sheet**:Planninginvestigations**Skill sheet**:Recording results |
| 6.2.6 Metal displacement reactions | **Securing Mastery Goals**● 3.6.1 Describe an oxidation, displacement, or metal–acid reaction with a word equation. ● 3.6.1 Use particle diagrams to represent oxidation, displacement and metal-acid reactions. **Enquiry processes**● 2.12 Make an experimental prediction. | **Know**- State which metal is more reactive in a pair of named metals. - State where different metals are found in the reactivity series. - Use observations from experiment to state whether or not a displacement reaction has occurred.**Apply**- Predict if a given pair of substances will react in displacement reactions. - Use the reactivity series to explain displacement reactions. - Use word equations and particle diagrams to represent displacement reactions.**Extend**- Explain predictions about displacement reactions. - Devise a model to explain displacement reactions. - Suggest the identity of unknown metals, given information about their reactions. | To start, set up a boiling tube containing silver nitrate solution and a coiled-up piece of copper wire. Ask students to find silver and copper in the reactivity series, and to predict what may happen in the boiling tube.Introduce the concept of displacement, and ask students to suggest what they will see in the boiling tube by the end of the lesson.Demonstrate the thermite reaction. Explain that aluminium displaces iron from iron oxide and introduce this as a displacement reaction based on the positions of iron and aluminium in the reactivity series.For the main lesson activity, students predict whether displacement reactions will occur between combinations of four metals and their nitrates (Mg, Zn, Cu, and Pb). Students then carry out the experiment, record their observations, and answer questions that follow.**Support**: An access sheet is provided where students are not required to use the reactivity series to predict the possibility of reactions. Look back at the copper wire in silver nitrate, set up at the start of the lesson. Ask students to describe and explain what they can see and why.Students should use the reactivity series, the word displacement, and a word equation in their explanation.Students decide if statements given on the interactive resource are true or false using mini-whiteboards. Students should be asked to justify their answers using the reactivity series, and write word equations.For homework, students draw a cartoon to show and explain what happens during a displacement reaction. | **Access:** Will a displacement reaction occur?**Practical**: Will a displacement reaction occur?**AT practical:** Interpreting chemical reactions**Animation:** Displacement reactions**Interactive**:True or false?**Skill sheet**:Recording results |

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| **Section** | **AQA syllabus statement** | **Outcomes** | **Lesson overview** | **Kerboodle Resources and Assessment** |
| **7 Earth** |
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| 7.1.1The structure of the Earth | **Securing Mastery Goals**● 3.7.1 The three rock layers inside Earth are the crust, the mantle and the core.**Enquiry processes**● 2.4 Select a good way to display data. | **Know**- Name the layers of the Earth. - State what a mineral is. - Design a simple model of the Earth using information about its structure.**Apply**- Describe properties of the different layers of the Earth’s structure. - Explain that most rocks are mixtures of minerals.- Describe advantages and disadvantages of a given model of the Earth’s structure.**Extend**- Compare the different layers of the Earth in terms of their properties.- Interpret data about the elements that make up the Earth’s crust. - Explain why models are good or poor representations of the Earth’s structure in terms of materials used. | To start, outline the heights and depths of mountain ranges and ocean trenches. Ask students to consider how big these are in comparison to the size of the Earth and explain that they are part of the Earth’s crust.Ask students to give ideas about how a scotch egg and apple are similar to Earth.For the main activity show students samples of minerals, explaining that a mineral is a single substance, which can be an element or a compound and is found naturally. Tell students that most types of rock are mixtures of minerals, showing granite as an example. Students label a diagram of the Earth’s structure, including a brief description of each layer, and assess each other’s work. Students answer questions based on this model.**Support**: Prompt students to think about how different properties of the layers can be shown using materials in their proposed models.On mini-whiteboards students place the layers of the Earth given on the interactive screen into the correct order, offering descriptions of each layer.Call out a layer of the Earth and students write down as many facts as they can about that layer on mini-whiteboards. Discuss answers given. For homework, students make models showing the structure of the Earth, as described in their activity sheet. | **Activity**: Modelling Earth’s structure**Interactive**:The Earth |
| 7.1.2Sedimentary rocks | **Securing Mastery Goals**● 3.7.1 Explain why a rock has a particular property based on how it was formed. ● 3.7.1 Identify the causes of weathering and erosion and describe how they occur.**Exceeding Mastery Goals**● 3.7.1 Predict planetary conditions from descriptions of rocks on other planets.**Enquiry processes**● 2.3 Make a conclusion and explain it. | **Know**- State a property of sedimentary rocks. - Describe how sedimentary rocks are made. - State the processes shown by different models of the stages in sedimentary rock formation.**Apply**- Explain why a sedimentary rock has a particular property based on how it was formed.- Identify the causes of weathering and erosion and describe how they occur.- Explain how a given model represents a particular process in the formation of sedimentary rock.**Extend**- Predict planetary conditions from descriptions of rocks on other planets.- Explain in detail each stage in the formation of a sedimentary rock.- Evaluate strengths and weaknesses for models of sedimentary rock formation, giving reasons. | To start, show students some sediment (sand) and a sedimentary rock (sandstone). Ask students to give ideas on how the sediment can be turned into the stone. Provide students with hand lenses and examples of sedimentary rocks (sandstone), metamorphic rocks (slate), and igneous rocks (granite). Ask them to list features and ask whether they think the rocks come from the same ‘family’.For the main lesson activity, explain that there are three types of rock all with unique features.Introduce sedimentary rock and its formation and properties.Students carry out simple experiments that model sedimentary rock formation processes, and then answer the questions that follow.Interactive resource with sedimentary rock keyword crossword. They then place the key words in order to describe sedimentary rock formation.Give simple descriptions of a stage of sedimentary rock formation and students write the stage name on a mini-whiteboard. Students draw a cartoon strip to show how a small pebble that was loosened by weathering goes on to form part of a new sedimentary rock. | **Practical**: Modellingsedimentary rock formation**Interactive**:Sedimentary rocks**Animation:** Sedimentary rocks |
| 7.1.3Igneous and metamorphic rocks | **Securing Mastery Goals**● 3.7.1 Explain why a rock has a particular property based on how it was formed. **Exceeding Mastery Goals**● 3.7.1 Identify circumstances that indicate fast processes of change on Earth and those that indicate slower processes.**Enquiry processes**● 2.12 Make an experimental prediction. | **Know**- State one difference between igneous and metamorphic rocks. - Describe how igneous and metamorphic rocks are formed. - Describe what you see when a substance representing lava is cooled.**Apply**- Explain in detail how igneous and metamorphic rocks form. - Explain why igneous and metamorphic rocks have particular properties based on how they were formed.- Predict observations when a substance representing lava is cooled at different temperatures.**Extend**- Discuss examples of rocks that illustrate the different methods of formation of igneous and metamorphic rocks.- Identify circumstances that indicate fast processes of change on Earth and those that indicate slower processes.- Predict observations when a substance representing lava is cooled, using knowledge about igneous rock formation to explain the answer. | To start, display a photograph of the Giant’s Causeway and ask students to consider how it was formed. Discuss how the causeway was formed by cooling lava. Show a video clip from the Internet of lava erupting from a volcano, and students recap what happens when lava leaves the volcano. This recaps the structure of the Earth, before introducing the other two types of rock.Introduce the difference between magma and lava.For the main lesson activity, discuss the formation and properties of igneous and metamorphic rocks. Using a short text on formation and crystal sizes of granite and basalt, students write a hypothesis on the relationship between crystal sizes in igneous rock and the temperature of the environment during formation. Students carry out a practical to mimic igneous rock formation using salol, and use their observations to answer questions that follow.**Support**: Students recap properties of sedimentary rocks before moving on. They should focus on identifying properties of each rock under a hand lens.Interactive resource where students complete a paragraph on the properties of the three types of rocks.Students role play igneous and metamorphic rock formation.For homework, students complete the practical sheet and research examples of each type of rock. | **Practical**: What determines crystal size in igneous rock?**Interactive**:Properties of rock types**Skill sheet**:Hypothesis |
| 7.1.4The rock cycle | **Securing Mastery Goals**● 3.7.1 Construct a labelled diagram to identify the processes of the rock cycle.**Exceeding Mastery Goals**● 3.7.1 Describe similarities and differences between the rock cycle and everyday physical and chemical processes.**Enquiry processes**● 2.3 Make a conclusion and explain it.**Enquiry processes activity**● 3.7.1 Model the processes that are responsible for rock formation and link these to the rock features. | **Know**- Give simple facts about how a rock can be changed from one type to another.- State what happens to wax in a model rock cycle.**Apply**- Use the rock cycle to explain how the material in rocks is recycled. - Describe how changes in the wax used to represent a rock represent the real rock cycle.**Extend**- Give a detailed description and explanation of the journey of material through the rock cycle.- Suggest similarities and differences between the rock cycle and everyday physical and chemical processes. | To start, students complete key word wordsearch on the interactive resource, suggesting what new words mean. Provide students with chunks of three different chocolate bars or cakes and ask them to decide which rock type they most closely resemble and why. For the main activity, display a diagram of the rock cycle and ask students to work in small groups to identify a possible route around the rock cycle. Routes are discussed as a class.**Support**: Students may be prompted to use a specific starting point for their routes. Students carry out a short practical where they use wax to model rock formation processes, and answer questions that follow.Students write sentences about the processes within the rock cycle in a logical order, and present to each other in pairs.Have the three rock type names written on large pieces of paper laid on the floor in a triangle. Divide students in the class to make three groups and place each group on one vertex. Students describe to each other how they move from one rock type to another. A correct answer allows the student to move; an incorrect answer means the student must sit back down. The winner is the person who can move around the rock cycle in the shortest amount of time.**Support**: Allow students to work in small groups.For homework, students produce a coloured poster of the rock cycle. | **Interactive**: The rock cycle**Practical**: Modelling the rock cycle**Skill sheet**:Recording results |
| 7.1.5Ceramics | **Securing Mastery Goals**● 3.7.1 Explain why a rock has a particular property based on how it was formed. **Exceeding Mastery Goals**● 3.7.1 Suggest how ceramics might be similar to some types of rock.**Enquiry processes**● 2.10 Write a fair test enquiry question.● 2.11 Identify control variables.● 2.13 Identify risks and hazards.● 2.13 Identify control measures. | **Know**- List the properties of ceramics. - List some uses of ceramics. - Suggest a simple method for comparing the strength of ceramic materials given a choice of apparatus.**Apply**- Use data on properties to decide which materials might be ceramics. - Explain why properties of ceramics make them suitable for their uses. - Plan a method for comparing the strength of ceramic materials, including devising a fair test question, identifying control variables, and identifying risks, hazards and control measures.**Extend**- Justify decisions made from property data about which materials might be ceramics.- Suggest how ceramic materials might be similar to some types of rock. - Plan a method for comparing the strength of ceramic materials, justifying choices of experimental techniques, apparatus and the measures to control risk. | To start, have an array of ceramic items around the room for students to look at and discuss properties.Using a range of ceramic materials as stimuli students complete the wordsearch on the interactive resource.For the main lesson activity, formally introduce ceramics, (formation, properties etc) and discuss common uses of ceramics, matching uses to properties. Students plan an investigation to compare the strength of different ceramic materials using the guidelines on the practical sheet. Students then record their observations in the results table provided.**Support**: The accompanying support sheet includes a list of suitable apparatus for students to use in their method for this experiment.Revisit the ceramic items available at the start of the lesson and ask students to describe why each item can be classified as a ceramic, in terms of properties. Students should also link common uses of ceramics with their properties.Students prepare a list of the properties of ceramics and suggest one use of ceramics that utilises each property, while distinguishing between chemical and physical properties.For homework, students complete the questions on the practical sheet. | **Interactive**: Finding the properties ofceramics**Practical**:Comparing ceramic strength**Skill sheet**: Planninginvestigations**Skill sheet**:Scientific apparatus |
| 7.2.1The night sky | **Securing Mastery Goals**● 3.7.2 Describe how space exploration and observations of stars are affected by the scale of the universe. ● 3.7.2 Explain the choice of particular units for measuring distance.**Enquiry processes**● 2.15 Understand the role of a theory in science. | **Know**- Name some objects seen in the night sky. - State a unit that astronomers use to measure distance. - Identify scientific evidence from secondary evidence.**Apply**- Describe how space observation of stars is affected by the scale of the Universe.- Explain the choice of light years as a unit of measuring distances in astronomy.- Draw valid conclusions that utilise more than one piece of supporting evidence.**Extend**- Describe the structure of the Universe in detail, in order of size and of distance away from the Earth.- Use the speed of light to describe distances between astronomical objects.- Assess the strength of evidence, deciding whether it is sufficient to support a conclusion. | To start, students use the interactive resource to match items in the night sky with their definition. Discuss why the objects are visible, highlighting the speed of light.**Extension**: Students identify reasons why they cannot see things well at night.Use a star map to show what is visible in tonight’s sky or show a current video of Tonight’s Sky from Hubble’s website.For the main lesson activity, use the Hubble website image gallery to show objects in the night sky. Explain how objects fit together to form the Universe. Use the activity sheet to reinforce student perception of our place in the Universe.Define a satellite and give examples of natural satellites such as the Moon. Discuss uses of man-made satellites and describe how scientists share data from these. **Support**: Show animations of satellites. An access sheet is available with easier text and comprehension questions. Students rank objects in order of distance from Earth and matching distances in light-time. Students guess where the furthest man-made object has gone, and think of three reasons why we may, or may not, visit other astronomical objects.Students list objects found in the Universe and rank them in size order.**Support**: Provide the list for students to rank.For homework, make a model of a satellite identifying different parts.**Support**: Use Met Office template for satellite model, available from their website. | **Access:** What is in the Universe?**Activity**: What is in the Universe?**Interactive**: What is in the night sky?**Skill sheet**:Converting units |
| 7.2.2The Solar System | **Securing Mastery Goals**● 3.7.2 Describe the appearance of planets or moons from diagrams showing their position in relation to the Earth and Sun. ● 3.7.2 Describe how space exploration and observations of stars are affected by the scale of the universe. **Exceeding Mastery Goals**● 3.7.2 Make deductions from observation data of planets, stars and galaxies.**Enquiry processes**● 2.1 Identify patterns in data. ● 2.3 Make a conclusion and explain it.● 2.6 Develop an explanation. ● 2.6 Communicate your idea, evidence and reasoning. | **Know**- Name some objects in the Solar System. - Explain how we see planets. - Identify some patterns in the Solar System.**Apply**- Describe how objects in the Solar System are arranged. - Explain why we see objects in the Solar System, and describe how they appear to move.- Describe how space exploration is affected by the scale of the Universe.**Extend**- Explain how the properties and features of planets are linked to their place in the Solar System.- Explain why we see objects in the Solar System, and why they appear to move as they do.- Make deductions from observation data of planets, stars, and galaxies. | To start, students sketch a diagram showing the objects they think are in the Solar System and their orbits. **Support**: Provide a diagram for students to add labels to.Show the video clip ‘Models of the Solar System – Earth, Sun and Moon’ from the Institute of Physics website. Students list three to five points from the video.For the main lesson activity, students make a moving model of Sun, Earth, and Moon in their books. Students add another planet, and use the model to explain why it seems to move forwards and backwards relative to Earth.Introduce the inner and outer planets using the student book.Using a long, narrow strip of paper, students can display relative distances of planets from the Sun by folding the paper, or by using a scale diagram.Discuss patterns in the separations and the scale of the Solar System.Students then work through the activity sheet individually. Discuss the problems with space travel arising from the scale of the Solar System.**Support**: Introduce the idea of scale and give students 30-cm rulers. The support sheet includes a table of data to help students answer the questions.Interactive resource where students order objects in the Solar System according to size.Each student writes down clues so their partner can guess which planet they are thinking of.For homework, students research benefits and costs of space travel.An alternative WebQuest homework activity is also available on Kerboodle where students research the planets of the Solar System. | **Activity:** The moving Solar System**Activity**: The Solar System to scale**Interactive**: Objects in the Solar System**Skill sheet**:Choosing scales**WebQuest**: Solar System tourist |
| 7.2.3The Earth | **Securing Mastery Goals**● 3.7.2 Explain why places on the Earth experience different daylight hours and amounts of sunlight during the year.**Exceeding Mastery Goals**● 3.7.1 Predict patterns in day length, the Sun’s intensity or an object’s shadow at different latitudes.**Enquiry processes**● 2.1 Identify patterns in data.● 2.3 Make a conclusion and explain it.**Enquiry processes activity**● 3.7.2 Relate observations of changing day length to an appropriate model of the solar system. | **Know**- Describe differences between seasons. - Describe the motion of the Sun, stars, and Moon across the sky. - Describe patterns in data linking day length during the year.**Apply**- Explain the motion of the Sun, stars, and Moon across the sky. - Explain why seasonal changes happen. - Use data to show the effect of the Earth’s tilt on temperature and day-length.**Extend**- Predict the effect of the Earth’s tilt on temperature and day-length. - Predict how seasons would be different if there were no tilt. - Interpret data to predict how the Earth’s tilt affects temperature and day-length. | To start, students list differences in seasons, and suggest why changes happen.Discuss navigation without a compass. Use a video clip from the Internet to show how to navigate using the North Pole and the Pole Star.For the main lesson activity, show students how the Earth always tilts towards the Pole Star, using a paper star on a wall as thePole Star and a globe to demonstrate. Students should identify when the UK has winter and summer.Using a globe, a lamp, and a thermofilm, demonstrate that winter is cooler because the Sun’s rays spread over a larger area when Earth tilts away from the Sun.Students complete questions on the activity sheet. Students complete the gap fill on the interactive resource to explain how seasons occur.Students predict what would be different ifEarth was not tilted.For homework, give students the temperature and day-length in a particular month for four countries between the equator and the North Pole. They write an account or postcards describing changes from the point of view of a tourist. | **Question-led****lesson**: The Earth**Activity**: The seasons**Interactive**: The Sun and the seasons**Animation:** Seasons |
| 7.2.4 The Moon and changing ideas | **Securing Mastery Goals**● 3.7.2 Describe the appearance of moons from diagrams showing their position in relation to the Earth and Sun.**Exceeding Mastery Goals**● 3.7.2 Compare explanations from different periods in history about the motion of objects and structure of the Universe.**Enquiry processes**● 2.1 Identify patterns in data.● 2.3 Make a conclusion and explain it.● 2.15 Understand the role of a theory in science.● 2.15 Understand how scientific ideas have changed. | **Know**- Name some phases of the Moon. - Explain simply why we see the Moon from Earth. - Show the different phases of the Moon using models provided. - Name the current model of the Solar System.**Apply**- Describe the phases of the Moon. - Describe the appearance of the Moon from diagrams of the Earth, Sun and Moon.- Explain phases of the Moon using the models provided. Describe evidence that led to a change in the model of the Solar System.**Extend**- Predict phases of the Moon at a given time. - Explain how total eclipses are linked to phases of the Moon. - Predict the phases of the Moon using models provided. - Compare explanations about the motion and structure of the Universe from different periods in history. | To start, check prior knowledge with five short questions. Students in groups write down as many ideas that people may have had about our Solar System/Universe and one observation that supports the ideas. Keep their ideas for later.For the main lesson activity, students model the phases of the Moon using the instructions on the practical sheet and then answer questions. Students suggest whether planets, or the moons around other planets have phases.Students use their model from the previous activity to make geocentric and heliocentric models of the Solar System, writing observations of each. Read out the observations and discuss.Draw a phase of the Moon and students describe its appearance in future or the past. This can be done in conjunction with the interactive gap fill as a summary.Students reorder statements on the interactive resource to describe how observations led to the geocentric model being discarded in favour of the heliocentric model.For homework, students should make a poster about how ideas about the Universe have changed over time.  | **Activity**:Changing Moon**Interactive**: From geocentric to heliocentric |

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| **Section** | **AQA syllabus statement** | **Outcomes** | **Lesson overview** | **Kerboodle Resources and Assessment** |
| **8 Organisms** |
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| 8.1.1Levels of organisation | **Securing Mastery Goals**● M3.8.2 Explain why multi-cellular organisms need organ systems to keep their cells alive. **Exceeding Mastery Goals**● 3.8.2 Suggest how damage to, or failure of, an organ would affect other body systems.**Enquiry processes**● 2.5 Use scientific vocabulary accurately, showing that you know its meaning and use appropriate units and correct chemical nomenclature. | **Know**- State what is meant by a tissue, an organ, and an organ system. - State the sequence of the hierarchy of organisation in a multicellular organism.- Use information provided to list the organs found in a given organ system, and state the function of that system.**Apply**- Define and state examples of tissues, organs, and organ systems. - Explain the hierarchy of organisation in a multi-cellular organism. - Interpret information provided to decide on the function of the individual organs and of the organ system.**Extend**- Explain in detail the hierarchy of organisation in a multi-cellular organism, using a range of examples.- Explain how the different tissues in an organ, and the different organs in an organ system function together.- Interpret information to explain the functions of several organ systems. | To start, ask students to build disassembled object, highlighting bricks working together to make the whole object work. Students put pictures of a cell, tissue, organ, organ system, and an organism into an order, and explain their decision. For the main lesson activity, students can label the digestive system on their activity sheet. Students then read through the information sheet and answer the questions on the accompanying activity sheet.Students research the organs and functions of a different organ system and present information.**Support**: Organise students into groups so that some students can lead the task.Students categorise words on the interactive resource.Produce a series of paper slips, each containing the name of one organ, students must then find others in the class with organs from the same organ system. For homework, students list life functions (MRS GREN) and explain how this function is carried out in the human body. | **Activity**:Organising a body**Animation**:Organisation in multicellularorganisms**Interactive**: Cells, tissues, or organs? |
| 8.1.2The skeleton | **Securing Mastery Goals**● 3.8.1 Explain how a physical property of part of the skeleton relates to its function.**Exceeding Mastery Goals**● 3.8.1 Predict the consequences of damage to a joint, bone, or muscle. **Enquiry processes**● 2.5 Add a diagram if it helps to make the meaning clearer. | **Know**- Name the main parts in the skeleton. - List the functions of the muscular skeletal system.**Apply**- Describe the structure of the skeleton. - Describe the functions of the muscular skeletal system.**Extend**- Explain the relationship between the bones and joints in the skeleton. - Explain the link between structure and functions in the muscular skeletal system. - Predict the consequences of damage to a bone. | To start, ask the question ‘What is your skeleton, and why do you need it?’ Write and group together key words and discuss. An interactive resource that asks students to label a diagram of the skeleton.For the main lesson activity, students use the activity sheet and photocopied images of bones to build and label a skeleton. Students then answer the questions that follow.**Support**: Students should work in mixed-ability groups.Discuss what the bones in certain regions of the skeleton do.**Support**: Students may be provided with a list of possible skeletal regions and functions to choose from.Students create a table listing several regions of the skeleton and the functions of the bones.For homework, students research different animals and how they achieve support, movement, and protection.  | **Question-led****lesson**: The skeleton**Interactive**: Name those bones!**Activity**: Build yourown skeleton |
| 8.1.3Movement: joints | **Securing Mastery Goals**● 3.8.1 Explain how antagonistic muscles produce movement around a joint. **Exceeding Mastery Goals**● 3.8.1 Predict the consequences of damage to a joint, bone, or muscle. ● 3.8.1 Consider the benefits and risks of a technology for improving human movement.**Enquiry processes**● 2.4 Design a table for the data being gathered.● 2.12 Identify and record key features of an observation.● 2.1 Calculate a mean from a data set.● 2.2 Analyse strengths and weaknesses in your inquiry. | **Know**- State where joints are found in the body. - State how a muscle exerts force during movement. - Carry out an experiment to make simple observations.**Apply**- Describe the structure and function of joints. - Explain how to measure the force exerted by different muscles. - Carry out an experiment to make and record measurements of forces using the correct units.**Extend**- Explain how the parts of a joint allow it to function. - Explain the relationship between the forces required to move different masses. - Carry out an experiment to record measurements of forces in newtons, evaluating the accuracy and precision of the method chosen. | To start, show animation of a skeleton walking. Discuss need for joints and muscles for movement.Students identify joints in their own arms (avoiding wrist and hands) and what range of movement they have.For the main lesson activity, introduce the parts of the arm needed for movement. Students then carry out an experiment investigating the forces required by the arm to lift different masses. Students display results on a graph and answer the questions that follow.In the interactive resource, students use fill in a crossword using key words in this topic.Evaluate the experiment as a discussion with students. For homework, students write a short paragraph about how a different joint elsewhere in the body works.An alternative WebQuest homework activity is also available on Kerboodle where students research hip replacements. | **Practical**: Forces forlifting**Interactive**:The role of joints inmovement**WebQuest:** Hipreplacements**Skill sheet**:Calculating means**Skill sheet**:Choosing scales**Skill sheet**: Recording results |
| 8.1.4Movement: muscles | **Securing Mastery Goals**● 3.8.1 Explain why some organs contain muscle tissue.● 3.8.1 Explain how antagonistic muscles produce movement around a joint. ● 3.8.1 Use a diagram to predict the result of a muscle contraction or relaxation.**Exceeding Mastery Goals**● Predict the consequences of damage to a joint, bone, or muscle. ● Suggest factors that affect the force exerted by different muscles.**Enquiry processes**● 2.3 Interpret observations carried out during a dissection.**Enquiry processes activity:**● 3.8.1 Explore how the skeletal system and muscular system in a chicken wing work together to cause movement. | **Know**- State the function of major muscle groups. - State the definition of antagonistic muscles. - Carry out an experiment to study the muscle system in a chicken wing.**Apply**- Explain the function of different muscles within the body. - Explain how antagonistic muscles produce movement around a joint. - Interpret observations in a chicken wing to describe how the muscles work together to cause movement.- Use a diagram to predict the result of a muscle contraction or relaxation.**Extend**- Explain how the muscle groups interact with other tissues to cause movement.- Explain why it is necessary to have both muscles in an antagonistic pair to cause movement.- Interpret observations in a chicken wing to explain how the muscles work together to cause movement. | To start, using a large image of the human body, students label the muscle groups and describe their function. **Support:** Provide students with labels and descriptions for them to match to the correct muscle groups on their diagram.Students observe any changes in the muscles of the upper arm when lifting a large textbook. In the main lesson practical, students explore how the skeleton and muscles work together within a chicken wing. Students make observations and answer questions.Students complete gap fill on antagonistic muscles on interactive resource. Students must find another antagonistic pair in the body (no names required) and explain how the muscle pair works in order to move the bones about the joint. For homework, provide students with a labelled leg diagram and ask students to write about antagonistic pairs.  | **Practical**:Investigating how a chicken wing works**Interactive**:Revisitingantagonisticmuscles |
| 8.2.1Observing cells | **Securing Mastery Goals**● 3.8.2 Use a light microscope to observe and draw cells. ● 3.8.2 Explain how to use a microscope to identify and compare different types of cell. **Enquiry processes**● 2.5 Add a diagram if it helps to make the meaning clearer.● 2.9 Use the measuring instrument correctly. | **Know**- State what a cell is. - Describe how to use a microscope to observe a cell. - Use a microscope to observe a prepared slide, with assistance.**Apply**- Describe what a cell is. - Explain how to use a microscope to observe a cell. - Use a microscope to observe a prepared slide and state the magnification.**Extend**- Explain what all living organisms are made of. - Explain what each part of the microscope does and how it is used. - Use a microscope to observe a prepared slide calculating a range of magnifications. | To start, ask students to draw an insect or small organism on the board and lead a discussion to consider size. **Support**: Clearly focus on the idea that increasing size helps to see objects. Write key words for of magnification on the board.Students look at small objects through a hand lens and consider what has happened and why.For the main lesson activity, students use microscopes in small groups to find out how they work. Students observe slides under the microscope and complete tasks from practical sheet.**Support**: The support sheet lists parts of a microscope. Students name the parts of a microscope on the interactive resource.Using cards each with a statement about how to use a microscope. Each student needs to stand up and read their card when they think it is their turn.**Support**: Identify the first card player.For homework, students complete the production of the leaflet from the practical activity.An alternative WebQuest homework activity is also available on Kerboodle where students research the development of the microscope. | **AT Practical:** Observing cheek cells under a microscope**Practical**:Discovering the microscope**Interactive**: What’s in a name?**Maths skills:** worked solution to a question on magnification**MyMaths:** link to a MyMaths activity to support observing cells**WebQuest**:Development of the microscope |
| 8.2.2Plant and animal cells | **Securing Mastery Goals**● 3.8.2 Use a light microscope to observe and draw cells. ● 3.8.2 Both plants and animal cells have a cell membrane, nucleus, cytoplasm and mitochondria. Plant cells also have a cell wall, chloroplasts and usually a permanent vacuole.● 3.8.2 Explain how to use a microscope to identify and compare different types of cells. ● 3.8.2 Suggest what kind of tissue or organism a cell is part of, based on its features. **Enquiry processes**● 2.9 Use the measuring instrument correctly.● 2.13 Identify features of an investigation which are hazardous.● 2.13 Identify ways of reducing the risk.**Enquiry processes activity:**● 3.8.2 Identify the principal features of a cheek cell and describe their functions. | **Know**- Identify one similarity and one difference between a plant and an animal cell. - Match some components of a cell to their functions. - With support, prepare and observe a microscope slide safely.**Apply**- Identify and compare the similarities and differences between plant and animal cells.- Describe the functions of the components of a cell. 1–3- Prepare and observe cells on a microscope slide safely.**Extend**- Explain the similarities and differences between plant and animal cells. - Explain the functions of the components of a cell by linking them to life processes. - Prepare and observe cells on a microscope slide safely, using scale and magnifications. | To start, students read the corresponding student-book spread and then use the interactive screen to name the parts of an animal cell.Ask students why we can’t see cells. Then lead them into explaining how scientists do see cells.For the main lesson activity, students complete cheek cell practical using the practical sheet and produce a labelled diagram of a cheek cell.**Support**: First, demonstrate the making of the slide, then help students to make the slide and set up the microscope if necessary.Ask students to follow the instructions to make a slide of an onion cell. Discuss with the students what they could observe in the cheek cell and what they could not see. Students identify parts of a cell that would not be seen in plant cells.For homework, students outline the different components of animal and plant cells. | **Interactive**: Parts of a cell**Practical**: Making a cheek cell slide |
| 8.2.3 Specialised cells | **Securing Mastery Goals**● 3.8.2 Suggest what kind of tissue or organism a cell is part of, based on its features. **Exceeding Mastery Goals**● 3.8.2 Deduce general patterns about how the structure of different cells is related to their function.**Enquiry processes**● 2.5 Use scientific vocabulary accurately, showing that you know its meaning and use appropriate units and correct chemical nomenclature. | **Know**- Name some examples of specialised animal cells. - Name some examples of specialised plant cells. - State structural adaptations of plant and animal cells, summarising this in a table or as a model.**Apply**- Describe examples of specialised animal and plant cells. - Suggest what kind of tissue or organism a cell is part of, based on its features. - Describe structural adaptations of plant and animal cells, summarising this in a table or as a model.**Extend**- Describe examples of specialised animal cells, linking structure and function.- Describe examples of specialised plant cells, linking structure and function.- Compare and contrast structural adaptations of plant and animal cells, summarising this in a table or as a model. | To start, students match plant parts with their function using playing cards or on the board.Students identify features of specialised cells and make suggestions about what the parts might be used for.For the main lesson activity, students research and build a specialised cell, and present it to the class. Students research specialised cells and carry out speed dating activity, teaching others about their cell.**Support**: The teacher controls which cells are researched and built by which student/group.Give more difficult cells to the more able students/groups.Interactive resource where students link cells to their specialised feature and function.Students asked to pick three specialised cells and name a special part and function for each on mini-whiteboards. For homework, students draw and label a specialised cell.  | **Question-led****lesson**: Specialisedcells**Activity**: Building a cell**Activity**: Speed dating**Interactive**:Matchmaking |
| 8.2.4Movement of substances | **Securing Mastery Goals**● 3.8.2 Explain why multi-cellular organisms need organ systems to keep their cells alive. **Enquiry processes**● 2.6 Record observations using scientific words.● 2.9 Choose a suitable range for the independent and dependent variable.● 2.9 Gather sufficient data for the investigation and repeat if appropriate. | **Know**- Identify substances that move into or out of cells. - State simply what diffusion is. - Make sets of observations or measurements of diffusion of coloured gel, identifying the ranges and intervals used.**Apply**- Describe the process of diffusion. - Collect data of diffusion of coloured gel, choosing appropriate ranges, numbers, and values for measurements and observations.- Explain why multi-cellular organisms need organ systems to keep their cells alive.**Extend**- Explain which substances move into and out of cells. - Explain the process of diffusion. - Choose and justify data collection methods of diffusion of coloured gel that minimise error, and produce precise and reliable data. | To start, students complete interactive resource deciding whether cells need certain molecules or not.Pose questions on observation and measurement and discuss**.**In the main lesson practical, students observe diffusion using the practical sheet. There should be a group discussion of observations. **Support**: The support sheet contains a results table for students to use. Help students write in their observations by modelling good practice.Groups feedback their ideas about what they have seen in the experiment and write notes on diffusion. Students act out role play to demonstrate why multi-celluar organisms need organ systems, and cannot just rely on diffusion.For homework, students to produce a drawing of a red blood cell, explaining how oxygen would get into the cell.  | **Interactive**:Wanted or not**Practical**:Observing diffusion**Animation:** Diffusion in cells**Skill sheet**:Recording results |
| 8.2.5Uni-cellular organisms | **Securing Mastery Goals**● 8.3.2 Explain how uni-cellular organisms are adapted to carry out functions that in multi-cellular organisms are done by different types of cell.**Enquiry processes**● 2.9 Use the measuring instrument correctly. | **Know**- Name an example of a uni-cellular organism. - Identify some structures in an amoeba. - Identify some structures in a euglena. - Select the appropriate apparatus to observe an amoeba and a euglena cell.**Apply**- Describe what a uni-cellular organism is. - Describe the structure of an amoeba and a euglena. - Explain how uni-cellular organisms are adapted to carry out functions that, in multi-cellular organisms, are done by different types of cell.- Select the appropriate magnification to observe an amoeba and a euglena cell through a microscope.**Extend**- Explain what a uni-cellular organism is and give detailed examples. - Describe the structure and function of an amoeba. - Describe the structure and function of a euglena. - Give justifications for the choice of magnification when observing an amoeba and a euglena cell through a microscope. | To start, ask to students to name small organisms in our environment, guiding students towards small animals and plants. Then show film of single-celled organisms such as amoeba.**Support**: Remind students about characteristics of life (MRS GREN)Having shown a film of an amoeba, start a discussion about all the things that a cell has to do to survive. For the main lesson activity, students carry out practical investigating uni-cellular organisms using the practical sheet.Students identify the common features of cells on interactive resource, and the unique features of uni-cellular organisms.Ask students to design an imaginary cell that would live in water.For homework, ask students to produce a written description of the cells that they have observed.  | **Practical**:Observing amoeba and euglena**Interactive**:Spot the difference |

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| **9 Ecosystems** |
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| 9.1.1Food chains and webs | **Securing Mastery Goals**● 3.9.1 Combine food chains to form a food web. | **Know**- State the definition of a food chain. - State the definition of a food web.**Apply**- Describe what food chains show. - Describe what food webs show. - Combine food chains to form a food web.**Extend**- Explain the link between food chains and energy. - Explain why a food web gives a more accurate representation of feeding relationships than a food chain. | To start, students share ideas in pairs about some of the key words in this lesson. Discuss as a class before using the interactive resource to complete some simple food chains.Students match the words with their definitions using prepared cards. For the main lesson activity, introduce the definition of a food web and show an example. Students discuss in pairs what they see before discussing as a class.Students then make their own food webs using the organisms provided on the activity sheet, and answer the questions that follow.**Support**: The support sheet provides students with a reduced number of organisms to make food webs. Images of organisms are accompanied by short notes explaining what they eat and what they are eaten by.Present students with a food web and ask them to write as many food chains as possible from that web using mini-whiteboards.Alternatively, present students with several food chains, and ask them to construct a food web from the food chains provided.Students work in small groups to act out a food chain from organisms provided on the board provided in three minutes. Students watch and evaluate each other’s role plays.For homework, students construct a food web and choose one food chain from their food web to annotate using key words. | **Interactive**: Who eats who?**Activity**: Food chains and webs**Maths skills:** worked solution to a question on food chains**MyMaths:** link to a MyMaths activity to support food chains and webs |
| 9.1.2Disruptions to food chains and webs | **Securing Mastery Goals**● 3.9.1 Explain issues with human food supplies in terms of insect pollinators.● 3.9.1 Describe how a species’ population changes as its predator or prey population changes. ● 3.9.1 Explain effects of environmental changes and toxic materials on a species’ population. **Exceeding Mastery Goals**● 3.9.1 Develop an argument about how toxic substances can accumulate in human food.**Enquiry processes**● 2.4 Decide the type of chart or graph to draw based on its purpose or type of data.● 2.4 Label the *x* axis with the name of the independent variable and the *y* axis with the dependent variable.● ● 2.4 Mark out an equal scale showing what each square of graph paper represents. | **Know**- State that one population of organisms can affect another. - State that toxic material can get into food chains. - Present population data as a graph, and describe simple patterns shown.**Apply**- Describe the interdependence of organisms. - Explain effects of toxic materials on a species’ population. - Present population data as a graph to describe trends and draw conclusions.- Explain issues with human food supplies in terms of insect pollinators.**Extend**- Explain the interdependence of organisms. - Explain how toxic materials can accumulate in human food sources. - Present population data as a graph, explaining trends and drawing detailed conclusions from data provided. | To start, discuss possible definitions of interdependence, population, and bioaccumulation.Interactive resource where students predict how populations will change in different circumstances.For the main lesson activity, students create a graph showing the information provided on the gannet population on the island of Grassholm over a period of 18 years. Students answer questions that follow.**Support**: Pre-labelled graph axes are provided on the accompanying support sheet.Students play a card game using the sort cards provided to work out the mystery of ‘What killed the herons?’**Support**: Prompt students towards the first card in the sequence.Students discuss features needed for the best and worst pesticides farmers can use. **Support**: Give prompts, such as, good pesticides would be species-specific, biodegradable, and insoluble.Students think up as many ways as possible that humans can affect a population of organisms. Students write this down and swap ideas. Groups must then work out what effect the human activities listed will have on a population and explain their answers to each other.As an extension to the gannet population activity, for homework ask students to write a prediction on the population of gannets for the different scenarios. | **Interactive**: Up or down?**Activity**: Changes in population**Information:**What killed the herons?**Animation**:Bioaccumulation**Skill sheet:**Drawing graphs |
| 9.1.3Ecosystems | **Securing Mastery Goals**● 3.9.1 Explain effects of environmental changes and toxic materials on a species’ population. ● 3.9.1 Describe how a species’ population changes as its predator or prey population changes. **Enquiry processes**● 2.9 Apply sampling techniques if appropriate. | **Know**- State that different organisms can co-exist. - State the definition of the term niche. - Record data from sampling an ecosystem.**Apply**- Describe how different organisms co-exist within an ecosystem. - Identify niches within an ecosystem. - Use quadrats to take measurements in an ecosystem, describing trends observed.**Extend**- Explain why different organisms are needed in an ecosystem.- Explain why different organisms within the same ecosystem have different niches.- Use quadrats and transects to take unbiased measurements in an ecosystem, describing trends observed in data. | To start, interactive memory matching game where students match key words to their definitions.Show students a quadrat and talk about the sampling techniques used to count the number of plants in a field.For the main lesson activity, introduce students to the idea of ecosystems, habitats, communities, and niches. Explain to students how different organisms can co-exist in the same environment. Students carry out investigation on the school field on plant abundance using sampling techniques.Students answer the questions on their practical sheets.Revisit the seven key words from the start of the lesson and ask students to provide the definitions.Divide the class into groups of three, assigning each group an organism from the school field. Students describe how the organisms are able to co-exist.For homework, students research an ecosystem, highlighting how organisms co-exist. | **Interactive**:Ecosystem keywords**Practical**:Investigating the distribution of a plant**Skill sheet**:Recording results |
| 9.1.4Competition | **Securing Mastery Goals**● 3.9.1 Describe how a species’ population changes as its predator or prey population changes. **Exceeding Mastery Goals**● 3.9.1 Suggest what might happen when an unfamiliar species is introduced into a food web.● 3.9.1 Make a deduction based on data about what caused a change in the population of a species.**Enquiry processes**● 2.1 Identify patterns in data.● 2.3 Make a conclusion and explain it.**Enquiry process activity**● 3.9.1 Use a model to investigate the impact of changes in a population of one organism on others in the ecosystem. | **Know**- State some resources that plants and animals compete for. - Interpret secondary data to describe simple predator–prey relationships.**Apply**- Describe some resources that plants and animals compete for. - Interpret secondary data to describe trends and draw conclusions about predator–prey relationships.**Extend**- Explain the effect of competition on the individual or the population. - Make a deduction based on data about what caused a change in the population of a species.- Suggest what might happen when an unfamiliar species is introduced into a food web. | To start, ask students to think about as many competitions as they can, steering students towards competition for living organisms to survive. Students then complete the interactive activity on environment.Provide students with animals for them to sort into predators and prey organisms. For the main lesson activity, ask students in pairs to produce and compare two spider diagrams to show what plants and animals need to survive. Students plot a graph to show the number of Canadian wolves in Quebec. This graph is drawn on top of an existing graph showing the number of caribou in the same period. Students must interpret the graphs to answer the questions that follow.Students pairshare ideas on what two wolf packs would compete for, and what is likely to happen in terms of outcome for this competition. Students sketch a graph for a predator–prey relationship, with a line to show the effect of competition. For homework, students research the adaptations of a squirrel and the population difference between red and grey squirrels.  | **Interactive:**Competition or environment**Access:** Predator–prey relationships**Activity**: Predator–prey relationships |
| 9.2.1Flowers and pollination | **Securing Mastery Goals**● 3.9.1 Insects are needed to pollinate food crops.● 3.9.2 Flowers contain the plant’s reproductive organs.● 3.9.2 Pollen can be carried by the wind, pollinating insects or other animals.● 3.9.2 Identify parts of the flower and link their structure to their function.**Exceeding Mastery Goals**● 3.9.2 Suggest how plant breeders use knowledge of pollination to carry out selective breeding.● 3.9.2 Describe similarities and differences between the structures of wind pollinated and insect pollinated plants.**Enquiry processes**● 2.9 Use the measuring instrument correctly.● 2.9 Carry out the method carefully and consistently. | **Know**- Name the parts of a flower. - State what is meant by pollination. - Name two methods of pollination. - Follow instructions to dissect a flower.**Apply**- Identify the main structures in a flower and link their structure to their function.- Describe the process of pollination. - Describe the differences between wind- and insect– pollinated plants. - Use appropriate techniques to dissect a flower into its main parts.**Extend**- Explain how the structures of the flower are adapted to their function. - Suggest how plant breeders use knowledge of pollination to carry out selective breeding.- Explain the processes of wind and insect pollination, comparing the similarities and differences between the two.- Record detailed observations from a flower dissection. | To start, students must link the key parts of a flower to their function using the interactive resource.Hold a discussion based on the question. ‘How do plants reproduce?’For the main lesson activity, students use forceps to dissect a simple flower, taking out the four key parts. These parts should then be drawn onto the practical sheet and labelled. Students then answer the questions that follow.**Support**: Demonstrate flower dissection in small groups and use larger flowers that are easier to dissect, for example, fuchsias.In groups, students design and perform a role play where they take on the roles of insects and the parts of the flower required for pollination. **Support**: Students should be told which roles to play in their groups, to limit the role play to its essentials.Show students pollen grains and ask them to decide on the type of pollination they represent.For homework, write an account that describes the process of insect or wind pollination. | **Interactive**: Parts of a flower**Practical**: Flower dissection |
| 9.2.2Fertilisation and germination | **Securing Mastery Goals**● 3.9.2 Describe the main steps that take place when a plant reproduces successfully. **Enquiry processes**● 2.9 Prepare a table with space to record all measurements.● 2.9 Carry out the method carefully and consistently.● 2.1 Select relevant data and do calculations. | **Know**- State what is meant by fertilisation in plants. - State what seeds and fruit are. - Make and record observations of germination.**Apply**- Describe the process of fertilisation in plants. - Describe how seeds and fruits are formed. - Make and record observations in a table with clear headings and units, using data to calculate percentage germination.**Extend**- Explain the process of fertilisation in plants, explaining the role of each of the parts involved in the process.- Explain how the germination of seeds occurs. - Make and record observations in a table, using data to calculate percentage germination, evaluating experimental procedure. | To start, introduce the idea of the germination of seeds and students complete gap-fill activity using the interactive resource.Students look at the instructions on a packet of seeds and discuss the weather conditions indicated that are required for seed germination and growth.**Support**: Use seed packets designed for children and recap on MRS GREN.For the main lesson activity, students carry out a practical to investigate germination with different amounts of water. Students calculate the percentage of successful germinations and plot a graph of their results. They then answer the questions that follow.Students discuss the words ‘accuracy’ and ‘precision’.Discuss why the ability to plot and interpret graphs is important in science, culminating in the conclusion that visual presentation is easier to interpret than tables of data.For homework, students produce labelled diagrams of fertilisation of a plant and germination of a seed. | **Interactive**:Germination**Practical**:Successful seeds**Animation:** Pollination and fertilisation**Skill sheet**:Recording results**Skill sheet**:Calculatingpercentages**Skill sheet**:Choosing scales**Skill sheet**:Drawing graphs**Skill sheet**:Accuracy andprecision |

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| 9.2.3Seed dispersal | **Securing Mastery Goals**● 3.9.2 Describe the main steps that take place when a plant reproduces successfully. ● 3.9.1 Suggest how a plant carried out seed dispersal based on the features of its fruit or seed.● 3.9.2 Explain why seed dispersal is important to survival of the parent plant and its offspring.**Exceeding Mastery Goals**● 3.9.2 Develop an argument why a particular plant structure increases the likelihood of successful production of offspring.**Enquiry processes**● 2.10 Identify a dependent variable.● 2.10 Identify an independent variable.● 2.11 Decide how to vary the independent variable between planned values.● 2.9 Prepare a table with space to record all measurements.● 2.9 Carry out the method carefully and consistently.**Enquiry process activity**● 3.9.2 Use models to evaluate the features of various types of seed dispersal. | **Know**- State what is meant by seed dispersal. - Name the methods of seed dispersal. - Plan a simple experiment, stating the variables, when given a hypothesis.**Apply**- Describe methods seed dispersal, and use the features of seeds and fruit to explain how they are adapted to their method.- Explain why seed dispersal is important to survival of the parent plant and its offspring.- Plan a simple experiment to test one hypothesis about seed dispersal, identifying a range of variables.**Extend**- Explain how the adaptations of seeds aid dispersal. - Develop an argument why a particular plant structure increases the likelihood of successful production of offspring.- Plan and design an experiment to test a hypothesis about seed dispersal, clearly explaining all the variables involved. | To start, show photographs or a short film clip about seed dispersal. Discuss why plants need to move away from the parent plant. Students suggest a definition of seed dispersal.Drop a few sycamore seeds from head-height and discuss observations.For the main activity, students design and carry out their own investigation of seed dispersal, before analysing results, and answering the questions that follow.**Support**: An access sheet is available that guides students through the planning process using a given hypothesis. The access sheet also includes a suggested table of results.Students group characteristics on the interactive resource into either wind or animal dispersal methods. Discuss students’ findings from their experiments. For homework, students should complete the questions on the practical sheet, and draw a graph of their results.  | **Access:** Investigating seed dispersal**Interactive**:Wind and animaldispersal**Practical**:Investigating seed dispersal**Skill sheet**:Planninginvestigations**Skill sheet**:Recording results**Skill sheet**:Calculating means**Skill sheet**:Drawing graphs**Skill sheet**:Choosing scales |

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| **10 Genes** |
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| 10.1.1Variation | **Securing Mastery Goals**● 3.10.1 Explain whether characteristics are inherited, environmental or both. **Exceeding Mastery Goals**● 3.10.1 Critique a claim that a particular characteristic is inherited or environmental.**Enquiry processes**● 2.12 Identify and record key features of an observation.● 2.12 Write a scientific description of the observation, using key words.● 2.6 Suggest a scientific idea that might explain the observation.● 2.6 Describe the evidence for your idea. | **Know**- State what is meant by the term variation. - State that variation is caused by the environment or inheritance. - Record observations of variations between different species of gull.**Apply**- Describe how variation in species occurs. - Explain whether characteristics are inherited, environmental, or both.- Record and categorise observations of variations between different species of gull.**Extend**- Explain how variation gives rise to different species. - Critique a claim that a particular characteristic is inherited or environmental.- Record and categorise observations of variations between different species of gull to suggest species boundaries. | To start, students discuss what the word variation means, and give a possible definition with examples.Give an example of inherited variation, environmental variation, and variation affected by both. Students suggest a reason for the variation of each type.Students read a short passage of text on the interactive resource, and select types of variation dependent on inherited factors, environmental factors, or both.For the main lesson activity, introduce key words. Discuss possible variation in humans due to the three types of factors (inheritance, environmental, or both) before moving on to the activity. In the activity students record variation within different seagull species.**Support**: A support sheet is available where students are given a list of possible variations within the gulls to choose from.Working in small groups, students list human variations as inherited, environmental, or variations affected by both. Students give the definitions of variation, inherited variation, and environmental variation.For homework, list variations between different pet animals and possible causes. | **Interactive**: Causes of variation**Activity**: Variation |
| 10.1.2Continuous and discontinuous | **Securing Mastery Goals**● 3.10.1 Explain whether characteristics are inherited, environmental or both. ● 3.10.1 Plot bar charts or line graphs to show discontinuous or continuous variation data.**Enquiry processes**● 2.4 Select a good way to display data.● 2.4 Explain the choice of type of graph.● 2.4 Explain why different kinds of data are better displayed on different kinds of graphs.**Enquiry processes activity**● 3.10.1 Graph data relating to variation and explain how it may lead to the survival of a species. | **Know**- State that there are two types of variation. - State the two types of graphs that can be drawn when representing the two types of variation.- Record results in a table and plot a graph on axes provided.**Apply**- Describe the difference between continuous and discontinuous variation. - Use knowledge of continuous and discontinuous variation to explain whether characteristics are inherited, environmental, or both.- Plot bar charts or line graphs to show discontinuous or continuous variation data.- Record results in a table and plot a histogram.**Extend**- Explain the causes of continuous and discontinuous variation. - Record results in a table, and identify and plot an appropriate graph to show variation within a species. | To start, students list as many sources of variation as they can just by looking at their classmates and discuss how to categorise them. **Support**: Students concentrate on listing variations, not grouping them.Introduce the difference between discontinuous and continuous variation using examples. Students apply this knowledge to group variations given on the interactive resource into the correct category.For the main lesson activity, formally introduce the difference between continuous and discontinuous variation. Demonstrate how to measure arm span before issuing the practical sheet.Students list ways humans vary and categorise into continuous and discontinuous variation, suggesting possible causes.Call out different types of continuous and discontinuous variations for students to decide on the correct type of variation using a mini-whiteboard. For homework, students create a suitable graph of eye colour from data gathered in the lesson.  | **Interactive**:Discontinuous orcontinuous**Practical**:Investigating arm span**Activity:**Variation |
| 10.1.3Adapting to change | **Securing Mastery Goals**● 3.10.1 Explain how variation helps a particular species in a changing environment.● 3.10.1 Explain how characteristics of a species are adapted to particular environmental conditions.**Exceeding Mastery Goals**● 3.10.1 Predict implications of a change in the environment on a population.● 3.10.1 Use the ideas of variation to explain why one species may adapt better than another to environmental change. | **Know**- Name an environmental change. - Give a possible reason for adaptation or extinction.**Apply**- Explain how organisms are adapted to their environments. - Explain how variation helps a particular species in a changing environment.- Describe how organisms are adapted to their environments.**Extend**- Explain how organisms are adapted to seasonal changes. - Explain how competition or long-term environmental change can lead to evolutionary adaptation or extinction and the role variation plays in a species success.- Predict implications of a change in the environment on a population. | To start, students describe possible changes to the organisms in the school grounds as adaptations to seasonal changes.**Support:** Prompt students to think about deciduous trees and hibernating animals.Students identify the adaptations of cheetahs and hyenas that make them successful hunters.For the main lesson activity, students read about environmental changes in the Arctic and effects on polar bears, and answer questions that follow.**Support**: Read text as a class or in small groups to ensure students can understand the material given.Formally introduce the idea of competition, and the importance of adaptations. In groups, students highlight four adaptations of an organism in the table provided on their activity sheet, before answering questions. **Support**: Students should concentrate on two or three adaptations for the chosen animal.Students produce a time line of the changes that take place in deciduous trees throughout the year and how this is linked to seasonal changes.Interactive resource where students link adaptations of a fish with the function of the adaptation that helps it survive.For homework, students research and write about situations where one organism has adapted better than the other, and the effect on their populations. | **Activity**: Climate change and polar bears**Activity**:Competition andadaptation**Interactive**:Something fishy! |
| 10.2.1Adolescence | **Enquiry processes**● 2.5 Write in a style to fit purpose and audience.● 2.5 Use clear language and well formed sentences. | **Know**- State the definitions for adolescence and puberty. - State changes to the bodies of boys and girls during puberty. - Interpret observations given, as changes that occur in boys or in girls.**Apply**- State the difference between adolescence and puberty.- Describe the main changes that take place during puberty. - Interpret observations given, to categorise the changes during adolescence.**Extend**- Explain the different between adolescence and puberty. - Explain the main changes that take place during puberty. - Interpret observations given, to categorise and explain physical and emotional changes during adolescence. | To start, students discuss what changes occur as we change from a child into an adult. **Support**: Students may find it easier to focus on physical changes, either observed in themselves or observed in their older siblings.Pose the question: ‘Why do we need to grow up?’ Write suggested answers on the board.For the main lesson activity, students sort cards with statements about adolescence on according to changes that occur in girls and in boys, then answer the questions that follow.**Support**: Take out cards relating to emotional changes, to allow students to solely focus on physical changes.Students suggest one typical problem a teenager might have about the changes that they experience during adolescence. Another student then gives advice.For homework, produce an information leaflet on changes at adolescence. | **Activity**: Changes during adolescence**Interactive**:Changes in puberty |
| 10.2.2Reproductive systems | **Securing Mastery Goals**● 3.10.2 Use a diagram to show stages in development of a fetus from the production of sex cells to birth. **Enquiry processes**● 2.5 Use scientific vocabulary accurately, showing that you know its meaning and use appropriate units and correct chemical nomenclature. | **Know**- Name the main structures of the male and female reproductive system, including gametes.- State a function of the main structures of the male and female reproductive system.- Extract information from text to state structures and functions of the key parts of the reproductive systems in a table.**Apply**- Describe the main structures in the male and female reproductive systems.- Describe the function of the main structures in the male and female reproductive systems.- Extract information from text to describe structures and functions of the key parts of the reproductive systems in a table.**Extend**- Explain how different parts of the male and female reproductive systems work together to achieve certain functions.- Explain the adaptations of some of the main structures that help them function.- Extract information from text to explain structures and functions of the key parts of the reproductive systems in a table. | To start, introduce the structures of the male reproductive system, outlining the functions of each of the key structures. Repeat for the female reproductive system.Students should complete the interactive resource, which asks students to label the different parts of these systems.For the main lesson activity, students label diagrams of both reproductive systems, and fill in tables summarising structures and functions, and answer questions that follow.**Support**: A support sheet is provided for students with partially filled-in tables.Students play card game linking reproductive structures with their functions.Play passing game where students name a structure before passing a ball on to another player to say the definitionProduce a crossword with names of the parts of the reproductive systems, using definitions as clues. | **Interactive**: Label these parts!**Activity**: Male and female reproductivesystems |
| 10.2.3Fertilisation and implantation | **Securing Mastery Goals**● 3.10.2 If an egg is fertilised it settles into the uterus lining.● 3.10.2 Use a diagram to show stages in development of a foetus from the production of sex cells to birth. ● 3.10.2 Describe causes of low fertility in male and female reproductive systems.**Exceeding Mastery Goals**● 3.10.2 Make deductions about how contraception and fertility treatments work. **Enquiry processes**● 2.5 Use scientific vocabulary accurately, showing that you know its meaning and use appropriate units and correct chemical nomenclature. | **Know**- State what is meant by a person being infertile. - State what is meant by fertilisation. - State that if an egg is fertilised it settles into the uterus lining.**Apply**- Describe some causes of infertility. - Describe the process of fertilisation and where it occurs in the body. - Use a diagram to show the main steps that take place from the production of sex cells to the formation of an embryo.**Extend**- Discuss some causes of infertility and how these may be treated. - Explain the sequence of fertilisation and implantation. | To start, students use the interactive resource to complete a paragraph on egg and sperm cells.List the three main key words from this lesson on the board: ejaculation, fertilisation, and implantation. Ask students to guess meanings and write these in their books in pencil, and revisit their definitions at the end of the lesson.The main lesson activity is split into two main sections plus one optional task.**Task 1 – The size of egg and sperm cells** Students use diagrams to carry out simple magnification calculations to deduce the actual size of egg and sperm cells.**Task 2 – Sexual intercourse** Students connect phrases together to sequence events that occur during sexual intercourse. **Task 3 – Fertilisation and implantation (optional)** Show the short film on fertilisation and cell cleavage.Students should place the following words in the correct order, defining each term; implantation, fertilisation, intercourse, gamete production, cell division.Students summarise the key causes of low fertility.For homework, students complete the storyboard of their own educational film to cover the entire topic. An alternative WebQuest homework activity is also available on Kerboodle where students research fertility treatment. | **Interactive**: Egg and sperm cells**Access:** Fertilisation and implantation**Activity**:Fertilisation andimplantation**Video**: Fertilisationand implantation**WebQuest**: Fertility treatment |
| 10.2.4Development of a fetus | **Securing Mastery Goals**● 3.10.2 Explain whether substances are passed from the mother to the fetus or not.● 3.10.2 Use a diagram to show stages in development of a fetus from the production of sex cells to birth. **Exceeding Mastery Goals**● 3.10.2 Predict the effect of cigarettes, alcohol or drugs on the developing fetus.**Enquiry processes**● 2.5 Use clear language and well formed sentences.● 2.5 Use scientific vocabulary accurately, showing that you knowits meaning and use appropriate units and correct chemical nomenclature.**Enquiry processes activity**● 3.10.2 Relate advice to pregnant women to ideas about transfer of substances to the embryo. | **Know**- State the definition of gestation. - State how long a pregnancy lasts.**Apply**- Describe what happens during gestation. - Describe what happens during birth. - Explain whether substances are passed from the mother to the foetus or not.**Extend**- Describe accurately the sequence of events during gestation. - Explain in detail how contractions bring about birth. - Predict the effect of cigarettes, alcohol, or drugs on the developing fetus. | To start, write a key word on the board. Students suggest another word that is connected to the key word, repeat the process.Lead a short discussion about the ideas of development. The main lesson activity is split into three sections with students in ‘home’ and ‘expert’ groups.**Task 1 – Becoming experts** Each member of the home group moves to a designated table to collect information from the resource card available.**Task 2 – Returning home** Students return to their home group and have five minutes to teach each topic to one another.**Task 3 – Answering questions** Students then attempt the questions on the activity sheet.Students link key words in this topic to their definitions using the interactive resource.Students revisit their ideas from the beginning of the lesson.For homework, write an account of the development of a baby | **Activity**:Developmentand birth**Interactive**:Development links |
| 10.2.5The menstrual cycle | **Securing Mastery Goals**● 3.10.2 The menstrual cycle lasts approximately 28 days.● 3.10.2 Identify key events on a diagram of the menstrual cycle.**Exceeding Mastery Goals**● 3.10.2 Make deductions about how contraception and fertility treatments work. ● 3.10.2 Explain why pregnancy is more or less likely at certain stages of the menstrual cycle.**Enquiry processes**● 2.4 Decide the type of chart or graph to draw based on its purpose or type of data. | **Know**- State the length of the menstrual cycle. - State the main stages in the menstrual cycle. - Present key pieces of information in a sequence.**Apply**- State what the menstrual cycle is. - Identify key events on a diagram of the menstrual cycle. - Present information in the form of a graphical timeline.**Extend**- Explain why pregnancy is more or less likely at certain stages of the menstrual cycle.- Make deductions about how contraception methods work. - Present information in the form of a scaled timeline or pie chart. | To start, ask students to suggest as many events in nature as they can that occur in cycles. Interactive resource in which students complete a paragraph on the menstrual cycle. For the main lesson activity, students sequence boxes containing events in the menstrual cycle in the correct order, and answer the questions that follow.Students place menstrual cycle event cards in the correct sequence to form a loop. Students scale the menstrual cycle to one minute and organise menstrual cycle event cards around a clock to represent this. **Support**: Students should work on the scale of two seconds = one day.For homework, students should prepare five questions on reproduction, together with a mark scheme.Ask students to find out how contraception methods work.  | **Question-led****lesson**: The menstrual cycle**Interactive:**Menstrual cyclefacts**Activity**: Timeline of the menstrualcycle |