

# Disciplinary Knowledge of Science



Year Group	<b>Enquiry Process: Analyse</b> <i>Analyse patterns (comparing, describing)          Discuss limitations (observe, describing)          Draw conclusions (observe, conclusions, apply)          Present data (numeracy, tables and graphs)</i>	<b>Enquiry Process: Communicate</b> <i>Communicate ideas (vocabulary)          Construct explanations (explain)          Critique claims (evaluate)          Justify opinions (vocabulary, applying, explaining)</i>	<b>Enquiry Process: Enquire</b> <i>Collect data (planning, comparing, numeracy, tables &amp; graphs)          Devise questions (evaluate, vocabulary)          Plan variables (Planning)          Test hypotheses</i>	<b>Enquiry Process: Solve</b> <i>Estimate risks          Examine consequences          Review theories (describe, explain)          Interrogate sources</i>
7	<b>7K – Forces</b> Pupils will carry out the 'Hooke's Law' investigation, with a focus on presenting data.  During the task, pupils will: <ul style="list-style-type: none"> <li>- Design a <b>table</b> for the data being gathered</li> <li>- Write <b>unit labels</b></li> <li>- Decide which type of <b>chart or graph</b> to draw based on purpose or type of data</li> <li>- <b>Label axes with the independent and dependent variables</b></li> <li>- Decide which numbers to start / finish on each axis</li> <li>- Mark out an <b>equal scale</b></li> </ul>	<b>7I – Energy (Renewable and Non-renewable Energy Resources)</b>  <b>Justify opinions and Critique claims</b> – Pupils are presented with advantages and disadvantages of renewable energy resources and match with each type of energy resources. Using this information, pupils complete a task relating to the UKs 'Building back greener' strategy. Pupils have to give reasons for agreeing with Boris Johnson's strategy and reasons for disagreeing with it. Pupils should then present an idea and explain reasons for their choice.	<b>7I – Energy (Renewable and Non-renewable Energy Resources)</b>  Pupils will complete a full investigation on finding the energy stored in different food e.g. crisps. They will focus on:  <b>Planning (variables), hypothesis, comparing, tables, graphs and numeracy.</b>	<b>7I – Energy (Climate Change)</b>  This is an ICT task. Pupils will be given the link for the NASA Climate Change website. Research the current and predicted consequences of climate change both locally and globally. Pupils will use this information to write a letter to the Prime Minister about why it is important that we reduce our use of fossil fuels.
8	<b>8C Breathing and Respiration</b> Pupils will complete a full investigation to compare their breathing rate for 'no, light and heavy exercise'. They will focus on:  <b>Planning (variables), hypothesis, comparing, tables, graphs and numeracy.</b>  Class Practical: Measuring breathing rate at rest and after exercise <ul style="list-style-type: none"> <li>• Discuss variables and make a hypothesis</li> <li>• Plot bar chart (rest / after exercise) or line graph (breathing rate every minute for 5 mins after exercise)</li> <li>• Make a conclusion about the effect of exercise on breathing rate</li> <li>• Discuss limitations of the practical</li> </ul>	<b>8G – Metals and their Uses</b> <b>Communicate ideas and construct explanations.</b> Pupils are presented with a table of data relating to a number of different metals. Pupils have to construct explanations as to why metals have been chosen for specific purposes. Pupils have to justify why they have made a decision to use a metal for a specific purpose.	<b>8C Breathing and Respiration</b> Pupils will complete a full investigation to compare their breathing rate for 'no, light and heavy exercise'. They will focus on:  <b>Planning (variables), hypothesis, comparing, tables, graphs and numeracy.</b>  Class Practical: Measuring breathing rate at rest and after exercise <ul style="list-style-type: none"> <li>• Discuss variables and make a hypothesis</li> <li>• Plot bar chart (rest / after exercise) or line graph (breathing rate every minute for 5 mins after exercise)</li> <li>• Make a conclusion about the effect of exercise on breathing rate</li> <li>• Discuss limitations of the practical</li> </ul>	<b>9E – Making Materials</b> Pupils to analyse data about the manufacturing process for plastics and paper bags. Pupils will be provided with information about the usage and disposal of each bag. Pupils to complete a life cycle assessment on the use of plastic and paper bags.  <b>7F – Acids and Alkalies</b> Pupils compare the hazardous nature of different acids by making simple observations of chemical reactivity. <ul style="list-style-type: none"> <li>• Pupils to place acids in order of hazard, describe how diluting acids affects the hazard</li> <li>• Pupils to suggest sensible precautions that can be taken to mitigate the risk</li> </ul>
9	<b>8E - Combustion</b> Pupils will carry out an investigation into how the type of fuel affects the temperature change.  Pupils will be provided with the aim and will construct a hypothesis themselves. The method will be demonstrated by the teacher. Pupils will then complete the experiment.  Once they have completed the practical, pupils will then: <ul style="list-style-type: none"> <li>- Calculate the mean and range for each fuel</li> <li>- Make a conclusion about which fuel is the best and comment on whether there is a real difference</li> <li>- Evaluate their experiment and suggest improvements</li> <li>- Use secondary data to support or refute their conclusion, suggest scientific reasons for their conclusion and evaluate a conclusion.</li> </ul>	<b>8E - Combustion</b> <b>Task 1:</b> After the spirit burner practical, pupils are given a worksheet with data on different fuels. Pupils are required to calculate the amount of energy released from each fuel and then decide which fuel they would use. Pupils are presented with energy release, volume of carbon dioxide released, efficiency and volatility. Pupils have to justify the decision they have made.  <b>Task 2:</b> Pupils are given worksheet 7IC-7 and are required to analyse the information on fuels and justify their answers using the data provided.	<b>8E - Combustion</b> Pupils will be asked to complete a practical on 'finding out the amount of energy stored in the different fuels ethanol and propanol'. They will have a worksheet 8Ec-3 (comparing fuels) to guide them and stick in their book. Pupils will plan the task and complete the practical. A results table will be completed.  Using their results a class average was calculated. The energy released is then calculated using the equation $Q=m \times c \times \text{temperature change}$ . A graph should be drawn, as well as writing a conclusion.	<b>7D – Ecosystems</b> Pupils identify the possible consequences to the environment, humans and other organism, from the use of persistent pesticides. Pupils will also weigh up the pros and cons of using these types of pesticide, as well as growing crops organically.

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10 Biology	<b>B1.3.2 Osmosis</b> Pupils will carry out an investigation into how changing the concentration of sugar solution affects the mass of a piece of potato.  Pupils will write a hypothesis based on their scientific understanding of osmosis and identify independent, dependent and control variables.  Once they have completed the practical, pupils will then: <ul style="list-style-type: none"> <li>- Calculate the percentage change for each piece of potato</li> <li>- Compare their results with other groups and identify any anomalous results</li> <li>- Identify any pattern in their results and suggest a scientific explanation for the change in mass (in terms of direction of water movement)</li> <li>- Suggest ways to reduce measurement errors</li> <li>- Use secondary data to plot a line graph showing concentration and percentage change in mass (positive and negative y-axis)</li> <li>- Estimate the concentration inside the potato using the line of best fit.</li> </ul>	<b>B1.3.2 Osmosis</b> Pupils will carry out an investigation into how changing the concentration of sugar solution affects the mass of a piece of potato.  Pupils will use their finding to explain the importance for diabetics to control their blood sugar concentrations.	<b>B1.3.2 Osmosis</b> <ul style="list-style-type: none"> <li>- Accurately measure and record the length and mass of each potato cylinder.</li> <li>- Record the lengths and masses of each potato cylinder in a table.</li> <li>- Re-measure the length and mass of each cylinder, after being left overnight in different concentrations of salt or sugar solutions (make sure you know which is which).</li> <li>- Record your measurements in the table. Then calculate the changes in length and mass of each potato cylinder.</li> </ul> Plot a graph with: 'Change in mass in g' on the y-axis and 'Concentration of sugar solution' on the x-axis  Plot another graph with: 'Change in length in mm' on the y-axis and 'Concentration of sugar solution' on the x-axis.	<b>B3.1.9 Development of Drugs</b> Students to analyse the way drugs are trialled and be able to define the key terms of this methodology. Compare the usefulness of animal drug trials and our ability to make links to human behaviour from these trials. Analyse drug trial data and draw conclusions from this information.
	<b>B4.1.1 Photosynthesis</b> Pupils will carry out an investigation into how changing the light intensity will affect the rate of photosynthesis in pondweed. <ul style="list-style-type: none"> <li>- To change the light intensity, pupils will change the distance between the lamp and pondweed.</li> <li>- Pupils will use the number of oxygen bubbles produced as a measure of the rate of photosynthesis.</li> </ul> Pupils will write a hypothesis based on their scientific understanding of photosynthesis and identify independent, dependent and control variables.  Once they have completed the practical, pupils will then: <ul style="list-style-type: none"> <li>- Calculate the mean for each distance used</li> <li>- Identify any pattern in their results and comment on whether findings fit with known scientific explanations</li> <li>- Use the inverse square law to calculate the light intensity</li> <li>- Plot a line graph to present data on light intensity</li> <li>- Use a line graph to estimate values of data between known values</li> <li>- Describe the relationship between distance and light intensity</li> </ul>	<b>B4.1.1 Photosynthesis</b> Pupils will carry out an investigation into how changing the light intensity will affect the rate of photosynthesis in pondweed.  Pupils will use their findings and apply their results to explain how greenhouses maximise the rate of photosynthesis and production of crops.	<b>B2.1.1 The Human Digestive System</b> Use qualitative reagents to test for a range of carbohydrates, lipids and proteins. To include: Benedict's test for sugars; iodine test for starch; Biuret reagent for protein.	<b>B2.1.1 The Human Digestive System</b> Pupils are to complete the risk assessment table at the start of the worksheet. Successful completion will demonstrate how pupils are able to identify hazards and risks, as well as suggest how an investigation can be completed safely in a school Science laboratory.

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10 Chemistry	<b>C5.1.1 Energy Changes</b> Pupils will carry out an investigation into how increasing the volume of sodium hydroxide added to hydrochloric acid affects the maximum temperature change  Pupils will write a hypothesis based on their scientific understanding of chemical reactions and identify independent, dependent and control variables.  Once they have completed the practical, pupils will then: <ul style="list-style-type: none"> <li>- Calculate a mean temperature change for each volume</li> <li>- Compare their results with other groups, identify any anomalous results and state whether their results are reproducible</li> <li>- Identify any pattern in their results and suggest a scientific explanation for the temperature change</li> <li>- Suggest ways to reduce measurement errors</li> <li>- Use their results to plot a line graph and construct two lines of best fit</li> <li>- Estimate the point of neutralisation using their graph</li> </ul>	<b>C1.1 Atomic Theory</b> Create a timeline for the history of the atomic model. This must include descriptions of the differences between the plum-pudding model, nuclear model and atomic model, as well as explaining how experimental techniques led to changes in the model. Pupils should ensure that they use key scientific vocabulary and communicate their ideas effectively	<b>C10 – Water Purification</b> <b>Using the required practical resource sheet:</b> <ul style="list-style-type: none"> <li>- Use appropriate apparatus to measure pH.</li> <li>- Use appropriate apparatus safely and techniques to heat a sample of water.</li> <li>- Estimate the mass of dissolved salts using evaporation.</li> </ul> Pupils will complete a full investigation. This will include: Planning (variables), hypothesis, comparing, tables, graphs and numeracy.	<b>C1.1 Atomic Theory</b> Create a timeline for the history of the atomic model. This must include descriptions of the differences between the plum-pudding model, nuclear model and atomic model, as well as explaining how experimental techniques led to changes in the model. Pupils should ensure that they use key scientific vocabulary and communicate their ideas effectively.
11 Chemistry	<b>C6.1.2 Factors Affecting the Rate of a Reaction</b> Pupils will carry out an investigation into how changing the concentration of hydrochloric acid will affect the rate of reaction with magnesium ribbon.  Pupils will write a hypothesis based on their scientific understanding of rates of reaction and identify independent, dependent and control variables.  Once they have completed the practical, pupils will then: <ul style="list-style-type: none"> <li>- Compare their results with others and identify any pattern in their results</li> <li>- Comment on whether findings fit with known scientific explanations</li> <li>- Suggest ways to reduce measurement errors</li> <li>- Use secondary data to plot a line graph, using a key to differentiate between different concentrations</li> <li>- Use a line graph to estimate values of data between known values (i.e. use a tangent to calculate the rate of reaction at a particular time)</li> </ul>	<b>C6.1.2 Factors Affecting the Rate of a Reaction</b> Pupils will carry out an investigation into how changing the concentration of hydrochloric acid will affect the rate of reaction with magnesium ribbon.  Pupils will use their knowledge of collision theory to explain the changes in the rate of a chemical reaction.	<b>C6 – Rates of a Chemical Reaction</b> <ul style="list-style-type: none"> <li>- Pupils to complete the Gas Syringe required practical using magnesium and hydrochloric (details found in booklet)</li> <li>- Pupils to complete the resource sheet.</li> <li>- Using the provided results, pupils should draw a graph and analyse the results.</li> <li>- Pupils to use numeracy skills to calculate the rate of the chemical reaction.</li> </ul>	<b>C10 – Life Cycle Assessments</b> Pupils to complete life cycle assessments on plastic vs glass milk bottles and plastic vs paper bags. Pupils to examine the consequences of using each material for the specified purpose.

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10 Physics	<p><b>P2.1.3 Electricity</b>          Pupils will measure the PD and Current for a range of lengths of wire from 30 to 10cm  <b>Before they complete the practical pupils will:</b>          - Design a results table to collect the data  <b>Once they have completed the practical, pupils will then:</b>          Decide what type of graph to draw (with reasons)          - Draw a graph of their results deciding on their own scale          - Express the relationship on the graph (proportionality)          - Look at secondary data from similar investigations and identify the independent and dependent variables.</p> <p><b>P5.3 Forces and Extension of a Spring</b>          Pupils will measure the un-stretched length of the spring and then add load to the spring to measure its stretched length and then calculate the extension of the spring          Pupils to use their results to explain Hooke's Law. Pupils will use the correct vocabulary when explaining Hooke's Law.</p>	<p><b>P5.3 Forces and Extension of a Spring</b>          Pupils will measure the un-stretched length of the spring and then add load to the spring to measure its stretched length and then calculate the extension of the spring          Pupils to use their results to explain Hooke's Law. Pupils will use the correct vocabulary when explaining Hooke's Law.</p>	<p><b>P5.3 Forces and Extension of a Spring</b>          Pupils will :-          - Hang different masses from a spring and measure the extension of the spring for each mass used.          - Convert mass to weight.          - Record their results in a results table.          - Use their results to plot a graph of extension against weight.          - Analyse results: Write a conclusion and calculate the spring constant for the spring. Force= spring constant x extension and the work done in stretching the spring          Elastic potential <b>energy = 0.5 x spring constant x (extension)<sup>2</sup></b>.</p>	<p><b>P4.1 Atomic Radiation</b>          Pupils to complete the Atomic Structure booklet whilst being taught the topic. This includes questions and tasks which involve reviewing the development of theory around the structure of the atom.</p>
11 Physics	<p><b>P6.2 Waves</b>          - Pupils set up cans with cold water in and place them near radiant heat source to warm the water up, they measure the temperature change over a fixed period of time.          - Pupils set up cans with hot water in and allow the water to cool, they measure the temperature change over a fixed period of time.          - The teacher demonstrates Leslie's cube (by filling with hot water and measuring the IR emitted for each side using the sensor)          - Once the method has been discussed pupils will: Design a results table for the data being gathered,          - While the water is heating up / cooling down pupils will:          - Decide the type of graph to draw based on the data that will be obtained from the experiment          - Once the results are collected the pupils will: Draw a graph labelling the x and y axes with scales.          - Make a conclusion from the data (black/silver)          - Suggest other possible conclusions that could be made from the data (matt / shiny)</p>	<p><b>P5.6.2.2 Newton's Second Law</b>          Investigate the effect of varying the force on the acceleration of an object of constant mass, and the effect of varying the mass of an object on the acceleration produced by a constant force.          Pupils will carry out the investigation and explain the results using the correct scientific vocabulary.</p>	<p><b>P2.1.4 Electricity</b>          Investigating the I-V characteristic of (a) a filament lamp (b) a resistor and a (c) diode at constant temperature.          Pupils will:          - Record their results for current and potential difference in a results table.          - Use their results to plot a graph of current against voltage.          - Write a conclusion for each component describing the shape of graph and why it is this shape.          - Calculate the resistance for the fixed resistor. Potential difference= current x resistance.</p>	<p><b>P5.6.2.2 Newton's Second Law</b>          Pupils will review Newton's Second Law 'that the acceleration of an object is dependent upon two variables - the net force acting upon the object and the mass of the object'.          Pupils will use the results of the investigation describe and explain their findings.</p>

## The Purpose of Practical Work

### Practical work to help pupils develop substantive knowledge:

There are five distinct purposes of practical work related to learning substantive knowledge. Pupils should always be made aware of the reason for each practical taking place.

Purpose	To help pupils to...	Examples of curriculum intent
1	Identify objects and phenomena	Materials such as glass, wood and metal; 2 magnets moving apart
2	Learn a fact	Pure water boils at 100°C, salt dissolves in water but not oil
3	Learn a concept	Osmosis
4	Learn a relationship	Hooke's Law
5	Learn a model or theory	Brownian motion as evidence for the particle theory of matter

### Practical work to help pupils develop disciplinary knowledge:

Pupils carry out practical work to use laboratory equipment of specific aspects of scientific enquiry. Built into every lesson of our KS3 scheme of work, pupils have the opportunity to develop their disciplinary knowledge (working scientifically skills). Each unit at KS3 has specific skills to develop within each unit.

We are developing a five year plan to consistently focus on the following skills and track their progression through the five year curriculum.

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