ACET Junior Academies'

Scheme of Work for Science

Big Ideas - Materials

Year 5 – Properties of materials

About this unit:

PoS – Properties and changes of materials

Students studied materials in years 1,2 and 4. They will have learnt how to identify them, and distinguish between them. They should have learnt the term 'properties', and know that the properties of a material are key to how we use it, and what we use it for. They will have learnt about how some materials can change state between solid, liquid and gas.

In this, our first look at materials in Y5, the students should be investigating and comparing the properties of the materials for themselves. This ties in with the link to scientists across the year. Instead of being taught about the properties, and then exploring them, students should start to work as scientists would, finding out for themselves which is the hardest/most soluble, and why we use different materials in different ways. The concepts and words used are not very different from Y4, but the way the students learn should be. They should be made aware that they are working like scientists to find things out and record data.

Later in Y5, the students will go on to investigate how they can change materials, and create new ones. They will contrast this with the reversible changes they learnt about in Y4. Key to success in that second unit will be their understanding of materials which is consolidated here, with knowledge and understanding of properties and use of key terms.

Unit structure

This unit is structured around seven science enquiries:

1. What are the properties of materials?
2. How are different materials used?
3. What's the best material for a spoon?

4a. Investigating solubility
4b. Investigating hardness
5. What are wires made of – and why?

Links to previous and future National Curriculum units

Y1&2 – Uses of everyday materials
Y3 – Rocks
Y4 – States of matter

- Later Y5 unit – Reactions (*changes of materials)*

KS3&4 - Chemistry

6. How are new materials invented?
7. Can you use your knowledge to help out Cadbury's?

Enquiry 1: What are the properties of materials?			
Links to previous learning	**Scientific skills**	**Assessment criteria**	**Curricular links**
Y1 & 2 Uses of everyday materials Y4 – States of matter	EA – Problem solving Asking questions Making predictions **Observing & measuring** **Key concepts:** All materials can be identified by their properties. We use key terms to describe the properties of a material.	**Can your children:** - Identify and describe the properties of a material - Use key terms relating to properties correctly	**Horizontal:** **Vertical:** KS3&4 Chemistry

Key terms	**Common misconceptions**
Wood, metal, ceramic, plastic, rock, fabric, glass, hard, soft, shiny, waterproof, strong, flexible/bendy, brittle, malleable	*Students commonly misunderstand 'hard' and 'strong'*

Suggested activities	**Resources**	**Useful links**
Review information from Y2 and Y4. Students should be given/shown a range of materials (given is better as they can handle them and get more information). They should group them – allow them to do this using whatever criteria they want. Usual groups are – type of material, or use, or properties. Today is about the properties. Introduce the key words they will need. Get the students to group the materials using these key words. This will lead to some materials being in more than one group. *GD – discuss this. Which are the most useful materials and why?* Hardness – how difficult it is to scratch Strength – how difficult it is to break Brittle – snaps easily Malleable – you can change its shape Shiny Mass (how heavy it is – it may be difficult to compare this if the size of the objects are different) *GD students may have an awareness of density* Conducts heat (it's ok to say 'carries heat' or 'heats up easily)	Examples of different materials – fabric, rock, plastic, metal, wood, ceramic, glass	

Conducts electricity (it's ok to say 'carries electricity' or 'lets electricity flow')		

Enquiry 2: How are different materials used?			
Links to previous learning	**Scientific skills**	**Assessment criteria**	**Curricular links**
Y1 & 2 Uses of everyday materials Y4 – States of matter	EA – Pattern seeking Asking questions Making predictions **Recording data** **Key concepts:** Different materials are used in different ways. The properties of materials make them useful in different ways.	**Can your children:** - Identify what purpose different materials are used for - Explain why a material is used in a particular way, with reference to its properties	**Horizontal:** **Vertical:** KS3&4 Chemistry

Key terms	**Common misconceptions**
Wood, metal, ceramic, plastic, rock, fabric, glass, hard, soft, shiny, waterproof, strong, flexible/bendy, brittle, malleable	

Suggested activities	**Resources**	**Useful links**
Wood, metal, plastic – students should think of different uses for these materials. Link with words from the previous lesson – *why* is a material used in a particular way? Discuss with students the best way of recording the data in an organised fashion. Students can make their own table, but difficulties with this should not hold them back from making observations. This should lead to discussions about how the materials can be different. Are all metals the same as each other? Or all plastics?		

Description of where a material is used	Name of material used	Property of that material

Make sub-groups of the materials. How many different types of plastic can you think of? *There's no correct answer – what is important are the students' decisions – e.g. flexible like carrier bags, hard like plastic trucks, rigid like a ruler.* Do the same for metal – hard, flexible, wiry etc. Does changing the shape of a material make it more useful? Think of a metal – it can be used as the end of a hammer, or as a thin chain for a necklace. Show pictures of both. When you change a lump of metal into a thin wire, how do you change its properties?		

<table>
<tr><th colspan="4">Enquiry 3: What's the best material for a spoon?</th></tr>
<tr><th>Links to previous learning</th><th>Scientific skills</th><th>Assessment criteria</th><th>Curricular links</th></tr>
<tr><td rowspan="2">Y1&2
Uses of everyday materials
Y4 States of matter</td><td>EA – Comparative/fair testing

Asking questions
Making predictions
Setting up tests</td><td rowspan="2">Can your children:
- Tell you why they were doing the investigation
- What factors they kept constant in order to make a fair test</td><td rowspan="2">Horizontal:

Vertical:
KS3&4 - Chemistry</td></tr>
<tr><td>Key concepts:
We can carry out an investigation to find out which material conducts (carries) heat best.
When we are comparing materials, we need to keep everything but the materials the same.</td></tr>
<tr><th colspan="2">Key terms</th><th colspan="2">Common misconceptions</th></tr>
<tr><td colspan="2">Investigate, materials, conduct, carry, heat, fast, slow, fair, constant</td><td colspan="2"></td></tr>
<tr><th>Suggested activities</th><th>Resources</th><th colspan="2">Useful links</th></tr>
<tr><td>Why do we use a wooden spoon for stirring a pan, but a metal spoon for eating? Some students may mention 'plastic' spoons for stirring pans – these are not plastic but silicon. Students may not have heard of silicon before – they can investigate a silicon or plastic spoon with the wood and metal, and investigate it further as a material.

<table><tr><td>Stirring a pan of hot food</td><td>Putting food into my mouth</td></tr><tr><td></td><td></td></tr></table>
Students should begin by thinking about what they want the spoon to do – be strong, not bend etc. The principal properties to guide them towards are that the spoon in the pan should not get hot (conduct heat), and the spoon I eat with should not give me splinters, and should be easy to wash.
The last two are obvious, but the first one is more difficult to measure.

Students can put a wooden cooking spoon and a tea spoon into a container of hot water, and see which gets hot first. Students should realise that this is unfair.

They should discuss how to make the test fairer – use a small wooden spoon (as are used in some takeaways) with a teaspoon, or a large metal spoon (like a serving spoon) with a large wooden spoon. Is the starting temperature of the water the same?</td><td>2 or 3 spoons of a similar size – wooden, metal and plastic or silicon
Container for hot water
Kettle or other source of hot water
Butter
Thermometer</td><td colspan="2">https://www.youtube.com/watch?v=pVwWjsabDXE – investigating heat conduction using spoons, butter and hot water</td></tr>
</table>

How do you decide when the end of the spoon has become hot? Allow the students to try this out – but that it depends on our judgement and is not really fair. You could use butter on the end of the spoon as a more reliable way of measuring when heat has passed up to the end. Students should become aware of more than just 'making a fair test'. They should be able to say what they want to keep the same/which variables they want to control, with an awareness that they might not be able to control some of them. They should begin to discuss the impact of this on the accuracy and precision of their results. This lesson is not so much about the results, as learning the process of investigating. When discussing a 'fair test', the students should be aware that they are keeping factors the same, but they should also know that ONLY the factor we are investigating (the material) changes between tests.		

<table>
<tr><th colspan="4">Enquiry 4a: Investigating solubility</th></tr>
<tr><th>Links to previous learning</th><th>Scientific skills</th><th>Assessment criteria</th><th>Curricular links</th></tr>
<tr><td rowspan="2">Y1&2
Uses of everyday materials
Y4 States of matter</td><td>EA – Comparative/fair testing

Asking questions
Making predictions
Setting up tests</td><td rowspan="2">Can your children:
- Tell you what they were trying to find out in this investigation
- Identify the factors that needed to be kept the same

GD – explain why they had to be kept the same</td><td rowspan="2">Horizontal:

Vertical:
KS3&4 Chemistry</td></tr>
<tr><td>Key concepts:
When we're carrying out an investigation to compare things, we should be measuring something so that we can give numbers in the answer.
When we are comparing things, we should keep everything except the things we're comparing the same.</td></tr>
<tr><th colspan="2">Key terms</th><th colspan="2">Common misconceptions</th></tr>
<tr><td colspan="2">Investigation, comparing, variable, the same, constant, fair, measure, number</td><td colspan="2"></td></tr>
<tr><th colspan="2">Suggested activities</th><th>Resources</th><th>Useful links</th></tr>
<tr><td colspan="2">Solubility – Sugar cubes, lumps, granulated, caster – which dissolves the fastest?

Students need to choose the variables:
- What will they change each time? (only one thing)
- What will they measure each time? (only one thing)
- What will they keep the same each time? (more than one thing)

These are the independent, dependent and control variables – but it is more important that the students have been involved in the decision making process around them and how to do the investigation than knowing the name of them.

Collect results and give a numerical conclusion, e.g. the caster sugar took 30seconds, but the sugar cube took 90seconds. GD students – instead of just saying which sugar is the fastest to dissolve, try and give a measure of how much faster it dissolves.</td><td>Sugar cubes, lumps, granulated, caster
Teaspoons or small spatulas
Beakers or small glasses for water
Stopwatches</td><td></td></tr>
</table>

Students should be given an outline table for results, in order that they can focus on the variables and result.

Type of sugar	Time taken to dissolve (s)

Students could also evaluate this investigation – was it easy to tell when the sugar had dissolved? Was it easy to keep factors the same? Can they suggest a better way of finding out the answer?

Enquiry 4b: Investigating hardness

Links to previous learning	Scientific skills	Assessment criteria	Curricular links
Y1&2 Uses of everyday materials Y4 States of matter	EA – Comparative/fair testing Asking questions Making predictions **Evaluating**	**Can your children:** - Tell you what they were trying to find out in this investigation - Identify where they could have made errors in their investigation*	**Horizontal:** **Vertical:** KS3&4 Chemistry
	Key concepts: We can measure the hardness of a material by scratching it. Some investigations don't give us very accurate results.		

Key terms	Common misconceptions
Hard – the hardness of an object means how difficult it is to scratch it. A soft material scratches easily, a hard one does not.	**Students often think they should evaluate their results, when it is their method – what they did & how they did it – that they need to review.*

Suggested activities	Resources	Useful links
Hardness – Give the students a range of materials of differing hardness – ensure there are at least 3-4 relatively hard objects. They need to rank them in order of hardness. Allow them to discuss first – have they considered the true definition of hardness? How will they measure hardness so that it can be ranked? It's unlikely that they will be able to do this entirely reliably in the classroom. Get different groups to try it, and then compare results – they may have different answers to other groups. Students should be encouraged to come up with ideas for how this could be carried out reliably – how can you make sure you scratch in the same way each time? How can you judge how easily something is scratched? *They should **evaluate** how they investigated the hardness. The important thing is **to identify what might have produced inaccurate answers.** Thinking of improvements to the method is a good idea, but less important than seeing problems with the method. This does **not** mean that the students carried out the method badly, it usually means that we don't have the resources to hand to carry out the investigation perfectly.		

Rockwell hardness test – youtube videos tend to be v complicated, but you could show the students the machines to illustrate that there are ways of scratching materials that are much more reliable than a human doing it!		

Enquiry 5: What are wires made of – and why?			
Links to previous learning	**Scientific skills**	**Assessment criteria**	**Curricular links**
Y1&2 Uses of everyday materials Y4 Electricity	EA – Problem solving Asking questions Making predictions **Observing** and measuring	**Can your children:** - Tell you what they were trying to find out in this investigation - Explain why two different materials are needed to make a wire	**Horizontal:** **Vertical:** KS3&4 Chemistry
	Key concepts: We can only tell whether something conducts or insulates electricity by testing it. Many objects need to be made from a combination or two or more materials		

Key terms	**Common misconceptions**	
Electricity, conduct (carry electricity/let it flow), insulate (stop electricity flowing),		
Suggested activities	**Resources**	**Useful links**
Show the students a wire leading to an appliance that is switched on. Recall – the appliance is working because a current is flowing along the wire and into the appliance. There is a completed circuit. Give the students short pieces of electrical wire. Let them see that it is made from two materials. What are the functions of the materials? Some may know that the metal in the centre conducts electricity, and that the plastic insulation prevents the electricity from 'leaking' out and not completing the circuit (this is a short circuit), or from causing electrical shocks. Electrical equipment – opportunity to recall knowledge from Y4. Set up circuits to test the electrical conductivity of the different parts of the wires (have some 'naked' metal wires and some 'empty' plastic insulation for them).	Short lengths of electrical wire. Short lengths of plastic insulation from around a wire (the core), and short lengths of the metal inner of a wire. Circuits equipment for testing conductivity.	

Students can use their evidence to write/draw a description of an electrical wire, and why – based on their properties – they are made from two different materials. They could compare the wire to the metal/wooden pan from the beginning of the unit. Two objects, each made from two materials, relating to conductivity.		

<table>
<tr><th colspan="4">Enquiry 6: How are new materials invented?</th></tr>
<tr><th>Links to previous learning</th><th>Scientific skills</th><th>Assessment criteria</th><th>Curricular links</th></tr>
<tr><td rowspan="2">Y1&2
Uses of everyday materials</td><td>EA – Research

Asking questions</td><td rowspan="2">Can your children:
- Describe how a new material was discovered
- Name a scientist and a new material that they discovered</td><td rowspan="2">Horizontal:
D&T

Vertical:
KS3&4 Chemistry</td></tr>
<tr><td>Key concepts:
New materials can be discovered by mistake, or by careful research.
Scientists who discover new materials – whether deliberately or by mistake – become well known.</td></tr>
<tr><th colspan="2">Key terms</th><th colspan="2">Common misconceptions</th></tr>
<tr><td colspan="2"></td><td colspan="2"></td></tr>
<tr><th>Suggested activities</th><th>Resources</th><th colspan="2">Useful links</th></tr>
<tr><td>Post its – discovered by accident

Wrinkle free cotton – discovered by a woman when it was difficult for women to have careers, let alone be scientists

Look at how these, or other materials were invented. Focus on the scientists involved, and what they did to make their discoveries. New materials are often discovered by mistake – get the students to think back through investigations they have carried out. Note that we make a prediction and try and prove it – but finding out something different, or that we're wrong, and investigating why, is lots more exciting than just being proved right!

What material would you like to invent? Ensure that the students are focusing on a material with particular properties, rather than inventing a new object. Describe it, why would you like to invent it, and how could you go about trying to make a new material like it?</td><td></td><td colspan="2">https://www.post-it.com/3M/en_US/post-it/contact-us/about-us/
Post it notes

https://www.sciencehistory.org/historical-profile/ruth-benerito
Wrinkle-free cotton – an unexpected scientist

https://www.visionlearning.com/en/library/Inside-Science/58/Ruth-Benerito/205
Wrinkle free cotton – difficulties of being a scientist</td></tr>
</table>

<table>
<tr><th colspan="4">Enquiry 7: Can you use your knowledge to help out Cadbury's?</th></tr>
<tr><th>Links to previous learning</th><th>Scientific skills</th><th>Assessment criteria</th><th>Curricular links</th></tr>
<tr><td rowspan="2">Y1&2
Uses of everyday materials
Y4 States of matter</td><td>EA – Problem solving

Asking questions
Making predictions
Setting up tests
Observing and measuring</td><td rowspan="2">Can your children:
- Tell you what they were trying to find out in this investigation
- Tell you how much better one material is than another</td><td rowspan="2">Horizontal:
D&T

Vertical:
KS3&4 Chemistry</td></tr>
<tr><td>Key concepts:
We can find out the best material for a purpose by investigating it.
Results of comparative tests are best when we can use a number in our answers.</td></tr>
<tr><th colspan="2">Key terms</th><th colspan="2">Common misconceptions</th></tr>
<tr><td colspan="2">Investigate, comparison, variable, fair, constant, the same, measure, result, number</td><td colspan="2"></td></tr>
<tr><th>Suggested activities</th><th>Resources</th><th colspan="2">Useful links</th></tr>
<tr><td>Show the students pictures of delivery trucks – how can they deliver chocolate on a hot sunny day without it melting?

Use toilet roll inners as the 'truck'. The truck can be covered in materials e.g. white paper, black paper, cotton, aluminium foil, coloured foil (you could show pictures of a Dairy Milk delivery truck, which is purple). The cooler you can keep the truck, the less likely the chocolate is to melt. Which material do they think will prevent the heat of the lamp from reaching the chocolate?

GD should weigh up practicalities such as the weight, bulk and cost of the material if it were to actually be wrapped around a truck.

Students should carry out a scientific investigation to decide which is the best exterior for a chocolate delivery truck.

- How will they make the test fair?
- What results will they measure in order to get an answer? How will they record their results?
- Can they draw a graph of their results to show which covering was the best?</td><td>Toilet roll inners
Materials for the exterior – white, black and coloured paper, aluminium foil, coloured foil

Timers

Table lamps or other heat sources

Chocolate which can be easily broken into squares</td><td colspan="2"></td></tr>
</table>

Students should be clear that the truck with the lowest temperature keeps the chocolate solid for longest.		