ACET Junior Academies'

Scheme of Work for Science

Big Idea - Materials

Year 5 – Reactions

About this unit:

PoS – Properties and changes of materials

In this unit, students will be combining what they learned earlier in the year, in Properties of Materials, and in Y4 – States of Matter. We will be looking at materials, and how they can change. The students will need to recall from Y4 that substances can melt, freeze, evaporate and condense – but that the substances involved stay the same before, during and after these changes. Now we will be looking at other ways of changing substances, some of which, like dissolving, are reversible, and others which create entirely new substances, and are irreversible. This means that we will be looking at making new substances which cannot be turned back into what they originally were. The most important part of this unit is that students identify whether change has happened, whether a new substance has been made, and whether the change is reversible or not. This can sometimes be difficult to do, but the students should know that these are the things we are looking for, even if we can't always identify them.

Towards the end of the unit, students will have the opportunity to carry out classic 'chemical reactions'. It's important that they realise that ALL the reactions studied up to this point involve 'chemicals'. Air, water, iron, rust, and sugar are all chemicals. Try and avoid suddenly referring to chemicals when the reactions seem more like 'chemistry' – they are just a continuation of what we have been studying with more familiar substances.

During this term, students should have the opportunity to review their class year book, and see where their chosen plants and animals are at in their life cycle.

Unit structure

This unit is structured around seven science enquiries:

1. Does it disappear?
2. Is it melting or dissolving?
3. How can we separate a mixture?
4. Faster or slower?
5. Can we reverse it?

Links to previous and future National Curriculum units

Y2 – Uses of everyday materials
Y4 – States of matter

KS3&4 - Chemistry

6. Can we make a new gas?
7. Investigating cool chemistry

Enquiry 1: Does it disappear?			
Links to previous learning	**Scientific skills**	**Assessment criteria**	**Curricular links**
Y2 – Uses of everyday materials Y4 – States of matter	EA – Observation over time Asking questions Making predictions **Observing** and measuring **Key concepts:** Recall states of matter and the terms use. When a substance dissolves, it is in the liquid, but it has changed.	**Can your children:** - Tell you about the different states of matter and the changes involved in them - Describe what happens when a substance dissolves	**Horizontal:** Maths – measuring volumes **Vertical:** KS3&4 Chemistry

Key terms	**Common misconceptions**	
Matter, state, solid, liquid, gas, melt, freeze, evaporate/boil, condense, dissolve,	*Students often think that dissolving something makes it 'disappear'.* *Students often confuse dissolving with melting.*	
Suggested activities	**Resources**	**Useful links**

States of matter, and dissolving

Review states of matter. In particular, look at the processes of change, and the words we use.

Look at ice, water and steam, and emphasise how these changes are **reversible**. Nothing new is being made, just the material changing state.

Investigate dissolving.

Dissolve equal volumes of the following substances into an equal volume of water (opportunity for measuring).

Substance	**Prediction – will it dissolve?**	**Observation – does it dissolve?**	**Any other observations?**
Sand			
Chalk			
Sugar			
Salt			
Oil			
Flour			
Coffee			

GD could discuss ways in which to dissolve it faster. How would they prove their ideas?

What happens to a substance when it dissolves? *Common misconception – it 'disappears'. Taste the sugar & salt water – have the sugar and salt disappeared?*

When a substance has dissolved, is it reversible?

Dissolve a lot of sugar in a small volume of water. 'Spill' a small amount on a surface, and leave it to dry. In a couple of hours, the water should have evaporated (review words and concepts from the beginning of the lesson), and the sugar should still feel sticky on the surface.

Dissolve a lot of salt in a small volume of water. Leave a small amount in a shallow dish overnight, in a warm spot. The water should evaporate, leaving the salt crusted around the dish.

Ice, water, steam (have a kettle available)

Sand
Chalk dust
Sugar
Salt
Oil
Flour
Coffee

Beakers or other containers
Method of measuring equal volumes of water – measuring cylinder, jug?
Water
Spoon or similar for stirring

<table>
<tr><th colspan="4">Enquiry 2: Is it melting or dissolving?</th></tr>
<tr><th>Links to previous learning</th><th>Scientific skills</th><th>Assessment criteria</th><th>Curricular links</th></tr>
<tr><td>Y2 – Uses of everyday materials
Y4 – States of matter</td><td>EA – Comparative/fair testing

Asking questions
Making predictions
Observing and measuring
Key concepts:
When we dissolve something, it is still there, but it has changed.
Melting and dissolving both involve a solid turning into liquid, but melting only involves the one substance, whereas dissolving involves two different substances.</td><td>Can your children:
- Describe a difference between melting and dissolving
- Tell you about what happens when a substance dissolves</td><td>Horizontal:

Vertical:
KS3&4 Chemsitry</td></tr>
<tr><th colspan="2">Key terms</th><th colspan="2">Common misconceptions</th></tr>
<tr><td colspan="2">Substance, melt, dissolve, state, change,</td><td colspan="2">Students often think that dissolving something makes it ‘disappear’.
Students often confuse dissolving with melting.
Students often forget that water is a chemical substance.</td></tr>
<tr><th colspan="2">Suggested activities</th><th>Resources</th><th>Useful links</th></tr>
<tr><td colspan="2">Chocolate – melt some chocolate (either in a microwave, or in a bowl sitting over some very hot water). Observe the changes in the chocolate as it melts. Observe any changes. Before you start – get the students to predict what they think the changes will be – and what the similarities and differences will be between the two processes and the end products.

Dissolve a small amount of chocolate in a small amount of hot water. Observe changes. Make sure it has dissolved fully.

Compare the processes in the two investigations. Allow the students to make honest comparisons – if there are unexpected results, say so and discuss how you could investigate further. If you have used food-standard equipment and hygiene procedures, the students could taste the products.

Draw a Venn diagram comparing the two processes. Key information – the chocolate is still there in both cases. When ‘melted’ it remains unchanged, apart from the state. When ‘dissolved’, although it is still there, it is now mixed with something else (water), and is not ‘the same’.

GD – can you get the chocolate ‘back’? Note – you can evaporate the water from the dissolved chocolate (use a tiny amount and leave 24 hours), but the chocolate will not be the same – although nothing has</td><td>Chocolate – chips or small squares
Small containers
A method of melting the chocolate
Warm water
Spoon or similar for stirring

Sugar
Scales

Vinegar
Water
Tea
Squash</td><td>https://www.stem.org.uk/resources/elibrary/resource/315591/what-temperature-does-chocolate-melt
Brian Cox – guidance on experimenting – at what temperature does chocolate melt.
This is not the investigation suggested for this lesson (which is comparing melting and dissolving), but may have some useful information.</td></tr>
</table>

'disappeared' from it. Allow GD students to see the label of the chocolate wrapper – it's actually made of a lot of component parts like cocoa butter, sugar and milk. Those things separated when the chocolate was dissolved – but they all stayed behind when the water left. *Dealing with a misconception – when something dissolves, it 'disappears'.* - Taste some sugar in solid form. - Dissolve the sugar in water, and taste it – you can tell it's in the water! - If you have accurate scales, weigh 100g of water, and add 10g of sugar. Weigh the total mass – you should have 110g (it may not be exact if the scales are not accurate, but you should get an answer that gives the right idea) - Dissolve the sugar in different liquids (e.g. vinegar, water, tea). Does it taste the same in all of them? You should be able to taste that the sugar is there, but that it's different in them all. If you just melted the sugar, it would 'just' taste of sugar.		

<table>
<tr><th colspan="4">Enquiry 3: How can we separate a mixture?</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">Y2 – Uses of everyday materials
Y4 – States of matter</td><td>EA - Problem Solving

Asking questions
Making predictions
Evaluating</td><td rowspan="2">Can your children:
- Describe how to separate a solid from a liquid.
- Make a judgement on how well materials in a sample were separated

GD – describe how to separate a dissolved substance from a liquid</td><td rowspan="2">Horizontal:

Vertical:
KS3&4 Chemistry</td></tr>
<tr><td>Key concepts:
Filtering separates solids from liquids.
A substance which has dissolved is still in the liquid.
GD – to get a dissolved substance on its own, you need to evaporate the liquid.</td></tr>
<tr><th colspan="2">Key terms</th><th colspan="2">Common misconceptions</th></tr>
<tr><td colspan="2">Solid, liquid, dissolve, separate, filter, evaporate,</td><td colspan="2">Students often think that dissolving something makes it ‘disappear’.
Students often confuse dissolving with melting.
Students often forget that water is a chemical substance.</td></tr>
<tr><th>Suggested activities</th><th>Resources</th><th colspan="2">Useful links</th></tr>
<tr><td>Students should be given 3 samples - sand & water, gravel & water, salt & water.

3 methods of separating – sieving, filtering, evaporating.
They should carry out each method of separating with each sample.
Observe what happens, and make a judgement about whether it separates the components, AND whether it is the best method of separating the components – does is separate them completely, or leave some mixed together?
The students should be exploring what happens, rather than ‘learning the right way to separate the samples’.

Record which method works best for each sample, with an explanation – recall SOM. Gravel and sand are solid particles which have a fixed shape. They cannot fit through holes of a certain size. When salt dissolves, it becomes liquid, and no longer has a fixed shape.</td><td>Y5 Melting and dissolving – some good resources/background.
Really useful concept cartoon

Sieves
Filter paper & funnels
Shallow dishes for evaporating
Beakers</td><td colspan="2"></td></tr>
</table>

Greater depth – sample containing gravel, sand, salt AND water (or any combination). Can you come up with a plan for separating them? Will your plan mean that each separate component will be on their own? Or will you just get one component away from the others? Point to reinforce – dissolving is a reversible change, just the same as melting. If you evaporate the water, the substance which dissolved will be left behind.		

<table>
<tr><th colspan="5">Enquiry 4: Faster or slower?</th></tr>
<tr><th>Links to previous learning</th><th colspan="2">Scientific skills</th><th>Assessment criteria</th><th>Curricular links</th></tr>
<tr><td rowspan="2">Y2 – Uses of Everyday materials
Y4 – States of matter</td><td colspan="2">EA – Pattern seeking

Asking questions
Making predictions
Setting up tests
Recording data
Evaluating</td><td rowspan="2">Can your children:
- Describe how to make a substance dissolve faster
- Identify an aspect of their method that would lead to inaccurate or unreliable results

GD – suggest improvements to their method</td><td rowspan="2">Horizontal:
Maths – measuring volumes

Vertical:
KS3&4 Chemistry</td></tr>
<tr><td colspan="2">Key concepts:
Heating makes substances dissolve faster.
Some investigations will give us an answer, but they are not perfect. It is a scientific skill to know what makes your investigation less than perfect, even if you can't solve the issues.</td></tr>
<tr><th colspan="2">Key terms</th><th colspan="3">Common misconceptions</th></tr>
<tr><td colspan="2">Evaluate, dissolve, faster, slower, time, temperature,</td><td colspan="3">Accurate – means you get exactly the right answer, with no doubt that it could be bigger or smaller.
Reliable – means you get a similar answer if you repeat it 3 times.</td></tr>
<tr><th colspan="2">Suggested activities</th><th>Resources</th><th colspan="2">Useful links</th></tr>
<tr><td colspan="2">Investigate whether heating makes a substance dissolve faster.

Demonstrate by dissolving a spoon of sugar in cold water, and in hot water – discuss how much sugar can dissolve in tea.

Demonstrate by putting an M&M into a known volume of water. Watch how it dissolves. Can you decide when it has 'completely dissolved'? Is it better to decide on a set diameter that the colour spreads out? How will you measure this? Should you set the clear container on grid paper?

Take a known volume of water (opportunity for measuring) and an M&M. How long does it take to completely dissolve in the water?

Student task - investigate what difference temperature makes to how quickly the M&M dissolves – see resource.</td><td>Sugar
M&Ms
Beakers/containers to hold water and sugar (clear plastic cups work well)
Measuring cylinders/jugs for measuring quantities of water
Kettle or other method of heating water
Ice or other method of cooling water
Thermometers for monitoring the temperature of the water</td><td colspan="2">https://www.middleschoolchemistry.com/lessonplans/chapter5/lesson6
Dissolving M&Ms – a similar investigation – but bear in mind that this has different aims, to be taught to older students who are learning about atoms & molecules.
The focus of our lesson is to evaluate the method; the sheet in the resource has them identifying variables, which should just be kept to a discussion in this Y5 lesson.</td></tr>
</table>

Students should write a comparative statement showing what they found. They could draw a graph of their results – but they should bear in mind the points made in the evaluation (see below) – are their results accurate or reliable enough to be able to see patterns on a graph? The students should evaluate their investigation, and identify what makes it difficult to get a 'perfect' answer. *This could be that it's difficult to know exactly when the M&M has dissolved, measuring the exact amount of water to keep it the same, how much variation was there in the temperature of the water, did they use the same colour M&M each time.* Students should be reassured that this doesn't make their investigation bad/wrong – good science is knowing where the issues are. *GD - Excellent science is being able to suggest improvements, or ways around the issues, but* emphasise that the most important thing is to identify the issues in the first place.		

<table>
<tr><th colspan="4">Enquiry 5: Can we reverse it?</th></tr>
<tr><th>Links to previous learning</th><th>Scientific skills</th><th>Assessment criteria</th><th>Curricular links</th></tr>
<tr><td>Y4 – States of matter.</td><td>EA – Pattern seeking

Asking questions
Making predictions
Observing and measuring

Key concepts:
Some changes produce a new substance, and you can't get the original substances back again.
Things we think of as 'waste products', like ash, or rust, are actually 'new substances' made from the old ones reacting with something else.
GD – new products are made by a substance reacting with something else – often air or water.</td><td>Can your children:
- Tell you that when a new substance is made, you can't get the original substance back.
- Name some substances which are 'new substances' made in a reaction</td><td>Horizontal:

Vertical:
KS3&4 Chemistry</td></tr>
<tr><th colspan="2">Key terms</th><th colspan="2">Common misconceptions</th></tr>
<tr><td colspan="2">Change, reversible, irreversible, substance, new, rusting, burning, baking</td><td colspan="2">*The 'arrow' in chemical reactions does not mean 'equals' – it means 'turns into'. Students do not need to use chemical equations, but if they do, make sure that they understand that it shows something turning into something else – it's different from a mathematical equation.</td></tr>
<tr><th colspan="2">Suggested activities</th><th>Resources</th><th>Useful links</th></tr>
<tr><td colspan="2">Rusting, burning, acid & alkali – 3 types of chemical reactions which are non-reversible. Chemicals react together to make a new substance - you can't get the originals back. Compare this with changes in states of matter – Y4 – when you can change between the 3 states. Reinforce that in changing states of matter, the substance stays the same.

Use any of the examples below to demonstrate irreversible change. In all of them, two substances are reacting, and a new substance is being made.

Rusting – look at pictures, and real life examples. Some students may be familiar with products and methods of getting rid of/dealing with rust. These are methods of preventing rust from worsening, or they remove the rust and replace with unaffected metal.
They could investigate rusting, and the economic costs – rusting cars, ships, bridges – because rust doesn't have the properties of iron. They could</td><td>Rusty objects – useful objects at different stages of rusting

Actual objects are better than pictures, as the students will be able to see that it is not a 'coating' – the metal changes to rust, and is worn away.

Iron nails left in air and water for a week previously

Paper, wood, alcohol
Matches
Controlled area for burning</td><td>https://www.bbc.co.uk/bitesize/clips/z4d9wmn</td></tr>
</table>

compare the properties of rust (the new substance formed) with iron (the original substance, before it reacted with water). Review magnetism – Iron, the most magnetic metal, is the metal which rusts. It is part of steel. You could leave different objects out in the rain (in a protected place) to see whether they rust. You could leave 2 iron nails for a week – one in water, one in air, and see whether they rust. The reaction is iron + water -> rust. You can't turn the iron back to rust. Burning Demonstrate burning 3 different substances – in a controlled manner – outside. Paper, wood, alcohol (to show that a liquid can burn). Students should make detailed observations of before, during and after. They could draw a Venn diagram. They should notice in all cases that a new substance was formed. *Any smoke is a new substance too – it dissipates into the atmosphere, but it is still present. Use this concept to reinforce the fact that dissolved substances don't disappear!* The reaction is wood (etc) + air -> ash/smoke. *See misconceptions. Students do NOT need to use scientific equations, but if they do, it's important that they are clear about the difference between -> and =.	Risk assessment!	

<table>
<tr><th colspan="4">Enquiry 6: Can we make a new gas?</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">Y2 – Uses of everyday materials
Y4 – States of matter</td><td>EA – Observation over time

Asking questions
Making predictions
Observing
Interpreting and communicating data</td><td rowspan="2">Can your children:
- State that a reaction which produces bubbles is making a gas
- Describe a reaction where a new gas has been made</td><td rowspan="2">Horizontal:
D&T

Vertical:
KS3&4 Chemistry</td></tr>
<tr><td>Key concepts:
If bubbles are being formed when two things are put together, that means that a new gas is being made.
When a new gas is made from other substances, you can't turn it back into what is was before</td></tr>
<tr><th colspan="2">Key terms</th><th colspan="2">Common misconceptions</th></tr>
<tr><td colspan="2">Reaction, new substance, change, reversible, irreversible, gas</td><td colspan="2">Because we can't 'see' the gas being formed, students don't think of it as a new substance being produced.
Bubbles in a bottle of fizzy drink are NOT a 'new gas' – they were previously dissolved in the liquid, and a change in pressure has allowed them to turn back into a gas. This is a very abstract/difficult concept for students to grasp – if they bring up bubbles in bottles of pop, point out that there is not a reaction between two materials to make the new gas.</td></tr>
<tr><th colspan="2">Suggested activities</th><th>Resources</th><th>Useful links</th></tr>
<tr><td colspan="2">A - Elephants toothpaste (see link), or you could mix an acid (e.g. lemon juice or vinegar) with some colour and washing up liquid, then add bicarbonate of soda for a 'volcano'. See links for making either.

In both cases, you have added two substances and created a new one – the bubbles of gas. You can't reverse the reaction.

Be careful not to refer to the substances in this lesson as 'chemicals' if you didn't in the last lesson (it would be best to refer to the substances in both lessons as 'chemicals'). Make sure that you discuss these reactions in the same way as the ones from the previous lesson – the paper and air in the previous lessons are 'chemicals', just the same as in this lesson!

B - Making cakes – make a batch of cupcakes with plain flour, and another using the same recipe but with baking powder.</td><td><u>Elephants toothpaste</u>
2L bottle
Funnel
Measuring cylinder of similar
Hydrogen peroxide
Dishwashing soap
Food colouring
Dry yeast
Warm water
Art materials for decorating the bottle

<u>Volcano</u>
Bicarbonate of soda
Vinegar
Dishwashing soap</td><td>https://www.stevespanglerscience.com/lab/experiments/elephants-toothpaste/ How to make elephant's toothpaste

https://www.youtube.com/watch?v=nFZhbEi19M8
Simple bicarbonate of soda reaction

https://www.youtube.com/watch?v=jjU1IAgRcQg
Bicarbonate of soda rocket – Test this carefully for quantities and measurements before doing it with students</td></tr>
</table>

Compare the results – the obvious results is that baking powder makes cakes rise. Inspect the cakes closely – the ones with BP should have 'bubbles' visible in them. These are a gas – a new substance made when the baking powder reacts with the other ingredients and is heated. *Opportunity to discuss how heat can make things happen quicker – review the previous lesson.*	Food colouring Beaker or similar Art materials for decorating the volcano <u>Baking equipment</u>	

<table>
<tr><th colspan="4">Enquiry 7: Investigating cool chemistry</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">Y2 – Uses of everyday materials
Y4 – States of matter</td><td>EA – Research

Asking questions
Making predictions
Interpreting and communicating data</td><td rowspan="2">Can your children:
- Describe a relatively new material, and say what it is used for
- Make a prediction about a new material which will be used in future</td><td rowspan="2">Horizontal:
D&T

Vertical:
KS3&4 Chemistry</td></tr>
<tr><td>Key concepts:
It's difficult to predict what new materials will be developed.
Scientists need to have an idea to try and develop – but they often make new discoveries by mistake.</td></tr>
<tr><th colspan="2">Key terms</th><th colspan="2">Common misconceptions</th></tr>
<tr><td colspan="2">Material, new, technology, investigate, research, predict</td><td colspan="2"></td></tr>
<tr><th>Suggested activities</th><th>Resources</th><th colspan="2">Useful links</th></tr>
<tr><td>Review the lesson in Autumn 2 where you thought about a material you'd like to invent.

What are some of the coolest, most recent discoveries? Can you imagine how they are going to be used in the future? Are they going to change the world and how we live?

What new materials did people from the 20th century predict that we would be using by now? Were they right? Are there materials that we use in the same way as people did 100 years ago? Why haven't they changed?

This is obviously going to change over time. Bear in mind the students should be considering new substances that are made, not 'inventions'.

Look back at the scientists we have studied this year. How do they work, and what do they do, to find out new things?</td><td>Predictions from the past – what did people think would be different about the materials we use?</td><td colspan="2">https://lifeboat.com/ex/10.futuristic.materials
Ideas about materials which may be developed in the future

https://prezi.com/pb63dm1yob72/how-the-materials-we-use-have-changed-over-time/
How materials have changed over time</td></tr>
</table>