SUSTAINABLE STORIES AND SOLUTIONS FOR OUR PLANET

A science investigation pack for teachers of 9–11 year olds: Sustainable materials – which hygiene products?

CENTRE *for* INDUSTRY EDUCATION COLLABORATION

innospec

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INTRODUCTION

The future holds many challenges for young people and our current model of development is placing an increasing burden on the planet. In order to secure the future of children all over the world, we need to make a decisive move towards sustainable development.

This publication will introduce and develop some of the issues and impacts of sustainability for primary aged children aged 9-11 years. All activities are linked to the English National Curriculum for Science, with a focus on the Year 5 programme of study for science content and the full upper key stage two programme of study for working scientifically.

Given that young children will become the next generation of adults; it is important that they are educated about sustainability issues so they can take positive action to help preserve their future in a changing world.

There are many definitions of sustainability. One of the most frequently used is taken from Our Common Future, also known as the Brundtland Report (1987):

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

In simple terms, sustainable development means meeting the needs of all people now – without having a negative impact on the needs of people living in the future.

INTRODUCTORY ACTIVITIES

In the two introductory activities, children consider their own motives behind sustainability as well as develop an awareness of vocabulary linked to current environmental issues. A glossary provides a comprehensive list of all key environmental vocabulary introduced here, then used throughout the activities. Children are encouraged to return to their original ideas to compare their definitions, make any final amendments and reflect upon the learning that has taken place.

MAIN ACTIVITIES

There are three main activities, which introduce children to a range of different challenges within the context of the sustainability of personal care products such as soap, shampoo and their packaging. The investigative approach provides opportunities for children to explore the varied roles of scientists and engineers in practical ways, allowing the development of key skills including discussion and problem solving. It is intended that children be encouraged to develop their own ideas and questions, methods of recording, conclusions and recommendations. The Questions for thinking included within each activity should be asked as a 'drip-feed' throughout, even though they are written towards the end of each set of teachers' notes.

POWERPOINT PRESENTATIONS

A presentation accompanies each main activity, and contains opportunities for higher order thinking, further discussion, and research. They have been created to help children develop a deeper understanding of our impact on the planet and encourage them to weigh up different opinions and evidence for themselves. Empowering young people to take responsibility for their own future is not only desirable: it is a crucial feature of their education.[1]

Each presentation extends the sustainability message to include wider environmental issues such as the environmental impact of personal hygiene products and the impact of the choices that we make, vehicle emissions and air pollution, single-use plastics and the importance of recycling, the environmental impact of washing and replacing items of clothing, alternative diets and an awareness of our carbon footprint, our use of fossil fuels and the development of renewable sources of energy.

The final slides of each presentation contain one company's story to embed the children's learning of sustainability into real life industrial contexts. This is what makes this publication unique in that, for every problem posed within the original main activity, children will learn about one company's solution and find out about how scientists and engineers are striving to find answers to sustainability issues.

In addition to the PowerPoint presentations, teachers may wish to make links with industry via local companies and company websites. STEM Ambassadors are volunteers from a wide range of science, technology, engineering and mathematics related jobs across the UK. They offer their time and enthusiasm and can be found via the STEM Learning website at ***https://www.stem.org.uk/stem-ambassadors***

2 Our Common Future (the Brundtland Report): United Nations through Oxford University Press, 1987.

SUMMARY OF ACTIVITIES

THEME	SUMMARY OF ACTIVITIES	APPROXIMATE TIME TAKEN
Introductory activity 1: Preparatory survey	A survey is carried out by each child to ascertain their thoughts about sustainability as well as their understanding of the impact of their own behaviour in actively bringing about change. Children are encouraged to question family members and compile an overview of current attitudes towards sustainability.	30 mins (+ 30 mins discussion)
Introductory activity 2: Environmental vocabulary	Children are challenged to create a 'big-book' style environmental dictionary which will help others in their school to learn about important environmental issues. They suggest definitions for a list of words provided and then refer to the glossary and return to the task to make amendments as they learn more about environmental issues in subsequent activities.	30 mins (+ 15 mins after each activity)
1 Sustainable Products: Which soap?	Children carry out a sequence of three investigations to research the environmental benefits of using a solid, as opposed to a liquid cleaning product, while developing their science and maths understanding through practical activities.	1.5–2 hours including regular observations over about 4 weeks
2 Sustainable Products: How much shampoo?	Children discuss the importance of using just the right amount of shampoo; as not enough will not wash the hair effectively but too much is a waste of shampoo. They investigate how much shampoo is the 'best' amount.	1–1.5 hours
3 Sustainable Products: What type of packaging?	Children discuss the importance of minimising the quantity of raw materials that we use to make single use packaging. They then explore a range of possible packaging materials before finding out about an innovative solution that one company is developing. They then test different types of paper as potential packaging for soap and shampoo bars.	1.5–2 hours

SAFETY GUIDANCE

It is important that schools refer to their own health and safety policies when planning, testing and evaluating all practical science activities for themselves. Resources and expectations must be age appropriate and investigations must be supervised by responsible adults at all times.

CLEAPSS is an advisory service providing support in practical science and technology. If at all possible, schools should ensure they have membership with CLEAPSS annually and this will enable them to access important ideas, guidance and safe practical ethics. This will also guide schools in how to correctly 'risk assess' their own practical sessions.

Disclaimer: CIEC assumes no liability with regard to injuries or damage that may occur as a result of using the information contained in the 'Sustainable Stories and Solutions for Our Planet' publication lesson plans.

INTRODUCTORY ACTIVITY 1: PREPARATORY SURVEY

1 HOUR, PLUS 15 MINS AFTER EACH ACTIVITY

A survey is carried out by each child to ascertain their thoughts about sustainability as well as their understanding of the impact of their own behaviour in actively bringing about change. Children are encouraged to question family members and compile an overview of current attitudes towards sustainability.

TYPE OF ENQUIRY

Survey / Researching using secondary sources

OBJECTIVES

Recording data and results of increasing complexity (UKS2 Working Scientifically)

Reporting and presenting findings from enquiries, in oral and written forms such as displays and presentations (UKS2 Working Scientifically)

SCIENCE VOCABULARY

Generations, positive, negative, impact, environment.

RESOURCES PER CHILD

- Photocopy of **Activity Sheet 1:** Survey plus additional copies to take home
- Pencil or pen

PRIOR KNOWLEDGE / EXPERIENCE

Children will have had experience of asking and answering simple questions to gather information or opinion.

ACTIVITY NOTES

Explain to the children that they are each going to complete a short survey which contains questions about looking after the Earth and our environment. Discuss with them that this is not a test, it is just to collect their ideas and that there are no right or wrong answers. Discuss with children that they all might have their own ideas and opinions about the questions they are being asked so that it is very important to answer honestly and with as much detail as they can.

Children should be aware that the teacher can read the questions aloud to them, if appropriate and explain any words or questions they do not understand without providing ideas for their answers. If a child is unable to respond, they should write ***'I do not know'.*** The accuracy of spellings is not important at this stage and there could be a time limit of thirty minutes for completion of the questionnaire, although some children might not need the full amount of time.

Once the survey has been completed, it would be interesting for children to compare their ideas and opinions. Children might also take copies of the survey home for family members to complete and then a wider range of responses can be compared, with a focus on differences and similarities across generations.

Activity Sheet 1: Survey

Complete this survey as honestly as you can. It would be interesting for you to ask family members too. Compare your answers with what other people think.

1. How important do you think it is that we look after the Earth and make sure that it is left in a good state for future generations?

   Why do you think this?

2. What things do you know about that can have a harmful effect on the Earth?

3. What things can we do to help the Earth?

4. What do you do at school/work to help look after the Earth for future generations?

5. What do you do at home to help look after the Earth for future generations?

6. What else do you think you could do?

7. What changes could you make to your own behaviour to help to look after the Earth for future generations?

8. What jobs do you know about where people make a positive impact on the environment?

9. What jobs do you know about where people are causing damage to the environment?

10. If you were Prime Minister, what rule or law would you introduce to help us to look after the Earth?

INTRODUCTORY ACTIVITY 2: ENVIRONMENTAL VOCABULARY

30 MINS + 15 MINS AFTER SUBSEQUENT ACTIVITIES

Children are challenged to create a 'big-book' style environmental dictionary which will help others in their school to learn about important environmental issues. They suggest definitions for a list of words provided and then, later, refer to the **Glossary** and return to the task to make amendments as they learn more about environmental issues in subsequent activities.

TYPE OF ENQUIRY

Grouping and classifying things / Researching using secondary sources

OBJECTIVES

Recording data and results of increasing complexity (UKS2 Working Scientifically)

Reporting and presenting findings from enquiries, in oral and written forms such as displays and presentations (UKS2 Working Scientifically)

SCIENCE VOCABULARY

See full vocabulary list contained in the activity on **Activity Sheet 2**

RESOURCES

per child

- Photocopy of **Activity Sheet 2**: Environmental vocabulary
- Later reference to **Activity Sheet 3**: Glossary
- Pencil or pen

PRIOR KNOWLEDGE / EXPERIENCE

Children will have had experience of asking and answering simple questions to gather information or opinion.

ACTIVITY NOTES

Show children the newspaper headline on shown below.

> Dictionary names 'single-use' as the phrase of the year
>
> There is a rising concern of how much plastic we use once and then throw away. This year has seen huge numbers of businesses pledging to phase out single-use plastics from their operations. Some governments are preparing to ban plastic straws, cotton buds, and other single-use plastics…

Discuss the information provided and describe how, each year, several dictionary companies compile a list of new and popular words that reflect the times we are living in. They have named 'single-use' as the phrase of the year and say that this phrase has been used four times as much over the past twelve months as it has ever before.

Explain to children that they are going to create a 'big-book' style environmental dictionary which will help other children in their school to learn about important environmental issues. There are so many new words and phrases that have appeared in our language over recent years, it is important that young people have a good understanding of what they mean.

Share the list of words on **Activity Sheet 2**. Ask if children can suggest definitions, without carrying out any initial research. They should write their ideas directly onto the sheet under each word provided.

Explain that they will return to the task on completion of the activities in this publication. It will be interesting to see how much additional detail children can include in order to improve their final definitions for the finished dictionary.

Children may also wish to compare their final definitions with those provided in the **Glossary** (**Activity Sheet 3**).

Activity Sheet 2: Environmental Vocabulary

Do you know what the words or phrases in the list below mean? Write your ideas under each word provided. You can return to the task later to make any changes or improvements.

acid rain	electric vehicle	going green	recycle / re-use
carbon footprint	emissions	greenhouse gases	pollution
climate change	environmental impact	landfill	precious metals
degradable	fossil fuels	microplastics	single-use
eco-friendly	global warming	non-renewable	sustainable

Activity Sheet 3: Glossary

acid rain	Water droplets that are acidic due to pollution in the air
carbon footprint	The total amount of carbon dioxide or methane gas you produce per year in your everyday life
climate change	The changes in different environments (temperature, rainfall, cloud cover etc) as a result of global warming
degradable	Able to break down in the environment naturally, or rot away over time
eco-friendly	Least harmful to the environment
electric vehicle	Vehicle with an electric motor powered by electricity from batteries
emissions	Created, given out or flowing from
environmental impact	Any change to the environment, either positive or negative
fossil fuels	A natural, non-renewable fuel, such as coal or gas, formed millions of years ago from the remains of living things
global warming	The processes that cause the average temperature of the Earth to rise
going green	Changing the way you live to help the environment for the better
greenhouse gases	Gases in the air that trap heat from the Sun, so the hot gases stay close to the Earth
landfill	Getting rid of waste material by burying it
microplastics	Very tiny pieces of plastic that pollute the environment
non-renewable	A fixed amount that cannot be replaced
recycle / re-use	To make something new out of something that has been used before To use for the same or a different purpose, something that has been used before
pollution	Any gas, liquid or solid that makes the Earth dirty, poisonous or unhealthy for living things
precious metals	Natural metals of high value that do not react compared to other metals
single-use	Designed to be used once and then thrown away or destroyed
sustainable	To keep it going or available for future generations

1. SUSTAINABLE MATERIALS: WHICH SOAP?

1.5–2 HOURS

PLUS 4 WEEKS OF OBSERVATION

Children carry out a sequence of three investigations to investigate the environmental benefits of using a solid, as opposed to a liquid cleaning product, while developing their science and maths understanding through practical activities. After an initial class input of about 30 minutes the first two activities will be ongoing over a period of four weeks and will take up to an hour over that period in 5–10 minute slots once or twice a week. The final activity will take about 30 minutes.

TYPE OF ENQUIRY

Carrying out comparative and fair tests

Observation over time

OBJECTIVES

Planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary (UKS2 working scientifically)

Estimate volume – for example, using 1cm^3 blocks to build cuboids including cubes and capacity using water (Y5 measurement)

Convert between different units of metric measure – for example, gram and kilogram, litre and millilitre (Y5 measurement)

SCIENCE VOCABULARY

Mass, volume, liquid, solid, shampoo

RESOURCES

per group of 4, unless otherwise stated

Activity 1a:

- Unused 100g bar of soap
- Unused 500 ml bottle of hand wash
- Record of the price of both items (if not at hand this could be checked online)

Optional

- 100g play dough
- 10 x small beakers that will hold at least 50ml liquid

Activity 1b:

- 5 slices of fresh white bread
- 5 new sealable bags
- Access to hand washing facilities and both soap and hand wash
- Access to hand sanitiser

Activity 1c:

- playground chalk
- trundle wheel or large measuring tape

SAFETY GUIDANCE

Mould can produce many microscopic spores which are breathed in and can exacerbate conditions such as asthma. The bags of mouldy bread should remain sealed at all times and be placed together within another bag for disposal.

PRIOR KNOWLEDGE / EXPERIENCE

Children will have compared and grouped materials together, according to whether they are solids, liquids or gases.

They will have set up simple practical enquiries, comparative and fair tests.

ACTIVITY NOTES

Introduction: Show children the image on **presentation slide 2** and ask children to identify which is the odd one out and, most importantly, ***why***. An important aspect of an activity like this is that there are very few possible wrong answers but a large number of possible correct answers. There are some suggestions included in the presentation notes and children may come up with more once they realise that you are genuinely interested in all of their responses and are not just looking for a single 'correct' answer.

Ask: Can they think of other products that come in different forms? For example, they might suggest clothes washing products which are typically either liquid or powder (although in the past this too was a solid bar), shampoo which is starting to be sold as a solid bar as well as a liquid, and bubble bath which is sometimes sold in solid bars as well as liquid in bottles.

MAIN ACTIVITY 1a: HOW LONG DOES SOAP LAST?

This activity will take at least 4 weeks, including observations over time. It is carried out concurrently with activity 2. Show children a bottle of hand wash and a bar of soap. Ask them to talk about the similarities and differences between the two products and possible advantages and disadvantages. Ask them to weigh the bar of soap and to make a note of the volume of handwash contained in the bottle. Ask children to work out how much of each product there would be if it were to be divided into 10 equal portions. Children who need more support may find it helpful to pour 500 mls of water into 10 containers and to divide 100g of (play)dough into 10 equal portions so that they can see that one tenth is 50ml and 10g respectively. If you have a record of the price of each item, children could also be supported to calculate the price of a tenth of each product.

Leave the handwash in a location where it will be regularly used for a set period of time (at least a fortnight, or until it is used up if that is sooner). Swap it for the bar of soap and leave it for the same period of time. Alternatively, if there are two wash basins which get an equal amount of use the two products can be used concurrently.

At the end of the period, weigh and measure the remaining amount of each product to calculate how much has been used. Remind children that each 50 ml of liquid equates to one tenth of the total quantity. Whereas for the solid one tenth equals 10g. Children can use this information to work out how long each product would last if the usage remains constant and how much each would cost per week. They could use a calculator to do this.

Discuss which product is cheaper to use and which one lasts longer. Children should be able to tell you that the bar of soap is longer lasting and more economical than the handwash.

MAIN ACTIVITY 1b: DOES A BAR OF SOAP CLEAN YOUR HANDS AS WELL AS LIQUID HAND WASH?

This activity will take at least 4 weeks, including observations over time. It is carried out concurrently with activity 1.

The activity is best done after a playtime, before children have washed their hands. To prevent contamination it is vital that the slices of bread is only touched by one person until it is sealed in the bag. The bags should not be opened again at any point.

Remind children of good hand washing technique. The four children in each group handles and seals a slice of bread in an appropriately labelled transparent bag after doing one of the following:

- Child 1 cleans their hands using a bar of soap.
- Child 2 cleans their hands with hand wash.
- Child 3 cleans their hands with hand sanitiser
- Child 4 does not clean their hands.

The last slice of bread is sealed in a bag without anyone handling it.

All five bags are left for up to a month in a warm, dark place. Ensure that the bread does not get so hot that it dries out otherwise mould will not grow at all.

One would expect to see very little, if any, mould growing on the untouched bread, minimal growth on the two slices handled by children who have washed their hands and a significant amount of mould on the slice handled by the child who had not washed their hands. Children may be surprised to see that although hand sanitiser reduces the amount of mould on the bread, there is still more than on the bread handled by children who washed their hands. As well as helping children to understand the importance of regular hand washing, this activity should show that solid and liquid forms of soap are equally effective.

However, as with all science experiments, there may be anomalies. In this case, for example, if a child sneezed while handling the bread, or if their sleeves came in contact with it there might be more mould than expected on one of the 'clean' slices. Because the activity has been carried out by more than one group there is a good chance that the collated class results will show what you are expecting. This provides a good opportunity to compare results, for finding and considering the reasons for anomalies, and emphasising the reasons why experiments are repeated many times, i.e. it is not unusual for these kinds of unexpected results to occur.

MAIN ACTIVITY 1c: WHY USE SOLID PRODUCTS?

Explain to children that the transport of products such as medicine, food and personal care products including soap and shampoo has a major impact on the environment. **In the UK in 2019**, domestic transport was responsible for emitting the equivalent of 122 metric tonnes of carbon dioxide. Transport is the largest emitting sector of greenhouse gas emissions and produced over a quarter of the UK's total emissions that year. Anything that manufacturers can do to reduce the amount of transport can help to reduce these emissions.

Remind children of the data collected during Activity 1 and remind them that the solid soap lasted much longer than the liquid soap because one of the major ingredients in liquid soap is water. When we use a solid product we add the water at the point of use, thus saving the use of fossil fuels to transport the water in liquid soap (hand wash).

Show children **presentation slide 3** and explain that this shows how much more space is needed to transport liquid rather than solid soap.

FACT CHECK

The difference in the amount of transport required is even more than this once the two products are packaged. This is because liquids need more substantial packaging than solids. We will address this issue in a later activity.

Tell children that the average size of an HGV lorry is 25 metres by 3 metres. Challenge children to draw at least one rectangle of this size on the playground. If space allows, ask them to draw 6.5 such rectangles to help them visualise the difference in the amount of transport needed depending upon whether the product is in solid or liquid form.

Finish by explaining to them that scientists, such as the ones working at Innospec, continue to work on ways to address environmental problems and one way that they are doing this is to find ways of making solid instead of liquid products. For example, until recently shampoo was only available as a liquid product. However, in recent years scientists have been developing ways to make a solid shampoo which is as effective as a liquid one.

BACKGROUND INFORMATION

Research shows that on average people use about 2.3g of liquid soap every time they wash their hands and about 0.35 g if they are using a solid product. Solid soap has also been shown to be as effective as liquid soap at removing microbes from the skin. However, solid soap needs more hot water to create a lather and also needs more raw material such as vegetable oil than liquid soap. Nevertheless, by the time transport costs, packaging and increased usage is taken into account it is estimated that the carbon footprint of liquid handwash is approximately 25% greater than solid soap.

EXTENSION OR HOME-BASED ACTIVITIES

Children could be challenged to look at liquid personal care products in their own homes and when out shopping. Ask them to see if the manufacturers make any claim about the 'eco-friendliness' of their products. Do the children always agree with the claims made?

QUESTIONS FOR THINKING

- Are solid products such as soap and shampoo as effective as liquid products?
- What are the benefits of liquid products?
- What are the benefits of solid products?
- Why is it important to reduce the amount of fossil fuels that we use for transportation?
- How does the manufacturer persuade one to buy a particular product?
- In what ways do they claim that it is beneficial to the environment?
- Is there any information that is missing that the children think should be included?

INDUSTRY LINKS AND AMBASSADORS

Scientists in industry, such as those employed at Innospec, are constantly working to produce better personal hygiene products. This is why we so often see words such as 'new' and 'improved' emblazoned on familiar items. Some of the changes made are to improve the customer experience or to make a product more effective. For example, a new toothpaste formulation (recipe) may claim to make your teeth whiter or reduce plaque more effectively than a previous formulation.

Scientists also take the environmental impact of a product into consideration alongside customer experience. For example, early formulations of shampoo bars were bought by people keen to reduce packaging and transport costs and for convenience when travelling. However, because they were not as effective or pleasant to use as liquid shampoo people rarely bought a second bar. Since then, scientists have experimented with different ingredients and processes to produce a solid bar which is as good as liquid shampoo.

The next job of the industry will be to persuade consumers to trust these new products, and that will be a job for their marketing teams.

If you find an ambassador with relevant expertise, ask them to talk to the children about any innovations their company has carried out. For example, what has the impact of the innovations been on the products' efficacy and/or the environment? Encourage ambassadors to bring samples for children to handle and see for themselves how the product is different to the previous versions.

CROSS CURRICULAR LINKS

English: Children draft, edit and produce scripts and poster advertisements for solid formulations of soap and shampoo, explaining their benefits. This creative thinking has excellent links with the genre of persuasive writing in the English curriculum.

Mathematics: Children solve problems involving the relative sizes of two quantities where missing values can be found by using integer multiplication and division facts. They can solve problems involving the calculations of percentages [for example, of measure e.g. 15% of 360].

Design and Technology: Children design new packaging for soap and shampoo bars, selecting from and using a wide range of materials as well as evaluating their functional properties and aesthetic qualities.

PSHE: Children learn what improves and harms their local, natural and built environments and develop strategies and skills needed to care for these (including conserving energy).

2. SUSTAINABLE MATERIALS:
HOW MUCH SHAMPOO SHOULD WE USE?

1–1.5 HOURS

Children discuss the importance of using just the right amount of shampoo; as not enough will not wash the hair effectively but too much is a waste of shampoo. They investigate how much shampoo is the 'best' amount.

TYPE OF ENQUIRY

Carrying out fair and comparative test

OBJECTIVES

Compare everyday materials on the basis of their properties including their solubility (Y5 materials)

Know that some materials will dissolve in liquid to form solution (Y5 materials)

Build a more systematic understanding of materials by exploring and comparing the properties of a broad range of materials (Y5 non statutory guidance)

Take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate (UKS2 Working Scientifically)

Plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary (UKS2 Working Scientifically)

SCIENCE VOCABULARY

Foam, volume, liquids, strength, ratio, waste, dissolve

RESOURCES

per group of 4, unless otherwise stated

- Access to water
- 3 empty plastic 500ml pop bottles
- Syringe or pipette (ideally to measure to the nearest 1ml)
- 500ml measuring jug
- 20ml shampoo
- Permanent marker pen
- **Presentation: How much shampoo?**

Optional

- **Activity sheet 4**

SAFETY GUIDANCE

Shampoo is safe for home use so is low risk. However, in the unlikely event that a child gets some in their eye, rinse their eyes with plenty of clean tepid water.

PRIOR KNOWLEDGE / EXPERIENCE

Children will have had experience of measuring volume accurately to the nearest 1ml. They will have created tables of results and used these to make graphs.

TOP TIP

A period of exploration before tackling an activity is likely to lead to the children working more productively than if tackling it 'cold'. The activities described in the Fun with Foam section of the CIEC resource The Science of Healthy Skin would work well for this.

www.york.ac.uk/ciec/resources/primary/science-of-healthy-skin/

Alternatively, the fun with foam activities could be used to consolidate or revisit the learning sometime after the main lesson.

ACTIVITY NOTES

Introduction: Show children the images on **Presentation slide 2** and ask them if they know what concentrated means. Explain that if a liquid is concentrated it contains less water which means that it can fit into a smaller bottle. Customers need to use a smaller amount of the concentrated product to get the same results as with the 'normal' product. Liquids which can be concentrated include fruit drinks, personal hygiene products such as shampoo and household cleaning products such as washing up liquid or fabric conditioner. Explain that making a more concentrated liquid is another way to reduce transport and packaging costs, because the same amount of 'cleaning power' will fit into a smaller sized container.

TOP TIP

Ideally children should be given as much independence as possible to organise themselves to carry out practical activities., However their ability to do this will depend upon several factors including levels of maturity and past experience. They are more likely to be successful if they are given set roles within the group; and you may find the CIEC role badges useful for this.

www.york.ac.uk/ciec/resources/primary/skills-for-science/#role-badges

It is also valuable to let children make mistakes when they set up their investigations, even when it is obvious to you that it is not going to work. If adults step in too quickly to give advice, children are less likely to learn for themselves than if they have an opportunity to evaluate their own work and plan how they would do things differently next time. In the long term this is likely to lead to more maturity and independence than if we provide too much scaffolding.

MAIN ACTIVITY:

Show children **Presentation slide 3** which has a letter from Innospec asking for their help. The letter uses language which children may need help unpicking (such as 'optimum amount of lather', 'recruiting scientists' and 'fossil fuels'). This is in order to more closely represent the language that would be used in a letter from industry as children respond maturely to this. Children are then asked to work in groups of 4 to devise a test to find out the optimum amount of shampoo needed. This is a challenging investigation for children to plan. They will need to find out how they can tell which amount of shampoo is effective given they cannot wash their hair in the classroom. Children might choose to measure the effectiveness of the shampoo for cleaning something else, such as hands or a piece of soiled cloth for example. Alternatively, they might decide to measure the amount of foam created by a fixed amount of shampoo in a measured volume of water.

This may seem like more time than is available in a busy curriculum for a single lesson. However, such time is well spent, and the learning is likely to be deeper than several different lessons which are more prescriptive. Moreover, not every child in the class will be doing exactly the same thing (a bugbear of many work scrutinies and OFSTED reports). Time for class discussion and evaluation will mean that children will learn from each other's investigations and mistakes as much as they do from their own.

Once children have had a go at designing and trying out their own investigations you could share the instructions on **Activity sheet 4** with them. It contains a modified description of the process used by the scientists at Innospec to measure the volume of foam produced by different products. Children could compare their own method with the Innospec approach.

If children's results and explanatory letters are sent to **ciec@york.ac.uk** they will receive a response from the company.

TOP TIP

Provide as many resources as possible for children. However, if they are given time to plan this activity a day or two ahead of carrying it out that will give time for more resources to be gathered, including those that you hadn't anticipated that they would need. It will also mean that you can share the task of providing materials with the children. For example, if one group suggest comparing different brands of shampoo, they can all bring in samples from home.

BACKGROUND INFORMATION

This activity gives an interesting opportunity to show children that it is not only solids (such as salt and sugar) which can be dissolved in liquids. Liquids, such as shampoo and household cleaning products, can also be dissolved in liquids.

The amount of minerals dissolved in tap water varies across the country. Hard water contains relatively high amounts of minerals such as calcium whereas soft water has relatively little dissolved minerals. The relative hardness of the water affects the quantity of product needed to create a foam with more being needed when using hard water.

EXTENSION OR HOME-BASED ACTIVITIES

Children may be surprised to learn that the water used in different parts of the country makes a difference to how much product is needed to make enough foam. If they live in a hard water area (most areas in the UK) you will be able to demonstrate this by repeating the activity with a sample of water that has been boiled and cooled, as this removes some of the minerals (which is why kettles tend to 'fur up' with mineral deposits). If they live in a soft water area you could use some mineral water to represent hard water and demonstrate the difference.

Ask children to look at packets of products that they use in the home including cleaning products, food and personal care products. Ask them to look for any advice about the amount to be used or portion size. They could discuss how well they think that most people follow this guidance.

QUESTIONS FOR THINKING

- Why is it important to use the right amount of shampoo?
- What happens if we don't use enough shampoo?
- What happens if we use too much shampoo?

INDUSTRY LINKS AND AMBASSADORS

If you are able to find a scientist with relevant expertise who can visit your classroom, ask them to bring a range of portable lab equipment they use to carry out the same tests that children have done in the classroom. Images showing the equipment in use, or of larger equipment that can't be taken out of the lab, would be useful for children to see alongside the real equipment.

CROSS CURRICULAR LINKS

English: Write a covering letter to explain their findings, to send to Innospec to accompany their results.

Maths: Select the best method(s) to present their results, and produce appropriate tables or graphs.

Activity Sheet 4

How to find the amount of shampoo needed to create the best amount of foam:

1. Add 100ml of water to a 500ml pop bottle

2. Add 1ml of the shampoo to be tested, using a syringe or pipette

3. Put the lid on

4. You now need to swirl the liquid around in the bottle at the same speed for 2 minutes. Don't shake it too much or the whole bottle will fill with foam and you won't have anything to measure!

5. Put the pop bottle down, and 30 seconds later measure the height of the foam (not including the liquid)

6. Repeat this 3 times and take the average of the 3 foam heights.

The research team is looking for at least 100ml of foam. If there is not enough foam with 1ml of shampoo try again with 2ml. If there is more than 200ml try again with less.

3. SUSTAINABLE MATERIALS: WHICH PACKAGING?

1.5–2 HOURS

Children discuss the importance of minimising the quantity of raw materials that we use to make single use packaging. They then explore a range of possible packaging materials before finding out about an innovative solution that one company is developing. They then test different types of paper as potential packaging for soap and shampoo bars.

TYPE OF ENQUIRY

Carrying out fair and comparative test

OBJECTIVES

Compare everyday materials on the basis of their properties (Y5 materials)

Know that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution. (Y5 materials)

Build a more systematic understanding of materials by exploring and comparing the properties of a broad range of materials (Y5 non statutory guidance)

Take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate. (UKS2 Working Scientifically)

Plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary (UKS2 Working Scientifically)

TOP TIP

When planning your lesson, where possible, it is a good idea to choose just one content knowledge and one working scientifically objective to focus on depending upon the learning needs of your class. This will enable you to focus your support on the learning objectives rather than trying to teach them all at the same time.

Any recording done by the children should reflect the learning objectives that you have chosen; for example if the Working Scientifically focus is to 'take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate' this should be what is recorded. Other aspects of the investigation can be done orally.

SCIENCE VOCABULARY

paper, dissolve, undissolved, change, soluble, property

RESOURCES

per group of 4, unless otherwise stated

- A selection of empty packaging including different types of plastic, card, metal and cellophane (or show Presentation slide 2).
- **Activity sheet 5** Optional: create a set of cards
- 3 x squares of at least two types of soluble paper such as Solvy or Super Solvy (at least 10cm2)
- 2-3 squares of other paper samples, e.g. brown paper, tissue paper, cellophane, greaseproof paper, polythene or crepe paper. (NB: Exact 10cm2 size squares reduces the number of variables children need to consider controlling. A range of sizes could be offered, if preferred.)
- translucent beakers or clear plastic cups (200 ml or larger)
- Small pieces of soap (these could be cut from a larger bar or the bars from hotel rooms would work well)
- Access to somewhere to wash hands
- **Activity sheet 6** (optional scaffolding for children)
- Presentation: Which packaging?

SAFETY GUIDANCE

Ensure that all packaging materials are clean and that there are no sharp edges.

Any spills should be wiped up promptly to prevent slipping.

PRIOR KNOWLEDGE / EXPERIENCE

Children will have compared and grouped materials together, according to whether they are solids, liquids or gases.

They will have set up simple practical enquiries, comparative and fair tests.

ACTIVITY NOTES

Introduction: Show children either the image on presentation slide 2 or the packaging samples you have provided. Ask them to talk about the different materials they can see and their different properties. Discuss each material's properties that have led to them to be used as packaging materials.

Activity sheet 5 starts with a matching exercise, which can be done be drawing connections on the sheet, or by matching pre-prepared cards. Ask children to see if they can match the materials cards to the product cards. Ask them to consider what different properties have to be taken into consideration when choosing packaging materials and whether some products are trickier to package than others.

Explain that all of this packaging has been developed by scientists to solve different problems and challenges. Scientists continue to explore and develop exciting ways to overcome new challenges, including reducing our environmental impact. Show the video clip on presentation slide 3 which shows how important it is to reduce our use of packaging materials such as plastic. This is because recycling is of limited impact when addressing the problem of waste.

MAIN ACTIVITY:

Distribute the paper samples and invite children to describe them, their properties, their similarities and differences. The children consider each material's use(s) based on their own experience of different kinds of paper.

Share the letter (on Presentation slide 4) from Innospec which asks for the children's support to find a material that could be used to wrap shampoo bars.

Give children time to work in their groups to plan their tests and to consider how they will report their findings to Innospec.

They may find it helpful to use the table on **Activity sheet 6**. However, depending upon the confidence of the children you may decide to let them decide for themselves (i) how many tests to conduct and (ii) how to present their findings.

If children's results and covering letters are sent to **ciec@york.ac.uk** they will receive a response from the company.

BACKGROUND INFORMATION

You may be interested to read about some of the innovations that are in the pipeline to reduce the environmental impact of personal hygiene products such as soap and shampoo.

EXTENSION OR HOME-BASED ACTIVITIES

Remind children of the phrase 'reduce, reuse, recycle' and ask them if they can explain why it is more important to reduce and reuse rather than recycle.

Challenge them to find a product or packaging that is currently single use and to see if they could design an innovative new product which could be used instead.

QUESTIONS FOR THINKING

- Why is it more important to reduce and reuse rather than recycle?
- Where does single use plastic go?
- How can scientists help us to tackle environmental problems?
- What can we do to tackle environmental problems?

INDUSTRY LINKS AND AMBASSADORS

There is a branch of science known as Green Chemistry. Green chemists focus their research on finding innovative ways to tackle environmental problems such as waste and pollution. You can find out more about one such science solution in the CIEC publication Potatoes to Plastics. If you were able to find a Green Chemist to come into your classroom they would be able to tell your children about the work that they do and the difference that they make.

www.york.ac.uk/ciec/resources/primary/potatoes-to-plastics

CROSS CURRICULAR LINKS

English: Children write persuasive texts to help people understand the benefits of using a solid shampoo in a soluble wrapper.

Design Technology: Children explore and evaluate the range of packaging that is currently used for personal care products.

Activity Sheet 5

paper	wood
tin	glass
card	fabric
plastic	waxed paper
apples	toy doll
bar of soap	toothpaste
sugar	flour
polystyrene	polythene
fizzy drink	cake
sandwich	hot drink
cooked pizza	shampoo
biscuits	washing powder
chocolate	milk

Activity Sheet 6

Sample code	Flexibility	Weight	Strength	Water solubility
A				
B				
C				
D				
E				
F				

We recommend sample ___ because

CIEC offers support for the teaching of science across the primary age range and beyond. This support includes CPD programmes, bespoke in-school CPD, interactive websites for teachers to use with their pupils, and a wide range of downloadable resources which encourage collaborative, practical problem solving. For more information, please visit our website:

www.ciec.org.uk

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