1. MIXING INGREDIENTS

1 HOUR

In this activity, children explore how oil and water behave when they are mixed together, predicting outcomes and testing different stirring devices. Children go on to observe how adding another liquid (called an emulsifier) to the mixture can help oil and water stay mixed for longer.

TYPE OF ENQUIRY

Problem solving

OBJECTIVES

Be able to give reasons, based on evidence from comparative tests, for the uses of everyday materials.

To carry out investigations making careful observations.

SCIENCE VOCABULARY

mix, mixture, liquid, separate, ingredient

RESOURCES

(per group of four, unless otherwise stated)

- **Activity Sheet 4**
- 3-6 x 1-litre beakers, measuring jugs or similar size transparent containers
- 3+ stirring devices with varying levels of efficiency e.g. 1-2 stirring devices from each of the following:
  - Low efficiency: wooden coffee stirrer, pencil, spoon, straw
  - Moderate efficiency: fork, manual hand whisk, coil whisk
  - High efficiency: rotary hand whisk, press whisk, milk frother, electric whisk,[1]
- 3 x 500 ml water (1500 ml in total)
- 3 x 40 ml cooking oil (120 ml in total)
- 5 ml washing up liquid (emulsifier)
- pipette, teaspoon, or syringe
- stopwatch

NOTE:

Quantities of the oil and water have been carefully considered, taking care to limit the amount of oil used for clean-up and resource cost purposes. The amounts specified keep oil use to a minimum whilst still allowing for good scientific investigative process.

1 To reduce resource cost and adult supervision requirements, only one electric whisk is needed per class.

SAFETY GUIDANCE

If using an electric whisk, it must be checked by the teacher before use and used on a stable surface. Children should operate the whisk under close adult supervision, with clear instructions to keep fingers, hair, and loose clothing away from the moving beaters.

Remind children to use whisks gently, limiting contact with the jug/container to avoid breakages.

To dispose of oil, it can be treated as food waste. Put it into a strong plastic bag containing absorbent material (e.g. sand, newspaper, a clean nappy, cat litter), tie the plastic bag and place it in the bin.

PRIOR KNOWLEDGE/EXPERIENCE

Children will have some experience of setting up simple practical enquiries and comparative tests.

ACTIVITY NOTES

Part 1

Present children with water and oil and ask what will happen if they are mixed together. Following small group discussion, ask children to share their ideas. Some may be aware that oil and water do not mix; they are known as immiscible liquids.

Groups make up three+ samples of oil and water (one for each stirring device they will test), adding the 40 ml of oil first each time and observing what happens when the 500 ml of water is added. They will see that the oil moves above the water.

Children may ask why this happens. The explanation goes beyond the primary curriculum, so teachers should use their judgement to decide whether to elaborate. A primary friendly explanation is that 'for its size' oil has less mass (or 'stuff' in it) than the same amount of water, so it floats on top of the water.

Children now explore the stirring devices, to find out how well each mixes the oil and water. Allow time for them to consider the criteria for a good stirring device, e.g. the longest lasting mixture or the shortest time taken for the ingredients to become fully mixed.

Note: The more stirring devices children try, the greater the range of results they will have to compare.

Encourage children to make reasoned predictions about how each stirring device will affect the mixing. They may describe the properties of the stirring devices, such as the type and thickness of the stirrer's material or the speed at which they stir/mix.

On testing the stirrers, children should discover that the milk frother or electric mixer create the longest lasting mixtures.

The class share and discuss their results in relation to their predictions and attempt to generalise the properties required for a 'good' stirrer.

Children should conclude that when water and oil are stirred, they create a temporary mixture; and the better they mix, the longer the mixture lasts before separating.

Part 2

Read the letter (**Activity Sheet 4**) to the class from a scientist at the real company Synthomer, to introduce the 'Sustainable Ingredients' challenges. In this first challenge, Synthomer explain that some ingredients they use don't stay mixed for long and they would like them to stay mixed for longer. They've heard that an ingredient called an emulsifier will help and invite children to find out if this is the case.

Explain that Synthomer do not mix oil and water but have asked the class to use these liquids because they have the same properties as the ingredients they use and are safe to use in the classroom. Tell children that you will provide an emulsifier, washing up liquid, for their investigation.

Children will now use two fresh samples of oil (40 ml) and water (500 ml) and select an appropriate stirring device. The existing samples which the children have just mixed can be used to reduce resources needed but some time will be needed to allow them to settle first. Before collecting their sample of emulsifier, groups plan their stirring method and how they will record their observations.

A child from each group collects a 5 ml pipette of the emulsifier and adds it to one of their two samples. Both samples should then be mixed using their chosen device. Groups compare both samples, looking at how well and for how long, each sample is mixed. They discuss the results of their observations and verbally share their findings with the class. Some of the Questions for thinking can be used to guide discussions. The class share their observations with each other.

TOP TIPS

When using the manual hand whisk, if children struggle with the standard one-handed whisking method, encourage them to rub back and forth with the handle of the whisk between the palms of their hands.

To ensure the class includes the full range of stirring devices you have provided, provide each group with a sub-set to test and allow time for each group to share their results with everybody at the end.

Stirring for 30 seconds and allowing 30 seconds for the mixture to settle produces good results.

Photographs taken at agreed intervals can be a good way of comparing the appearance of the mixtures.

Measuring jugs can be purchased cheaply from low-cost homewares stores,[2] or 2-litre pop bottle can be collected, cut to size, and 100 ml increments marked on the side in permanent marker.

Provide a tray and/or paper towel to provide a surface to store stirrers in between uses to help reduce the post-activity clean-up.

If resources allow, children compare the top one or two stirrers identified in their earlier investigation to see which performs best, or ask each group to try a different stirrer, ensuring that broader range of the stirrers is tested.

At the end of the lesson, include children in the oil disposal process by discussing the absorbent materials you will use (**refer to safety guidance on page iv**) and how keeping oil out of the school drainage system prevents drain blockages.

Plenty of warm soapy water will be needed to clean up the jugs and stirrers which have been in contact with the oil.

2 1-litre measuring jug 50p from Dunelm and ASDA (correct at time of publication)

BACKGROUND INFORMATION

This information is to support the teacher's knowledge of the subject only. It should not be used in the classroom.

Polymers are a family of materials we encounter in lots of everyday items from clothes to cars. They can occur naturally (such as silk) or be manufactured and are often called 'plastics' (such as disposable coffee cups). They can be liquids or solids (including powders) and can be made to have different properties such as being flexible, brittle, stretchy, transparent, opaque, biodegradable and much more; to make them fit for purpose. Many products are made from or include polymers, like polythene used for food packaging, nylon used to make clothing, and the ingredients used to make the glue we use at home and school. Some polymers act as the 'glue' in paints; others are used to make strong and flexible gloves.

Making polymers requires heat to help the ingredients to change into a new product (or 'react'). When the ingredients change, a lot of heat is generated. Companies have dedicated teams of scientists and engineers who work out how to reduce the impact of their products on the environment by:

- using less heat
- finding ways to recover heat from reactions
- reducing the amount and type of waste products that can be harmful to the environment
- improving the durability of their end products.

These companies also help their customers to find ways to use heat when they mix the polymers to make their products. One example is a polymer that has been designed so the customer (company making gloves) needs **a third less** energy; as the gloves can now be made thinner than before, whilst having the same important properties of strength and elasticity.

Emulsifiers are an important addition in the mixing/changing process. They ensure that the ingredients mix evenly throughout the whole vessel, resulting in the reaction taking place evenly throughout the vessel. Poor mixing results in poor reactions and can have safety and environmental impact, with poor material produced that could need to be disposed as waste.

QUESTIONS FOR THINKING

- Why are the oil and water separate?
- Can you think of any other liquids that do not mix?
- How did the different stirrers affect how long the oil and water stayed mixed together?
- How does the stirring speed affect the mixing process?
- What effect did the washing up liquid have on the mixture?
- Can you think of any other liquids that you mix together at home? What do you think will happen when you mix them?
- Can you think of any liquids and solids that can be mixed? What happens to them?

USING THE PRESENTATION

Before beginning part two of this activity, share slides 2 and 3 of the PowerPoint presentation with children to introduce the idea of different ingredients being made and used by different companies.

Following part two, revisit presentation slide 2 and introduce one company that carries out this kind of work; Synthomer, which is an example of Company B. They buy emulsifiers from Company A to make their product, which other companies then buy from them. Slide 4 shows children the equipment Synthomer uses to mix emulsifiers with other liquids to make their important ingredient (or 'product'). This piece of equipment is called a feed vessel and works like a blender which you might find in a kitchen. It mixes ingredients evenly, to ensure the mixture has a consistent texture. The creamy white colour at the top shows where the separate ingredients are becoming mixed.

Slide 5 shows an industrial scale reactor. It works in a similar way to the feed vessel but it is much larger, meaning larger volumes of ingredients can be added to make larger volumes of product. Inside the reactor, temperature, mixing speed, and the order ingredients are added can be controlled using automated computer programs, to ensure the same recipe and process is followed each time. To support development of science capital, encourage children to make connections between the industrial stirring machines to items in their daily lives which work in similar ways. They may suggest items such as whisks, coffee frothers and food blenders.

To conclude the lesson, use the STEM Careers slide at the end of the presentation to highlight real-world jobs in STEM to further nurture children's science capital. Share Susana's career profile to inspire pupils by helping them make connections between their classroom learning and the science that is used in exciting jobs.

INDUSTRY LINKS AND AMBASSADORS

Scientists and engineers working in a wide range of industry sectors can be asked to bring photographs or videos of reactors/industrial stirrers in action or types of stirring required for different purposes. Pictures and videos of 'bad' mixing, where batches or liquids have been spoiled or resulted in solid lumps, would also be worthwhile, and are often very memorable for children! Photographs or real samples, where safe to do so, of emulsifiers or other ingredients used to make products will enhance children's understanding.

STEM CAREERS

Susana, pictured here with a jar of Synthomer's important ingredient, is a scientist who works as a team with fellow scientists and other colleagues at Synthomer to develop ingredients that are more sustainable by being less harmful to the environment and safer for people. Susana loves her job because she feels she is contributing to a better world.