Practical Chemistry Experiments

The following lesson plans were delivered by NTU undergraduate chemistry students in four special schools in Nottinghamshire in January/February 2024 as part of a project organised by education charity Ignite!. The sessions culminated in pupils showcasing the experiments they had conducted at the Real Science in Schools Symposium 2024, a key event during the Nottingham Festival of Science and Curiosity.

The project aimed to develop the skills of chemistry students in communicating science, the confidence of teachers in special schools to deliver practical chemistry lessons, and the engagement of pupils attending special schools with practical science, encouraging them to enjoy science experiments and see themselves as scientists.

These resources are welcome to be used by others when delivering practical chemistry. They were delivered to pupils aged between 10 and 18 years old, in special schools supporting children with a wide range of special educational needs. The sessions were delivered with small groups, and equipment was either shared in small groups or each child had their own equipment to conduct their own experiment.

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Feedback on the sessions:

- The teachers commented that “there were many moments of wonder ... things like melting sweets making a rainbow, or the slime that was both a solid and a liquid were great experiences for our pupils” and “Slime was a big hit in our class”
- The students commented that “Due to the practical nature of my lessons, the children were often very excited and were very thankful for ‘making them have fun’”.

Practical Chemistry Experiments

Topic:	Materials and their properties
Activity:	Sorting objects into groups
Lesson Objectives:	• To learn about the different properties of materials • To learn about sorting things into categories
Equipment:	• Chalk pens • Materials made from glass, plastic, wood, metal, plants
Method:	Use chalk pens to draw circles on the floor and then put the objects into the correct categories. Encourage discussion of why the materials should go into the category. Ask pupils to think of ways we could test materials to work out which category they should go in. Are there other materials around the room that we could sort?
Recording:	Photographs are taken of the circles on the floor and this is put into their books. Or children could write up the lists.

Topic:	Materials and their properties
Activity:	Floating and sinking
Lesson Objectives:	• To learn about the different properties of materials • To learn how to make predictions • To understand how to conduct an experiment to find out an answer
Equipment:	• A large tub of water • Materials made from glass, plastic, wood, metal, plants • A magnet
Method:	Start by making predictions about which objects will sink and which will float. Make a note of these predictions. Invite pupils to add objects in one at a time. Ask children to describe what is happening as the objects float and sink. How does what happened compare with what they predicted? What can we tell from whether the objects float or sink? Test out if any of the materials are magnetic by putting them next to the magnet.
Recording:	Photographs are taken of categories of materials the float and sink and this is put into their books. Or children could write up the lists.

Topic:	Solids, liquids and gases, reversible and irreversible chemical reactions
Activity:	Heating and cooling objects
Lesson Objectives:	• To learn about reversible and irreversible chemical reactions • To make predictions
Equipment:	• Bunsen burner, microwave, toaster or hob • Fridge, freezer or ice bath • Materials such as chocolate, water, bread, egg
Method:	Take a chunk of chocolate and heat it up (bain marie or microwave). Observe what happens. Then leave it to cool in the fridge. Observe what happens. Take an ice cube out of the freezer and heat it up (leave it in room temperature or using a Bunsen burner). Observe what happens. Then pour it back into the ice cube tray, put it in the freezer and see what happens. Take a piece of bread and heat it up (toaster). Observe what happens. Ask the pupils to think of any way we can get it back into being a piece of bread. Take an egg and boil it (hob). Observe what happens. Ask the pupils to think of any way we can get it back to being a liquid.
Recording:	Photographs are taken of the experiments is put into their books. Or children draw what happened.

Cornflour slime

Topic: Solids and Liquids – Non-Newtonian Fluids	Session Number:	Date:

Learning Objectives

To be able to make accurate observations of an experiment.	To use straightforward evidence to answer questions related to their findings.	To understand that different liquids can have different properties.

Warm Up

Begin by a simple 'Solids, Liquids and Gases' Match and Draw activity in which the students identify if the items are solids, liquids, or gas (easily searchable online via Twinkl).

Main Activity

Starter: Introduce the activity through a questions: what things can we list that are liquid, what things can we list that are solid, what things can we list that are both?	Equipment list (for each student) A large bowl Food colouring 200-300g of corn flour 200ml of water A spoon	Main Activity: Start by delivering a cornflour slime demonstration. Ensure everyone is wearing safety goggle for this experiment. Once you have made it, give pupils the opportunity to put their hands in the slime to feel it. The pupils could choose which colour you use first, before then selecting their own colours and having a go themselves. Method: 1. Pour the cornflour into the bowl. 2. Pour the water in, mixing slowly using a spoon. Keep adding more water until the mixture becomes thick. 3. Add a few drops of food colouring to make the slime the colour you want it. 4. Put your hands in the slime and experiment with handling it.

Explanation

The slime is a non-Newtonian liquid which mean it is different to 'normal' liquids. The slime gets thicker when it is pressed. This is because the cornflour is not dissolved in the water so when it is pressed, the water molecules are pushed away. Other non-Newtonian liquids react in different ways. For example, tomato ketchup gets runnier if you shake it

Conclusion

The students will reflect on their experiment by answering the following questions:

- When was the solution a liquid? What are the properties of a liquid?
- When was the solution a solid? What are the properties of a solid?
- Can you think of any other materials that are sometimes liquid and sometimes solid?

Extension

For students who have completed all previous tasks, there is a 'States of Matter – True or False' quiz to complete (easily searchable online via Twinkl).

Felt-tip Chromatography

Topic: Liquids and Viscosity	**Session Number:**	**Date:**

Learning Objectives

To be able to understand that viscosity is a useful property of liquids.	To be able to use straightforward evidence to answer questions related to their findings.	To be able to record observations based on what happened in the experiment.

Warm Up

Begin by a simple state of matter true or false quiz, using Bamboozle or Twinkl (easily searchable online).

Main Activity – Kitchen Roll Chromatography

Starter Activity: Introduce the activity through a questions – how many different colours are in the ink in felt-tip pens? Ask the pupils to predict what colours make up the different colours, and write down their predictions.	Equipment list (for each student): A selection of felt tip pens Kitchen Roll (pre-prepared strips if necessary) A bowl or cup Water Scissors	Main Activity: Start by demonstrating the experiment, highlighting the steps to take in the right order. The pupils could choose which colour you test out first, before then selecting their own colours and having a go themselves. Method: 1. Cut a long strip of kitchen roll. Draw a single-coloured dot with a non-washable felt tip pen about 2–3 cm from the bottom of the strip. 2. Add a small amount of water to the bottom of a bowl. 3. Carefully place the dot-end of the strip into the water, without submerging the dot in the water (the water level should be lower than the dot on the strip) and let the rest of the strip hang over the edge of the bowl. 4. Watch as the water absorbs up the paper strip and through the coloured dot. See what happens to the ink.

Explanation

Coloured inks are often made up of several different inks. Each colour of ink has a different solubility in water so will get carried a different distance by the water, allowing you to see all of the different inks. You can see that what appears to us to be just one colour ink is actually made-up of lots of different colours.
This technique is called chromatography and can be used in chemistry to find out what is in an unknown mixture.

Conclusion

The students will reflect on how the results different from their predictions.
The students will either draw or label a diagram of the experiment set up used. Many diagrams can be found online (via Twinkl/TES).

Extension

For students who have completed all previous tasks, there is stick and cut activity ‘Properties of Solids, Liquids and Gases’ to complete (easily searchable online via Twinkl).

Dissolving

Topic: Dissolving	Session Number:	Date:

Learning Objectives

To understand what it meant by dissolving.	To identify what solids dissolve in water.	To make accurate predictions.

Warm Up

Begin by a simple dissolving true or false quiz, using Bamboozle or Twinkl (easily searchable online).

Main Activity

Starter:

Introduce the activity through questions: what does dissolving mean?

Ask the pupils to predict what will happen when you put the polystyrene cup in nail varnish remover, and write down their predictions.

Then deliver a dissolving demonstration. Ensure everyone is wearing safety goggle for this experiment. Pour 100ml of acetone nail varnish remover into a beaker. Place a polystyrene cup bottom-down into the beaker, press it down until the bottom dissolves and then push the rest of it down until it all dissolves. Engage the students by asking them what they can see happening.

I will begin with a dissolving demonstration in which I will show a polystyrene cup being dissolved by nail polish remover.

This will be followed by the students completing their own investigation into what materials dissolve.

Equipment (for each student):

Cup
Salt
Sugar
Coffee
Chalk
Sand
Beakers
Spoons or measuring scales

Highlight that when dissolving you need a solute and a solvent. In the demonstration, you had the polystyrene cup as the solute and the nail varnish remover as your solvent. For their experiment, they will be testing lots of different solutes and they will be using water as their solvent.

Main Activity:
Pupils will then have a go at completing their own investigation into what materials dissolve.

Method:

1. Pour 100ml water into different beakers.
2. Use a spoon, or if you have access to measuring scales, measure out 10g of the solutes: salt, sugar, coffee, chalk and sand. As you go, ask the pupils to predict which ones will dissolve and which ones won't. Write down their predictions.
3. Place the solutes into the different beakers and stir for 30 seconds.
4. Observe to see if the solutes have dissolved or not.
5. Test out adding more of the solute into the ones that have fully dissolved.
6. Test out stirring for longer for the ones that haven't dissolved.

Explanation
Dissolving happens when the attraction between the particles of the solvent and solute are strong enough to overcome the attraction of the particles of the solute for one another.

Conclusion
The students will reflect on how the results different from their predictions. The students will sort the different solvents into two categories: things that dissolve in water and things that don't dissolve in water. Ask the pupils to think of other things they know dissolve in water, and other things they might like to test out.

Extension
For students who have completed all previous tasks, there is a 'Solute, Solvent and Solution' Match and Draw activity to complete (easily searchable online via Twinkl).

Lava Lamps

Topic: Irreversible and reversible reactions	**Session Number:**	**Date:**

Learning Objectives

To show understanding of solids, liquids, and gases.	To understand that liquids have different densities.	To create their own mini 'lava lamp'

Warm Up

Begin with a simple cut and stick activity matching the 3 states of matter to their properties (easily searchable online).

Main Activity

Starter: Introduce the activity. There is a good SEN worksheet on TES to introduce what we're doing to do. Deliver a demonstration of how to make a lava lamp, making sure to highlight the order that the steps need to be completed in. Engage the students by asking them what they can see happening. Ask them why they think the oil sits on top of the water – is it more dense or less dense? What about the food colouring? What is happening when you put the tablet in? Invite the students to choose the colour you use for the demonstration.	Equipment (for each student): A clean plastic bottle Vegetable oil Fizzing tablets (effervescent tablet) Food colouring	Main Activity: Pupils will then complete their own investigations. Method: 1. Fill the plastic bottle about a 1/3 with water. 2. Carefully pour the vegetable oil into the bottle until it is almost full. 3. Add a few drops of food colouring 4. Break your tablet in half and drop it in into the bottle and watch!

Explanation

The oil floats on top of the water because it is less dense or lighter than water. The food colouring has the same density as the water, so it sinks through the oil and mixes with the water. When you add the tablet, it sinks to the bottom then starts to dissolve. As it dissolves it makes gas, carbon dioxide. Gas or air is lighter than water, so it floats to the top. The air bubbles bring some coloured water with them to the top. When the air comes out of the coloured water blob, the water gets heavy again and sinks. It does this over and over again until the tablet is completely dissolved.

Conclusion

Students will draw a labelled diagram/drawing of the experiment, with the oil at the top and the water at the bottom, and bubbles rising.

Extension

For students who have completed all previous tasks, invite the pupils to make a list of other things that float and sink in water.

Rainbow in a Jar

Topic: Density	**Session Number:**	**Date:**

Learning Objectives

To understand that different liquids have different densities.	To understand what density is.	To make accurate observations.

Warm Up

Begin with a conversation about density, why some things float and other things sink. Do a simple word-search activity to embed key words (easily accessible online).

Main Activity

Starter: Explain what the activity is. Invite the children to put the materials in the order from most dense at one end to least dense at another end. Ask them why they think that and make a note of their predictions. Deliver a demonstration of the activity, making sure to highlight the order that the steps need to be completed in. You could also do this step-by-step all together as there are many steps to remember.	Equipment (for each student): Tall glass/jar Food colouring Honey Blue dish soap (non-toxic) Water Olive oil or vegetable oil Baby oil Beakers Pipettes (if you have them) or tablespoons	Main Activity: Pupils will then complete their own investigations. 1. In a beaker, mix honey and purple food colouring and add to the bottom of the jar. 2. Add blue dish soap to the jar 3. In a beaker, mix water and green food colouring and carefully add to the jar. 4. Add olive oil or vegetable oil to the jar. 5. In a beaker, mix baby oil with red food colouring and add it to the jar.

Explanation

Density is the reason that this experiment works! **Density** is a measure of how much mass (or “stuff”) there is in a given volume. Density is a ratio of mass to volume and can be found by dividing an object’s mass by its volume (D=m/v).

Conclusion

The children will reflect on their predictions at the start about the densities of the different materials.
The children will draw a labelled diagram of the jar, or use worksheets that can be easily found online (via Twinkl).

Extension

For students who have completed all previous tasks, invite the pupils to discuss where they think other materials would go if we added them into the experiment. You could also come back to the keyword wordsearch.

Skittles Experiment

Topic: Liquids and dissolving	**Session Number:**	**Date:**

Learning Objectives

To be able to make accurate observations of an experiment.	To understand that sugar dissolves in water.	To understand that warm water has more energy than cold water.

Warm Up

Begin with a simple stick and cut activity matching the 3 states of matter to their properties (easily searchable online via Twinkl). This acts as a brief recap of the main points previously learnt.

Main Activity

Skittles colour mixing Introduce the activity through questions: what does dissolving mean? Before you start to deliver a demonstration of the activity, ask the pupils to predict what will happen when your pour water into the middle of the plate, and write down their predictions. Then deliver a demonstration. Ensure everyone is wearing safety goggle for this experiment. Engage the students by asking them to describe what is happening.	Equipment (for each student): Skittles (around 12) Still, warm water Plate	Main Activity: Pupils will then have a go at completing their own skittles experiment. Method: 1. First, place the coloured sweets around the edge of the plate in a circle shape. 2. Then, get some warm, still water in a jug. Ask an adult for help. 3. Next, pour the warm water into the middle of the circle until it reaches the sweets. 4. Watch what happens. 5. Repeat the experiment with cold water to see the difference.

Explanation

Skittles are coated in food colouring and sugar. When you pour water over the skittles, the coloured coating dissolves, spreading through the water. The colour and sugar **dissolve** into the water and then spread through it, making the water the colour of the sweets. Hot water has more energy than cold water so dissolves the sugar and food colouring quicker.

Conclusion

Pupils will complete a labelled diagram/drawing of the experiment to show what happened to the colours.

Extension

For students who have completed all previous tasks, they will complete a cut and stick activity to show the method of the experiment (easily searchable online via Twinkl).

Bath Bombs

Topic: Chemical reactions, dissolving	**Session Number:**	**Date:**

Learning Objectives

To understand that how to accurately measure out materials.	To understand how to make predictions.	To understand that the release of carbon dioxide is an irreversible reaction.

Warm Up

We will begin by completing a quick quiz about reversible and irreversible chemical reactions (easily searchable online).

Main Activity

Starter: Introduce the activity through questions: has anyone used a bath bomb before, what happens when you put a bath bomb into water, and why do you think that might happen? Deliver a demonstration of how to make a bath bomb, making sure to highlight the order that the steps need to be completed in and how to measure things out carefully.	Equipment (for each student): • Two bowls • A tablespoon • Ice cube tray, or something to shape the bath bombs • Bicarbonate of soda • Cream of tartar • A small amount of water • Food colouring (optional) • Essential oils (optional)	Main Activity: Pupils then have a go at making their own bath bombs. 1. In one bowl, mix together two tablespoons of bicarbonate of soda with one tablespoon of cream of tartar. 2. In the other bowl, mix together a tablespoon of water and 3-4 drops of food colouring and essential oils. 3. Tip the dry ingredients into the bowl with the wet ingredients and thoroughly mix together until combined. The result may still be a little crumbly but will stick together when pressed. 4. Shape the mixture into the mould you're using and press down firmly to ensure the mixture sticks together. This will make two small bath bombs. 5. After being left for at least 24 hours, the bath bombs can be eased out of the mould and placed into a tub or bath of water to watch the reaction. You can test out the difference between warm and cold water.

Explanation

When the bicarbonate of soda and cream of tartar are put into the water, they dissolve and there is a chemical reaction which takes place, releasing carbon dioxide into the water, which we observe as bubbles. This makes the bath bomb break up and releases the oils and colouring which dissolve into the water.

Conclusion

Once the pupils have created the bath bombs, they will write up their predictions for what will happen when they put it into the water.
Once the pupils have finished the experiment, they will record their observations of what happened and compare this with what they had predicted.

Extension

Invite the children to reflect on whether this chemical reaction is reversible or irreversible.