Kitchen Chemistry!

Teacher Resource Pack

OÉ Gaillimh
NUI Galway

Kitchen Chemistry Videos – Introduction

The development of the Kitchen Chemistry videos is a joint venture between the School of Education and the School of Chemistry at the National University of Ireland, Galway (NUI Galway). The venture was developed with EXPLORE funding. EXPLORE is where NUI Galway students and staff partner up and deliver innovative ideas. The motivation behind the Kitchen Chemistry videos is to promote science among primary school students. The six video series and associated teacher resource pack expands on current scientific outreach efforts by the School of Chemistry and also the recent Science Hook series (freely available on iBook or web platform, www.sciencehooks.scoilnet.ie) developed in the School of Education.

The Kitchen Chemistry resources offer primary teachers a collection of videos that capture novel and engaging aspects of chemistry-based science topics. The collection is also available trí Ghaeilge. This teacher pack provides details regarding the six videos. The pack provides: a methodology, a simple explanation of the science, extension activities, and worksheets for early, middle and upper years. Scoilnet.ie has facilitated and supported the production of a Kitchen Chemistry website.

This teacher pack was co-authored by Dr Veronica McCauley, Martin McHugh, Laura Finnegan (School of Education), Nicole Walshe, Christine Conway (School of Chemistry) and consultant teacher Sara McGeachy (Clonoulty Central National School, Co. Tipperary).

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Innovation through
student & staff collaboration

Oh so Slimy!

This is a fun and easy video experiment that looks at how to create slime. Depending on how you mix the ingredients, you will get something that is stringy, slimy or more like mála. This is a great, quick and easy sensory science experiment or video demonstration.

Equipment

- PVA Glue (regular water soluble glue)
- Borax Powder
- Water
- Food Colouring (any colour)
- Mixing bowl and spoon
- Two equal sized jars/glasses to measure the glue and water
- Teaspoon
- Droppers

Method: Measure out equal amounts of water and glue (approximately half a cup of each).

Add them to the mixing bowl.

Mix them together thoroughly.

Add a few drops of food colouring.

To make the Borax Solution: Add one teaspoon of Borax powder (bought in local pharmacy) into another clean cup and half fill it with water. Mix well.

Add a few drops of Borax solution to the mixing bowl that contains the glue, water and food colouring and stir.

As you stir the slime will start to form.

You may need to add more Borax solution to ensure that all the liquid turns to slime.

Note: Slime can be stored in a zip lock bag (to keep it fresh and pliable for many weeks to come).

Precautions: Wear aprons, wash hands after the experiment, do not eat the slime, and avoid contact with eyes and fabrics.

Note: If you do not use food colouring, your slime should wash off most surfaces and out of most washable fabrics. Food colouring will stain your skin for quite a while and may stain clothing permanently, so use care if you create coloured slime. You can use disposable gloves to handle the slime until it dries.

Teacher Notes: White PVA glue is a plastic made from oil. Borax is a natural mineral mined from the earth. People sometimes add it to their washing to make the detergents work well. The experiment produces a fluid, cross-linked polymer. A polymer is a large molecule typically found in plastics. The slime polymer is composed of strands of PVA held together by the borate particles via hydrogen bonding. This cross-linking causes the slime. This is an irreversible reaction much like when an egg becomes a hard-boiled egg.

The slime experiment is popular amongst all years while also being educational, students get to work on a recipe, use measurement, observation and teamwork skills to create the slime. Following this, a range of extension activities can be conducted in which students obtain and present evidence.

Extension Activities:

1. Slime acts as both a solid and a liquid, get students to think and list all of the other slimy substances they know. An example in the home is ketchup.

2. Students should investigate the properties of the slime. Ask students to hold the slime in their hands and see if it runs through their fingers. How far can they stretch the slime? Does it ever change colour? Get the students to turn the slime into a small ball and drop it on their desk. The slime will act as a solid when put under stress so it won't splash or make a mess. Get students to predict what will happen and get them to explain their results.

3. Ask the students to stand in a line and hold hands. Keeping their hands together, ask one student to take two steps forward, ask another to take two steps backwards. Keep this going and the students will eventually realise that they are acting just like the slime. Their hands represent the chemical bonds that hold the slime together. They should also notice that if they move too much, their line will break, just like the slime.

Worksheets: Every experiment comes with three worksheets, one for early, middle and upper years. They can be easily copied and given to students after the activity or for homework.

O So Slimy – Worksheet (Early years)

1. What colour is the slime?

____

2. What does the slime feel like?

____

____

3. Can you name the four ingredients that you used to make slime?

____

____

____

____

4. Draw a picture of the slime and some of the materials you used to make it in the box below:

O So Slimy – Worksheet (Middle years)

1. Describe the slime: what does it look like and feel like?

2. In the box below, draw and label the materials you used to make the slime.

3. This slime is a type of plastic, can you name three other things made of plastic?

O So Slimy – Worksheet (Upper years)

1. Describe the word slime.

2. What is the definition of the word **slime** in the dictionary?

3. Describe the word recipe.

4. What is the definition of the word **recipe** in the dictionary?

5. If you were making the slime again, what would you do differently?

This video creates an amazing colour-changing liquid you can make with cabbage. The solution shows if a substance is an acid or base. When the cabbage solution is mixed with another liquid,

Cabbage Magic!

a colour change occurs and indicates if the solution is acidic or basic. This is a fun, visual experiment that uses everyday objects.

Equipment

- Red cabbage
- Chopping board and knife
- Water
- A blender
- A sieve
- A measuring jug and spoon
- Various jars/glasses to hold liquids
- Household items to test such as: Milk, 7-Up, Water, Rennie, Baking Powder, Lemon, Mashed Kiwi, Vinegar, Fabric Softener, Washing-Up Liquid, Bleach, Drain Cleaner.

Method: Cut up about a quarter of a head of red cabbage into small pieces.

Place the cabbage and about 250ml of water into a blender and blend until the cabbage is in uniform tiny pieces.

Pour the mixture through the sieve pushing the liquid through with the back of a spoon if needed.

The strained liquid is our indicator and it is what we will use to test our household liquids

Pour equal amounts of the household liquids into jars or glasses (it must be a clear container in order to see the colour change).

Now pour a small amount of your strained liquid (the red cabbage indicator) into each of the household liquids

Take note of the colour change in each liquid and compare this with the Red Cabbage Indicator scale below in order to determine the pH of the liquid.

Precautions: You must be careful to keep strong acids and bases well away from children. You must also warn students that they must never drink anything during an experiment as it can be dangerous. Some household products can cause skin irritations. Do not allow these to contact skin; rinse thoroughly with water if they do.

Teacher Notes: Some very common household solutions are acids and bases. Acids are solutions that will donate hydrogen ions in a solution, and usually taste sour. Some common acids are citrus fruit juices and household vinegar. Bases are solutions that accept hydrogen ions in solution, and usually feel slippery.

How do you tell if something is an acid or a base? You use a chemical called an indicator, which changes in colour depending on whether a solution is acidic or basic (alkali). (Specifically, an indicator works by responding to the levels of hydrogen ions in a solution.) There are many different types of indicators, some are liquids and some are concentrated on little strips of "litmus" paper. Indicators can be extracted from many different sources, including the pigment of many plants.

Red cabbage contains an indicator pigment molecule called flavin. Very acidic solutions will turn anthocyanin, a red colour. Neutral solutions result in a purplish colour. Basic solutions make a greenish-yellow or yellow colour.

Because red cabbage has this indicator pigment, it is possible to determine the pH of a solution based on the colour it turns the red cabbage juice. The pH of a solution is a numerical measure of how basic or acidic it is. A solution with a pH between 5 and 7 is neutral, 8 or higher is a base, and 4 or lower is an acid (see figure 1).

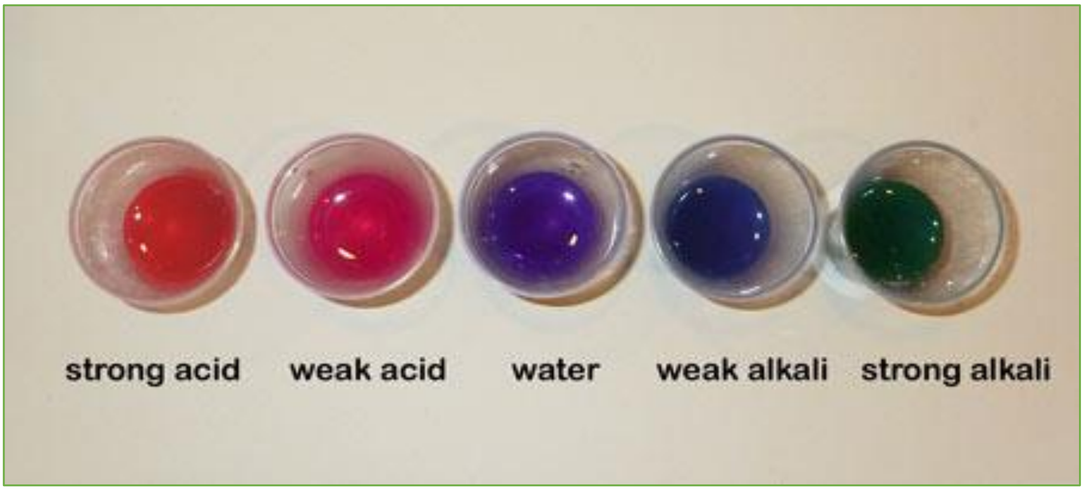


Figure 1: Colour change from strong acid to strong base (alkali)

Extension Activities:

1. An extra experiment for more advanced classes where they could be given three clear unidentified liquids. They then have to test all three liquids and decide if the liquids are acids, bases or neutral.

2. As a demonstration, you can get a straw and blow gently into the cabbage indicator. Since the air we exhale contains carbon dioxide, it reacts with the indicator to create carbonic acid and the indicator will change its colour accordingly.

Worksheets: This video experiment has four worksheets. The first is a results worksheet that students can fill out in class. The remaining three are the early, middle and upper year worksheets.

Cabbage Magic – Results

Name: Date:

Name of liquid	Colour Change	Acid, Neutral or Base?
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		

Cabbage Magic – Worksheet (Early years)

What colour was the magic liquid?

____

What was the magic liquid made of?

____

Name three colours you made in class.

____

____

____

Can you draw a picture of the experiment? Use as many colours as you can!

Cabbage Magic – Crossword (Middle years)

C	C	O	E	A	O	F	D	P	W	P	H	N	Z	R	F	N	C	N	I
P	A	W	A	M	L	S	W	C	C	F	Y	H	S	F	R	F	Z	S	W
Y	A	B	E	V	H	S	H	K	B	V	O	T	P	W	R	W	H	Y	M
U	Q	S	B	W	T	N	A	M	T	M	K	R	I	P	A	C	L	J	U
B	Y	U	T	A	M	Z	C	T	W	T	F	J	S	P	T	V	C	D	I
U	L	X	Y	O	G	Q	B	P	I	H	L	L	B	N	U	U	B	L	G
S	O	P	G	Q	M	E	B	I	I	V	B	P	D	V	V	C	L	U	S
Q	I	S	L	X	M	V	T	M	N	O	D	P	J	N	B	V	Z	D	D
A	G	Y	W	R	I	Z	G	J	Y	H	D	B	Q	D	A	E	V	I	J
Y	O	H	A	F	B	Y	Y	K	B	Q	A	I	R	S	M	M	S	W	I
Y	J	T	I	L	X	M	N	Z	D	G	X	Y	C	F	O	P	F	I	R
I	C	T	M	A	A	H	K	X	R	T	U	O	C	A	O	W	I	M	L
I	U	U	K	A	L	G	D	V	U	A	V	Y	O	D	L	M	H	H	O
O	V	P	E	I	K	V	D	X	J	O	K	B	L	I	Q	N	C	L	B
M	U	X	T	J	U	I	N	D	I	C	A	T	O	R	L	J	Y	H	K
H	U	M	D	X	Q	G	I	Z	X	H	A	T	U	F	U	P	A	U	G
P	U	W	U	S	D	X	C	T	J	J	P	E	R	A	L	P	Q	W	N
S	A	R	B	C	Y	I	F	O	X	M	Y	S	D	F	U	P	U	S	I
E	R	R	R	I	R	E	L	A	C	S	I	A	Z	Z	G	B	L	U	N
L	B	C	O	B	O	Z	Y	V	O	W	R	B	S	E	Z	E	C	L	E

Search for these words:

Colour

Litmus

Acid

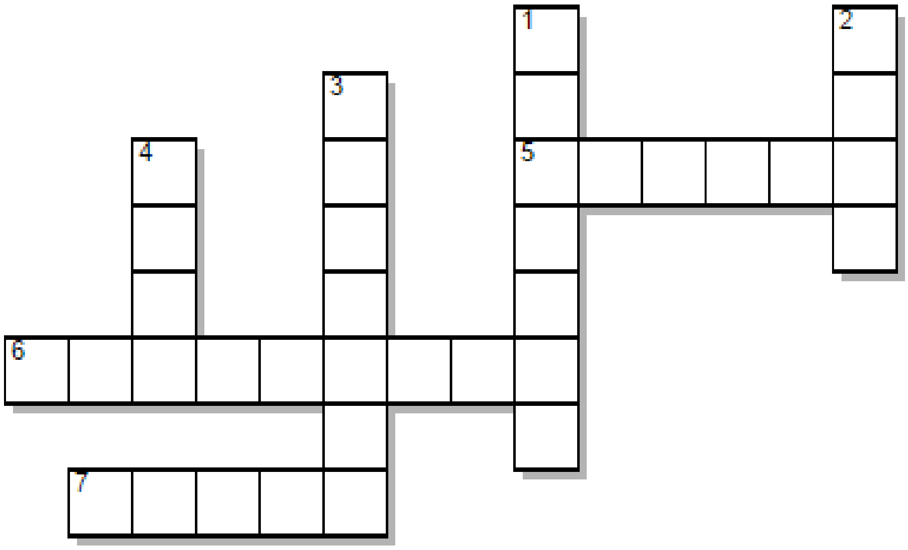
Base

Cabbage

Indicator

Scale

CABBAGE MAGIC – CROSSWORD (Upper years)



ACROSS

5 PH indicator made of paper
6 Lets you know which way a car is going to turn
7 Something used to measure weight

DOWN

1 What do you count in a rainbow?
2 Turns green/blue with cabbage indicator
3 Important vegetable for this experiment
4 Turns red with cabbage indicator

Tie-dye Milk/Runaway Pepper

There are two experiments in this video. The first is Tie-dye Milk and the second is Runaway Pepper. Although they are two separate experiments they demonstrate the same scientific principle of surface tension.

Tie-Die Milk

Equipment

- Milk
- Bowl
- Washing-up Liquid
- Small amount of water in a bowl/cup
- Food Colouring in a variety of colours
- Cotton Buds

Method: Place the milk in the bowl. No need to fill the bowl to the top, you just need enough so that the food colouring can move around in it.

Add a few drops of each of the food colourings

To make the washing-up liquid solution: Mix a few drops of washing up liquid with the small amount of water and mix.

Using a cotton bud, dip one end into the washing up liquid solution.

Slowly dip this end of the cotton bud into the bowl of milk and food colouring and watch the food colouring move across the bowl.

This is because the washing up liquid broke the surface tension and the food colouring is now able to move freely.

Precautions: Do not let students drink the mixture or any of the ingredients.

Teacher Notes: The movement that you observe is due to a couple of factors: The ability of soap to separate out water and fat by a chemical reaction. Milk is mainly made up of water and fat. One part of the soap molecule grabs on to a water molecule and one end grabs on to a fat molecule. This separates the water and fat in the milk and creates a turbulent effect. This partly explains why the milk starts rumbling and swirling around as soon as the soap is added.

The second factor is the strong surface tension of water. Water molecules are strongly attracted to each other. This tension creates an invisible film or skin on the surface. The added soap breaks the film, or surface tension, of the water and food colouring moves along with the disturbed water, creating beautiful patterns. We see the benefits of soap when we wash dishes. The soap allows us to cut through the grease, which is fat on our pots and pans. The same principle is at work here.

Extension activities:

1. Get students to explain why milk is important. Get them to link their explanation to the experiment in terms of the main components of milk: fat, protein and water.

2. This experiment can be conducted with different types of milk to see if that has an impact on the experiment. This will develop the students' observational and critical thinking skills.

3. See which group of students can create the most elaborate 'tie-die' effect. Take a picture of their entries and present them on a smart board or projector. Get the students to vote for the winner.

Worksheets: There are three worksheets for each half of the video. The Tie-Die Milk worksheets are below.

Tie-Die Milk – Worksheet (Early years)

Draw a picture of the colours in the milk in the box.

Tie-Die Milk – Worksheet (Middle years)

1. List all the colours you made in the experiment.

2. In the two pictures below, can you draw what the colours looked like in the bowl before you added the washing up liquid and after?

Before

After

Tie-Die Milk – Worksheet (Upper years)

1. What happens to the food colouring when you first put it on the milk? Why do you think this happens?

____

____

2. What happens when you add the drop of soap?

____

____

3. What direction does the food colour move when you first add the drop of soap?

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4. What direction does the food colour move after the experiment has been running for a while?

____

____

5. Does the movement go on forever? What happens?

____

____

6. What happens if you add another drop of soap after the colours have stopped moving?

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Runaway Pepper

Equipment

- Water
- Bowl
- Ground pepper
- Washing up liquid solution from previous experiment

Method: Pour some water into the bowl

Sprinkle some pepper into the bowl

Dip a cotton bud into the washing up liquid solution and then dip the bud into the bowl with the pepper

Watch the pepper race to the side of the bowl as the surface tension breaks.

Precautions: Again, do not let the students ingest any of the materials. Students should be careful with the pepper as it is easy to make a mess.

Teacher Notes: The pepper rests on the surface of the water, due to connections and bonds between the water molecules. By adding soap to the water, the surface tension of the water is reduced. Now, the water wants to spread out flat (water normally bulges up slightly, like when you overfill a glass of water, or if you have a single drop of water sitting on a flat surface). As the water flattens out, it carries the pepper that's floating on the surface away from the source of the soap and to the edge of the water. You may also find that now the surface tension of the water is lower, some pepper grains sink to the bottom of the water.

Kitchen Quicksand

In this video, the combination of cornstarch and water results in a substance that exhibits the properties of a solid and a liquid depending on the amount of pressure applied to it. These types of fluids that don't behave like what we think of as "normal" fluids are called non-Newtonian fluids.

Equipment

- Corn-starch/ Corn flour
- Water
- Food colouring
- Mixing bowl and spoon
- Two containers of equal size to measure 2 parts cornflour and 1 part water

Method: Measure out two parts corn flour and one part water.

Add food colouring to the water.

Mix the food colouring and corn flour together in the mixing bowl using a spoon or your hands.

If the mixture does not appear to be coming together add a small amount of corn flour slowly until the correct constituency is observed.

Precautions: Food colouring can stain cloths, it is advised that students have aprons and plastic gloves. Students have to be warned not to ingest any materials in this experiment.

Teacher Notes: The quicksand is made up of tiny, solid particles of cornstarch suspended in water. This type of mixture is called a colloid. When you bang on it with a spoon or quickly squeeze a handful, it freezes in place, acting like a solid. The harder you push, the more compressed and less fluid the parts of quicksand become, but when you open your hand, the quicksand drips like a liquid. Try to stir the quicksand quickly with a finger, and it will resist your movement. Stir it slowly, and it will flow around your finger easily. This is what's known as a non-Newtonian fluid. It acts more Ooze--it gets more viscous when you apply a shearing force. This is why you should move slowly in a pool of quicksand. The slower you move, the less the quicksand will resist your movement.

Extension Activities:

1. Put small plastic toys into the quicksand and see if they sink. This works well with toy soldiers.

2. Ask the students to define a solid and give examples. Ask them the same for liquids. Now that they have a definition for both, get them to define the quicksand. This is good at encouraging comparative skills.

KITCHEN QUICKSAND – WORKSHEET (Early years)

With the help of your teacher, place you hand in the quicksand and make a handprint in the box. Write your name and age beside your hand print.

Kitchen Quicksand – Worksheet (Middle years)

1. What did the quicksand feel like when you picked it up?

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____

____

2. What happened when you let go of the quicksand? Did it still feel like a solid or did it turn back into a liquid?

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3. Draw a picture of the quicksand.

Kitchen Quicksand – Worksheet (Middle years)

List some properties of solids

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____
____
____
____
____

List some properties of liquids

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____
____
____
____
____

Does the quicksand behave like a solid or liquid or both? Explain your answer.

Sink or Swim?

This video shows how liquids can be used to show some principles of density in a very colourful way. It is designed to appeal to visual learners.

Equipment

- A clear tall glass
- A number of different liquids with different densities: Maple Syrup, Washing up Liquid, Water with Food Colouring, Cooking Oil
- A number of solids with different densities: Cork, Blueberries and Cherry tomatoes

Method: First pour the syrup into the glass slowly being careful not to get any on the sides (this is so we do not have to wait for the syrup on the side to reach the bottom of the glass)

Next pour in the washing up liquid

Next pour in the coloured water by pouring it slowly down the side of the glass

Finally add the cooking oil and allow the liquids to settle for a few minutes

When the liquids have separated out, add the solids carefully, one by one.

The most dense liquids and solid will be near the bottom and the least dense liquids and solids will be at the top.

Precautions: Students have to work diligently with the materials so that they don't mix when conducting the experiment. Some of the materials will stain and none of the materials should be ingested.

Teacher Notes: Sink or swim works on the basis that liquids have different densities. Liquids/Solids/Gases with a low density float above those of higher density. Density is how much mass a material has, for a given volume. For example, if we consider the sugar content of two cans of coke (Coke and Diet Coke). For a given volume (same size can), there is more sugar in the coke liquid than in the diet coke liquid, making it more dense. When both cans are placed in a tank of water, the less dense can (Diet Coke) will float and the other (Coke) sink.

Different densities means that when the liquids in the video are mixed, they will separate according to their density. This can be very simply shown with oil and water. The density of water is $1gm/cm^3$, whereas the density of oil is lower at $0.9gm/cm^3$. Thus the oil floats on water. This is demonstrated in figure 2.

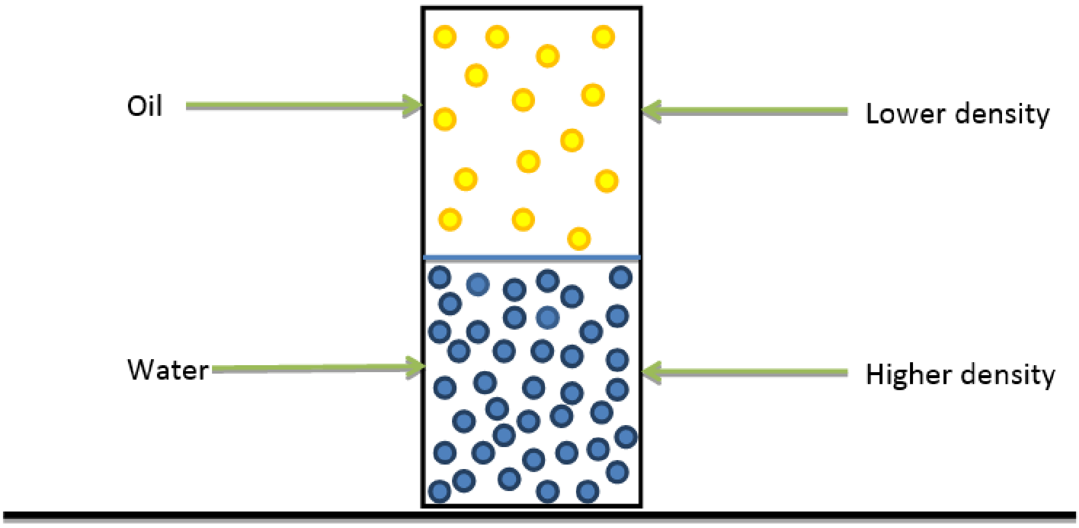


Figure 2: Diagram of oil floating on water due to their different densities.

Extension Activities:

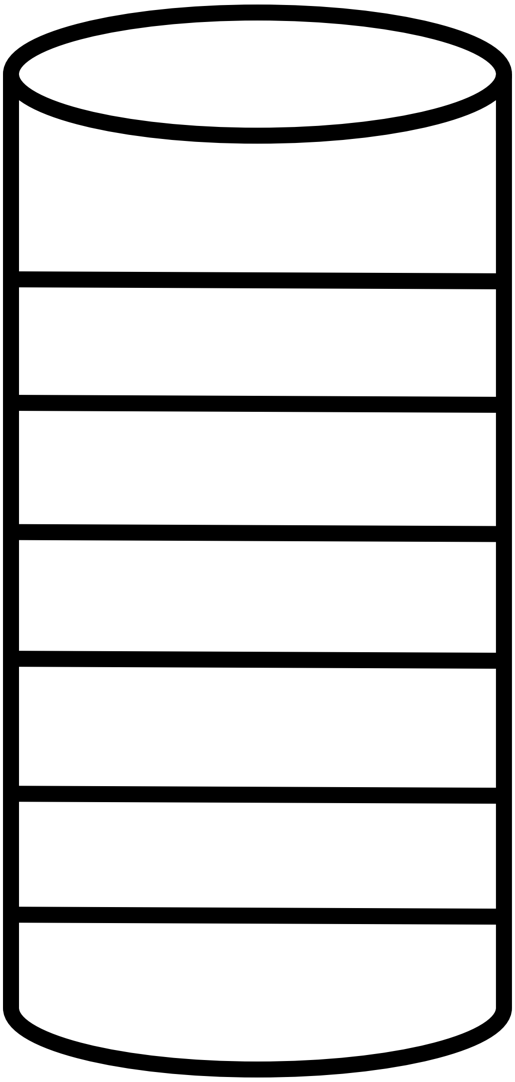
1. Upper years can be given two unknown liquids and water. Through an investigation ask the students to find out which liquid is the densest and the least dense. Then they can predict what the mystery liquids are, based on the density.

2. If performing this experiment as a demo, ask the class to predict whether the liquids will sink or float.

3. Get students in groups to research and present information on oil spills and their environmental impact.

Sink or Float? — Worksheet (Early years)

Colour in this density tower with your favourite colours.



Sink or Float? – Worksheet (Middle years)

How many layers of liquids are there in the glass?

____

Starting with the liquid on the bottom, what order are all the liquids in?

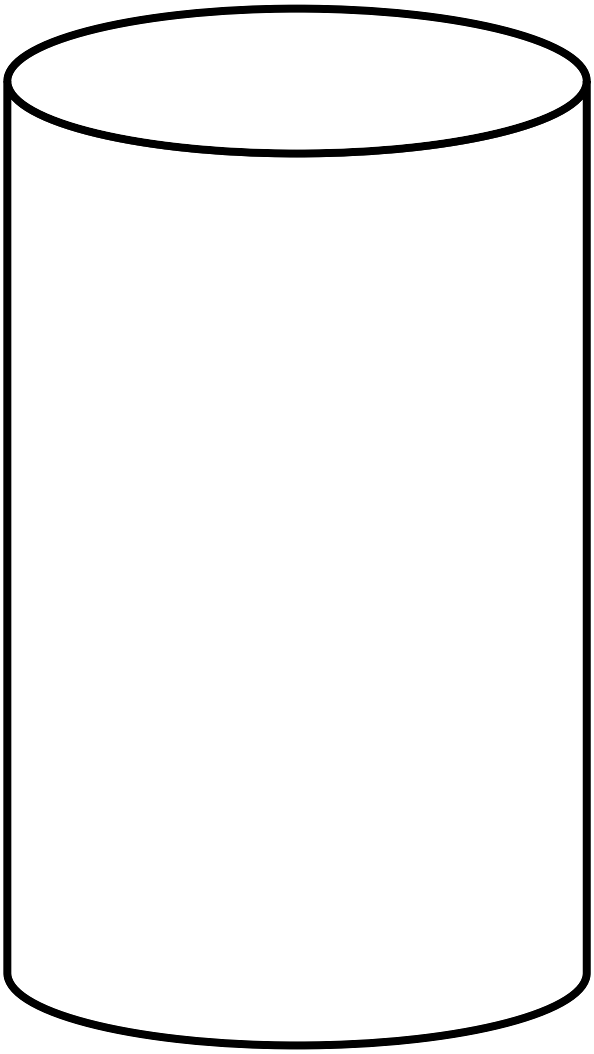
1.___________________________________

2.___________________________________

3.___________________________________

4.___________________________________

Draw and label a picture of the layers in the glass.



Sink or Float? – Worksheet (Upper years)

Draw a picture that explains the word - Density

Colours of the Rainbow

This is a fun and easy video experiment that uses science to explore the variety of colours that are found in each coloured marker. Children love using coloured markers but rarely think of the multiple colours within each single marker. This is a fun sensory science experiment or video demonstration.

Equipment

- Coloured Markers
- Jam jar/glass
- Water
- Filter Paper/Coffee Filters
- Teaspoon/Dropper

Method: Fold Coffee Filter paper in half, four times until you are left with a small wedge shape

Open out the folded filter paper to reveal a line-creased circle

Put a dot from each of the coloured markers on each section, 1-2 inches from the centre, forming a circle of coloured dots.

Rest filter paper on top of an open jam jar/glass and with a dropper/teaspoon, let a few drops of water fall onto the centre of the paper.

Watch what happens as the water is absorbed into the paper.

Precautions: Coloured markers may stain skin and clothes, wash hands after the experiment.

Teacher Notes: This process is called chromatography. (The word "chromatography" is derived from two Greek words: "chroma" meaning colour and "graphein" to write). Chromatography is a way of separating mixtures of different chemicals. For example, pen inks are often made up of a range of different colours. The different molecules in the ink have different solubilities. Solubility is the ability of the ink to dissolve in different fluids, for example water. The fluid that the ink molecules dissolve in is called a solvent (water in this case). Because of the different characteristics of the molecules in the ink, they travel at different speeds when pulled along a piece of paper by the solvent. For example, black ink contains several colours. When the solvent flows through a word written in black, the molecules of each one of the colours behave differently, resulting in a sort of "rainbow" effect. The water helps these colours to separate on the paper. Chemists Chromatography in laboratories to separate out mixtures of chemicals.

The chromatography experiment is popular amongst all years while also being educational, students get to experience inquiry, predict the colour make up of each colour and using, observation and teamwork skills explore this separation technique. Following this, a range of extension activities can be conducted in which students obtain and present evidence.

Extension Activities

1. This quest is based on techniques used in crime labs to investigate ink samples found at crime scenes. Challenge students with the CSI Fido Mystery game. Tell students that the teacher received a note this morning saying Fido the dog has gone missing. The note was signed "Love Fido". Now everyone knows Fido is a dog and cannot write notes, so the teacher thinks that someone is playing a trick. There are 3 suspects, the neighbour, the gardener and the milkman. Show students each of their pens and ask them to use Chemistry to figure out who wrote the note! (Tips: Nail polish remover works best as the solvent. Cut coffee filter paper in strips of 15cm long, 4cm width. Draw a line using a pencil and ruler about 1cm from bottom of paper. The strips of paper are then sat gently into the containers containing about 0.5 cm height solvent. It may take up to 30 minutes to let the ink separate out into its components).

2. If every student uses two coffee filters, they can create butterflies or insects like the picture below. Tie the two filters together and use pipe cleaners to make antennas.

Worksheets: Every experiment comes with three worksheets, one for early, middle and upper years. They can be easily copied and given to students after the activity or for homework.

Colours of the Rainbow – Worksheet (Early years)

1. What colour markers did you use?

____

____

____

____

____

____

____

2. What happened to the coloured dots once the paper started to get wet?

____

____

3. Draw a picture of the filter paper and each of the coloured marker dots in a circle in the box below:

Colours of the Rainbow – Worksheet (Middle years)

1. Describe what happened to each of the coloured dots once the paper absorbed more water?

____

____

____

2. In the box below, draw and label a picture of the experiment.

3. List the marker colours and what colours they separated into:

Brown	maker ink separates into	*Yellow*	*Red*	*Blue*

Colours of the Rainbow – Worksheet (Upper years)

1. Chromatography is a way of separating mixtures of different chemicals. Describe how you separated the ink mixture of one of your colour markers.

2. List the marker colours and what colours they separated into:

Brown	maker ink separates into	*Yellow*	*Red*	*Blue*

3. If you were doing this experiment again, what would you do differently?

4. What other ink types could you test in this experiment?