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Royal Society of Biology

Royal Society of Biology

Gopher Science Labs

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BIOCHEMICAL SOCIETY

Gopher Science Labs was developed by the Royal Society of Biology and the Biochemical Society. This resource was produced thanks to generous support from the Welsh Government's National Science Academy and the Biochemical Society.

Contents

CLEAPSS

Safety checked but not trialled by CLEAPSS

Gopher Science Labs

Gopher Science Labs was created and developed by the Royal Society of Biology in collaboration with the Biochemical Society. Its activities are designed to ease pupils' transition from primary to secondary education. The Gopher Science Labs resources were produced thanks to generous support from the Welsh Government's National Science Academy and the Biochemical Society.

Gopher Science Labs activities use simple hands-on science designed to facilitate learning by primary aged children. Simple household items, familiar analogies, simple language and fun are used to encourage children's natural curiosity to find out how and why everyday things work.

Secondary schools can run Gopher Science Lab days with their feeder primary schools. Secondary students are trained to become demonstrators and deliver the activities to the primary pupils on transition days. During this process the secondary students develop their skills in communication, innovation and increased self-confidence. All students gain an increased awareness of the applications of the science they learn about in the classroom.

To find out more about Gopher Science Labs please visit the Royal Society of Biology website:
www.rsb.org.uk/gophersciencelabs

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How do butterflies drink?

This activity demonstrates the principles of capillary action, and explores how butterflies use capillary action to feed.

Required resources

3 types of drinking straw – wide, medium and narrow gauge

1 petri dish, sellotape, red food colouring and a felt-tip marker

Water

Try it!

Fill the petri dish with water and add red food colouring.

Sellotape all 3 straws together so that the bottoms are lined up.

Predict which drinking straw you think the water will rise up the most.

Place them all in the water, making sure they don't touch the bottom. Don't suck! Count to thirty.

Ask your partner to mark on each straw with a felt tip pen where the water reached. Measure the distance travelled.

Note down your result.

Questions to ask

In which drinking straw did the water travel highest?

Try to explain why you think that is.

What might this tell us about how butterflies 'drink'?

Explanation

The water travels highest in the narrow straw. Capillary action works because water is 'sticky'. When water hits the straw, adhesion occurs between the water and the straw surface so the water 'clings' to the straw. If the tube is very narrow then cohesion (where water molecules are attracted to each other) and adhesion combine to lift the water.

Butterflies 'drink' using a long tube-like mouthpart called a proboscis. The drinking straws mimic the butterfly's proboscis 'tube'. Different species of butterfly have different sized proboscises. A butterfly uses both 'sucking' and capillary action to feed from different food sources.

Extension

Pinch your thumb and forefinger together under water. Remove them from the water, and very slowly pull them apart. You should see a small drop of water ‘stuck’ there (this tiny gap mirrors the smallest straw). Now, open the gap wider, what happens? Even though water is highly cohesive, it can’t stick together in a big straw.

Explore other examples of capillary action in the real world, for example in plants, wax rising up a candle wick or even how paper towels absorb water.

Table

Type of straw	Distance travelled by water (mm)
Narrow	
Medium	
Wide	

Which straw did the water travel highest in?

Can you smell as well as a shark?

This activity explores how sensitive our sense of smell is and compares it to a shark.

Required resources

1 litre jug (1000ml) and a 1ml pipette

4 small beakers/containers

Small amount of perfume or smelly liquid

Water

Information

1 part per million (1ppm) = 1 drop in 1 million drops of water.

Try it!

First prepare your solutions:

- Add 25 drops of perfume to 1 litre of water. Stir thoroughly and pour a small amount into the 1st beaker. This is roughly 1000ppm.
- Thoroughly wash the jug and refill with water. Add 5 drops of perfume, stir and pour into 2nd beaker. This is roughly 200ppm.
- Thoroughly wash the jug and refill with water. Add 1 drop of perfume. Pour half the water away, and refill to the top with water. Pour into the 3rd beaker. This is roughly 20ppm.
- Finally, half fill the 4th beaker with just water.
- Label each beaker and note down the concentration.

Mix them up. Sniff each container.
Order them from strongest to weakest solutions.
Can you work out which concentration of perfume each one contains just by smelling?
Test your friends.

Remind pupils not to taste or drink the liquid

Questions to ask

Which is the weakest / strongest solution?

Which containers were you able to smell perfume in? Compare with your friends.

What other smells do you think are easy to detect? Why?

Explanation

A shark's sensitivity to smell varies between species, but they should be able to smell 1ppm in water (the solution containing 20ppm is 20 times more than the minimum a shark could smell). Some sharks can smell 1 part per billion of fish oil in water! Sensitivity also varies depending on the substance. Humans can only smell as little as 200ppm. So, it will have been very difficult to smell the one at 20ppm perfume.

A much larger part of a shark's brain (2/3 of its weight) is dedicated to the olfactory lobes (which analyse smell) than in humans. Sharks have evolved this amazing sense because of their need to find and kill their prey. In fact, research has shown that sharks respond more strongly to smells from injured prey, therefore allowing them an easy 'kill'.

Table

Concentration of perfume (parts per million)	Letter on beaker	Tick if you can smell the perfume
Water		
20ppm		
200ppm		
1000ppm		

Compare your last column with your friends. Were some of you able to smell better than others?

Why do slugs and snails need slime?

This activity will explore the properties of slug and snail slime and allow pupils to create their own.

Required resources

Bowl and a teaspoon

Sachet of cornflour and toothpaste

Water

Try it!

Work in pairs or small groups.
Put 4 teaspoons (tsp) of cornflour into the bowl.
Add water bit by bit, stirring constantly until it gets 'gloopy'– you need to stir slowly!
Now, experiment. Discuss or write down your observations.

- Gently tip the bowl from side to side to see what the mixture is like 'at rest'.
- Move the spoon quickly through the mixture. Now move it slowly.
- Pick some up in your hands and squeeze hard, and then release it.
- Experiment with the mixture in other ways – tap it, prod it…

N.B. Dispose of this mixture in the bin, not the sink.
Next, squeeze some toothpaste into a clean, dry bowl.
Repeat experiments.

Wash hand afterwards
Don't allow pupils to taste cornflour or toothpaste

Questions to ask

What happens when you apply a 'force' (squeeze, push etc…) to the cornflour?

What happens when you apply force to the toothpaste?

How are the two liquids different 'at rest'?

Do all liquids behave in this way? Compare to water.

Explanation

The cornflour mixture and toothpaste behave differently to water. Their viscosity (how easily it flows) depends on the 'force' you apply to them. The corn-flour mixture became thicker/stiff when you squeezed it or pushed the spoon quickly (applied more 'force'). When you moved the spoon slowly, or applied less 'force', it became runnier. In contrast, the toothpaste became runnier when you applied more force to it, and was thicker/stiff at rest.

Slug and snail slime behaves in a similar way. Slugs and snails need slime to help them move along on their large muscular 'foot', but they also need it to be 'sticky'. At any one time parts of the 'foot' are contracted (tensed) and other parts are relaxed, which creates a rippling effect as the animal moves. As the foot ripples it applies a different force to the slime, which causes the slime to be both solid and runny, just like in your experiments. This means the animal can both 'stick' and move on vertical surfaces and even upside down.

Extension activities

- Explore slugs and snails in the school grounds. You could carefully collect a snail and place on a piece of Perspex to watch how the foot ripples underneath as it moves (see www.arkive.org/garden-snail/helix-aspersa/video-06.html).
- The cornflour mixture is an example of a 'Non-newtonian' liquid. Explore what this means. Did you know you can 'run' on the cornflour mixture? (Look on www.youtube.com for videos) What would happen if you walked slowly?
- See http://web.mit.edu/nnf/research/phenomena/slug.html for more info.

Observations table

Condition	Cornflour Mixture Observations	Toothpaste Observations
At rest - gently tip bowl from side to side		
Moved spoon fast		
Moved spoon slowly		
Squeezed mixture hard		
Released mixture through fingers		
Prodded it		
Tapped it		

Add your own experiments to the table.
You could add a 3rd column with observations just using water.

Do you see what I see?

This activity helps to understand how the eye works and explores some limitations of sight by testing your peripheral vision.

Required resources

Set of small objects of the same colour (small car, train etc…)

1 large 12cm protractor, piece of string (30cm long) and sellotape

3 differently coloured paddles (or other objects of the same type)

(Sellotape one end of the string to the middle of the protractor's straight edge)

Try it!

Work in pairs or small groups.

Person 1 (P1) holds the protractor in front of them with the middle of the straight edge touching their neck. Let the string hang loosely over the top.

Keep eyes facing forward all the time!

Person 2 (P2) picks an object and takes hold of the other end of the string.

P2 slowly moves the object from behind P1's right shoulder to the front of P1's face in a semi-circle. The string should keep the object at an equal distance.

Stop moving the object when P1 can correctly identify the object.

Use the string to 'line up' the 'stop point' with the protractor.

Read off the angle at which the object stopped. Note it down.

Repeat the experiment with another object.
Repeat the experiment over the left shoulder.
Swap over, so Person 1 does the measuring.

You could repeat the experiment using number of fingers, dots on cards or colours.

Questions to ask

Are you quicker at seeing certain objects than others?

Why do you think this is?

Does it make a difference if you try the experiment over the left shoulder?

What are the limitations of peripheral vision?

Explanation

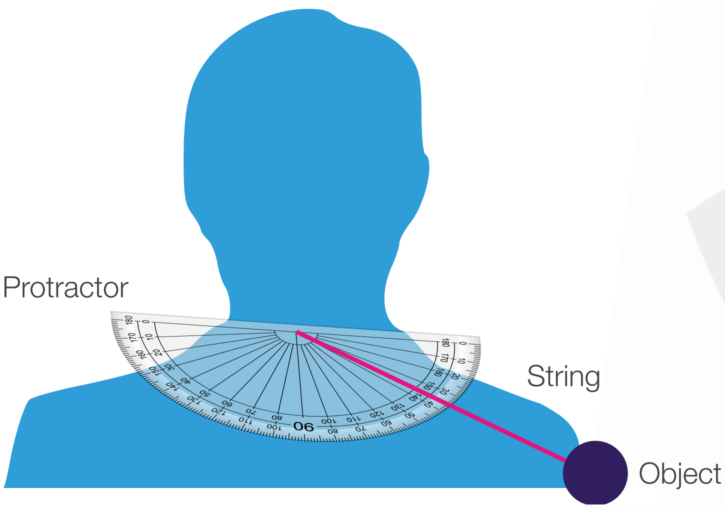
Peripheral vision allows us to gather information about our surroundings. Without it we would see the world through 'tunnel vision'. It is controlled by the distribution of rods and cones within our retina, the light sensitive lining at the back of the eye. Cones are sensitive to colour. Rod cells are better at sensing objects, but they are not sensitive to colour. There are fewer rods and cones at the periphery (the outsides) of the retina.

When you see something out of the corner of your eye, its image focuses on the periphery of your retina, where there are fewer rods and cones. That is why it is difficult to make out the colour and shape of something you see out of the corner of your eye.

Extension

- Try repeating the experiment with different coloured paddles, and stop the paddle when you can correctly identify the colour. N.B. it is important to be aware that this may raise issues of colour blindness.
- Try the experiment in dim and bright light. Predict what you think might happen. Try it. Does it make a big difference?
- You could try other visual experiments exploring persistence of vision.

Object (insert below)	Person 1 Angle	Person 2 Angle
Object 1 Right shoulder		
Object 2 Right shoulder		
Object 1 Left shoulder		
Object 2 Left shoulder		



The Lemon Battery

This activity demonstrates that batteries are devices that can power other devices such as an electric clock, and explores how you can make batteries using fruit.

Required resources

2 small beakers (50 ml)

1 lemon (or lemon juice)

An electric clock

2 copper and 2 zinc strips

1 metal wire

2 connecting blocks

Water

Soil (optional)

Try It!

First set up the 'Lemon' Clock

Using the diagram in the booklet provided with the clock pack, assemble the electric clock. Screw the metal strips into the connecting block and connect the loose wire as shown in the diagram.

Predict What do you think will happen to the clock when the metal strips are placed into small beakers if they contain (a) water or (b) lemon juice?

Add 10ml water to each small beaker. Place one pair of metal strips into each small beaker making sure the strips do not touch each other. Observe the clock.

Repeat using lemon juice (Optional)
Repeat the activity but this time carefully place the metal strips in a lemon instead of the beakers. Observe the clock. What do you think will happen?

Questions to ask

In which liquid did the clock work?

Try to explain why you think that is.

What might this tell us about lemon juice?

Explanation

The lemon battery is a simple type of electrical device that illustrates a battery's main components. A strip of zinc metal and a strip of copper metal are inserted into the lemon juice.

Batteries have a negative and a positive electrode that carry a current. The zinc and copper strips in the lemon battery are the electrodes.

The current is a flow of particles called electrons. Electrons flow through wires and form negatively charged particles (ions) in order to flow through the solution (electrolyte) to carry the charge between electrodes. Many fruits act as an electrolyte. The acid electrolyte in citrus fruits (lemons, oranges, grapefruits, etc.) is citric acid. Water does not act as an electrolyte.

Extension

Try repeating the activity using different fruits and vegetables or fruit juices (limes, oranges, grapefruits, potatoes, carrots etc). What happens?

Explore the voltage produced by the fruit batteries.
You could also try wiring a single lemon to a multimeter (multimeter must be provided) to measure the voltage. Push a zinc strip and a copper strip into the lemon and connect up the strips by the wires to the multimeter. Repeat this with other fruit and note the different measurements with the different fruit.

Type of fruit	Did the clock work?	Voltage
Lemon		
Orange		
Grapefruit		
Lime		

Don’t blow it!

Discover how much air your lungs can hold and explore more about how physical activity affects your vital capacity.

If you have any breathing difficulties (asthma or other condition) you should be careful when participating in this activity, or use your partner’s results.

Follow normal rules for P.E. and Games activities.

Use a fresh balloon for each pupil and each time.

Note: Anyone with a latex allergy should not handle balloons.

Required resources

Balloons, a ruler, a calculator

Try it!

Work in pairs or small groups.
Before you start, stretch the balloon by blowing it up 3-4 times.

1st Experiment - Measure your VITAL CAPACITY.
Inhale as much air as you can and blow into the balloon forcefully in one go.

Pinch the end of the balloon, and place onto a level surface.

Ask your partner to measure the diameter of the balloon using the ruler.

Repeat this process two more times – calculate the mean and note it down.

Once you have your mean, use this equation to work out the volume of the air:

$V= 4/3 \varpi r^3$
$4/3 \times 3.14 \times \text{radius}^3 =$ Volume of air (cubic cm)
(To calculate radius^3: if diameter is 4cm then radius will be 2cm, $2 \times 2 \times 2 = 8cm^3$)

2nd Experiment – activity

Run on the spot for 30 seconds, or remain seated and wave your arms up and down for 1 minute, and then repeat experiment 1.

Questions to ask

Why is it important to repeat the measurement 3 times to get a mean?

What happens to your vital capacity after exercise? Why?

What do you think will happen to your vital capacity if you do more regular exercise?

How might an athlete’s vital capacity compare to a non-athlete?

Explanation

Lungs are essential for the transport of oxygen around the body. The amount of air you move in and out of your lungs while breathing normally is called the TIDAL VOLUME. The maximum amount of air moved in and out is called the VITAL CAPACITY, this is when you inhale and exhale more forcefully.

You should all have different results for your vital capacity. It might have dropped slightly after doing the short amount of exercise in this experiment; however it is possible to increase it through regular exercise. An athlete will have a higher vital capacity than a non-athlete. This means they are able to distribute oxygen around their body at a faster rate, ensuring their muscles perform better.

Extension

You can also measure your TIDAL VOLUME by breathing normally into the balloon.

Table

N.B. As you are still growing, your lung capacity may change naturally over the next few years.

Person 1	Diameter 1 (cm)	Diameter 2 (cm)	Diameter 3 (cm)	Mean (cm)	Volume of air - cubic cm (cm^3)
VITAL CAPACITY - at rest					
VITAL CAPACITY - after activity					

(To get the mean, add your 3 results together and divide by 3).

Can you beat the test?

Explore how words influence what we see and discover how the brain handles mixed messages.

Please be aware that this activity may raise issues of colour blindness. You can make your own word cards using different colours to take account of this.

Required resources

Word card

Stopwatch

Try it!

Work in pairs or small groups.

Your partner should record your times on the stopwatch and check you are doing the test properly.

Read through the experiments below. Predict what you think might happen.

1st experiment
Person 1 reads through the words on the card.
Say the word, not the colour.

When you have finished, Person 2 records the time on the stopwatch.

2nd experiment
Now repeat the experiment but say the colour, not the word. Record time.

Swap over. Repeat experiments for Person 2.

Questions to ask

Were your predictions accurate?

Is it easier to say the words or the colours?

Do certain words 'trip up' everyone?

Can you improve your ability to do the test by repeating the experiment?

Explanation

Everyone responds differently to this test; however you should have found it easier to say the word rather than the colour. The words have a strong influence over your ability to say the colour. The interference between the different information (what the words say and the colour of the words) your brain receives causes a problem.

John Ridley Stroop first discovered this phenomenon in 1935; as such it is called the Stroop Test. There are 2 theories that explain the test.

1) The interference occurs because words are read faster than the colours are named.

2) The interference occurs because naming colours requires more attention than reading words.

Whichever theory you agree with, the brain is having problems processing these mixed messages.

Extensions

- Repeat with the flashcards upside down. Say the colour, not the word. Record time. Does turning the cards upside down make a difference?
- Make up your own Stroop test. Use different words e.g. non-colour words. Use long words compared to short words. Does this make a difference to your times?
- John Ridley Stroop's 1935 paper is available online if you want to read it. http://psychclassics.yorku.ca/Stroop/

	Time – Words (seconds)	Time – Colours (seconds)
Person 1		
Person 2		

The marvellous colour-changing cabbage

Teacher notes

This experiment uses red cabbage juice to test whether common kitchen chemicals are acids or bases.

Learning objectives

- Observe the colour change when chemicals are added to red cabbage juice.
- Discover why red cabbage is a natural indicator - a chemical that changes colour when it comes into contact with an acid or a base.

Although all the household chemicals used are commonly found at home, they can still be irritant or corrosive and must be handled carefully.
Ensure all solutions are stored safely.

Required resources

Chromatography paper (can be coffee filter paper)
5 small containers
5 pipettes
A selection of testing chemicals: lemon juice, vinegar, baking powder and washing powder (mixed with water)
To buy a red cabbage in advance.
Access to a sink and kettle, to prepare your red cabbage juice.
Water

Teacher preparation in advance required:
Chop half a red cabbage up into small pieces and place in a large container. Pour boiling water onto it and leave for 10 minutes for the solution to turn a deep purple. Allow to cool. Remove the cabbage. This will last for a few days in a sealed tub.

Pupil notes 30-40 minutes

This experiment uses red cabbage juice to test whether common kitchen chemicals are acids or bases.

Try it!

Explore your test chemicals.

Predict what colour change you think will occur when added to the red cabbage juice.

Pour approximately 1cm of red cabbage solution into each of your containers.

Prepare a 'control' container by adding 5-10 drops of water from a pipette to one container. Note the result.

In each of the remaining containers, use different pipettes to add 5-10 drops of the different household chemicals. You may need to add more than 10 drops from some of the chemicals.

Observe the colour change. Note it down.

Questions to ask

- Were your predictions accurate?
- Why did you prepare a 'control' container?
- Which chemicals do you think are acids? Which are bases?
- Why did some need more drops than others?

What's going on?

Red cabbage contains a water-soluble pigment called anthocyanin that changes colour when it is mixed with an acid or a base. It is a natural universal indicator. The pigment turns red in acidic solutions with a pH less than 7 and the pigment turns bluish-green to yellow in alkaline (basic) solutions with a pH greater than 7.

The pH scale runs from pH 0 to pH 14. Some acids are more acidic than others, closer to 1 on the scale, and some bases are more alkaline, closer to 14 on the scale. This is why there is a range of colours.

Other fruits and vegetables also contain anthocyanins. They give the plants their bright colours. You could try cranberries or beetroot instead of red cabbage.

Extension activities

Make your own litmus paper:
Soak some chromatography or filter paper in very strong red cabbage solution. Let it dry. Cut the dried paper into thin strips. You can now use these to dip into different household chemicals and observe the colour change. Or 'paint' your different chemicals onto the paper to create a picture.

Make secret spy letters:
Use the washing powder solution and a paintbrush to write secret messages onto filter paper. Let it dry. Dip it into red cabbage solution to see the message reveal itself.

Test Chemical	Number of drops added	Colour change	Acid or Base?
Water			
Lemon Juice			
Vinegar			
Washing powder			
Baking powder			

There are spare rows at the bottom of the table to add your own test chemicals.

What’s the best way to clean up an oil spill?

Teacher notes

This experiment uses different materials to test the most effective way to clean up an oil spill.

Learning objectives

Explore the properties of different materials.

Predict which material will be more effective at cleaning up oil.

Required resources

2 bowls

Olive oil

A selection of testing materials:
polyester cloth, cotton wool, ‘moon sand’ (hydrophobic sand), normal sand.

Disposal – Do NOT pour oil down the drain. Collect oil as per the double bag method and place in bin. Mix left over water with LOTS of washing up liquid before pouring down drain followed by lots of water.

Extension

If you use the extension activity with feathers in oil and experiment with the best way to clean the feathers, then only use clean feathers, and ensure all pupils wash their hands afterwards and monitor this washing. If you are in any doubt about the feathers purchase some from a craft shop.

Pupil Notes 30-40 minutes

This experiment uses different materials to test the most effective way to clean up an oil spill.

Try it!

Half fill a bowl with cold water.

Add the testing materials to explore their properties.

What happens when you remove them?
Do some soak up water more than others?

Predict which of the different testing materials will remove the most oil.

Half fill 2 bowls with cold water.
Add a teaspoon of oil to each. Do this near natural light so you can easily see the oil. Use the different materials to try and remove as much oil as you can from the bowls:

- First, dip the cotton wool and polyester cloth into one bowl. What happens?
- In the other bowl, sprinkle a teaspoon of the moon sand next to one half of the oil globule, and the normal sand to the other side. What happens?

Questions to ask

What happened to the oil in the water? Why?

Which material was the oil most attracted to (moved towards)?

Which material removed the most oil from the water?

Which soaked up the most water?

How might this experiment help you decide on the best way to clean up an oil spill? (Think about where an oil spill might occur)

Explanation

Oil and water are not attracted to each other – they won't mix and oil will generally float on the surface of water. Oil spills are often dealt with by using chemicals which break down the oil, but this poses problems for marine life as they digest the broken-down oil. So finding alternative solutions is vital.

The polyester and the 'moon sand' remove the most oil from the water for different reasons.

Polyester is oleophilic (likes to absorb oil). You should have noticed the oil soak into the cloth. Polyester can be used to collect oil because it floats on water, doesn't fall apart like the cotton wool, and absorbs the oil.

The 'moon sand' is hydrophobic (does not like to absorb water), but will let oil pass through. When sprinkled beside or on the oil, the oil moves toward it and creates oil-filled sand-clumps that fall to the bottom making it easier to scoop up. This type of sand was originally developed to help clean up oil spills, but as it is so expensive it is never used.

Extension

- Experiment with fresh water versus salty water, to more accurately predict what would happen out at sea. Does it make a difference?
- Explore some other uses for 'moon sand'.
- Dip feathers in oil and experiment with the best way to clean their feathers. Oil breaks down the water-resistant properties of bird feathers. It can impair a bird's ability to fly and keep warm. As they preen they ingest the oil. Ingestion causes dehydration and impairs digestion.

Material	Notes
Polyester	
Cotton	
'Moon sand'	
Normal sand	

Why do leaves change colour in the Autumn?

Teacher notes

This experiment will explore what pigments are present in green leaves and why leaves change colour in the autumn.

Learning objectives

- Discover what pigments are present in green leaves.
- Use chromatography to separate the pigments.

Nail varnish remover (acetone) is highly flammable. Ensure room has adequate ventilation, and avoid naked flames.

A teacher could handle the acetone but if pupils handle it then only hand out small quantities.

Required resources

White coffee filter paper
Small container of nail varnish remover (acetone)
Small transparent beaker, pencil, scissors, cocktail stick
You will need to provide fresh leaves (you could use fresh coriander or spinach or collect leaves)
Take care when selecting leaves. Many can be poisonous. Refer to CLEAPSS to check that leaves are safe to use
Put a small amount of acetone into the test beaker (no more than 0.5cm high)
Hang the filter paper into the beaker so it dips into the acetone (make sure the green spot is above the acetone)
Now ask the pupils to watch what happens
It may take up to 10 minutes

Pupil notes (30-40 minutes)

This experiment will explore what pigments are present in green leaves and why leaves change colour in the autumn.

Predict
Discuss what you already know about leaves and their colours.

Predict what colours you think will be present in the leaves.

Try it!

Cut your filter paper into a strip roughly 2cm wide and 10cm long.

Draw a pencil line on your filter paper 2cm from one end.

Roll up and pinch a few coriander leaves between your fingers.

Start to rub the leaves into a small dot on the middle of the pencil line (you will need to make sure your leaves are squeezed tightly between your fingers so the dot remains small).

Build this dot of pigment up by rubbing a few times and letting it dry.

Wrap the other end of the filter paper around a pencil so it is secure (or poke a cocktail stick through) - this will allow you to hang the filter paper into the beaker.

Questions to ask

What happens to the filter paper when you dip it into the acetone?

What happens to your green pigment spot?

Why do you think the pigment travels up the filter paper?

Is green the only colour to show on the filter paper?

Explanation

A pigment is a natural colour found in plants. You should see the acetone rise up the filter paper and drag the green spot of pigment with it. You will notice that it separates into green and yellow colours. The yellow colour travels furthest.
Most leaves are green because they contain the pigment Chlorophyll. It is important in photosynthesis because Chlorophyll traps the light energy from the sun to make food for the plant. Carotenoid pigments are also present in leaves. They are usually brown, orange and yellow colours, and help with photosynthesis as well as protecting structures in the leaf.

During the spring and summer, Chlorophyll usually hides the Carotenoid pigments, but during the autumn Chlorophyll starts to break down and is not replaced. The Carotenoid pigments become more visible, which is why you see the leaves change colour in the autumn.

Extension

Buying fresh leaves and herbs or using dried coriander leaves mean you can do this experiment in winter. During the spring and summer you may wish to collect leaves from trees in your local area. Some leaves will leave a good smudge of pigment on the filter paper, but you may need to cut and crush the leaves up with a pestle and mortar, a bit of sand for abrasion and the acetone to get your pigment for testing. Do different leaves contain different coloured pigments?