THE UNIVERSITY of EDINBURGH
Easter Bush
Science Outreach Centre

ROSLIN

Science @ home

SIMPLE HANDS-ON ACTIVITIES EXPLORING REAL-LIFE SCIENCE

Marvellous Mixtures
Can I separate my leafy mixture?

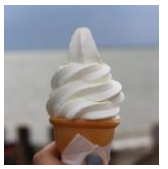
Mixtures, made by **mixing two or more substances together**, are all around us. You've probably made one or used one today! Scientists at the Roslin Institute are interested in mixtures – as well as making them, they use different scientific techniques to separate mixtures and investigate what they are made from.
In this activity, you will make a mixture and use different techniques to separate it, the same way our scientists do. We will give you an example to try out, and some ideas for you to **create your very own science investigation**.

What do you need?

- ❑ Red Cabbage
- ❑ Spinach
- ❑ Glass of water
- ❑ Toilet paper
- ❑ Teaspoon
- ❑ Sieve
- ❑ Blender or spoon
- ❑ Bowl
- ❑ Protection for clothes and table!

Let's get started!

1 **Mixtures are reversible** – they can always be separated back into their original parts. Sometimes this is easy to do, but it can be more difficult. Look at the three foods below - *can you spot the mixtures? Could you separate them at home?*

	1 	2 	3 
a) What is it made from?			
b) Is it a mixture?			
c) Can you separate it easily?			

For mixtures that are hard to separate, we need to use scientific techniques, and sometimes we need special lab equipment. But for today's experiment you can use equipment from your kitchen.

2 Let's make our first mixture. **Put 2 leaves of red cabbage and a handful of spinach into your bowl.**

Draw what you have in your bowl and then answer **Y** (yes) or **N** (no).

a) Is this a mixture? ❑

b) Is it made of two or more substances? ❑

c) Can you separate it? ❑

d) Is it easy to separate? ❑

Next we're going to make a different kind of mixture by **blending** the red cabbage and spinach together. When we do an experiment, we make a prediction about **what we think will happen**. This is called making a **hypothesis**.

e) If red cabbage and spinach are blended together to make a vegetable juice, what colour do you think the juice will be?

.....

f) Do you think you can separate the mixture back into the red colour from the cabbage leaves and the green colour from the spinach leaves?

.....

Answers: 1a) peas b) no c) not applicable. 2a) different types of fruit b) yes c) yes, you can pick out the fruit. 3a) cream, sugar, vanilla flavouring b) yes c) no, but it can be done

Answers: (a – d) Y, (e-f) own answers

Do your experiment

Grown-ups: Please read through the advice for supervising adults before starting the experiment.

3

This investigation takes around 15 minutes to set-up and a further 30 minutes to get the final results. Follow the **method** (instructions) with a grown-up and read about what is going on under each box.

1. Take the mixture you made in step 2 and **tear up the leaves** into smaller pieces.

2. Protect your table and clothes with suitable protection.

3. A grown-up will put your mixture in a blender. Add **10 teaspoons of water**. A grown-up will blend the leaves and water until you have a smooth paste.

If you don't have a blender, you can mash up the leaves in the water using a wooden spoon.

Never touch the blades of the blender- grown-ups will do this step!

4. Pour your mixture into a sieve and place the sieve over the bowl.

Use the **sieve** to separate the liquid from the solid parts of the leaves.
Use a spoon to push the liquid through the sieve into a bowl.

Red cabbage juice causes stains - protect your table and clothes!

5. Look at the liquid that comes through the sieve into the bowl. –

What colour is it? Is this the colour you thought it would be?

Draw what you see here.

What's going on?

The leaves have been broken down into smaller parts.
Some parts of the leaves stay **solid** and others turn into a **liquid**.

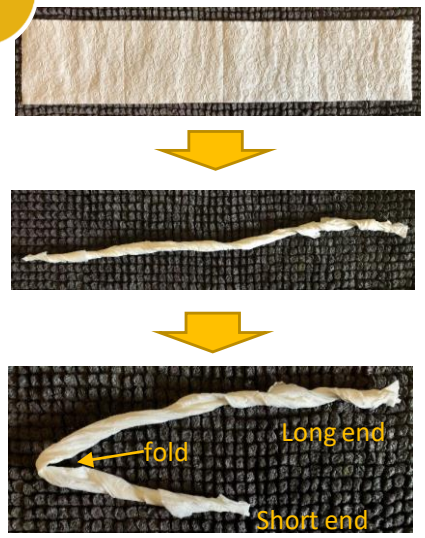
You have **separated** the mixture into its solid and liquid parts.
This technique is called **filtration**.

You have made a vegetable leaf **solution.** A **solution** is a special type of mixture.
Your mixture contains substances from the leaves that are **dissolved** in water.

Go to next page for more instructions →

Do your experiment

3



6. Take **5 sheets of toilet paper** (joined together) and carefully twist them to make a long **wick**.

Fold the wick one-third of the way along.

7. Fold the wick at the fold and **dip the fold** into your vegetable leaf solution for **10 seconds**.

Straighten out the wick and draw what it looks like on the next page in section 4 in the **before** box– include the colour!

8. Take your glass of water, and dip **short end into the water**.

Let the long end rest on the table (use a cloth to prevent staining!).

Keep out of reach of younger children.

The direction the leaf solution will move

9. The water will soak along the wick, taking the colour with it - wait until the water reaches the end of the paper (20 to 30 minutes).

Stretch the wick out and draw what it looks like now on the next page in section 4 in the **after** box– don't forget the colours!

You are going to use a technique called **chromatography.**

Chromatography **separates** some of the **substances** that are **dissolved** in the vegetable leaf **solution**.

Look closely and you will see that the water travels from inside the glass up the paper wick, it looks like the water is climbing the paper!

The water from the glass makes the vegetable leaf solution move through the paper and **separates** the substances in the solution.

What did you discover?

4 Use the spaces below to draw the paper wick before and after the chromatography experiment.

Before

After

Look at the pictures below and read about what makes the cabbage red and spinach green.

Spinach is green because it contains **green-coloured pigments**.
Chlorophyll is one of the green pigments you have separated.

This cabbage is red because it contains a **red-coloured pigment**.
Anthocyanin is the red pigment you have separated.

Look at your results and think about these questions:

1. What have you separated from the cabbage and spinach leaves? .....
2. Did the colours travel the same distance? .....
3. How far has the green pigment travelled? .....cm How far has the red pigment travelled? .....cm
4. Was your **hypothesis** correct? .....

You have found out that you can **separate** out the pigments that make spinach leaves green and red cabbage leaves red by using two scientific techniques - **filtration** and **chromatography**.

What next?

5 In this experiment you used toilet paper and **water** to separate green and red pigments from spinach and cabbage leaves.

Why not try the experiment again, but at step 7 put **vinegar** in the glass or **dissolve some baking soda in water.**

Make a prediction: *What will happen? Will you see the same colours?* Have a go and draw your results.

6 **More experiment ideas…**

Does changing the paper affect how the mixture is separated?
Try using some different types of paper to make the wick. *Do some types of paper separate the pigments better? Which one gives the best results?*

Can you separate the colours from other colourful fruit or vegetable mixtures?
Use some other colourful fruit and vegetables to make new mixtures and repeat the experiment. *Can you separate the orange pigment from carrots? Or the red pigment from red peppers?*

How do we do chromatography in the lab? Mouse poo mixtures

Real-Life Research

This is Judit Aguilar, she is a scientist. She works at the Roslin Institute and spends most of her day in the lab.
In the lab she tries to separate different mixtures, just as you have done, but Judit doesn't use toilet paper to separate her mixtures, she uses special machines. Here Judit shows you how she used chromatography to find out what was in mouse poo!

1 What did Judit need?

- ❑ Mouse poo
- ❑ Liquid to dissolve the mouse poo
- ❑ Chromatography machine

This is the machine that Judit uses to do chromatography.

2 What did Judit want to find out?

Judit is studying **fatty acids**. These are small molecules that are made in the guts of animals and humans and they are important for our health.

She wanted to know how many different **fatty acids** there are in mouse poo, and how much of each one there was.

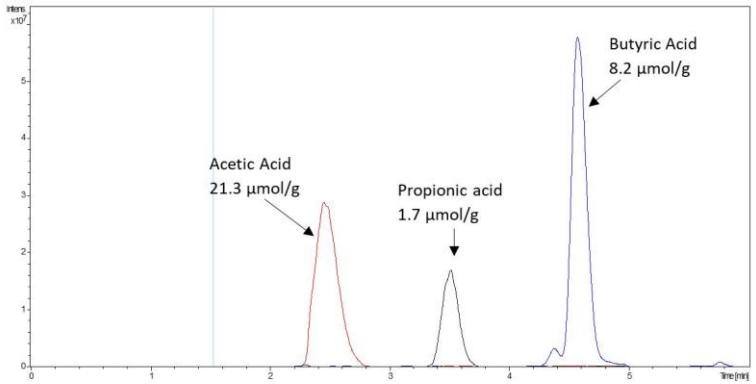
3 How did Judit separate the mouse poo mixture?

1. Judit measured out 1 gram of mouse poo – *yuck!*
2. She added a liquid to dissolve some of the substances that were in the poo.
3. She used filtration to remove the solid poo from the liquid poo solution.
4. She put some of the liquid **mouse poo solution** into the chromatography machine.

4 What did Judit find out?

The machine gave Judit a reading that shows **three different fatty acids** were in this sample of mouse poo.

Each of the fatty acids were present in different amounts. This isn't shown by the height of the lines, instead look closely at the **numbers** in the picture - they tell you how much of each fatty acid is in the sample.



Think and discuss

1. a) Which fatty acid is there most of? b) Which fatty acid is there least of?
2. If we changed what the mice eat, do you think the fatty acids in their poo would change? Why/why not?

Answers: 1. a) Acetic acid b) Propionic acid 2. Own answers

A guide for grown-ups

1. About this resource

This series of simple hands-on activities aims to support families to do Science @Home, but can also be explored in the classroom, it is brought to you by the Easter Bush Science Outreach Centre at the University of Edinburgh. All of our activities are based on the scientific method, which is used in school and in scientific research to answer scientific questions. This resource can be used to encourage your young science explorer(s) to ask and answer their own scientific questions. It also gives a little peek into how scientists at the Roslin Institute answer their own questions about science.

Share your investigations by tagging @EBSOClab & @roslininstitute on Twitter.

2. Advice about supervising the activity

- Read and follow the instructions with your young science explorer, this activity is to be carried out by children working with a grown-up. The grown-up is fully responsible for carrying out this investigation safely.
- This activity has been designed for 9-14 year olds. Younger children will need more support with reading through the instructions and carrying out the investigation.
- Do not eat or drink during the experiment, just like in a science laboratory!
- Grown-ups are responsible for using the blender as the blades are sharp and could cause serious injury.
- **Red cabbage juice stains and can damage furniture and clothing**. Protect the experiment area and your clothes with suitable coverings such as old table cloths, newspaper, plastic cover, apron etc.
- **Red cabbage can also stain your skin**, so avoid touching the liquid.
- If using vinegar in the chromatography experiment (section 5), take care not to splash it into eyes.
- Keep the experiment **out of reach of younger children** - it looks very colourful and fun but it is not suitable for little people!
- Wash your hands with soap and warm water after your experiment, just as we do in the lab.

3. The Scientific Method

All good investigations begin with a question, the scientific method is how scientists answer those questions:

HYPOTHESIS Predict - what do you think the result will be?

↓

METHOD How are you going to do your investigation?

↓

RESULTS What did you see? Can you measure it? Can you make a table or a graph of your results?

↓

CONCLUSION What did you find out? Was your hypothesis correct? If not, why do you think this is?

4. Chromatography Fact file

Does changing the chromatography liquid change the substances in the mixture? Yes, but not always in the same way. In the lab we use different liquids depending on the substances we want to investigate.

Does changing the liquid to vinegar or baking soda give different colours? Yes, anthocyanin (the red pigment) changes colour in both acid and alkaline solutions. Vinegar (acid) changes the pigment to a pink colour and baking soda (alkali) changes the pigment to a blue colour. Chlorophyll (the green pigment) does not change colour in either acid or alkali solutions, it stays green. The water in the first experiment is neutral (neither acid nor alkaline).

5. Find out more about this research

You can read more about the science behind our Real-Life Research activity by reading this interview and visiting the Roslin Institute website.

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