Bringing Back glass

into the primary science classroom

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A Primary Science Teaching Trust Resource

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The Worshipful Company of Glass Sellers of London

The Worshipful Company of Glass Sellers of London received its Charter in 1664. Initially founded to regulate the glass selling and pot-making industries within the City of London, the role of the livery company today is to:

- Maintain cordial relationships within the Company, the City and the wider glass industry
- Stimulate interest in glass in all its aspects
- Carry out charitable works, with special emphasis on education
- Maintain the Company's traditions, values and customs
- Provide pastoral care for members in distress
- Support the Lord Mayor & the Corporation of the City of London

Glass in Society is the name under which our educational projects are operated, and this promotes the modern technological uses of this most versatile material. Schools are invited to apply for funding for glass-related equipment, such as microscopes, telescopes, lenses and mirrors, to kindle the interest of students in science.

The charity is embarking on its largest ever investment in this new learning resource in association with the Primary Science Teaching Trust (PSTT) to celebrate the UN International Year of Glass 2022.

We hope that this resource will help teachers to inspire future generations of young scientists. After all, "We are only limited by our imaginations!"

Foreword

Glass has been with us for more than 5,000 years, but it is easy to overlook its importance. We rely on it in almost every aspect of our daily lives – whether cooking, communicating, carrying or creating.

The Primary Science Teaching Trust is therefore delighted to launch this new resource in the International Year of Glass. The activities here will help children explore the importance of glass for scientific experimentation, problem-solving and technology. With a great set of practical investigations for use both inside and outside the classroom, we hope it will also engage their sense of wonder and discovery.

We are always keen to hear about the impact our resources are making on learners. So please do get in touch to share your experience of using these lessons, and enjoy bringing glass back into the classroom.

Martin Pollard,
CEO, Primary Science Teaching Trust

Acknowledgement

The Primary Science Teaching Trust would like to thank the Worshipful Company of Glass Sellers for their support in the production of this resource.

Bringing back glass into the primary science classroom

Celebrating the United Nations International Year of Glass, 2022, by 'bringing back glass into the primary school classroom', the Primary Science Teaching Trust (PSTT) is delighted to be working with support from The Worshipful Company of Glass Sellers of London to share this resource with primary science educators.

All the activities in the resource pack are designed to support delivery of engaging science lessons that enable primary school children to explore the properties, uses and benefits of glass and to actively engage in meaningful and relevant investigative science.

Why use glass in the primary science classroom?

Roman Glass Flask, 131-300AD*

Archaeological evidence shows that glass has been used as apparatus for scientific experimentation since the 1st Century AD/CE. When glassmakers in Venice and Murano discovered ways to improve the thermal properties of glass by adding various chemicals to the sand and sodium carbonate that had been used to make glass for many thousands of years, scientific glassware became more widespread and ultimately, synonymous with laboratory science.

Children will be very familiar with glass in their everyday lives. From windows to mirrors, glassware to television and mobile phone screens, we are surrounded by glass. They may be unfamiliar with its importance in less visible uses. The fact that optical fibres made from glass transmit huge volumes of data around the world, supply power where metals cannot be used, transmit light through medical equipment such as endoscopes and that they can be used as sensors may be surprising.

Whilst primary science exploration does not generally require the use of specialist equipment, experience of practical science from an early age is important in developing children's appreciation of the world around them. Working scientifically increases essential skills in addition to improving understanding of scientific concepts. Practical work often promotes a positive attitude to science, with children benefitting from meaningful, real-life examples that can motivate and inspire a longer-term interest in the subject.

In the primary classroom, teachers have naturally tended towards the use of cheap, readily available materials to enable children to undertake practical work, with plastics representing a sizeable proportion of these. We are all conscious of issues surrounding single use plastic production and waste and, in this resource, we focus on the benefits of using glass more generally as a resource material, from time to time, to develop children's understanding of its properties.

So what are the main benefits of using glass in the classroom?

- Glass is made from naturally occurring materials that are abundant
- Glass is readily available, reusable and completely recyclable
- Glass is inert, non-toxic, and impermeable, so when cleaned it will not harbour any harmful chemicals from previous use

What can you expect to find in this resource?

We are providing a range of activities for primary school children, including some suitable for the Early Years Foundation Stage (EYFS). Some activities are more appropriate for younger children, whilst others are clearly more suited to an older age group. Of course, whilst a suggested plan is included, all activities can (and should) be adapted to meet the needs of the children with whom you are working. For each activity, we suggest appropriate learning intentions and vocabulary. A glossary is provided for convenience at the end of the booklet, as is general health and safety advice.

Additional materials to support the use of this resource are provided on the PSTT website. These include:

- a table providing links for each activity to UK national curricula (England, Scotland, Wales and Northern Ireland)
- a pdf providing background science and information about common misconceptions relevant to the activities

We would encourage you to support children to develop their own questions related to the activities and find answers to these through further investigation. Where possible, children should have opportunities to share their learning with a wider audience and taking part in the Great Science Share for Schools, focusing on glass as a sustainable material, would be a great way to do this.

*Science Museum Group. Glass flask, Roman, 151-300AD. A628119 Science Museum Group Collection Online. Accessed March 4, 2022. tinyurl.com/bddw49bt.

Scientific Enquiry

Bringing glass back to the primary science classroom provides an opportunity to develop an understanding of the different types of scientific enquiry and the progression of scientific skills. These are identified on each activity in the booklet.

The symbols below indicate the types of enquiry and skills that can be developed (and assessed) through each activity. These symbols could also be displayed in your classroom to help the children identify and recall the skills being used (a link is provided on the IYoG page on the PSTT website).

Should we wear glass shoes?

A sequence of activities to help EYFS children understand the properties and uses of glass

BRIGHT IDEAS TIME...

Begin by showing the children a picture of a glass shoe. Ask them, "Who would like to wear a shoe made of glass?" and provide lots of opportunity for children to share their ideas. Ask: "What about a glass hat or coat?" You could use the terms 'Plus', 'Minus' or 'Interesting' (PMI) to help children to think about why glass might be good, bad or interesting to use for the object.* Find any familiar kitchen object (such as a pan or utensil) and repeat the PMI questions, considering whether this object should be made of glass.

*For more information about using PMI questions, visit the PSTT website here: **tinyurl.com/mr2b2mw4**

For nursery children, you might find it simpler to use smiley and sad faces to replace 'plus and minus' vocabulary.

Enhancements in continuous provision

TO FAMILIARISE CHILDREN WITH OBJECTS MADE OF GLASS...

You need: areas set up as a kitchen and a ballroom, costumes and props

Play, observe & ask:

- Support children to act as if they are wearing glass shoes in their play.
- Although the glass shoe or kitchen object will not actually be made from glass, encourage children to use this vocabulary in their play. A discussion about why shoes are not made from glass could arise; this is fine, as it feeds into a later discussion.

Key vocabulary: relating to the properties of glass – transparent, smooth, rigid, fragile, hard

TO ENCOURAGE CHILDREN TO UNDERSTAND THE CHARACTERISTICS OF GLASS...

You need: glass objects in many shapes and colours (e.g. vases, jars, bottles, beads, marbles, ornaments, drinking glasses, jugs), magnifying glasses, torches

Play, observe & ask:

- Encourage children to look at, and feel, the glass. Talk about textures and transparency.
- What happens if you shine a torch through coloured glass? What effects can you make?
- Why do we need to handle glass carefully?

Key vocabulary: relating to the properties of glass – transparent, smooth, rigid, fragile

TO CONSIDER THE MATERIALS USED IN FOOTWEAR...

You need: a collection of footwear (as wide a variety as possible, but this could include trainers, wellington boots, sandals, sparkly party shoes, cowboy boots, flippers)

Play, observe & ask:

- Who might wear this shoe?
- What is it made from? Why?
- How is it similar/different to the shoes you are wearing?

Key vocabulary: relating to the properties of glass – transparent, smooth, rigid, fragile

Adult-led activities

BE A GLASS DETECTIVE

- Walk around the room/building/local area looking out for objects made from glass.
- Take photographs so that conversations can continue back in the setting. Some photographs could be made into cards for sorting or matching activities.
- Talk about what kind of things are made from glass and why.
- Use the information from this activity, and children's observation work in continuous provision, as a basis for discussing what they now know about glass.

IS GLASS A GOOD MATERIAL TO MAKE SHOES FROM?

- Based on all the knowledge they have gained, ask children to think of reasons why glass would or would not be a good material for shoes.
- The results could be recorded on a class chart to show that there are different points of view.
- Vote – is glass a good material for shoes?
- Ask – Would glass be a better material for making something else? Why is it a good material in this instance?

Early Years Science Provision Map – Glass

ICT

Learn about: using equipment to help with observation

You need: glass jars, digital microscopes, substances for close observation (e.g. sand, compost, earth)

Support pupils to use the digital equipment to see details.

Play, observe & ask:

- What can you see?
- How is it different to looking with just your eyes?

Key vocabulary: microscope, observe, describe, magnify

CONSTRUCTION

Learn about: what makes glass a suitable material for windows

You need: construction toys (e.g. duplo), boxes, materials to make windows (paper, card, plastic packaging, cellophane)

Build model houses

Play, observe & ask:

- Our houses need windows. What are real windows made from? Why?
- Which other materials have similar properties that make them suitable for windows?

Key vocabulary: transparent, opaque, strong

Notes

If possible, before doing this activity, go for a walk in the local area. Look at different sizes and shapes of windows (if you can see stained glass windows, this is even better). Emphasise that although they look different, they are all made from glass.

Glass

GARDENING

Learn about: the parts of a plant

You need: glass jars, compost, bulbs

Plant bulbs and discuss how to take care of them.

Play, observe & ask:

- How will you take care of your bulb?
- As they grow, the roots should become visible through the glass. Why does the plant need roots?
- Can you name the parts of the plant?

Key vocabulary: bulb, seed, grow, roots, stem, leaves, flower

Notes

If you have a big enough glass container then a seed potato would be ideal for this activity.

As glass jars have no drainage, watering needs to be carefully supervised!

ART AND DESIGN

Learn about: habitats

You need: glass jars, small model animals (invertebrates work well) sand, stones, leaves, bark, grass

Play, observe & ask:

- Can we make a habitat for this animal?
- Where does it like to live?
- What materials will we need?

Key vocabulary: habitat, animal names, names of materials used

Notes

If completed with natural materials, this a good outdoor activity as children can compare real habitats to those they are making. Alternatively, the habitats could be made from collage materials such as paper, card, pipe cleaners etc.

OUTDOORS

Learn about: worms

You need: large glass jar, gravel, sand, soil, leaves/grass, worms

Make a wormery – put a layer of gravel in the bottom of the container. Layer soil and sand until almost full, add some worms and put leaves and grass on top.

Play, observe & ask:

- Observe the worms – how do they move?
- What happens to the layers of sand and soil? Why?
- What happens to the leaves and grass?

Key vocabulary: worm, soil, sand, move, mix

Notes

Keep out of direct sunlight.

The soil needs to be moist but not too wet.

Monitor the worms frequently. The worms should be kept for no more than 2 weeks before being released.

Glitter Discovery Jar

Exploring materials, light and shadows

INTRODUCTION

Have you ever shaken a snow globe and watched the 'snow' falling? The first snow globe was created by accident in 1900 by Erwin Perzy I, when he was experimenting, trying to improve the brightness of the newly invented electric light bulb!

In this activity, we create a 'not quite snow' globe, to explore material properties, with the added interest of shining a torch through the liquid to watch the shadows that are created.

LEARNING INTENTIONS

- ☑ To learn about shadows and how they are formed
- ☑ To explore and observe closely
- ☑ To offer explanations, describe and record what is observed

RESOURCES (PER GROUP)

- Jam jar with lid – transparent ones
- Water
- Food colouring
- Glitter
- A range of foil/glittery/shiny items (sweet wrappers)
- Aluminium foil
- Torch
- White screen or A3 paper

WHAT TO DO:

Today we are going to be physicists and materials scientists

1. Encourage the children to explore the resources and discuss the properties of the materials.
2. Fill a jam jar with water and add a small amount of the glitter.
3. Give the children time to predict what will happen when the top is fitted to the jar and it is turned upside down.
4. Ask them to describe what happens and why.
5. Add food colouring to the water, along with some foil pieces – scrunched up into different sizes and shapes. Replace the lid and shake. Children should observe what happens and could change the shapes of foil included. Older children could focus on why the objects float or sink, the movement of liquids and solids and whether this changes over time.
6. Set up the jar so the torch light can shine through the jar onto the white paper. Observe what happens and discuss ideas about this. For older children, discuss how shadows are formed and encourage the use of vocabulary related to light.

KEY QUESTIONS

1. Why have we chosen: a smooth, transparent jar, coloured water, glittery pieces?
2. How does everything move when you turn or shake the jar? Why do you think this happens?
3. Which materials float or sink? Can you change how the objects float or sink?
4. Which materials reflect the light really well?
5. How can you produce a clearer shadow?

KEY VOCABULARY

Liquid
Solid
Transparent
Opaque
Shadow
Reflect/ reflection
Light
Sink/float
Gravity

EXTENSION / FOLLOW UP ACTIVITIES

Children could investigate changes to the glitter jar to explore the outcomes, e.g. using different jars, colours or glittery items.

They could change the liquid and explore whether the movement of materials changes, e.g. adding glycerine to the water or using baby oil, etc.

ADDITIONAL RESOURCES (IF REQUIRED):

- Glycerine
- Beads
- Other liquids; oil, shampoo, bubble bath

ANTICIPATED ACTIVITY TIME: **30 – 60 MINS**

Mirror Images

Investigating how coated glass can be used to create mirrors

INTRODUCTION

The Egyptians made mirrors from sheets of polished metal. The Romans made glass mirrors with a metal layer. In 1835 silvered-glass mirrors were created which could be produced on a large scale and were affordable. In this activity, children will explore how light is reflected from different surfaces and consider what makes a good reflective surface. They will then create their own mirrors from sheets of glass and investigate how different coloured backgrounds affect the properties of a glass mirror.

Children would benefit from a prior understanding of light sources and how light is reflected.

LEARNING INTENTIONS

- ☑ To understand how & why we see clear images of objects in a mirror
- ☑ To understand the properties of glass that make it suitable for making mirrors

KEY QUESTIONS

1. What do you notice about the surfaces that create a clear image?
2. Why do think that glass is used to make mirrors?
3. How clear is the image in your homemade mirror?
4. Can you see colours in the image on your homemade mirror?
5. Which background colours produce the best mirror images?

KEY VOCABULARY

Light
Light source
Light rays
Mirror
Surface
Object
Image
Reflect/ reflection
Properties: rough, smooth, shiny, transparent, translucent, opaque, reflective

RESOURCES (PER GROUP)

- Clip/picture frames are an ideal source – cover all edges with masking tape
- Acrylic paints – silver, black, white and primary colours
- Paint brushes
- Paper towels
- A variety of objects with shiny surfaces – e.g. small mirrors, aluminium foil, spoons, coloured glass bottles, empty picture frames, coloured paper or card to put in the frames

WHAT TO DO: Today we are going to be physicists

Before the session, clean the glass panes with warm soapy water and dry.

1. Ask children to look at a mirror and discuss the way it is formed from a sheet of glass, one side with a silvery coating. Pose a question to investigate: Does the coating need to be silver?
2. Lay the glass on a paper towel.
3. Children should paint one side of the glass with a generous coat of silver acrylic paint (or another colour, to compare these) and leave to dry (about 30 minutes).
4. While the paint is drying, provide the children with objects with shiny surfaces, including glass. Ask them to look at any images of themselves in these surfaces. Look at the picture frames with and without coloured paper behind the glass. Look at smooth and crumpled foil. Discuss the properties of the surfaces that produce a clear image (reflection) and those that do not. Encourage children to give reasons for their observations.
5. When the paint is dry, ask the children to turn their glass pane over so that the unpainted side is facing them and to examine their reflection closely, noting which colours (if any) are visible in their image. Encourage the children to compare the effect of the different coloured backgrounds on the homemade mirrors.

EXTENSION / FOLLOW UP ACTIVITIES

Challenge the children to create multiple images using 2 mirrors. You could prompt them to start by placing the mirrors at right angles and placing an object in between them. Can they move the mirrors to create more reflections?

- Use 2 mirrors to create a simple periscope
- Use 3 mirrors to create a simple kaleidoscope
- Investigate reflections in curved mirrors

ADDITIONAL RESOURCES (IF REQUIRED):

- 2 or 3 mirrors per group
- An object to view in the mirrors e.g. a Lego minifigure

ANTICIPATED ACTIVITY TIME: **1 – 1.5 HOURS,** including time for paint to dry

Making Music

Creating a glass musical instrument

INTRODUCTION

Glass is a good material to help children explore and understand sound, as it produces a pleasant tone when struck. The sounds produced can easily be altered. In this activity, children will be able to explore making musical sounds by creating vibrations in a glass tumbler, bottle or jar and investigate how the pitch of sounds can change. Children will learn that sounds can be higher or lower in pitch. This activity encourages the children to think about the properties of glass, the sounds it produces when struck and its stiffness compared to other containers made from different materials.

LEARNING INTENTIONS

- ☑ To investigate how sounds are made
- ☑ To know that sounds are made when an object vibrates
- ☑ To find and describe relationships between the pitch of a sound and features of the object that produced it.

RESOURCES (PER GROUP)

- 3-5 glass drinking tumblers, bottles or jars
- Water
- Spoon (metal)
- Food colouring (optional)
- Measuring jug

WHAT TO DO:

Today we are going to be acousticians

1. Ask the children to think about sounds and how they are made, drawing out how all sounds come from vibrating materials.
2. Show the children 3-5 glass tumblers, bottles or jars of the same size and shape.
3. Using a metal spoon, ask the children to strike the glass and listen to sounds that they make. Give the children the opportunity to discuss their observations.
4. Now pour water into one of the glasses and then strike it again. Encourage the children to discuss whether or not the sound changed.
5. Spend some time talking about children's ideas on how different sounds could be made using different amounts of water.
6. Using a measuring jug, pour different amounts of water into the glasses. Food colouring could be added to show the water levels more clearly.
7. Using a metal spoon, the children should tap the glases and listen to the sounds that are made. Can they 'tune' the glasses and place them in order from low to high pitch?
8. The children could record which glass made the lowest-pitched sound and which made a higher-pitched sound.

KEY QUESTIONS

1. How are the sounds made/what materials are vibrating?
2. What materials do you think sounds can travel through?
3. How can we change the pitch of the sounds?
4. Which glass made the highest/lowest pitched sounds?
5. How do the amounts of water and air in the glass change as the pitch changes?

KEY VOCABULARY

Vibrate / Vibration
Sound
Pitch
High
Low
Volume

EXTENSION / FOLLOW UP ACTIVITIES

Children could create a graph to show how the pitch changes during the investigation, by measuring specific amounts of water and creating their own scale from 1-10 to represent the pitch of the sounds.

Children could create their own melody or play a simple tune.

Children could compare the sounds produced by other materials (such as plastic, wood or metal beakers).

Ask the children to think about other ways that a glass can make a sound. They could then explore these practically (e.g. by blowing across the opening of a glass bottle, or making a wine glass 'sing').

ADDITIONAL RESOURCES (IF REQUIRED):

- Plastic, wooden, metal or ceramic containers

ANTICIPATED ACTIVITY TIME: **15 – 20 MINS**

Plant Germination & Growth

Investigating how light affects seeds and seedling

INTRODUCTION

Glass containers have often been used for growing plants in schools as they are so readily available. Glass jars enable children to see the changes, growth and development of a plant from germination onwards. This activity encourages pupils to think about the properties of a glass jar compared to a plastic pot. It also makes them consider glass as a transparent, translucent or opaque material and the impact this has on light travelling through to a seed or seedling.

Further investigation into plant growth using glass of different types will be explored after germination.

LEARNING INTENTIONS

- ☑ To discover the effect of glass colour on germination
- ☑ To observe how seeds grow into plants
- ☑ To observe, measure and draw conclusions

RESOURCES (PER GROUP)

- Glass jar and plastic pot
- Seeds e.g. cress (fast growing)
- Compost/soil
- Trowel/fork
- Watering jug
- Range of coloured markers for glass
- Coloured tissue paper & glue
- Range of paints
- Paint brushes

WHAT TO DO:

Today we are going to be botanists

1. Discuss with the children the various ways we plant seeds, perhaps in pots or directly into the soil outside. Explain that in this investigation, glass jars will be used.
2. Compare a glass jar and plastic pot and consider the properties and potential benefits/issues with using each material.
3. Ask the children to predict what will happen if a seed is planted in the glass jar and whether they think the colour or covering of the jar itself will affect germination.
4. Provide a range of materials that may be used to colour or cover the jar, including paint, marker pens and tissue paper.
5. Set up a 'control' jar, with no cover. Add the compost and then plant a few seeds in the middle.
6. Cover the jars with a variety of materials, then plant seeds inside, being careful to add in a similar amount of compost and seeds to each. Aim to have some jars fully opaque, and others translucent or transparent.
7. Add the same amount of water and then leave the seeds to germinate.
8. Observe over time, taking notes, photographs and measurements of progress, as appropriate.

KEY QUESTIONS

1. What are the properties of plastic and glass? Can you identify some uses of each?
2. Why do you think it might be better to grow seeds in either a glass container or plastic pot?
3. How do you think we make the glass opaque or translucent? Do you think this will affect germination?
4. What do seeds need in order to germinate?
5. What conditions do the germinated plants need to grow?

KEY VOCABULARY

Plastic	Grow/growth
Glass	Seed
Transparent	Bulb
Opaque	Compost
Light	Soil
Water	

EXTENSION / FOLLOW UP ACTIVITIES

Children should investigate how different light conditions affect plant growth after germination – for example, they could cover seedlings that emerge in another glass jar and compare growth with and without a cover, or change the colour of the jar (again using markers or paints) to investigate whether this affects the rate of growth of the seedlings.

Children could explore different types of seeds (as some need light to germinate whilst others do not) to investigate rates of germination.

Children might like to suggest other ways to change the glass and investigate whether these affect the rate of germination (for example wrapping in fabric or newspaper). They could explore whether insulating the container affects the rate of germination.

ADDITIONAL RESOURCES (IF REQUIRED):

- Additional glass jars
- Other seed types
- Insulating materials

ANTICIPATED ACTIVITY TIME: **45 – 55 MINS,** Observe over several days

Make your own microscope

A simple way to observe objects in greater detail

INTRODUCTION

Microscopes are expensive pieces of equipment, but they are made of just three main parts: a light source, a stage (which holds the specimen and in this case, allows light to pass through) and at least one lens to magnify what you are looking at. With some patience and skill, a DIY microscope can be made using only simple (and low cost, or no cost) equipment, and by creating a lens from a droplet of water.

LEARNING INTENTIONS

- ☑ To make careful observations
- ☑ To notice that light is reflected from surfaces
- ☑ To demonstrate that light travels from a source to objects and then to our eyes

WHAT TO DO:

Today we are going to be optical engineers

Gather the items on the equipment list then follow these steps:

1. Carefully, cut out three pieces of flat transparent plastic from your recycled materials. Two pieces need to be approximately 3cm wide and 4cm long to sandwich the samples you want to view. The third piece should be approximately 4 cm wide and 7 cm long to hold your water lens.
2. Fold your piece of foil and place it on the lid of the jar so that it will reflect horizontal light upwards through the glass jar (photo 3).
3. Once you have attached the jar to its lid with the foil inside, investigate the best position to place your torch so that you have an upward light source which is not too dazzling. Then use mounting putty to attach your pens to the top of the jar. They need to be parallel to each other with a gap of approximately 4cm (photo 4).
4. Punch a hole in the middle of your larger piece of plastic (photo 5).
5. Run water over the hole (by immersing it or using a pipette/tap). Use a pipette to create a rounded drop of water on the larger piece of plastic (photo 6). The water droplet should be the shape of a convex lens (not too big so it looks ready to drip!).
6. Choose a flat, translucent object to view, and cut a small piece so that it can be sandwiched between your pieces of plastic.
7. Place your slides on the 'stage' between your pens.
8. Place your water lens above the sample balanced on the pens.
9. Close one eye and focus the other through the water lens. You will need to be quite close to your microscope, so sitting in a comfortable position is important (photo 8).
10. To see the magnified object in focus, you will need to slowly move your eye up or down. Carefully, move the plastic piece holding the water droplet so that you can examine your whole specimen.

Note: Sometimes you may need to raise your water lens to get the best focus (if this is the case, you could try using slightly thicker pens to position it).

RESOURCES (PER GROUP)

- Clean glass jar
- Flat, transparent plastic (e.g. recycled fruit punnets)
- Foil
- Torch
- Mounting putty (e.g. Blu Tack)
- Two identical pens/pencils
- A selection of translucent flat objects to observe, e.g. leaf skeletons, feathers, paper towel, printed plastic/potato starch wrapping, bank notes or pond water
- Scissors
- Hole puncher
- Extra glass jars and pipettes if collecting water samples

Note: glass slides are optional

How to make your own no-cost microscope:

1. You will need

2. Cut out your flat, transparent plastic slides

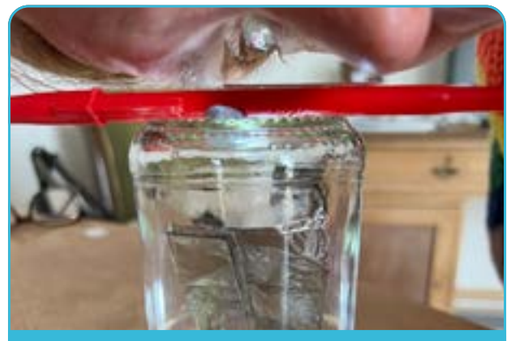
3. Create an upward light source

4. Assemble your stage

5. Make your water lens step 1

6. Make your water lens step 2

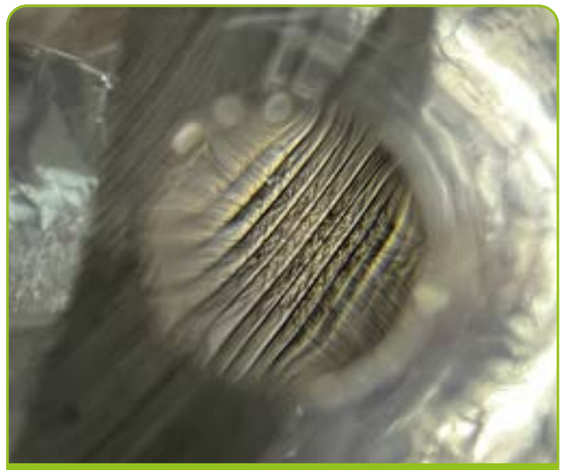
7. Gather some flat, translucent objects to observe



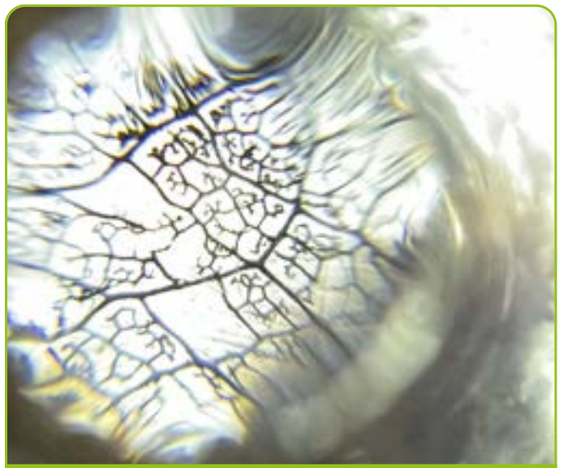
8. Close one eye, move close to and look through the lens. Slowly move up and down to focus

What could you look at? These examples might inspire you...

The transparent section of money



The barbules and hooklets of feathers



The structure of veins in a leaf skeleton

The surprising texture of potato starch wrapping

The fibres of kitchen roll or tissues

Pond water: algae (single celled, plant-like and not moving) and protozoans (single celled, animal-like and moving)

KEY QUESTIONS

1. Why is it important that we use a transparent glass jar to make the microscope?
2. How does the light travel from the light source to your eyes? Could you draw this in a diagram?
3. What happens to your view of the material you are looking at?
4. Can you think of something else that uses a lens to make it easier for people to see objects?
5. Why are lenses important to scientists?

KEY VOCABULARY

Transparent
Translucent
Opaque
Reflected
Light source
Lens
Microscope
Stage
Magnify
Refract
Converge
Field of view
Resolution

EXTENSION / FOLLOW UP ACTIVITIES

Go on a walk outside to collect anything that you would like to observe. A smear of soil? An insect's wing? Remember translucent samples will work best.

Can you draw some of the samples seen through the water lens? This could be extended from observational drawings to a piece of art if you have time.

Learn about the history of microscopes with the Science Museum.

ADDITIONAL RESOURCES (IF REQUIRED):

- tinyurl.com/yckmyyhj
- tinyurl.com/2b6dsbxt
- tinyurl.com/56cn4ffx

ANTICIPATED ACTIVITY TIME: **30 – 60 MINS,** can be extended if desired

Soil profiling

Can you discover what's in my spade?

INTRODUCTION

Farmers and horticulturalists use soil profiles to help them work out the best crops to grow in various locations and to improve soil quality. In this activity, children will be looking closely at soil structure and its texture. Soil is a mixture of tiny particles of rock, dead plants and animals, air and water. Soil also has many microorganisms living in it, which cannot be seen.

Different soils have different properties depending on their composition. Investigating soil texture allows us to understand how soil is made up: the amount of sand, clay, chalk and silt within it. A glass jar provides an ideal container in which children can explore soil composition.

LEARNING INTENTIONS

- ☑ To explain that soils are made from rocks and also contain living matter
- ☑ To classify soils
- ☑ To observe how soil can be separated through sedimentation

RESOURCES (PER GROUP)

- Jam jar
- Soil sample
- Sieve
- Spoon
- Beaker of water
- Washing up liquid

WHAT TO DO:

Today we are going to be soil scientists

1. Encourage children to look at their soil samples, describing and discussing what they can see in the soil. They can rub the soil between their fingers and describe how this feels.
2. Ask the children to prepare their soil sample – sieve out any stones and plant material. Break the soil up so that it is as fine as possible.
3. Half fill the jam jar with soil.
4. Fill the jam jar up to about three quarters full with water and add a few drops of washing up liquid.
5. Place the lid securely on the jar and shake it for about a minute until the soil is well combined with the water.
6. Leave the contents of the jam jar to settle for 48 hours, making sure it is left undisturbed during this time.
7. Without disturbing the contents, ask the children to look carefully at the contents of their jar. They will see that the soil has settled into layers.
8. Descriptions of sandy, clay and silty soils are provided in the glossary for reference. Share these with the children. The layers will settle with the largest particles at the bottom (sand) and the smallest at the top (clay), with silt in between.

KEY QUESTIONS

1. What do you find/see in the soil as you sieve it?
2. What does each layer look like? How are the layers different?
3. Can you suggest ways to make the glass opaque or translucent? How do you think this will affect germination?
4. Broccoli grows well in damp soil. Which soil is best for growing broccoli? (Clay soil)
5. Celery needs fertile, moisture-retentive soil that is wet but still drains. Which soil is best for growing celery? (Silty soil)

KEY VOCABULARY

- Soil
- Separate
- Soil profile
- Particles
- Layers
- Settle

EXTENSION / FOLLOW UP ACTIVITIES

Make a 'Jar-arium'

Create a miniature terrarium in a jam jar. This is a small ecosystem containing everything the plant needs to survive.

1. Cover the bottom of the jar with 2cm layer pebbles. On top place a 1cm layer of charcoal. This is the drainage layer.
2. Place a coffee filter on top to stop the soil mixing with the drainage layer.
3. Cover the coffee filter with approx. 5cm of soil. The jam jar will now be half full.
4. Moisten the soil.
5. Plant your plant. Screw on the lid.

Other questions to investigate:

Which soil type absorbs the most water? Which soil type drains most easily? How can soil be improved so that it is better for growing plants?

ADDITIONAL RESOURCES (IF REQUIRED):

- Other seed types
- Insulating materials
- Additional glass jars with lids

ANTICIPATED ACTIVITY TIME: **60 MINS:** Set up session: approx **40 MINS**. Leave for two days. Review time **20 MINS**

Water Cycle in a Jar

Can we recreate the water cycle indoors?

INTRODUCTION

The water cycle describes the continuous way that water moves throughout the Earth and its atmosphere. Before completing this activity, children should have found out about the water cycle. The activity encourages pupils to think about the properties of a clear glass jar compared to containers made from different materials.

It also provides an opportunity to consider other properties, in particular whether glass is a transparent, translucent or opaque material, and the impact this has on light travelling through to the water.

LEARNING INTENTIONS

- ☑ To observe the stages of the water cycle
- ☑ To understand that temperature affects the rate of evaporation
- ☑ To observe changes over time and draw conclusions

RESOURCES (PER GROUP)

- Glass jar with lid
- Water
- Marker pen
- Sticky labels (optional)
- Measuring jug
- Blue food colouring (optional)
- A 'control' jar with no cover for the class
- Other containers for comparison (plastic or cardboard)

WHAT TO DO:

Today we are going to be hydrologists

1. Discuss the stages of the water cycle with the children, encouraging them to think about how the water cycle works by focusing on the changes of state that take place.
2. Ask the children to think about what will happen if we place a container with water in a warm place.
3. Compare a transparent glass jar, an opaque plastic container and a cardboard box and consider the properties and potential benefits/ issues with using each material.
4. Ask the children to think how they could recreate the water cycle using a glass jar and provide a range of materials to set up the investigation.
5. Use the marker to write the stages of the water cycle activity onto the side of a bottle. Draw arrows to show how the water rises as evaporation and descends as precipitation.
6. Set up a 'control' jar, with no cover.
7. Discuss the amount of water needed to represent ground water/collection. Children could investigate differing amounts and compare their results.
8. Add the same amount of water as at least one group to the control jar and leave each group's jar next to the window. Discuss the importance of leaving the jar by the window.
9. Observe jars over time, taking notes, photographs and measurements of progress, as appropriate.

KEY QUESTIONS

1. What are the stages of the water cycle and can you explain the changes?
2. Where can you see liquid water in the jar?
3. What happened to the water in the uncovered jar?
4. How does the temperature affect the rate of evaporation?
5. Why is transparent glass better than a translucent or opaque material for demonstrating the water cycle?

KEY VOCABULARY

Glass
Plastic
Water
Cycle
Transparent
Opaque
Light
Condensation
Evaporation
Precipitation
Collection

EXTENSION / FOLLOW UP ACTIVITIES

Children could investigate how temperature affects the rate of evaporation further, by leaving uncovered jars in different locations at different temperatures, and comparing the difference that temperature makes by measuring how much water is left in the jars.

Children could write an explanation text to show their understanding of how the water cycle works.

Children could create a story map or comic strip to explain the journey of a rain drop through the water cycle.

ADDITIONAL RESOURCES (IF REQUIRED):

- Thermometers

ANTICIPATED ACTIVITY TIME: **30 – 40 MINS.** Observe over several days.

Make your own thermometer

How does temperature vary around the school?

INTRODUCTION

There are many different types of thermometer, and many will be familiar to children: digital, data loggers, temperature 'guns' and liquid crystal thermometers, in addition to those made more traditionally with glass.

In this activity, children will learn how a glass thermometer works by constructing their own. The thermometer will show changes in temperature, and although it may not be very accurate, it will certainly promote discussion.

LEARNING INTENTIONS

- ☑ To understand how a glass thermometer works
- ☑ To investigate what happens to the liquid and air inside
- ☑ To make careful observations and explanations

KEY QUESTIONS

1. Why have we chosen these resources? Could we use any alternative ones?
2. Why is it useful to add colouring to the liquid?
3. What happens when the homemade thermometer is moved to different locations?
4. Can you explain why the level of the liquid changes?

KEY VOCABULARY

Liquid
Solid
Glass
Transparent
Temperature
Thermometer
Expand/ contract

RESOURCES (PER GROUP)

- Transparent glass bottle
- Straw/tube
- Water
- Food colouring
- Multipurpose reusable adhesive (e.g. Blu Tack / Play-Doh)
- Large bowl
- *Warm water
- Ice cubes
- Commercial glass thermometer (one for the class will suffice)

*Alternatives to this are hot water bottles/hand warmers/microwave wheat pack.

WHAT TO DO:

Today we are going to be physicists

1. Encourage children to explore the resources and compare these to a commercial glass thermometer. Ask them to discuss similarities of individual resources to the parts of the thermometer.
2. Assist the children in creating a bottle thermometer:
   - Half fill a bottle with water and add some food colouring (so the liquid can be seen).
   - Place the glass straw into the bottle, making sure it does not touch the bottom of the bottle and is under the surface of the liquid.
   - Wrap pliable, reusable adhesive around the straw and opening of the bottle to suspend it in position, ensuring that no air can escape from or enter the bottle (without this, the thermometer will not work).
3. Place the bottle thermometer in warm water or on a hot water bottle or hand warmer and observe what happens.
4. Children could move the thermometer to different locations and observe changes in the liquid level.

On a hot sunny day, it may be possible for the liquid to rise out of the top of the thermometer!

EXTENSION / FOLLOW UP ACTIVITIES

Using a thermometer or data logger alongside your homemade thermometer, add a scale onto your glass straw.

Observe temperature changes over a day or a week.

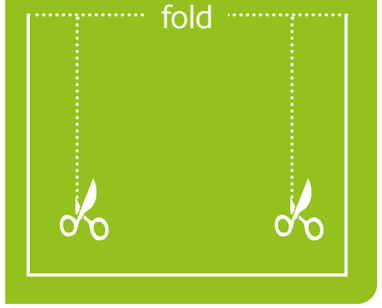
Investigate whether other liquids could be used in your thermometer (e.g. baby oil).

Find out about the Celsius scale, or other scientists who have had temperature scales names after them (e.g. Daniel Gabriel Fahrenheit).

ADDITIONAL RESOURCES (IF REQUIRED):

- Thin card

Fold in half and cut along top and bottom, then slide onto straw



ANTICIPATED ACTIVITY TIME: **15 – 60 MINS** depending on the time to explore and develop the investigation.

Fire fighting

Creating an 'invisible' fire extinguisher

INTRODUCTION

Glass must be heated to high temperatures (over 1400°C) to change from a solid to a liquid, but sudden heat can shock some types of glass into cracking. In this activity, children consider the importance of choosing 'heat resistant' glass for holding candles as they use a chemical reaction to extinguish fires. The children will observe candle flames, discuss what a flame/fire needs in order to burn and consider the implications for fire safety.

LEARNING INTENTIONS

- ☑ To understand the fire triangle
- ☑ To explore a non-reversible chemical reaction
- ☑ To explain their observations

RESOURCES (PER GROUP)

- ■ Heat resistant glass jar (e.g. kilner jar or scented candle jar)
- ■ Beaker or jug (at least 500ml)
- ■ Matches or a lighter
- ■ Sodium bicarbonate (also called bicarbonate of soda, baking soda)
- ■ White vinegar
- ■ Tablespoon
- ■ Tealight

WHAT TO DO:

Today we are going to be fire fighters

This activity may be done as a teacher demonstration or by the children under careful supervision. Children may find it difficult to pour an invisible substance without spilling liquid over the flame.

1. Light a tealight and ask the children to discuss what is needed to support the flame, explaining that the wax is a fuel, a lighter (e.g. a match) provides heat to ignite the fuel and oxygen is present in the surrounding air.
2. Discuss children's ideas about using glass as a candle holder and why it is important to choose heat resistant forms.
3. Blow out the candle and ask the children to explain what has been 'removed' to extinguish the flame.
4. Put the tealight in the glass jar and light it.
5. Into the jug, put about 2 tablespoons of sodium bicarbonate and pour in enough vinegar to produce a lot of fizzing.
6. The bubbles should come near the top of the jug and then subside.
7. At this point, hold the jug over the jar, tilt it gently. Be careful to ensure that the liquid stays in the jug and does not pour into the glass jar.
8. Encourage the children to observe carefully what happens to the flame, noting that no liquid leaves the jug.

KEY QUESTIONS

1. Is it safe to use glass where there are flames or a hot surface, such as an oven? Why do you think this?
2. What do you notice when the vinegar and sodium bicarbonate are mixed? What can you hear?
3. What do you think the bubbles are? Where do they go?
4. What happens when you tilt the jug over the flame in the jar?
5. Why do you think the flame goes out?

KEY VOCABULARY

- Chemical change
- Non-reversible change
- Fire extinguisher
- Solid
- Liquid
- Gas
- Carbon dioxide
- Flame
- Oxygen
- Reaction
- Wax

EXTENSION / FOLLOW UP ACTIVITIES

Children could explore what happens if they vary the amounts of chemicals being used.

They could try using different chemicals to see if these also work, for example mixing sodium bicarbonate and citric acid crystals (available from pharmacies and supermarkets) in the jug and then adding water.

Invite local firefighters to school to talk to the children about their work and fire safety.

ADDITIONAL RESOURCES (IF REQUIRED):

- ■ Citric acid crystals

ANTICIPATED ACTIVITY TIME: **30 MINS**

Make a Model Lung

Discover how cigarette smoking affects our health

INTRODUCTION

Scientists often use models to help them to explain how things behave, to help them predict what might happen and to encourage discussions. A glass jar can be used as a very effective model of a human lung to encourage children to consider the impact of smoking cigarettes on the body.

This activity is intended as a very visual teacher demonstration to stimulate discussion with upper primary school children and help them make sensible choices for their own bodies.

LEARNING INTENTIONS

- ☑ To understand how cigarette smoking can affect our lungs
- ☑ To observe closely
- ☑ For children to realise that they can be responsible for aspects of their own health

RESOURCES (PER GROUP)

- ■ A kilner jar (or empty scented candle jar with a metal lid or ceramic tile to act as a lid)
- ■ Strips of newspaper, approximately 6x2 cm
- ■ Matches or lighter
- ■ A piece of sponge which will fit inside the lid of the jar, e.g. a kitchen sponge
- ■ Two wide rubber bands

WHAT TO DO:

Today we are going to be medical researchers

1. Show the children a sponge and have them share ideas about how this might be a good representation of the lungs. Explain that the small holes in the sponge are similar to the tiny air sacs in our lungs.
2. Attach the sponge to the lid of the jar using the two rubber bands at right angles to each other, explaining that the sponge is representing just one of our lungs.
3. Explain that each strip of paper will represent a cigarette and the jar will be the body into which the cigarette smoke will enter. Light a piece of the paper, drop it into the jar and close the lid. A lot of smoke will be trapped in the jar and the flame will quickly be extinguished due to the lack of oxygen.
4. Leave the jar closed and repeat the activity every 15 or 30 minutes throughout the day. There is no need to clear the paper out of the jar each time. Near the end of the day, open the jar, remove the bands from the sponge and show the class the blackened surface.
5. Remind the children that this is after just one day's "smoking" and ask them to predict how this might change further over time, leading to a wider discussion about making healthy choices.

KEY QUESTIONS

1. What do you think made the sponge blacken?
2. How do you think the lungs will change over time: another day, week, month, year or years?
3. Why do you think cigarette smoking is bad for you?
4. Which parts of the body does the cigarette smoke harm? Why do you think this?
5. What effect might smoking have on your general health?

KEY VOCABULARY

Breathe/ breathing	Respiratory system
Lungs	Smoke
Oxygen	Nicotine
Health	Chemicals

EXTENSION / FOLLOW UP ACTIVITIES

Children could research the effects of smoking on the body in a variety of different ways.

ADDITIONAL RESOURCES (IF REQUIRED):

- ■ N/A

ANTICIPATED ACTIVITY TIME: **5 MINS** at regular intervals throughout the day.
15 MINS to discuss findings.

Investigating Windows

Is double glazing more effective than single glazing?

INTRODUCTION

Double glazing is common in many buildings, including homes, offices and schools. How does double glazing work and is it effective? Why do we not just have one pane of glass in windows and save resources? In this activity, children will explore whether double glazing is more effective at preventing heat loss than just a single pane of glass. It will enable children to investigate a practical application of glass that connects to the world around them – their classroom or bedroom may have double glazed windows.

LEARNING INTENTIONS

- ☑ To learn about one of the uses of glass
- ☑ To carry out a fair test
- ☑ To present results in a line graph and draw conclusions

RESOURCES (PER GROUP)

- 2 small glass jars with their lids
- 1 large glass jar that can fit over the top of the smaller jars. Alternatively use a glass measuring jug
- Warm water
- 2 thermometers
- Timing device (stopwatch or timer on a tablet)

WHAT TO DO:

Today we are going to be materials scientists

1. Begin with a discussion about why we have windows in buildings at all. Ask the group to share their ideas about why windows are made of glass and why some windows have a single pane whilst others have double (or even triple) glazing (focus on the retention of heat).
2. Ask the children to predict which form of glazing might be more effective at retaining heat in a building.
3. Explain how the resources provided could be used to model double glazing, and test their ideas.
4. Fill the two smaller jars with warm water.
5. Take the temperature of the water in each jar and record this.
6. Screw the lids on top of the jars.
7. Place the larger jar upside down over the top of one of the jars.
8. Leave for 5 minutes, then remove the larger jar and take/record the temperature of the water in both smaller jars. Replace their lids and put the larger jar over the same smaller jar as before.
9. At five-minute intervals (for half an hour) repeat point 5.
10. Present results in a line graph.

KEY QUESTIONS

1. Did the temperature increase or decrease in each jar?
2. By how much did the temperature change in each jar?
3. Which jar had the greater change in temperature (the one covered by the larger jar or the one that wasn't)?
4. Why does the temperature of the water change over time?
5. Do your results suggest one or two panes of glass would be effective at retaining heat in a building?

KEY VOCABULARY

- Temperature
- Thermometer
- Material
- Conductor/ conduction
- Insulator/ insulation
- Heat energy
- Circulate
- Convection*

*not expected at primary but useful to explain in simple terms

EXTENSION / FOLLOW UP ACTIVITIES

This activity could lead to a wider discussion about the impact that poorly insulated buildings have on the environment. Children could explore ways to improve the insulation of their school/home to reduce the amount of energy that is needed to heat them.

Children could investigate the effect of triple glazing using a third glass container to cover one of the jars.

Children could learn about how windows have changed over time.

ADDITIONAL RESOURCES (IF REQUIRED):

- Jars of varying shapes and sizes

ANTICIPATED ACTIVITY TIME: **45 MINS**

Arctic Ice

Protecting the Arctic from radiant heat (sunlight)

INTRODUCTION

Scientists are trying to find ways to slow down global warming and give us a little more time to reduce our carbon emissions. Dr Leslie Field is one of these scientists and she believes that preserving and restoring ice in the Arctic will help. In the 'Arctic Ice Project' the effect of adding a thin layer of tiny, hollow, glass beads in key places is being investigated. The material looks like sand, floats on water and initial tests show it doesn't harm wildlife. In this investigation, children will mirror the research to see whether glass beads might reflect sunlight and reduce melting.

LEARNING INTENTIONS

- ☑ To understand how science and engineering can be used to solve global problems
- ☑ To plan a comparative test (including recognising and controlling variables where necessary)
- ☑ To compare reflection and thermal conduction in different materials

RESOURCES (PER GROUP)

- Desk lamp with adjustable height and incandescent bulb (not LED)
- 2 chocolate buttons
- 2 cake cases
- Timer
- Cling film
- 7 glass marbles
- Block (wood/book)

WHAT TO DO:

Today we are going to be geoengineers

1. Collect the equipment. Explain that the chocolate buttons will represent the Arctic ice and that a desk lamp will represent sunlight.
2. Place the chocolate buttons in the cake cases and cover with cling film. Ensure there is enough cling film so that you can easily lift it up, but that there is only a single layer covering the chocolate.
3. Add the marbles (6-7 should cover the surface of the chocolate) to one cake case. You will compare this to a cake case with only cling film covering the chocolate.
4. Arrange the lamp so that it will shine equally on your samples and measure the height of the bulb.
5. Turn on the light and begin timing. Every minute (or 2 minutes), remove the samples from the light (a block under the cases helps do this quickly) and lift the cling film. Can you press into the chocolate and leave a dent? Is there melted chocolate on the cling film?
6. Return the samples and continue until each sample has melted and compare the times.

KEY QUESTIONS

1. How will you know that the chocolate is warming?
2. What similarities and differences are there between ice and chocolate?
3. Does a layer of glass beads (marbles) slow down melting under radiant heat (sunlight)?
4. What do you predict will happen with other materials?
5. How can you make a fair comparison with other materials?

KEY VOCABULARY

- Thermal insulator
- Global warming
- Arctic ice
- Reflective
- Reflectivity
- Melt/melting
- Radiant heat (sunlight)
- Visible light
- Geoengineering
- Conductor/ conducting

EXTENSION / FOLLOW UP ACTIVITIES

- Children could plan an investigation, trying other materials on top of the chocolate, such as sand, foil or plastic beads.
- *Watch: tinyurl.com/am5rayxj This shows heat being conducted rather than radiated. Can children predict and then set up a fair test to find out about glass' thermal conduction properties?
- Adding a layer of beads to key areas in the Arctic would cost an estimated $300 million and some scientists are worried that the material might cause problems later. Alternative geoengineering ideas include making clouds or releasing sun-blocking gases into the atmosphere. Have a class debate, 'Should we be trying to slow global warming with geoengineering, or will it make things worse?'

**This is an Explorify activity. You will need to sign in/create a free account in order to access the resource*

ADDITIONAL RESOURCES (IF REQUIRED):

- Sand, foil, plastic beads
- Ice, materials including glass with the same thickness
- arcticeproject.org

ANTICIPATED ACTIVITY TIME: **40 – 90 MINS**

Feed the birds

What types of food do different garden birds prefer?

INTRODUCTION

Glass is an excellent material to use as a bird feeder as in addition to being abundant and recyclable, it is inert, so won't harbour dangerous chemicals and can easily be cleaned to maintain fresh supplies for the birds.

In this activity, younger children could build or simply place feeders around the school grounds and observe the birds that feed. Older children will build a bird feeder from a recycled glass ramekin dish and could investigate which food is the most popular with the local bird population, linking to the shape of their beak. Prior to building the bird feeder, pupils should have conducted a survey of birds found in the school grounds.

LEARNING INTENTIONS

- ☑ To be able to explain the relationship between the shape and size of the bird's beak and the food it eats
- ☑ To be able to name and identify a variety of common birds

RESOURCES (PER GROUP)

- Glass ramekin
- String
- Marker pen
- Ruler
- Scissors
- Plastic plate or container lid pre-drilled with 4 holes or provide a bradawl and block of wood if the children are drilling the holes themselves. Using a piece of masking tape over the plastic may help to prevent cracking
- 4 plastic straws (non-bendy)
- Different types of bird food

WHAT TO DO:

Today we are going to be ecologists

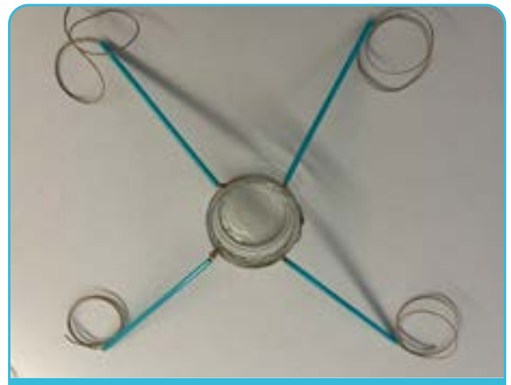
1. Use pictures of common birds to allow children to discuss local bird populations and beak types before encouraging them to plan an investigation of popular food types for the feeders they will create.
2. Explain to the children that they are going make feeders and investigate bird behaviour at the feeders.
3. Show the children the resources for making a bird feeder and demonstrate the construction (see images) and support groups to make these.
4. Discuss the materials the bird feeder is made from and how it needs to be regularly cleaned to prevent birds passing disease to each other. Glass can be sterilised by heating in an oven or washing in very hot water, making it a good choice for the feeders.
5. Position feeders in the school grounds. The positioning of the feeders will need careful consideration as they will need to be viewed from a distance, so the birds are not disturbed.
6. Discuss ways of gathering data about the birds, e.g. watching birds at different times of day; tallying visits to the feeder over a fixed amount of time; recording the amount of food left in a location at the end of the day; taking pictures of birds on feeders, etc.

To make the feeder:

1. Cut a piece of string that will wrap around the top of a ramekin twice. You need to allow extra for tying a knot. Double the string and lay out on the table.

2. Cut 4 x 60cm pieces of string and tie these onto the doubled piece of string. Space them out leaving a gap at each end to allow for tying to the ramekin.

3. Tie the doubled string around the glass ramekin, ensuring that it is tightly knotted.



4. Space the 4 pieces of string evenly and slide a straw onto each piece.

5. Thread the string through the holes and slide the lid down to rest on the straws. Pull the four pieces of string tightly and make sure the ramekin is balanced before tying the pieces of string together to form a loop for hanging.

Note: If the children are drilling their own holes for the lid, make sure that they mark the position first. If you are using a lid with a groove, add extra holes around the side for drainage.

KEY QUESTIONS

1. What do you think the local birds usually eat?
2. What do bird seed packs (the type you might buy) contain?
3. Where are the best locations for hanging feeders? Why do you think this?
4. Do you think all species birds eat the same type of food? Why do you think this?
5. Why do you think beak shape might determine what food a bird eats?

KEY VOCABULARY

Beak
Food
Habitat
Environment
Food chain
Adaptation
Organism
Reproduce
Generation
Natural selection

EXTENSION / FOLLOW UP ACTIVITIES

Carry out investigations into bird behaviour.

Investigate which bird seed is the most popular in the local bird population – you could weigh food placed in the feeder or tally visits to the feeders for a given length of time. Compare with an earlier survey of birds seen in the same location to see what impact the type of food offered has on visits.

Investigate the best location for bird feeders in the school grounds.

Investigate whether birds prefer to feed at certain times of the day. It may be helpful to use a camera to monitor a feeding station.

Children could grow their own bird food, e.g. sunflowers, thistles, teasels and berry plants.

ADDITIONAL RESOURCES (IF REQUIRED):

- Binoculars
- Bird identification book/chart
- Pencil and clipboard
- Printed recording sheet

ANTICIPATED ACTIVITY TIME: Building feeder: **45 MINS**
Observation of feeders: **2 WEEKS**

Glossary

adaptation	a process of physical changes leading to an animal or plant species becoming better suited to its environment
Arctic ice	the cover of sea ice in the Arctic region of the Earth
beak	a hard projecting mouth structure
breathing	taking air into the lungs and then expelling it
bulb	the underground food storage organ of some plants (dormant for part of the year) that contains the growing point of the new plant
carbon dioxide	an acidic, colourless gas (at room temperature), whose molecule consists of 1 carbon and 2 oxygen atoms
chemical/non-reversible change	the transformation of a substance into one or more different substances
chemical	a form of matter with a specific composition and characteristic properties
circulate/circulation	the movement of a fluid around a closed system, for example blood around arteries, veins and capillaries
compost	a mixture of materials, usually from decomposed organic matter, that fertilise and improve soil
condensation	the process of a gas becoming a liquid (usually due to cooling)
conductor/ conduction	a material that allows heat (or electricity) to flow through it easily - conduction is the process of transferring energy through particles that are in contact with each other
convection	the transfer of heat energy through the movement of particles in liquids and gases
converge	come together/move towards a point
cycle	a series of events repeated in the same order
environment	the surroundings or conditions that people, plants or animals live within
evaporation	the process of a liquid becoming a gas (usually due to heating)
evolution	changes in the characteristics of a species over several generations – partly due to the process of natural selection
expand/contract	become bigger (expand) or smaller (contract) in volume
field of view	the part of the sample that is visible through the microscope
food	nutrients like fats, proteins, carbohydrates, vitamins and minerals that provide nutrition and energy for a living organism
food chain	the flow of energy from one living thing to another
gas	a state of matter where the particles are very far apart; gases flow, take the shape of their container and can be compressed
generation	a single line of descent from an ancestor; a form or stage in the life cycle of an organism
geoengineering	a deliberate, large-scale intervention to change the Earth's climate

Glossary

glass	a non-crystalline solid unless it is very very hot in which case it might not be a solid!
global warming	long-term heating of the Earth's climate system
gravity	a force between two objects based on their mass and the distance between them; typically we think of gravity acting between Earth and an object, causing the object to be pulled towards the centre of the Earth
habitat	the environment in which an organism resides, providing support for its survival and reproduction
heat	a form of energy; heat energy always flows from a warmer to a colder place
insulator/insulation	a material that resists the flow of heat (or electricity) passing through it
lens	a transparent, curved material (often glass), that is used to change the direction of light rays to form an image
light	a form of energy that makes things visible; it is part of the electromagnetic spectrum
light rays	the path along which light travels
light source	an object that generates light, such as the Sun or a torch
liquid	a state of matter where the particles are further apart than in a solid, allowing it to flow; a liquid cannot be compressed and will take the shape of its container
loud	the amplitude (size) of a sound wave, louder sounds have more energy than quieter ones
lungs	organs of the body whose function is to extract oxygen from the air and transfer it to the bloodstream and to release carbon dioxide back into the air
magnify	make larger
material	the substance (matter) from which an object is made.
melting	the process of a solid becoming a liquid (usually due to heating)
microscope	an instrument that enlarges the view of objects, enabling objects that are too small to be seen by the naked eye to be viewed
mirror	a reflector of light
natural selection	the process by which populations of living organisms adapt and change
nicotine	a chemical extracted from plants that is found in cigarettes
opaque	impenetrable to light; a material that is opaque absorbs or reflects light that falls on it and does not allow the light to pass right through
organism	a living thing
oxygen	a colourless, odourless, tasteless gas (at room temperature), essential to life
particles	one of the extremely small constituents of matter (e.g. atoms, molecules, electrons)
pitch	how high or low a sound is, dependant on the frequency (or speed) of a vibration
plastic	natural or synthetic polymers (materials composed of very long chain molecules); typically, these are made through industrial processes
precipitation	water released from a cloud; it may be in the form of rain, hail, sleet or snow
radiation/radiant heat (sunlight)	the transfer of heat energy through the emission of waves that are absorbed into, reflected by, or pass through a colder body
reaction	a process leading to the transformation of a substance into one or more different substances
reflect/reflection/ reflective	a change in the direction of a light ray away from a surface instead of passing through it. When light hits a reflective or shiny surface, it will reflect from and travel away from the surface in a predictable path
refraction	a change in the direction of a light ray caused by its movement from one material into another, leading to a change in speed
reproduce/ reproduction	the process by which organisms produce new living organisms with characteristics or features similar to that of the parents
respiratory system	the organs of the body involved in breathing
resolution (microscope)	the ability of a microscope lens to distinguish detail
seed	a part of a plant that has the potential to grow into a new plant
shadow	a dark area created when an object blocks the path of light, preventing the light from passing through it
sink/float	move below the surface until submerged/resting on or near the surface of a fluid
smoke	a suspension of carbon and other particles in air, typically as a result of burning or (verb) to inhale a cigarette
soil	a mixture of minerals, organic matter, gases, water, rocks and some organisms
soil profile	a cross-section of soil, showing its constituent parts as layers
solid	a state of matter where the particles are close together; a solid has a fixed volume (cannot be compressed), will not flow and will support its own shape
sound	a form of energy created by vibrations that can be transferred from one particle to the next
stage (microscope)	the platform of a microscope where the sample to be viewed is placed
temperature	a measure of hotness or coldness, usually measured with a thermometer
thermometer	a device for measuring temperature
translucent	allowing the passage of some light, but no detailed shapes can be determined when looking through the material
transparent	allowing light to pass through unchanged, so objects can be seen distinctly
vibrate/vibration	a repeated movement either side of a fixed point, e.g. side to side or up and down
water	a transparent, odourless, tasteless and colourless liquid, essential to life, that freezes at 0°C to form ice and boils at 100°C to create water vapour
water vapour	gaseous form of water

Health and Safety

The Primary Science Teaching Trust wants primary school children to undertake practical science work and of course, to do so safely. Below we suggest some measures that you should consider when using glass as proposed in this booklet.

However, school environments and children vary considerably, and it is the responsibility of every adult supervising children performing these activities to undertake their own risk assessments and put measures in place that are appropriate to the children and situation. Please refer to the guidance provided by your employer.

The PSTT advises all teachers to refer to the CLEAPSS or SSERC websites for up to date health and safety information and general advice when planning any practical activities for children.

For example, teachers will find the following CLEAPSS documents particularly useful when undertaking activities related to heating and burning:
P004 Safe Heating for Practical Science
P018 Investigating Burning

Please note that these recommendations do not cover all aspects of health and safety that should be considered when undertaking the activities suggested in this resource.

Details about CLEAPSS and how to access their advice can be found here: https://primary.cleapss.org.uk

If you work in a Scottish school, your H&S advisor is SSERC. Visit their website: https://www.sserc.org.uk/
SSERC will be able to advise you on all STEM matters in Scotland.
For help and advice, email: primary@SSERC.Scot

Using Glass

Glass jars, bottles and sheets are fine to use with primary school and EYFS children, but they need to learn how to look after the material and and in particular, how to act if an accident, such as a breakage, occurs. You should check:

- Could the object be dropped and cause injury? Ensure children are told how to handle glass objects and where these may be held. Plan what you and the children will do if an object is dropped and broken and make sure the children understand this.
- Is the glass container clean? Wash in warm soapy water or use a dishwasher.
- Does it have any chips or cracks? Cracked glass should not be used. Sharp edges must be taped.
- Do children have enough room to move and work without knocking into each other or glass objects?
- Is the glass suitable for heating?

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