Sketchbook SCIENCE

ALEX FARRER AND ISABELLE DUBOIS

A Primary Science Teaching Trust Resource

Primary Science Teaching Trust

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Foreword

As a child, one of the most astonishing things a teacher told me was that snowflakes are unique. The numbers that fall on our planet's surface may be countless, but their different journeys through the atmosphere mean that no two will be alike. My sense of wonder at this fact was equalled by the beauty of the magnified snowflake photos shared by our teacher, and we were then asked to conjure up our own unique patterns.

I have no great talent for drawing, but of course that was not the point. Just like science, art is accessible to all children in different ways, and involves a variety of skills and knowledge; there is no one 'right' way to develop as a scientist or artist. The creative interplay between the two disciplines can stimulate children's imagination, develop their abilities, and perhaps even be transformational for some.

The eight diverse projects in this resource aim to tap into that potential. They provide engaging, practical activities – tried and tested in the classroom – that explore the relationship between science and art. The Primary Science Teaching Trust is delighted to share them with you.

Martin Pollard,
CEO, Primary Science Teaching Trust

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Nathan Williams

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Alex Farrer

Alex Farrer is Head of Science at Wimbledon High Junior School and a PSTT Fellow. She enjoys exploring the connections between science and other areas of learning, and finding new ways to enhance these through developing skills in different contexts.

Isabelle Dubois

Isabelle Dubois is Head of Art at Wimbledon High Junior School and is passionate about encouraging all of us to see ourselves as artists.

Introduction

Sketchbook Science

Sketchbook Science is a set of eight projects that combine learning in both science and art. Each project was developed and trialled by the authors working in collaboration with the science subject leaders and art leaders from a group of eighteen schools. In developing the projects, the teachers paid rigorous attention to ensuring that the essence of good teaching in both science and art was maintained, enabling meaningful learning to take place in both subjects.

The projects cover the teaching of substantive concepts relating to the biological, chemical and physical sciences, and they all offer opportunities to develop disciplinary knowledge and to learn and apply skills of science enquiry. Each suggested learning activity takes inspiration from the work of great artists and designers. The projects also introduce the children to new skills and techniques in art, and each project culminates a piece of work in which the children apply and communicate their new learning and skills in both science and art. The lessons are generally more appropriate for children aged 7 – 12, but they are highly flexible and can be adapted to use with different age groups. They are also intended to act as inspiration for teachers for how to develop their own *Sketchbook Science* projects.

Each *Sketchbook Science* lesson contains:

- Expected learning outcomes for children's conceptual development, as well as skills in working scientifically that the children might learn and apply;
- Key artistic and scientific vocabulary;
- Resource lists;
- A step-by-step list of suggestions about what to do in the learning activities for art and for science investigations;
- Ideas for recording and presenting results from the science investigations;
- Examples of artwork produced by schools that have trialled the activities;
- Information about the artists that inspired the learning activity ideas;
- Further resources related to the activities;
- Background science explanations to support teachers; and
- Links to related Explorify activities.

Links to all UK science curricula are provided in a separate document that can be accessed **here**.

A note about images included in the resource

All images reproduced are with permissions from the schools that created them, or they are from the public domain. Where an image is referenced but the relevant permissions to reproduce it are not in place, there is a hyperlink included so that teachers can find the images on an appropriate website. Please note that these links are intended for teachers' use, rather than for children to use to do independent research.

Rationale for Sketchbook Science

Artists and scientists have much in common. They both start with a keen interest in the world and utilise skills such as observing, investigating, asking questions, suggesting improvements and developing ideas. Scientists and artists also use a wide variety of approaches and practise skills in a curious and creative manner. Time spent immersed in art activities can be a useful way to explore scientific knowledge and understanding, giving opportunity to explore misconceptions, widen links and improve both scientific and artistic vocabulary.

Would we describe individuals such as **Leonardo da Vinci**, **Anicka Yi** and **Maria Sybilla Merian** as scientists, or artists, or both? They have all demonstrated a deep and broad understanding of more than just pure science or pure art, and their contributions to society are the result of new approaches and ideas that use both scientific and artistic knowledge and skills.

Victorian plant and animal hunters produced incredibly detailed sketchbooks documenting their finds, showing great skill in both science and art to leave a record of what they had discovered. Modern artist-anatomists also need to be highly skilled in both disciplines in order to record and explain the anatomy of the human body. When children see art and science as completely separate subjects, opportunities for connections are missed, but studying art and science in combined projects enables children to develop their skills in both areas.

Delving deeper into science and art together gives children opportunity to describe the world around them, use their creative and imaginative skills, experiment and take risks, learn from mistakes, and reflect and decide how they can make improvements. The study of inspirational artists and scientists can help to break down stereotypical views of what a scientist or artist looks like and how they behave. *Sketchbook Science* encourages the recognition that creativity and curiosity belong to both science and art, and encourages children to consider more broadly their own identities as scientists and artists.

Art is an excellent curriculum area for children to build resilience as learners and to develop a growth mindset. Creating art can be challenging for children who do not view themselves as artists and who may have a tendency to be overly self-critical. It is helpful if teachers are mindful of how children perceive their artistic skills. For children who struggle with self-perception of their abilities in art, it could be useful to begin with some of the more abstract Sketchbook Science activities, e.g. Feltscapes, and work towards those which include more realistic or observational drawing, e.g. Dotty Fruit. Highlighting that artists don't produce their finished work in one attempt but will begin with research, sketching, drafts and redrafts can help the children to understand that developing as an artist is a process. Encourage them to reflect on how they see their skills developing during a project and over the course of a school year.

For further information about growth mindset, see the work of Carol Dweck: this animated version of her book '**Mindset**' provides a very accessible 6-minute overview.

To inspire children to persevere and to see the value in re-drafting their art, see **Austin's Butterfly**.

Health and Safety

PSTT recommends that a full risk assessment is carried out before undertaking any of the art and science activities suggested in the projects in this resource. **CLEAPSS** and **SSERC** both provide up-to-date guidance for schools.

CLEAPSS – check with the school to see if they have membership; this is needed in order to access the complete set of resources and guidance.

SSERC – guidance intended for schools in Scotland, but relevant to all schools.

The Projects

Project	Science topic	Art skills and techniques
Dotty Fruit	Plants – seeds and seed dispersal	Repeating patterns, clay sculpture
Pollination in a Vase	Plants – parts of a plant and pollination	Collage, mosaic, mixed media
Elongated Figures	Humans – skeleton and movement	Drawing to capture movement, sculpture
Not Junk but Art	Materials – properties, plastics	Drawing to capture movement, collage, using tools
Feltscapes	Materials – changing materials	Experimenting with colour and texture
Liquid Art	Materials – changes of state and different liquids	Drip painting, large-scale action painting
Shadows and Silhouettes	Light – light and shadow	Drawing from a model, using fine liners and fine pencils
Space Craters	Earth and space	Watercolour, creating different effects with watercolours

Dotty Fruit

In this project children will learn more about seeds and fruit, with opportunities to observe seeds closely and to consider relationships between their size and shape and the size and shape of the fruit, and how they are dispersed. They will use their observations to create drawings and sculptures, taking inspiration from artists such as Yayoi Kusama. In science, the activities will support the development of children's understanding of the life cycles of flowering plants. In art, the activities will help children to learn and apply techniques to create sculptures out of clay and to use a variety of pens and patterns to communicate ideas.

Pumpkins designed by children at one of the project schools and photographed with mirrors to re-create an infinity room in the style of Yayoi Kusama.

Learning outcomes

CONCEPTUAL UNDERSTANDING IN SCIENCE

The children will develop ideas about:

- The different stages of the life cycle of a flowering plant
- Different methods of seed dispersal and how these are related to the appearance of the seeds

ARTISTS AND THEIR WORK

The children will create their own work taking inspiration from the work of:

- Yayoi Kusama
- Henri Matisse

SCIENCE ENQUIRY

These activities provide opportunities for:

- Observing and measuring the similarities and differences between fruit using a variety of scientific equipment
- Deciding how to gather, record and present data in tables

TECHNIQUES IN ART

The children will develop and apply skills in:

- Drawing and pen work using repeated patterns
- Creating sculptures using clay
- Making adaptations and refinements in response to feedback

KEY WORDS SCIENCE

life cycle
reproduction
seed formation
seed dispersal
germination
pollination
flowering plant
fruit
ovary
flower
seed
circumference
height
width
mass
length
estimate

Resources

SCIENCE

- A range of different fruit - peppers, kiwi, oranges, tomatoes, squash, pumpkins, melon or cucumbers work well
- Tweezers
- A sharp knife and chopping board for an adult to cut the fruit in half
- Measuring tapes
- String
- Rulers
- Magnifying lenses
- Weighing scales

Note: be mindful of food waste and discuss with the children the best way of ensuring as little food is wasted as possible. Try to use fruit that are in season at the time of completing the investigation.

ART

- A selection of A4 and A3 paper in different colours (including black)
- A selection of A4 and A3 card in different colours (including black)
- Black fine liner pens
- White fine liner pens
- Crayons

For the sculptures:

- Acrylic paint in a variety of colours
- Black marker pens
- Air drying clay
- Modelling tools (including cutting wire)
- Newspaper
- Acrylic pens

KEY WORDS ART

outlines
contour lines
clay
modelling tools
rolling
shaping
smoothing
joining
painting
colour blocks
varnishing
repetition
reflections
patterns
shape
polka dots
line
space

HEALTH & SAFETY NOTES

- Check for allergies.
- Ensure that the school policy regarding the use of knives is followed; consulting health and safety advice from **CLEAPSS** or **SSERC** is recommended.
- Particular considerations include:
  – the consistency of the fruit being cut;
  – the children's experience with knives;
  – the children's maturity; and
  – the benefits of adult supervision.

Part 1: Science investigation – fruit

The children explore a range of fruit to find out the similarities and differences between them. This could be an open-ended exploration, or a pattern-seeking enquiry to answer questions that the children suggest such as:

Do larger fruit have larger seeds?

Do larger fruit have a greater number of seeds?

Are the seeds in a fruit the same colour as the external colour of the fruit?

Is there a link between the shape of the fruit and the shape of the seeds in the fruit?

Do plants always grow from seeds?

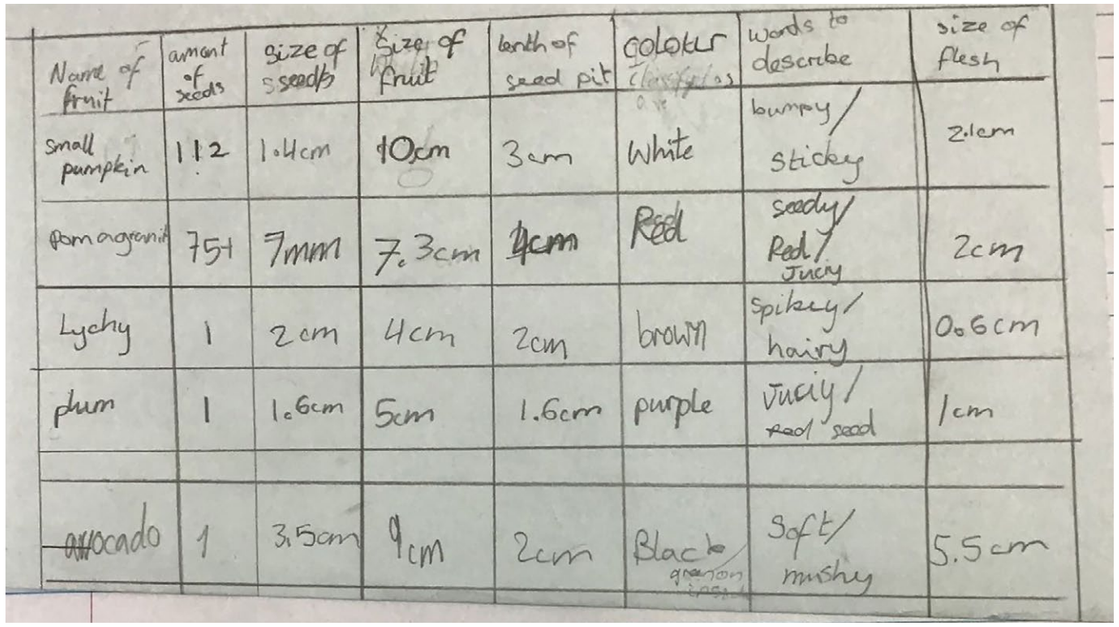
How does a plant like a spider plant create baby spider plants?

During their exploration, children will have some questions about the best way to take measurements to compare the different fruit. Key points to note are:

- Make a range of scientific equipment available for the children to choose from to make their measurements, including balances or weighing scales, tape measures, rulers and magnifying lenses.
- They may need help with measuring features of the fruit and/or seed, such as circumference. It may be useful to demonstrate how a piece of string and a ruler can be used to find out the circumference of an irregular shape.
- This investigation is good for supporting children to discuss variations in the same species and how much evidence is needed to be able to draw a conclusion about the similarities and differences between fruit.
- While the children are exploring the fruit, encourage them to discuss what they remember about what a seed is and what seeds need to begin to grow. They could soak some of the seeds in water overnight to see if the seed coat will come off or not, and use microscopes or hand lenses to look closely at the seeds. Discuss with the children which seeds are removed before eating a fruit, and which seeds we eat, and the health benefits that we gain from doing so.
- Ask the children to think about how the seeds would be dispersed when growing wild. Would they be dispersed by water, wind, animals, or by another method? As well as looking closely at the seeds, can clues be found about the seed dispersal method in the appearance of the fruit?

Children estimating the number of seeds in two different fruits.

RECORDING AND PRESENTING RESULTS



Name of fruit	amount of seeds	size of seeds	size of fruit	length of seed pit	colour	words to describe	size of flesh
small pumpkin	112	1.4cm	10cm	3cm	white	bumpy / sticky	2.1cm
pomegranate	751	7mm	7.3cm	4cm	Red	seedy / Red / Juicy	2cm
Lychy	1	2cm	4cm	2cm	brown	spikey / hairy	0.6cm
plum	1	1.6cm	5cm	1.6cm	purple	Juicy / Red seed	1cm
avocado	1	3.5cm	9cm	2cm	Black green	Soft / mushy	5.5cm

Table drawn by a child in one of the project schools exploring the similarities and differences between fruit.

Encourage the children to create a table to record the measurements and observations that they make. They could transfer their data to a bar graph, which would help them to explain patterns in the variations of such features as the number or length of seeds in different fruit. The tables that the children devise might include numerical and/or descriptive data.

As part of their exploration, children revise their understanding of the life cycle of a flowering plant and the role of the fruit and the seed. The following questions might be helpful to prompt discussion and check their understanding:

What is inside a seed?

What does 'germinate' mean?

What conditions does a seed need to germinate?

What is a fruit?

What does dispersal mean?

Card ordering: give children a set of cards that describe the life cycle of a flowering plant and ask them to arrange the cards in the correct order.

Seed dispersal
The seeds are dispersed from the fruit.

Germination
The seed germinates.

Growth
The plant produces leaves and grows bigger.

Fertilisation
Seeds develop in the ovary in the base of the flower.

Fruit formation
The base of the flower swells to become a fruit.

Pollination
Pollen is transferred from one flower to another by an insect (or the wind).

Flower formation
Buds grow on the plant and open into flowers.

See useful links section for further information.

Part 2: Techniques in art – drawing pumpkins

Children start by carefully observing a selection of different-shaped pumpkins, squash and gourds from different perspectives. Pumpkins are a good choice of fruit for getting children to focus on shape and to develop their confidence to be bold in their drawing. Pumpkins were often the inspiration for Yayoi Kusama, but other fruit could be used as alternatives. Close attention needs to be paid to the contour lines as well as the outline of the whole fruit, so that the drawing of the fruit is given structure and form. Henri Matisse produced a series of still life pencil sketches of pumpkins, which would be useful to look at carefully before starting to see how he captured volume and shape (see the inspirational artists in the supporting information section).

A simple representation of a pumpkin using contour lines

A Dotty Fruit creation from one of the project schools.

WHAT THE CHILDREN DO:

1. Use pencil to practise drawing three or four pumpkins.
2. Look carefully at the "Dotty Pumpkins" drawn by Yayoi Kusama and notice the repetitive patterns that she drew behind the pumpkins' shapes.
3. Choose a piece of paper to be the background colour (this could be one colour of A3 paper or two A4 pieces of differently-coloured paper so that the background space is split in two). A colour wheel could be useful to help with the colour choice, as contrasting colours need to be chosen if using two colours.
4. Draw the pumpkin on another piece of paper or card. The shape should be quite generous, and the contour lines inside should create a pumpkin shape. Some children might want to create more than one pumpkin, varying the sizes and shapes. Others might want to cut their pumpkins in half and draw the inside of their pumpkins to reveal the seeds.
5. Glue the pumpkin drawing in place on the background paper with a glue stick and then use fine liners to dot the pumpkins and draw repetitive patterns onto the background in the style of Yayoi Kusama.

Displays of the children's work could be used to link to other areas in the curriculum:

- **PSHE kindness to others (pumpkins aren't perfect, just like people)**
- **Sustainability - using wonky fruit**
- **Celebration of autumn or harvest.**

Examples of some abstract geometric repetitive patterns similar to those used by Yayoi Kusama in her paintings

Dotty Fruit creations from project schools where children have chosen to complete the repetitive background patterns in different ways.

Part 3: Pumpkin sculptures

WHAT THE CHILDREN DO

1. Look carefully at photographs of Yayoi Kusama's sculptures of pumpkins, especially at how they are decorated.
2. Take a ball of clay and use a modelling tool to make a hole in the centre.
3. Use the modelling tool to draw contour lines onto the clay. Use tip of fingers or modelling tools to press the lines and to shape the sections of the pumpkins. Use finger pressure to refine the pumpkin shape. Fill the cracks and smooth the surfaces using fingers or the flat section of the tools.
4. Use a small piece of clay and roll it into a stalk shape.
5. On the top of the pumpkin, create a socket before adding the stalk.
6. Attach the stalk by scratching both pumpkin and stalk base and using a little bit of water. Twist the stem in place and press with a little extra water to make sure that, once dry, the stalk will not fall off.
7. Wait until the clay hardens.
8. Paint the pumpkin with a base layer of acrylic paint in the chosen colour.
9. Use black marker pens to add repetitive dots of various sizes along the contour lines in the style of Yayoi Kusama.

There are many instructional videos on YouTube that might be useful, but the key points to remember are:

- Pay close attention to joining the clay pieces together ;
- Make sure that the clay pumpkins are left to dry in a well-ventilated place (stand on newspaper and/ or cake drying racks to let them dry uniformly). This could take up to a week.
- Experiment with taking pictures of the painted clay pumpkins together using mirrors to recreate the "infinity mirror rooms" imagined by Yayoi Kusama. This also provides an opportunity to link with the children's science learning about light.

SUPPORTING INFORMATION

BACKGROUND SCIENCE

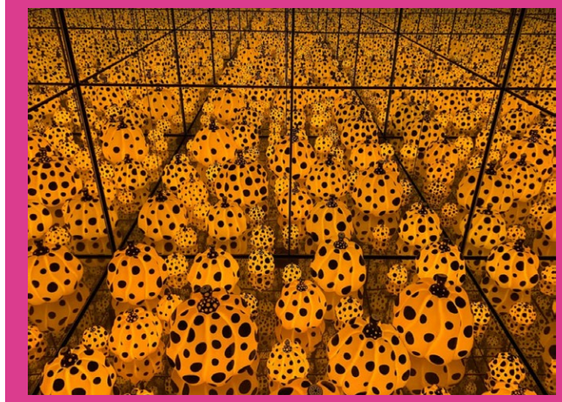
Plants produce seeds to ensure the continuation of their species. When the conditions are right (enough water and warmth), a seed will germinate using the energy stored in the seed itself. Once it has produced its first leaves, the new plant starts to photosynthesise, meaning that its leaves use light energy from the Sun to make its own food from water through its roots and carbon dioxide from the surrounding air. Oxygen is released into the air as a by-product and the sugars made by the leaves are used by the plant to continue growing. As the plant matures, it produces flowers, which are essential for it to reproduce. When the flowers open, a process called pollination occurs. Pollen is produced by the male part of the flower (the stamen) and this is transferred – either by animals such as bees or by the wind – to the female part (the stigma) of another flower. When a flower has been pollinated, this leads to the formation of seeds inside the ovary at the base of the flower. As the seeds mature, the ovary swells to become a fruit. Mature seeds are then dispersed or carried to a new area, where they have the space and conditions to germinate into a new plant. There are various ways in which seeds can be dispersed. Animals might eat the fruit and later on deposit the seeds (which are resistant to digestion by the animal) in their faeces. Animals can also disperse seeds by burying them, or by carrying them on their fur, in which case the seeds are often spiky or sticky. Some seeds are dispersed by the wind; occasionally this is aided by the seed being attached to wing- or parachute-like structures. Seeds might also be dispersed by water, with some having air pockets inside the seed to help them to float and travel a long distance away from the parent plant.

Fruit come in many different shapes and sizes and colours, with a variety of colours, shapes and sizes of seeds inside (or sometimes outside) them. A fruit such as a strawberry has seeds on the outside and a peach has just one central seed inside. Fruit are very important for us to eat, as they contain lots of vitamins and nutrients that help us to fight off infections.

INSPIRATIONAL ARTISTS

YAYOI KUSAMA (BORN 1929)

Yayoi Kusama is a Japanese artist, who is sometimes called "the princess of Polka Dots". This is because she uses dots repetitively and extensively in the paintings, sculptures and installations that she creates. When she was growing up, her family grew flowers and pumpkins for their seeds, and she developed a love of featuring them in her art: drawing them, sculpting them and using them in her infinity room installations.



Yayoi Kusama's "The Spirits of the Pumpkins Descended into the Heavens" (2015), exhibited at the National Gallery of Australia in Canberra, ACT, Australia.

More about Yayoi Kusama and her work.

HENRI MATISSE (1869-1954)

Henri Matisse was a hugely influential French artist, who altered the course of modern art with his vast collection of paintings, drawings, sculptures, etchings and paper cut-outs. Looking at **Still life with pumpkin – 1943** might be useful for helping the children to sketch contour lines in their drawings.

More about Henri Matisse and his work.

USEFUL LINKS

Look inside fruit to get children thinking about how they vary with the help of these amazing websites:

- **Peering through MRI scans of fruit and veg**
- **Hidden Patterns Inside Various Fruit and Vegetables**
- **Information about seed dispersal via animals can be found here:**

EXPLORIFY ACTIVITIES

- **Bananas**
- **Pineapples**
- **Flowering plants**
- **Imagining life without flowering plants**

START WITH ART EXPLORIFY ACTIVITIES

- **Seeds and nuts**

Pollination in a Vase

In this project children will learn more about the role of different parts of the plant in plant reproduction and create abstract representations of flowers and pollinators, taking inspiration from botanical artists such as Maria Sybilla Merian, Senaka Senanayake, Suzanne Valadon and Lilian Thomas Burwell. In science, the activities will support the development of children's understanding of pollination. In art, they will help children to learn and apply collage techniques.

A "Pollination in a Vase" collage from one of the project schools, inspired by the work of botanical artists.

Learning outcomes

CONCEPTUAL UNDERSTANDING IN SCIENCE

The children will develop ideas about:

- The different parts of the flower and the role that flowers play in plant reproduction
- Why pollinators visit flowers and the role that they play in plant reproduction

ARTISTS AND THEIR WORK

The children will create their own work taking inspiration from the work of:

- Suzanne Valadon
- Senaka Senanayake
- Lilian Thomas Burwell
- Maria Sybilla Merian

KEY WORDS SCIENCE

leaf
leaves
flower
petal
seed
fruit
pollination
pollinator
insect
germination
nectar
bees
moths
butterflies
pollen
stigma
stamen
reproduction
metamorphosis
life cycle

SCIENCE ENQUIRY

These activities provide opportunities for:

- Looking for patterns and relationships
- Using scientific language to communicate ideas
- Observing and recording

TECHNIQUES IN ART

The children will develop and apply skills in:

- Collage techniques such as tearing, cutting, mosaic and overlapping
- Choosing and arranging colours and materials to create effect
- Using a variety of mixed media to convey form and shape

Resources

SCIENCE

- Clipboards
- Outside area where a variety of different plants are in flower
- Cut flowers to pull apart
- Tweezers
- Magnifying glasses

ART

- Lace or lace paper doilies
- Photocopies of a selection of Blue Willow plates to tear into pieces
- Gold pens (or gold paint)
- Paper, card and foam in various shades of green
- Photos of flowers to cut out (these could be from magazines or newspapers, or photocopies)
- Brown paper or card (from recycling)
- Watercolour paint to paint the background

KEY WORDS ART

foliage
lush
overlap
lace
paper
card
foam
still life
abstract
realistic
form
shape
space
background
foreground
proportion
symmetry
collage
mosaic
tearing
cutting

Part 1a: Science investigation – why do plants have flowers?

The children can find out more about flowering plants, look for patterns and record their findings by looking at plants close to their classroom. They could initially look at some flower images or real flowers to get them thinking (see Background information).

The children could gather information to investigate their own questions, such as:

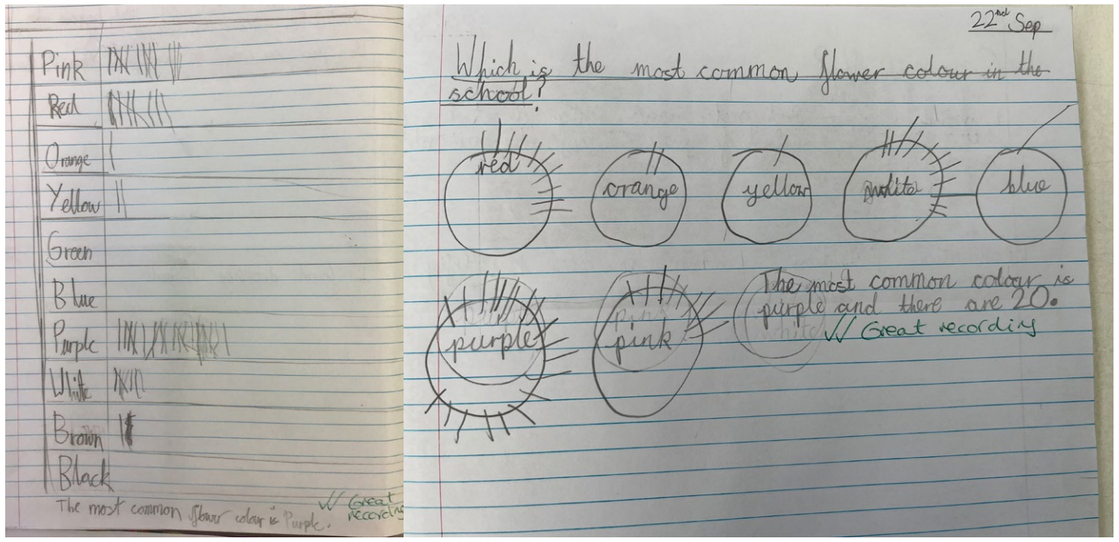
- What is the most common flower colour growing near the school?
- Are there more flowers in sunny or shady areas?
- Which flower colour is most popular with insects?
- How many different types/species of pollinator are seen visiting the plants?
- At what time of day can the most pollinators be seen?

Children making observations in their flower investigation.

RECORDING AND PRESENTING RESULTS

Encourage the children to choose their own way to record their results that will be clear and easy to understand. They might choose to use a tally chart, a table or a series of observational drawings.

It would be useful to discuss with the children how long they should carry out their observation for and whether they think that their results would change at a different time of year, in different weather conditions, or in different areas.



Examples of children's work after looking for patterns in the colours of flowers in the school grounds.

Part 1b: Developing science knowledge about flowers and pollination

The children should also carry out activities to check that they have a secure understanding of pollination, parts of a flower and the role of pollinators. There are some useful resources to help with this in the Background information section. Children should be encouraged to look closely at flowers, using magnifying glasses and gently pulling a flower apart to identify different parts. They can use their findings to draw diagrams to explain what happens when the flower is pollinated by an insect such as a bee. As well as looking at real flowers, children should look at the work of inspirational botanical artists, including Suzanne Valadon, Senaka Senanayake, Lilian Thomas Burwell and Maria Sybilla Merian, who have depicted flowers and pollinators in their work (see Supporting information). Role play, or the drawing of a comic strip, would help children to communicate their understanding of pollination and give them opportunity to practise key vocabulary.

Part 2: Creating the collage

WHAT THE CHILDREN DO:

1. Look at the work of the inspirational artists and discuss how they have depicted flowers.
2. Using one of the images of flowers in a vase, draw the outline of a vase on an A4 piece of paper, taking care to use all the space and looking at the line of symmetry.
3. Draw a curved line across the top of the vase to make the vase's mouth. Add a few more curved lines across the vase to create the illusion of form.
4. Tear pieces of Blue Willow paper (or similar) and glue them onto the vase to create a mosaic, leaving a gap of a few millimetres between the pieces.

Tearing paper to create the collage of the vase.

1. Use gold pens or gold paint to fill in the cracks. This is known as Kintsugi; golden (kin) and repair (tsugi), the Japanese art of repairing broken pottery. When the vase is completed, it should be carefully cut out.
2. To prepare the background, use an A3 piece of thick white cartridge paper, or A3 watercolour paper. Use watercolours to paint a background and let it dry.
3. Use brown paper to create the effect of a table and glue paper doilies or lace on top to create a tablecloth.
4. Place the cut-out vase on the table cloth.
5. Cut leaf shapes out of a variety of green paper, card and foam and arrange them in an overlapping design to create the foliage in the bouquet, adding pictures of flowers cut from magazines, or photocopies of flowers painted by Maria Sybilla Merian, and rearranging them until the desired effect is achieved.
6. Glue on the vase, leaves and flowers.
7. Draw, colour and cut out pollinators, such as bees or butterflies, ready to glue onto the bouquet, using a fold if a 3D effect is desired. Children can use their artwork to explain the role of pollinators in the natural world.

Completed "Pollination in a Vase" collages from a project school.

SUPPORTING INFORMATION

BACKGROUND SCIENCE

Flowers are essential for some plants to be able to reproduce. When a flower has developed and opened, a process called pollination occurs. Pollen is produced by the male part of the flower (stamen) and this is transferred to the female part (the stigma) of another flower. The pollen is usually transferred with the help of a pollinator, often an insect such as a bee or a butterfly. Insects are attracted to the flower by the brightly coloured petals, pleasant smell or sweet nectar. As an insect tries to get to the nectar, tiny grains of pollen brush off the stamen and stick onto the insect's body. The insect then flies to a different flower to find more nectar and, while it does this, the pollen grains brush onto the stigma of the second flower. Pollen grains of insect-pollinated flowers are often sticky to help with this process. Some flowers are wind-pollinated. They tend to have stamens that hang outside the flower and produce large quantities of pollen, as much of it is wasted. The stigma in wind-pollinated flowers is often sticky and also hangs outside the flower structure to increase the chances of pollen landing on it as it is blown past by the wind.

When a flower has been pollinated, this leads to the formation of seeds inside the ovary at the base of the flower. As the seeds mature, the ovary swells to become a fruit. Mature seeds are then dispersed or carried to a new area where they have the space and conditions to germinate into a new plant. Pollinators are very important as, without them, some plants would not be able to develop seeds to grow into new plants. Many fruit that we enjoy eating would not be able to grow without insects as pollinators.

USEFUL LINKS

This BBC Teach video explains the different parts of the flower and what their functions are:

More about The anatomy of the flower

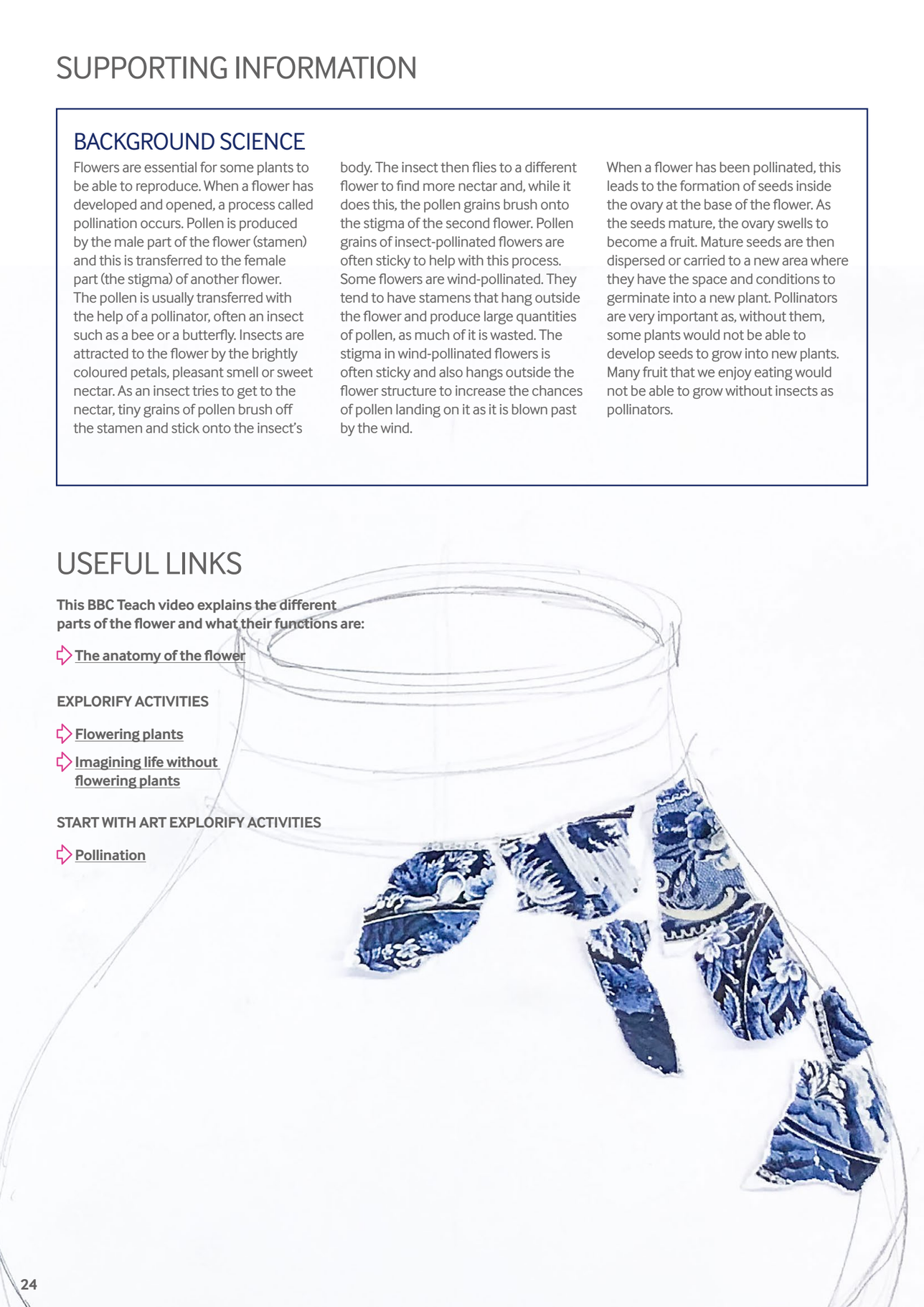
EXPLORIFY ACTIVITIES

More about Flowering plants

More about Imagining life without flowering plants

START WITH ART EXPLORIFY ACTIVITIES

More about Pollination



INSPIRATIONAL ARTISTS

SUZANNE VALADON (1865-1938)

Suzanne Valadon was a French painter who also sat as a model for some of the great artists of her time. She taught herself how to draw and painted portraits, still life, flowers and landscapes in a range of different styles. She was the first woman painter admitted to the National Society of Fine Arts.

"Vase with flowers" (1921) by Suzanne Valadon.

"Bouquet de roses, bleuets et fougères" (1930) by Suzanne Valadon.

More about Suzanne Valadon and her work.

LILIAN THOMAS BURWELL (BORN 1927)

Lilian Thomas Burwell is an African-American sculptor and painter, who comes from a family of artists. Her artwork is an abstract expression of her own response to the natural world.

More about Lilian Thomas Burwell and her work.

MARIA SYBILLA MERIAN (1647-1717)

Maria Sybilla Merian was from Frankfurt in Germany. She was a naturalist as well as an artist, with a particular interest in insects. She illustrated a wide range of insect species, capturing stages of their life cycles, including the metamorphosis of the silkworm.

"Flowers in a Chinese Vase" (1670-1680) by Maria Sibylla Merian.

More about Maria Sybilla Merian and her work.

SENAKA SENANAYAKE (BORN 1957)

Senaka Senanayake is a Sri Lankan artist, whose work is characterised by brilliant colours. He is a passionate environmentalist and advocate for the natural world, and this is reflected in his paintings.

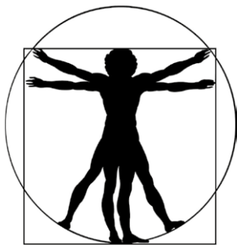
More about Senaka Senanayake and his work.

Senaka Senanayake's own website.

Elongated Figures

In this project children will learn more about the proportions of the human skeleton and find out about how these proportions can vary. Taking inspiration from the drawings, paintings and sculptures of artists such as Alberto Giacometti, Chris Ofili, Louise Bourgeois and Leonardo da Vinci, the children will create their own sculptures representing human figures.

In science, the activities will support the development of children's understanding of the main body parts associated with the skeleton and provide an opportunity for them to decide how to collect measurements and record and analyse their data. In art, the activities will help children to learn and apply their sculpture techniques using a range of materials.



A silhouette showing Leonardo da Vinci's "Vitruvian Man". Leonardo has depicted the figure with 4 arms and 4 legs, so that 16 poses can be achieved simultaneously. His notes accompanying this work tell us that, according to Vitruvius, the length of a person's outspread arms is equal to their height.

An "Elongated Figure" in the style of Alberto Giacometti, created by one of the project schools.

Learning outcomes

CONCEPTUAL UNDERSTANDING IN SCIENCE

The children will develop ideas about:

- How skeletons are used for support, protection and movement in humans and some other animals

ARTISTS AND THEIR WORK

The children will create their own work taking inspiration from the work of:

- Alberto Giacometti
- Chris Ofili
- Louise Bourgeois
- Leonardo da Vinci

KEY WORDS SCIENCE

endoskeleton
vertebrate
joints
humerus
femur
muscles
tendons
skeleton
bones
support
protect
move
spine
ribs

SCIENCE ENQUIRY

These activities provide opportunities for:

- Choosing appropriate ways to measure arm span and height accurately in centimetres
- Choosing suitable ways to record data
- Using results and scientific language to draw conclusions about patterns that are discovered
- Suggesting ways of improving investigations

TECHNIQUES IN ART

The children will develop and apply skills in:

- Drawing techniques that capture movement
- Planning sculptures using a range of malleable materials
- Finishing sculptures in different ways, such as polishing or painting

Resources

SCIENCE

- Measuring tapes
- Metre rulers
- Rulers of different lengths
- String
- Floor space and wall space
- Books and pens for marking distances (or the playground and chalks could be used)

ART

Project 1 – creates more lightweight sculptures using clean, less expensive materials

- Wire/pipe cleaners
- Foil
- Thick card to act as a base
- Black paint spray or bronze-coloured acrylic paint or shoe polish
- Plasticine/glue gun for attaching to the base

Project 2 – creates more solid and durable sculptures and allows for experimentation with plaster

- Modroc Plaster of Paris bandage
- Piece of wood with holes drilled into it by an adult, or air drying clay for the base
- Black and silver acrylic paint
- Charcoal or shoe polish
- Optional decoration for the base: papier mâché, sand, twigs

KEY WORDS ART

form
malleable
rigid
elongated
proportion
balance
movement

Part 1: Science investigation – is your arm span greater or smaller than your height?

At the start of this activity, children look at a variety of images including "The Vitruvian Man" by Leonardo da Vinci, "No Woman No Cry" by Chris Ofili and "Walking Man" by Alberto Giacometti, along with photographs of vertebrate animals including humans, chimpanzees and dinosaurs. The children then need to take measurements of height and arm span to find out the answer to their questions, including whether their height is greater than the distance between their outstretched arms (fingertip to fingertip), or the other way round, or are they equal?

Questions to support this activity can include:

Which is greater, your arm span or your height?

Does everyone's arm span and height fit the same pattern?

Have you found a pattern? Is this the same in adults and children?

Are you a chimpanzee or a T.Rex?

This investigation is a good opportunity to let the children choose the most appropriate equipment to use, and to think about the best way to record their data, although they may encounter challenges with measuring longer distances with subjects that might move!

It can be useful to demonstrate how the measurements of height and arm span could be taken and to give some tips about avoiding common mistakes. Some key points to note are:

- The children may need help to measure height. One way of doing this is to ask a child to lie on the floor and to mark where the top of the head and the soles of the feet are and then measure the distance between them once the child has moved.
- It can be problematic to measure arm span, as children can find it hard to keep their arms outstretched. Marking the distance lying on the floor when arms are outstretched, between the tips of the longest finger of each hand, and then measuring the distance between them once the child has moved away, is easier than doing this standing up, but does require lots of floor space. A wall could also be used, or this task could be carried out in a playground using chalks as markers. The National Physical Laboratory has a useful video showing the pitfalls involved when trying to find out if someone is taller or wider (see Useful links).
- This investigation is good for supporting children to recognise anomalous results, the need to repeat their readings and the importance of choosing the correct equipment for measuring.

RECORDING AND PRESENTING RESULTS

Encourage the children to record in a table the height and arm span of each person that they measure. They need to think about the units that they are using (all measurements in centimetres might be a sensible choice for ease of comparison) and they might like to have a way of indicating the answer to their questions that the data suggest. Some children may benefit from being provided with table outlines or pre-prepared tables, e.g.:

Name of child	Height in cm	Arm span in cm	Height is greater (rectangle)	Arm span is greater (rectangle)	Height = arm span (square)

Image of a T. Rex and a chimpanzee to show the different body proportions of different vertebrates.

Part 2: Techniques in art – capturing movement

Alberto Giacometti's famous sculptures are very simple, with the details stripped away. He believed that, by making the figures thin and without detail, he could show their innermost feelings. Children could look at photographs of some of his sculptures, and also some of Louise Bourgeois' later works, and decide whether they think that they are portraying confident, shy, quiet, or nervous personalities. Using their findings about the proportions of the human body, they should use pencil and paper to complete quick life drawing sketches.

KEY TECHNIQUES TO TRY:

- Look carefully at a friend, who could be standing still, in a pose or in a balance.
- Quickly sketch a series of 4 stick drawings of them in different poses.
- Remember to elongate the figure as Giacometti did, making the neck, legs and arms longer than they appear in real life.
- Try to capture movement by drawing the subject in different slanted or curved positions.

The children then need to analyse the different sketches to see how well a feeling of movement has been captured.

This is an ideal opportunity to carry out some activities to check that the children understand how bones and muscles are involved in movement. A simple model can be used to demonstrate the role of bones, muscles and tendons, and simulations can be used to check understanding (see Useful links for how to model the role of muscles and bones). The children can think about the poses that they have chosen and explain how their muscles helped their bones move into each balance position.

"Maman" (2002) by Louise Bourgeois.

"Walking Man II" (1960) by Alberto Giacometti.

Part 3: Elongated figure sculptures

WHAT THE CHILDREN DO

Project 1

1. Use the preliminary sketches and each other as models to bend wire into a shape that represents a human figure. Sculptures in the style of Giacometti or Bourgeois can be created by moving the wire or pipe cleaners until they form the desired elongated shape and pose.
2. Cover the wire structures with foil and attach a small piece of plasticine at the feet to keep them upright (alternatively, an adult could use a glue gun to attach the feet to a base of thick card).
3. Check that the figure balances and adjust as necessary.
4. The figures can be sprayed with black paint and/or dry brushed with bronze-coloured acrylic paint to "age" them if desired.

Project 2

1. Use the preliminary sketches and each other as models to bend wire into a shape that represents a human figure. Sculptures in the style of Giacometti or Bourgeois can be created by moving the wire or pipe cleaners until they form the desired elongated shape and pose.
2. Take the wooden base with pre-drilled holes and insert the long legs and feet of the wire structure into the holes. An adult should use a glue gun to secure the legs. Make sure that the finished wire shape of the figure is as intended.
3. Use strips of Modroc Plaster of Paris bandage quickly dipped into water to wrap around the wire, starting at the base and moving slowly upwards towards the upper body and extremities.
4. Reflect on the weight of the sculpture and, depending on the position of balance, lighten the arms or torso if needed.
5. Add texture to the base using papier mâché, small twigs, sand and PVA glue if desired.
6. Leave the sculpture to set for 2 days before painting with silver/bronze acrylic paint (patina can also be added to the sculpture using black charcoal or shoe polish).

An "Elongated Figure" in the style of Alberto Giacometti, created by a one of the project schools.

SUPPORTING INFORMATION

BACKGROUND SCIENCE

Animals that have a backbone (spine) within their bodies are called vertebrates. Examples of vertebrates are fish, mammals, reptiles, birds and amphibians. The human skeleton is inside our body (an endoskeleton) and is made of bones that are connected together with ligaments. Our skeleton allows us to grow bigger, provides protection for the organs inside us, strengthens and supports our body, and enables it to move in a range of different ways. We have joints where our bones meet, and muscles are attached to our bones by tendons. The muscles can change shape, which causes the bones to move. If a muscle contracts, it will get shorter and pull on the bone attached to it. If the muscle relaxes, it goes back to its original size and the bone moves back to where it was. We are able to move because of muscles contracting and relaxing.

INSPIRATIONAL ARTISTS

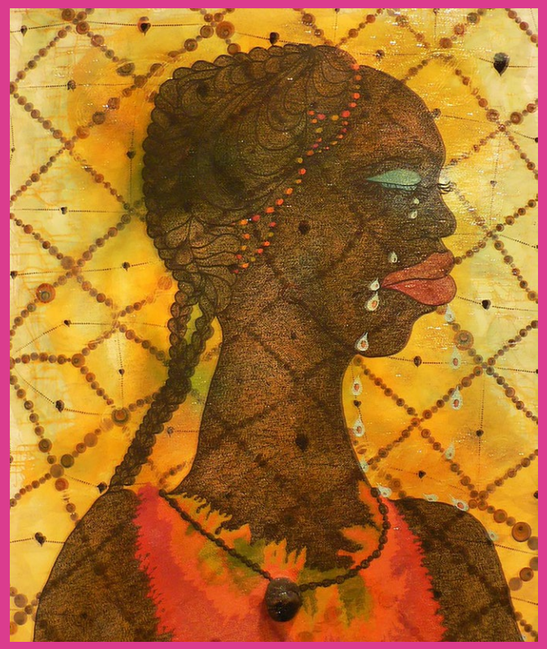
ALBERTO GIACOMETTI (1901 – 1966)

Alberto Giacometti was a Swiss artist most famous for his sculptures. He is also known for his painting, draughting and printmaking. His elongated sculptures represent human and animal bodies in their most fragile forms.

More about Alberto Giacometti and his work.

CHRIS OFILI (BORN 1968)

Chris Ofili was born in the UK and is of Nigerian descent. He is often classified as a punk artist and is famous for using elephant dung in his work. His work is varied and he is included here because his mixed media piece '**No woman, No Cry**' illustrates the effect of elongating a subject's features.



"No Woman, No Cry" (1998) by Chris Ofili.

No Woman, No Cry can also be viewed here.

More about Chris Ofili and his work.

LOUISE BOURGEOIS (1911 – 2010)

Louise Bourgeois was a French-American artist best known for her large-scale sculptures, although she was also a printmaker and painter. In the late 1990s, she started using the spider as a motif for much of her art. Her largest spider sculpture, "Maman", is over 9 m high and is named as a tribute to the strength of her own mother. Her other works often have darker meanings, so teachers should check carefully before sharing anything other than "**Maman**" with children.

More about Louise Bourgeois and her work.

LEONARDO DA VINCI (1452 – 1519)

Leonardo da Vinci was born in Vinci, a small town in the north of Italy. He is regarded as one of the greatest artists in history. Leonardo excelled in many areas, including drawing, painting, engineering, architecture and sculpture. His interest in the human body, muscles and proportions revolutionised the way in which future artists visualised and rendered human forms.

More about Leonardo and his work.

USEFUL LINKS

- NPL Measurement at Home
- BBC Teach – How do our muscles and bones work?

EXPLORIFY ACTIVITIES

- Funny bones
- Broken bone

START WITH ART EXPLORIFY ACTIVITIES

- Human proportions and movement

Not Junk but Art

In this project children will learn more about plastics and the differences in their properties and create sculptures using recycled materials. In science, the activities will support the development of the children's understanding of properties such as density, flexibility and hardness, and they will have the opportunity to use and make classification keys to group and identify different plastics. In art, the activities will help children to practise their collage techniques and experiment with their use of different materials and tools.

A piece of mixed media wall art created in one of the project schools, using plastic bottles and other plastic recycling.

Learning outcomes

CONCEPTUAL UNDERSTANDING IN SCIENCE

The children will develop ideas about:

- The properties of plastic and its different uses due to these properties
- The problems caused by plastic pollution
- Ways to reduce, reuse and recycle plastic

ARTISTS AND THEIR WORK

The children will create their own work taking inspiration from the work of:

- Katsushika Hokusai
- Aurora Robson

KEY WORDS SCIENCE

environment
pollution
decompose
biodegradable
non-biodegradable
plastic
synthetic
rubbish
recycle
density
classify
identify
transparent
translucent
opaque

SCIENCE ENQUIRY

These activities provide opportunities for:

- Setting up comparative tests
- Considering variables in an investigation
- Making careful observations
- Constructing and interpreting classification keys

TECHNIQUES IN ART

The children will develop and apply skills in:

- Drawing techniques that capture the movement of waves
- Planning and creating collages using recycled materials
- Using tools such as scissors and glue (and, if possible, glue guns with supervision)

Resources

SCIENCE

- Variety of clear, colourless, and white and blue plastic recycled items
- Containers such as bowls to test if the plastic samples float or sink in water
- Magnifying lenses

ART

- Copies of "The Great Wave off Kanagawa" by Hokusai
- Large piece of cardboard for the base (the side of a cardboard box would be ideal)
- Variety of clear, colourless, and white and blue plastic recycled items (including plastic packaging such as polystyrene and bubble wrap)
- PVA glue (or glue guns if available and used with supervision)
- White and blue paint
- Black, blue and green felt pens
- Paintbrushes

KEY WORDS ART

malleable
rigid
flexible
movement
shape
form
outline
line
space
volume
3-dimensional

Part 1: Science Investigation – identifying and classifying plastics

WHAT THE CHILDREN DO:

1. Prior to the science lesson, children will need to bring in a variety of plastic objects that would be recycled. They need to collect a range of different items, ideally made from different types of plastic. Good items to bring include shampoo bottles, margarine tubs, plastic ballpoint pens, plastic bottles, plastic disposable cutlery, squeezy tubes, carrier bags, plastic packaging, bottle tops, plastic water bottles, plastic milk bottles, yoghurt pots, plastic straws and bubble wrap.
2. Sort the plastic objects into two groups using any property, e.g. colour, function, type of plastic, hardness, flexibility – encourage the children to choose their own criteria. Sorting the objects using hoops works well, or the children could draw a Venn diagram.
3. Explore specific properties of the plastic items. First, test them to see whether they float in water, recording results in a table.
4. Next, test the plastic samples to see whether they are rigid or flexible, recording results in a table.
5. Record any other observations, such as the recycling number if there is one, whether the plastic is waterproof, strong, opaque or transparent. The table in the supporting information can be used to give the children further information and the name of the plastic.
6. Make a yes/no key to sort the plastic. Questions that could be asked include:

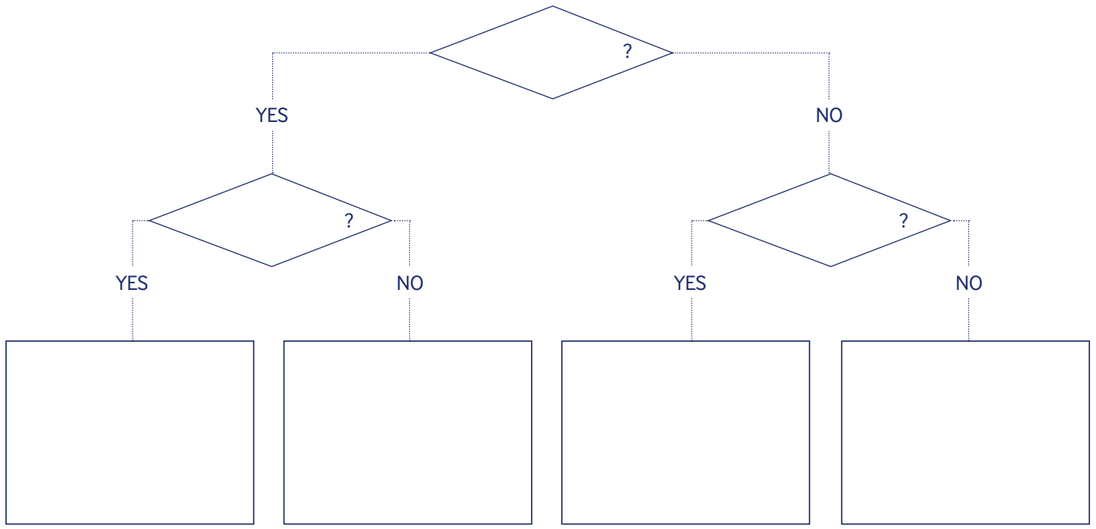
Does the plastic float?

Will the plastic bend easily?

Are there any white marks when you try to cut it?

RECORDING AND PRESENTING RESULTS

Encourage children to record their test results in a table. Hoops or Venn diagrams can be used for sorting the plastics.
An outline of a sorting key could be provided:



Iberian Lynx sculpture made from plastic waste by street artist Bordalo II in 2019 and put on display in Lisbon to raise the profile of plastic pollution and the problems that it causes.

Part 2: Close study of "The Great Wave off Kanagawa" (1830 – 1832) by Katsushika Hokusai

WHAT THE CHILDREN DO:

1. Study the painting carefully. Ask the children questions about the painting, such as:

What do you think that the marking in the left-hand corner is for?

What is about to happen?

Why are the people out in the boats in such poor weather conditions?

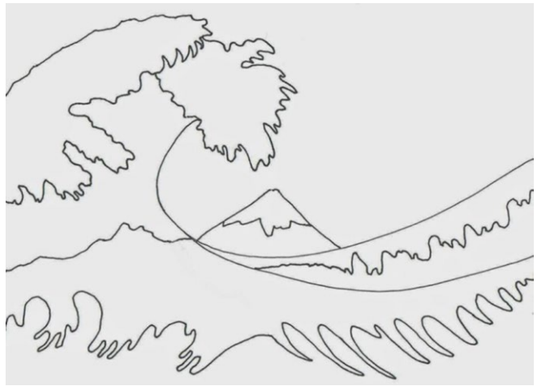
What does the shape of the smaller wave remind you of?

What is at the centre of the painting?

How has the artist captured the movement of the waves?

There is a similar image created by Michael Foreman on the cover of the book Kensuke's Kingdom by Michael Morpurgo, which can also be a useful reference and might also already be familiar to the children.

2. Study the painting and use pencil to sketch an outline of the Great Wave. Practise copying the outline carefully,



A careful copy of the Great Wave.

"The Great Wave off Kanagawa" (1830 – 1832) by Katsushika Hokusai.

Part 3: Plastic wave sculptures

WHAT THE CHILDREN DO

1. Prior to the art lesson, make a collection of a variety of items from recycling to use in this art activity. Encourage the children to bring in as many as they can, and support this with collecting items from within school, or from other staff. Ideally, the collection will include transparent and translucent items, and white and blue opaque items. Good items to bring in include bottle tops, plastic water bottles, plastic milk bottles, yoghurt pots, plastic straws, denim fabric, white cloth, blue cloth, bubble wrap, blue or white packaging materials, blue or white plastic carrier bags.
2. A piece of cardboard box will be used as the base. Copy an outline of the Great Wave carefully onto the cardboard.
3. Use blue paint to colour in the base of the waves.
4. Use black felt pens, or another shade of blue paint, to add lines to the waves to accentuate their movement.
5. Add volume to the waves by adding crinkled, gathered sheets of plastic and small plastic items, such as bottle tops, and gluing them on with PVA glue, once they are happy with the position (under close supervision, glue guns could also be used).
6. Carefully cut out some parts of plastic bottles to give different shaped pieces.
7. Ensure that all parts of the Great Wave are attached firmly.
8. Add splatters of white paint, or use felt tip pen colour, to add more movement to the wave and accentuate the "foam" effect.
9. Recycled objects could also be used to create a large wall display, with the children working collaboratively.

A Great Wave 3-dimensional collage created by one of the project schools.

"Ona" (2018) by Aurora Robson, at the Jordan Schnitzer Museum of Art, University of Oregon.

SUPPORTING INFORMATION

BACKGROUND SCIENCE

Plastic pollution is a growing worldwide problem, with single-use plastic rubbish in landfill sites and oceans taking a very large number of years to decompose (a plastic bag might take 20 years to decompose, and some plastic bottles might take 450 years). Plastic rubbish can harm wildlife and microplastics can make their way into food chains, creating health concerns for animals (including humans) that might ingest them. Plastic is made from fossil fuels, such as oil or natural gas, which are found underground, and the extraction of this raw material causes additional environmental and sustainability issues. To tackle the plastic pollution problem, initiatives in communities such as schools aim to reduce, reuse and recycle. Plastic has many useful properties, which has meant that it has been used in the past for many objects and, to reduce plastic usage, alternative materials need to be found. There are many types of plastic and some of these are cheap to make, flexible, strong, lightweight, waterproof and can be moulded into specific shapes. Some plastics will float on water and some will sink, depending on their density. Some plastics are flexible and some are rigid, some are hard-wearing, and some will withstand high temperatures. They are often chosen as the material to make objects, because there is such a wide range of types of plastic offering very varied properties. There is a recycling symbol on most plastics, which helps to identify the type of plastic it is.

Example of a recycling number found on many types of plastics.

INSPIRATIONAL ARTISTS

AURORA ROBSON

Aurora Robson (born 1972) is a multi-media artist who founded "Project Vortex", a group of artists who carry out environmental clean-up efforts and use the collected plastic debris in their artwork. The proceeds from selling the amazing sculptures are then donated to organisations that remove plastic pollution from water sources.

More about Aurora Robson and her work

KATSUSHIKA HOKUSAI

Katsushika Hokusai (1760-1849) was a very highly regarded Japanese artist who was famous for his **woodblock prints**. He also liked to paint pictures of the sea and often gave elaborate public performances of his experimental art. In "The Great Wave off Kanagawa", Mount Fuji, the highest mountain in Japan, is visible in the background. The towering wave is about to crash into three tiny boats filled with fishermen, showing the brutal power of the sea. The smaller wave is the shape of Mount Fuji and the larger wave shows powerful movement, with a menacing, claw-like shape overpowering the boats. The signature of Japanese characters is visible in the left-hand corner; this is how Hokusai signed his work.

More about Katsushika Hokusai and his work

Name of plastic	Shortened name of plastic	Flexibility?	Does it float on water?	Recycling number
Polythene	PET	Flexible	Floats	1
High density polythene	HDPE	Rigid	Floats	2
Polyvinyl chloride (thick)	PVC	Snaps when bent	Sinks	3
Polyvinyl chloride (thin)	PVC	Creases with white stress lines	Sinks	3
Low density polythene	LDPE	Flexible	Floats	4
Polypropylene	PP	Rigid – cutting makes white stress marks	Floats	5
Polystyrene	-	Creases with white stress lines	Sinks (floats in salty water)	6
Expanded polystyrene	-	Snaps when bent	Floats	6

Image taken from PSTT's See Through Science "The Environment".

USEFUL LINKS

- Practical Action Plastics Challenge
- Plastics Playtime from the Centre for Industry Education Collaboration
- Primary Science Teaching Trust – See Through Science 'The Environment'

EXPLORIFY ACTIVITIES

- Imagining life without plastic
- Sorting Toys
- Closer look at plastic

START WITH ART EXPLORIFY ACTIVITIES

- Throwaway plastic

Feltscapes

In this project children will learn more about the properties and uses of felt and how to change sheep's wool into felt. In science, the activities will support the development of children's understanding of reversible and irreversible changes. In art, the activities will help children to learn and apply the technique of wet felting, taking inspiration from contemporary textile artists such as Moy Mackay and traditional Iranian felt-makers.

Samples of "half-felt" made by children, ready to use in their feltscapes.

Learning outcomes

CONCEPTUAL UNDERSTANDING IN SCIENCE

The children will develop ideas about:

- The reasons for using felt for different purposes based on its properties
- Changes that result in the formation of a new material and which are difficult to reverse

ARTISTS AND THEIR WORK

The children will create their own work taking inspiration from the work of:

- Moy Mackay
- Iranian rug-makers
- Other contemporary textile artists

KEY WORDS SCIENCE

irreversible change
reversible change
fibres
property
material
object
use
agitation

SCIENCE ENQUIRY

These activities provide opportunities for:

- Researching and discussing the history of felt-making around the world and the benefits of using felt for a variety of uses

TECHNIQUES IN ART

The children will develop and apply skills in:

- Experimenting with techniques involved in making a new material and creatively using different materials to create colour and texture

Resources

SCIENCE

- Magnifying lenses and/or microscopes
- Access to computers and/or a variety of dictionaries, encyclopaedias and books for research
- Small pieces of old towel
- Square pieces of bubble wrap
- Bamboo mats (sushi mats are ideal) or rolling pins can be used instead
- Wool rovings (white and different colours)
- Washing up liquid
- Scraps of bubble wrap
- Bowls for hot soapy water
- Pieces of old netting
- Vinegar (optional)

ART

- Wool rovings
- Different colours of wool
- Different colours of threads
- Scraps of old material
- Felt or half-felt created in the first part of this project

KEY WORDS ART

texture
tone
colour
threads
wet felting
textile
wool roving

Part 1: Science investigation – researching information about felt

Ask children to use their research skills to find out as much as they can about felt. Photographs of where felt is used, e.g. hats, robes or the linings of musical instrument cases, could be used as stimuli. This **website** and this set of **resources** give helpful advice about supporting children to do their own online research and to evaluate the usefulness and reliability of sources.

To help develop their research skills, make sure that the children are encouraged to:

- Ask lots of open questions using the key words;
- Use a variety of sources such as encyclopaedias, websites, interviewing teachers or family members, looking at art, using dictionaries;
- Record the information they find out; this could be in a table, or as annotated drawings, or as notes about the answers to the key questions;
- Evaluate what they find out, and consider particularly how they know if the information is likely to be correct; and
- Record where they found their information – a whole class approach (e.g. using **Padlet**) might be useful for this.

Examples of questions that children might ask to get started with research:

- How long have people been making felt?
- Which cultures traditionally use felt to make textiles and rugs?
- What properties does felt have?
- How do the properties of felt compare to those of other fabrics?
- What is felt used for?
- Is felt environmentally friendly?

After their initial research about felt-making, the children might think of additional questions that they would like to ask, for example:

- Why do the layers of wool fibres need to be placed in opposite directions?
- Why do we use water?
- Why do we use soap?
- Why is hot water used and not cold?
- Why do you need to rub the felt?
- Why do we use vinegar?

RECORDING AND PRESENTING RESULTS

Example of how a project school presented their research facts.

This guitar case has a felt lining.

It is important to teach children how to carry out research, rather than to just expect them to be able to go and find information. Once they have thought about questions that they would like to ask, it is helpful to discuss how to find a variety of useful sources of information. When typing key words into a search engine, it is vital to use words that will provide useful information. If children simply type in "felt", many options of places to buy different colours of felt fabric will appear, rather than information about uses, properties or history. This provides an excellent illustration of the importance of the most useful key words. Using search engines specially for children, such as **Kiddle**, with search terms such as "uses of felt" and "felt facts", will yield more useful information. It is also important to allow time to discuss with the children how they know they can trust the source of information and, when they find contradictory information, how they might decide which source is correct.

This guitar case has a felt lining.

Making a felt robe for Bakhtiari shepherds, Shahr-e-Kord, Iran.

Iranian felt rug design.

Part 2: Science investigation – how can we change the properties of sheep's wool by making felt?

The instructions for making felt might seem complicated initially, but it is useful to remember that the main method involves the same technique as shrinking a delicate woollen jumper if washed on the wrong cycle in the washing machine. To make felt from wool, this situation needs to be re-created, with lots of hot water, soap and agitation!

How to start to make felt – place bubble wrap on top of a towel and start to build up layers of thin pieces of wool roving.

WHAT THE CHILDREN DO:

1. Start by laying a piece of old towel on the table. Cover this with a bamboo mat if available (if not, the towel on its own will be fine) and a square piece of bubble wrap, and start to lay out a layer of wool roving on the top.
2. Pull the wool very gently from the wool roving shank. It is a good idea to let the children look at the fibres of the wool with a hand lens, or a microscope, at this stage before the fibres are changed by the felt-making process.
3. Add another thin layer of wool, but at right angles to the first layer. Then add another layer, so that there are 3 or 4 layers, firstly a horizontal layer, then a vertical layer, another horizontal layer and preferably another vertical layer on top of that. Small scraps of wool rovings in other colours can be added to any of the layers.
4. Cover the wool roving layers with a piece of net and sprinkle hot soapy water on the top. Using a scrap of bubble wrap, start to work hot soapy water into the wool layers, gently at first so as to not disrupt the layering, but making sure that the wool gets hot, wet and soapy.
5. Carefully peel off the netting and turn the felt over. Repeat the process, applying lots of agitation, heat, soap and water. Remove the netting to turn the felt often, turning the felt over and around so that all fibres are "wet felted". This may take up to 20 minutes.
6. The felt then needs to be rolled to give the fibres further agitation. This can be done by rolling up the sushi mat, or with a rolling pin. At least 30 rolls will be needed. If the felt hasn't been agitated enough, or the water wasn't hot or soapy enough, then "half-felt" will be formed. This can be used to make feltscapes in the same way as felt. It would be interesting to look at the fibres of the half-felt under a microscope and compare them with wool fibres and fabric that have been fully felted.
7. Once the felt has shrunk and is more robust, the excess soapy water should be squeezed out. Rinse the felt with water by submerging it in clean water and squeezing the water to remove the soap.
8. The rinsing process can be repeated with a bowl of vinegar water to ensure that all traces of soap are removed.
9. A final rinse in clean water is a good idea, squeezing thoroughly to get rid of excess water.
10. The felt can then be dried on a rack or a washing line. Once dry, encourage children to look at the fibres with a microscope and compare them to the fibres of wool roving.

Layer 3-4 layers of wool, alternating horizontal and vertical layers and adding small pieces of coloured wool to make a "mat" of wool.

Scrub the wool layer carefully through a piece of net with hot, soapy water, turning frequently.

Use a bamboo mat or a rolling pin to roll felt, turning the felt frequently. The felt should shrink dramatically!

Piece of felted art from a project school, inspired by landscapes by Henri Rousseau, and the book *Running Wild* by Michael Morpurgo.

Part 3: Making felt landscapes or ‘feltscapes’

WHAT THE CHILDREN DO

1. Once the children have made their felt or half-felt samples, and these have dried, they can use them to create felt landscapes.
2. Cut up pieces of felt or half-felt ready to use in a felt landscape.
3. Use wool rovings as a base layer, laying down 3-4 layers, alternating vertical and horizontal layers as before.
4. Add pieces of the felt that have been made, along with thread, wool and fabric, to make the desired landscape scene.
5. Lay a piece of netting over the top of the scene and carefully carry out the felt-making process previously used to make the pieces of felt (starting from step 4).
6. Hang the feltscape up to dry and display. The children might decide to join their feltscapes together to make one big artwork.

USEFUL LINKS

- Information about felt
- British Felt

EXPLORIFY ACTIVITIES

- Drying fabrics

SUPPORTING INFORMATION

BACKGROUND SCIENCE

Felt is a very useful material that can be made from wool (usually sheep’s wool) through a process called wet felting. The fibres of wool have very small hooks, which can only be seen with a microscope, and these hooks interlock during the rubbing and rolling with hot water and soap that wet felting involves. Once the woollen fibres are interlocked and matted together, the resulting felt fabric is tough and strong and can be used for many purposes due to its properties. Felt absorbs sound and so can be used in music studios or instruments to reduce noise. It is also a good insulator and is durable and flexible, so can be used for hats, slippers or other clothing. Felt has been used for thousands of years, since shepherds used it to make their tents, blankets and slippers. It was even used by Ancient Romans for clothing and armour, due to its wide range of useful properties. Felt is still used today for many purposes and can be made in an environmentally friendly way, without using machinery.

INSPIRATIONAL ARTISTS

MOY MACKAY (BORN 1966)

Moy Mackay is a Scottish contemporary textile artist who was born in 1966. Her felt paintings use wool roving, silk and merino wool to add texture and depth of colour.

- More about Moy Mackay and her work
- Other contemporary artists who work with felt
- Traditional Iranian felt-making

Liquid Art

In this project children will learn more about the properties of liquids and create large-scale liquid artworks using paint of different viscosities. In science, the activities will support the children's understanding of viscosity, water resistance and gravity. In art, the activities will help children to learn and apply drip painting techniques inspired by artists such as Jackson Pollock, Frank Bowling and Madhuri Bhaduri.

Example of large artwork created by one of the project schools, using pouring and dripping techniques.

Learning outcomes

CONCEPTUAL UNDERSTANDING IN SCIENCE

The children will develop ideas about:

- The properties of liquids
- The gravitational force that pulls objects down towards the Earth
- The water resistance (or frictional force) between an object and the liquid it is placed in, or a liquid and the surface of the slope it is flowing down

ARTISTS AND THEIR WORK

The children will create their own work taking inspiration from the work of:

- Jackson Pollock
- Frank Bowling
- Madhuri Bhaduri

KEY WORDS SCIENCE

viscosity
water resistance
gravity
average
anomalous
reliable
streamlined
liquid particles
friction
volume
flow
force

SCIENCE ENQUIRY

These activities provide opportunities for:

- Setting up comparative tests
- Considering variables in an investigation
- Making accurate measurements
- Recognising the need to repeat measurements
- Constructing and interpreting bar graphs

TECHNIQUES IN ART

The children will develop and apply skills in:

- Drip painting
- Large-scale action painting

Resources

SCIENCE

For investigation 1:

- 500 ml measuring cylinders X 5
- A variety of liquids to test, such as shampoo, vegetable oil, washing up liquid, bath foam and water (500 ml of each will be needed)
- Timers
- Plasticine ball with long thread securely attached X 5

For investigation 1:

- A large flat board or tray, or a thick smooth piece of cardboard
- Timers
- A variety of liquids to test, such as oil, washing up liquid, shampoo, ketchup, syrup, bath foam, water

ART

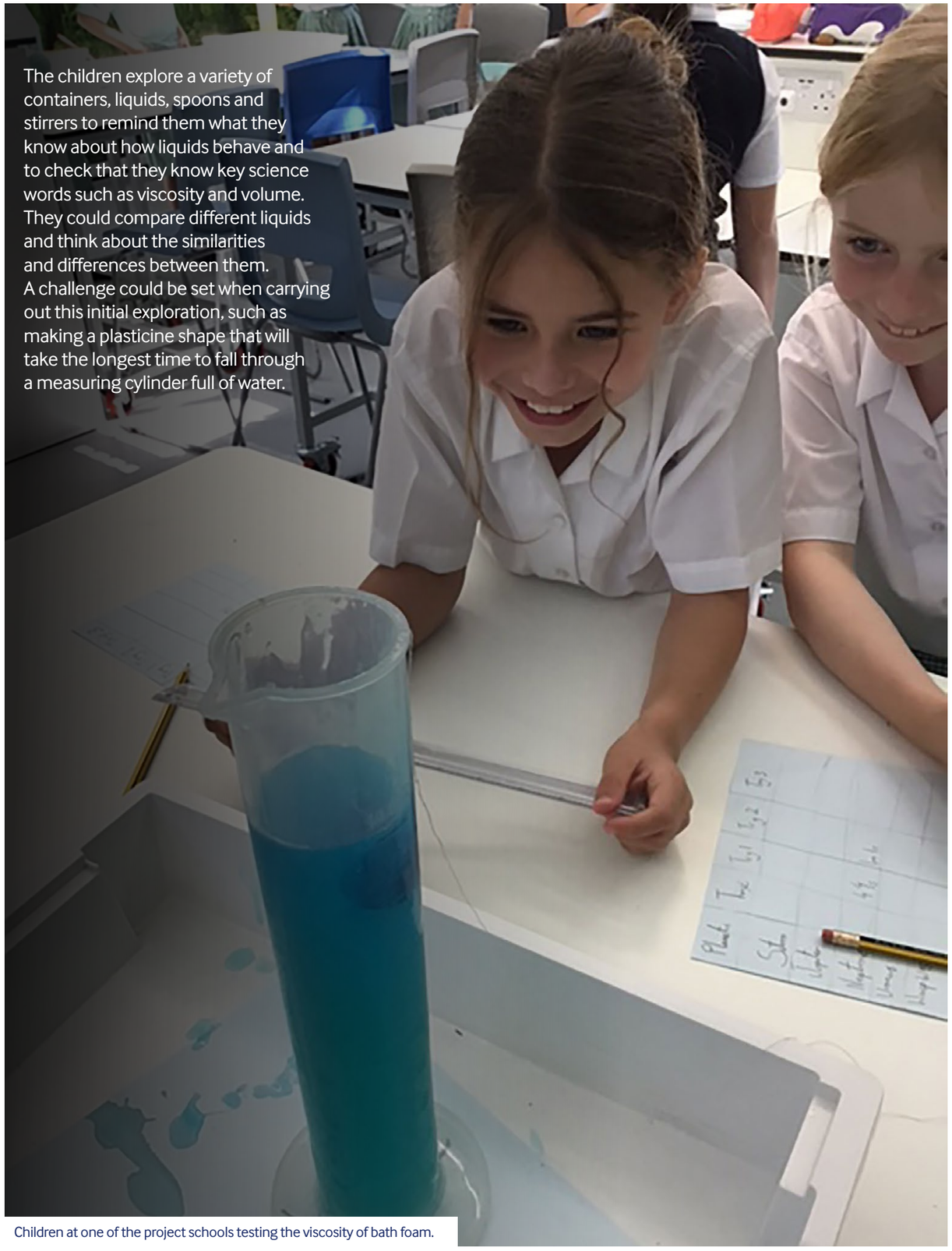
- Large paper (e.g. roll of craft paper or wallpaper)
- PVA glue
- Poster or acrylic paint in various colours (water and PVA will be mixed with the paint to change the viscosity)
- Sticks (hard paintbrushes or recycled wooden chopsticks could be used)
- Paintbrushes
- Newspapers to cover floor
- String
- Paper cups or recycled yoghurt pots

KEY WORDS ART

drizzle
pour
splat
drip
splash
abstract
fluid
viscous
movement
self-expression
pendulum

Part 1a: Science exploration

The children explore a variety of containers, liquids, spoons and stirrers to remind them what they know about how liquids behave and to check that they know key science words such as viscosity and volume. They could compare different liquids and think about the similarities and differences between them. A challenge could be set when carrying out this initial exploration, such as making a plasticine shape that will take the longest time to fall through a measuring cylinder full of water.



Children at one of the project schools testing the viscosity of bath foam.

Part 1b: Science investigation – which liquid is the most viscous?

INVESTIGATION 1: BALL DROP

Measuring cylinders filled with different liquids can be used for this test. Drop plasticine balls through the liquid and time how long the ball takes to reach the bottom to see how much the water resistance slows the fall of the ball due to gravity.

During this investigation, the children will encounter some of the challenges associated with setting up comparative tests. Some key points to note are:

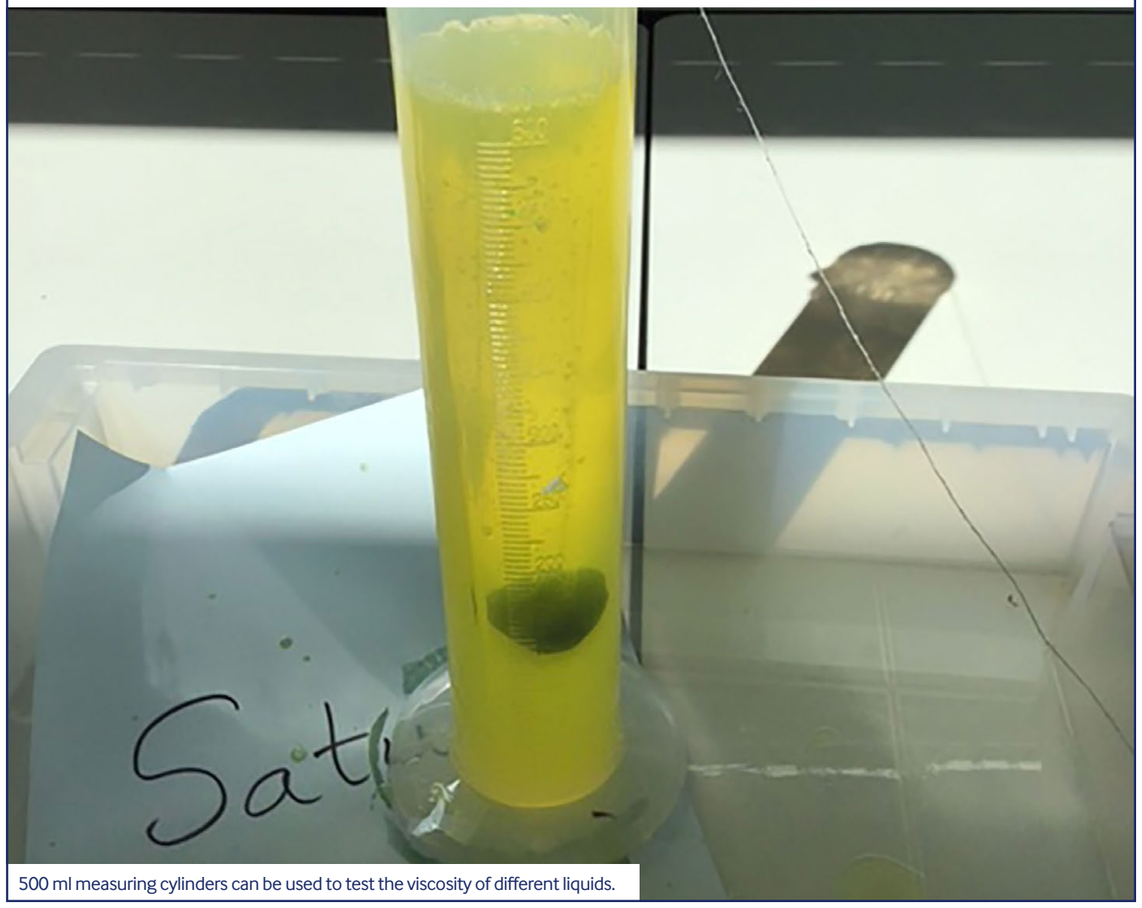
1. It is a good idea to prepare the plasticine balls ahead of the investigation. 50 g balls of plasticine can have some thread wrapped into them, leaving a long thread that can be used to pull each ball out of the cylinder after the test.
2. Carrying out a preliminary test using water in the measuring cylinders will help the children to make decisions about what they need to control, what they are changing, and what they will measure after dropping the ball.
3. This investigation is good for supporting children to recognise anomalous results and the need to repeat their readings to check if their test is reliable.

INVESTIGATION 2: LIQUID RUN

A board can be used as a "race track" to see which liquids will flow more quickly down a slope. A start line and a finish line can be drawn on the board, and liquids can be timed to see how long they take to flow between each line. It is a good idea to test the liquids one at a time.

During this investigation, the children will again encounter some of the challenges associated with setting up comparative tests. Some key points to note are:

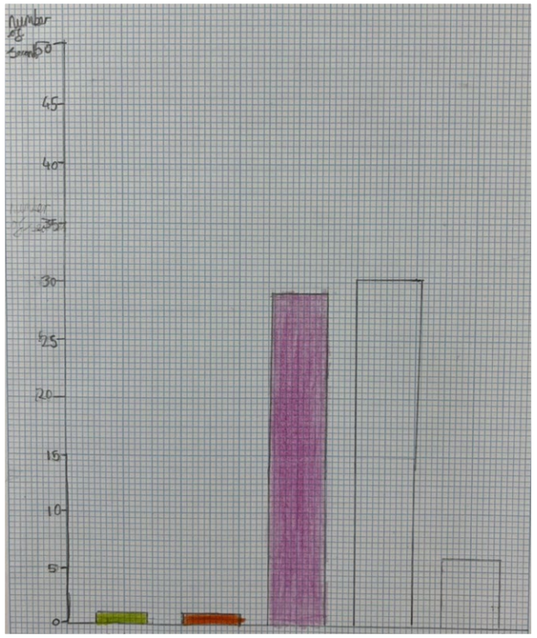
1. It is a good idea to put the test liquid in small pots ready to pour down the "race track".
2. Carrying out a demonstration or preliminary test with one of the liquids will help the children make decisions about what they need to control, what they are changing, and what they will measure.
3. This investigation is good for supporting children to recognise the challenges associated with controlling variables, such as keeping the angle of slope of the race track the same in each test.



500 ml measuring cylinders can be used to test the viscosity of different liquids.

RECORDING AND PRESENTING RESULTS

The children need to focus on thinking about the variable that they will be changing in their investigation (the liquid) and the variables that they will need to control such as the mass of the plasticine ball, the amount of liquid, when to start timing, when to stop timing and how to drop the ball. Pre-prepared tables could be used to record results, or children could make their own. Older children could think about how to ensure that their results are reliable by repeating the tests to check for any anomalous results. This investigation provides a useful opportunity for children to practise drawing bar graphs to present their results.



One of the children who carried out the "ball drop" investigation has drawn this graph. What needs to be added to it to make it easier to understand?

Liquid	Time for plasticine ball to fall (in seconds) 1st try	Time for plasticine ball to fall (in seconds) 2nd try	Time for plasticine ball to fall (in seconds) 3rd try	Average number of seconds for the plasticine ball to fall
Shampoo				
Oil				
Bath foam				
Water				
Washing up liquid				

Liquid	Time for liquid to run down slope (in seconds) 1st try	Time for liquid to run down slope (in seconds) 2nd try	Time for liquid to run down slope (in seconds) 3rd try	Average time for liquid to run down slope (in seconds)

Part 2: Poured paintings in the style of Jackson Pollock

WHAT THE CHILDREN DO:

1. Look carefully at some of the works of Jackson Pollock and Frank Bowling, who both 'poured' their paintings. Consider how viscous the paint used by each of them would have been in order to create the different effects that they present. It might also be interesting for the children to look at how some artists represent liquid in their art. While Madhuri Bhaduri does not pour her paintings, her work conveys many of the properties of liquids. Having studied the different pictures, focus on a work by Jackson Pollock and discuss in more detail how he created it, before the children create their own in his style.
2. The first step is to ensure that the paint is of an appropriate viscosity. Make a mixture of 50% PVA glue and 50% water, stir well and set aside. Choose colours in either poster or acrylic paint and then dilute them with the glue/water mixture that was set aside. The exact amount of the glue/water mixture needed is quite experimental, as the aim is to achieve a viscosity that will run, drip and pour at the right speed. The final paint mixture will probably need to be about half paint and half the glue/water mixture.
3. Protect the floor from paint splashes with newspaper or sheeting. This might be a good activity to do outside!
4. Place a large sheet of paper or plain fabric canvas flat on the floor. The back of old wallpaper could also be used.
5. Decide which technique to use. This could be 'drip painting', e.g. splatter, drip, splash, or drizzle. Sticks dipped in paint work well for these techniques, but make sure that clothing is protected and that the paint goes on the paper rather than elsewhere! Children can use their bodies to help express movement in their painting, by swinging their arms, flicking or making other movements; again, care is needed to contain any mess.
6. Another technique is to use a pendulum to drip the paint around. This could be made by putting a hole in the bottom of a paper cup, half-filling it with paint, taping over the hole at the bottom until ready, and then swinging it around over the paper. If this style of "pendulum art" is chosen, it would be a good idea to test the technique with some water before using the paint and paper. More information about this technique can be found in the Useful links section.
7. Pouring paint is another technique to try. This can be done by carefully pouring paint from a container such as a yoghurt pot onto the paper. If the paper being used is on a rigid base (like a piece of cardboard), it can be picked up and tipped from side to side to allow the paint to run across the painting to create specific patterns.
8. Experiment with the different techniques to achieve the desired effect.

These techniques could also be used by a group to create a really large piece of art, which could then be displayed in the school.

SUPPORTING INFORMATION

BACKGROUND SCIENCE

Properties of liquids include that they are able to flow, be poured and that they take the shape of whatever container they are put into whilst retaining the same volume. Viscosity is a measure of how easily a liquid will flow, or its thickness. The viscosity of a very viscous (thick) liquid such as custard will slow down objects when they move through it. It is a gravitational force that pulls objects down towards the Earth when they are placed in a liquid (or when liquids flow down a slope). It is the water resistance (or frictional force) between an object and the liquid that it is placed in that slows the objects down as they fall through the liquid. This is because there is friction between the surfaces of the particles in the liquid and the object. When a liquid flows down a slope, there are frictional forces between the slope surface and the liquid particles.

INSPIRATIONAL ARTISTS

JACKSON POLLOCK (1912 – 1956)

Jackson Pollock was a famous American painter, who painted abstract paintings. He worked on a very large scale, using the whole of his body to help him cover the canvas with paint. He invented "drip painting", where paint would be dripped, poured, splattered, drizzled or splashed onto a flat surface on the floor, using sticks or hard brushes that had been dipped into paint of various viscosities. This technique is also known as "action painting". To find out more about how to paint in the style of Jackson Pollock, please see the links below.

For an interactive exploration of how to create an online Jackson Pollock painting, teachers may like to look at **this website** and decide whether to use this with the children.

More about Jackson Pollock and his work.

MADHURI BHADURI (BORN 1958)

Madhuri Bhaduri is an Indian artist, who mostly works in oil paints, but she has experimented with other media and with sculptural pieces. She describes her painting as a way of understanding the complexities of emotions. Many of her works are poetic and feature water.

More about Madhuri Bhaduri and her work.

FRANK BOWLING (BORN 1934)

Frank Bowling was born in Guyana and moved to Britain at the age of sixteen. Bowling's early art consisted mostly of figure paintings, but later he increasingly worked in the abstract. He creates his very large works in vibrant colours and using techniques such as spilling, dripping and brushing, and he refers to these as "poured paintings".

"Texas Louise" (1971) by Frank Bowling.

More about Frank Bowling and his work.

USEFUL LINKS

How to paint like Jackson Pollock (The Museum of Modern Art)

Pendulum Painting from the OKIDO Blog

EXPLORIFY ACTIVITIES

Different liquids

Melting

START WITH ART EXPLORIFY ACTIVITIES

Water

"Convergence" (1952) by Jackson Pollock.

Shadows and Silhouettes

In this project children will have the opportunity to explore how shadows can be created and find out how the size and shape of the shadows can be altered. They will use what they have found out about shadows to create a silhouette self-portrait, analysing their work, suggesting improvements and looking at the works of other artists for inspiration. In science, the activities will support the children to explore relationships between variables. In art, the activities will help children to create a variety of tones using different thicknesses of pencils and fine liners.

Silhouette portrait created by a project school.

Learning outcomes

CONCEPTUAL UNDERSTANDING IN SCIENCE

The children will develop ideas about:

- Why shadows are formed
- How the size and shape of shadows can be altered

ARTISTS AND THEIR WORK

The children will create their own work taking inspiration from the work of:

- Tim Noble and Sue Webster
- Cornelia Parker
- Chinese shadow puppetry

KEY WORDS SCIENCE

light source
light
rays
opaque
shadow
block
transparent
translucent
direction
silhouette
rays
torch
lamp
torch

SCIENCE ENQUIRY

These activities provide opportunities for:

- Looking for relationships between variables
- Finding ways to make improvements
- Using scientific language and diagrams to communicate ideas

TECHNIQUES IN ART

The children will develop and apply skills in:

- Drawing from a model
- Using pencil and fine liners for drawing
- Making adaptations and refinements in response to peer feedback

Resources

SCIENCE

- Torches and/or lamps
- Variety of opaque, transparent and translucent materials, such as lollipop sticks, card, plasticine, bubble wrap and sticky tape

ART

- Large pieces of paper
- Masking tape or sticky tac to attach the large pieces of paper to the wall
- Chairs (though children can sit on the floor)
- Pencils
- Fine liners
- Black felt tip pens

KEY WORDS ART

line
silhouette
pattern
shape
pencil
fine
straight
curved
diagonal
vertical
horizontal
portrait
thin
thick

Part 1: Science investigation – how can the size and shape of a shadow be changed?

At the start of this investigation, children explore how they can create shadows using torches and a variety of objects made from different materials. They can try opaque, transparent and translucent materials and attempt to make large and small shadows of different shapes and shadows, with blurred and sharp edges. The art created by Cornelia Parker, or Tim Noble and Sue Webster, can be used for inspiration as well as other shadow art such as Attraction. The children might also like to find out more about the origins of Chinese shadow puppetry.

RECORDING AND PRESENTING RESULTS

Ask the children to explain how the shadow is formed, using diagrams and scientific words, and explain what needs to be changed to make the shadow a certain size and shape. This might take the form of a labelled diagram, a verbal explanation, or an animation. Objects can be used instead of people to make the shadows as they are much easier for keeping the shadows still!

Children from a project school made an animation to demonstrate their understanding of shadow formation.

Exploring different hand shapes to find out how the shape and size of shadows can be changed.

"Young lady and house" (c1800s) – Chinese shadow puppetry.

Part 2: Techniques in art – pencil line drawing

Once the children have developed an understanding of shadow formation, they need to work in groups of 3 to draw around their own shadows. This is the first step in creating their own silhouette self-portrait. They need to use their knowledge of shadow formation to create a shadow with a sharp outline, so that it is easy to draw around. Victorian silhouette portraits were very popular and captured the features and character of a person very well.

Stick a large piece of paper to a flat wall, so that one child can sit in front of it. Another child will need to shine the torch from the correct place so that a shadow of the seated child's head and neck falls against the paper. This works best in the semi-darkness. The third child then needs to draw quickly and carefully around the shadow to create a pencil outline of the seated child's profile. This is a challenging task and children will need to work together, giving each other advice and help, and taking time to practise. They then need to swap roles so that everyone has created their pencil outline.

Some children may need to have someone to hold their head still, as the best outlines are created with a very still head and a very still torch. Keeping their heads very still might be easier to achieve when sitting on the floor and hugging their knees. Other sources of light such as lamps or projector lights can be experimented with. To achieve a successful outline of the shadow, the children need to draw swiftly and confidently before their subject moves. The group will benefit by working well together to solve problems and by refining their techniques as they work.

It might be helpful to begin with a teacher demonstration to show how to carry out the task, pointing out possible problems and asking the children to think of improvements to the techniques.

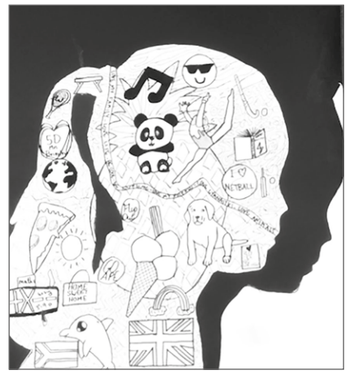
Children in a project school practising silhouette line drawing.

Part 3: Silhouette portraits

WHAT THE CHILDREN DO

1. Take the pencil outline that was created in the science activity, cut it out carefully and stick it onto black paper, playing with negative space and creating the reverse of the Victorian silhouettes.
2. Discuss how to use the self-portraits in a more modern way than the Victorian silhouette style, looking at a variety of possible lettering styles, logos and how repetition can be used.
3. Use fine liners to fill the outlines with patterns and lettering, showing their hopes, dreams and personalities.
4. Play with the outlines and with negative space by duplicating the outline to make a stronger image if desired.

A Victorian silhouette portrait.



Silhouette portraits created by children from a project school.

SUPPORTING INFORMATION

BACKGROUND SCIENCE

Light travels in straight lines and, when it reaches an object, some of it is absorbed and some is reflected. The reflected light is what enables us to see an object. Light can pass through some materials, e.g. glass or water and, where we can also see through the materials, we call them "transparent". Light can also pass through some materials that we cannot see through and we call these "translucent". Materials that light cannot pass through at all are called opaque. When light shines on an opaque object, a shadow will form behind it as the light is blocked from reaching this area. If light shines through a transparent object, there will be no shadow as the light travels through the material.

The shape, size and sharpness of the outline of a shadow vary according to where the object is in relation to the light source. If the object is moved closer to the light source, the shadow will get bigger and, if the object is moved further away from the light source, the shadow will get smaller. To create a shadow with a clear enough edge to draw around, attention needs to be paid to the position of the light source, experimenting with angle and distance. The light source also needs to be held very still.

USEFUL LINKS

- The shadow artists Attraction have appeared on UK television and their performances can be seen here
- Origins of Chinese shadow puppetry

EXPLORIFY ACTIVITIES

- Light and dark
- Moving shadows
- Shadows

START WITH ART EXPLORIFY ACTIVITIES

- Light and shadow

"Cold Dark Matter: an exploded view" (1991) by Cornelia Parker.

INSPIRATIONAL ARTISTS

TIM NOBLE (BORN 1966) AND SUE WEBSTER (BORN 1967)

Tim Noble and Sue Webster are British artists, who make selections of ordinary objects, recycling and even rubbish into 3D shapes. They then point light at the shapes to create shadows. Their shapes are constructed, and the lights positioned, to make the shadows into recognisable forms, e.g. portraits.

"Wild Mood Swings" (2009 – 2010) by Tim Noble and Sue Webster. NB: A better quality version of this image can be found on the artists' own website: **Artworks for Change**

More about Tim Noble and Sue Webster and their work.

CORNELIA PARKER (BORN 1956)

Cornelia Parker is a British artist best known for her sculpture and installation pieces. She also works with embroidery, photography and film. She is driven by her curiosity and likes to challenge viewers of her art to question their relationship with the material world.

More about Cornelia Parker and her work.

Space Craters

In this project children will learn more about the surfaces of planets and create representations of these by using watercolour and applying different effects. In science, the activities will support the development of children's understanding of the relative sizes and distances of the planets in our solar system. In art, the activities will help children to learn and apply techniques using watercolour.

Watercolour planets by a child in a project school.

Learning outcomes

CONCEPTUAL UNDERSTANDING IN SCIENCE

The children will develop ideas about:

- The relative sizes of planets and relative distances between planets in our solar system
- Some of the differences between the planets

ARTISTS AND THEIR WORK

The children will create their own work taking inspiration from the work of:

- Lucien Rudaux
- Wassily Kandinksy
- Pannaphan Yodmanee

KEY WORDS SCIENCE

solar system
orbit
Mercury
Venus
Mars
Jupiter
Saturn
Uranus
Neptune
moon
crater
planet
meteorite
meteor
force
diameter
circular

SCIENCE ENQUIRY

These activities provide opportunities for:

- Considering variables in an investigation
- Making accurate measurements
- Recognising the need to repeat measurements
- Constructing and interpreting line graphs

TECHNIQUES IN ART

The children will develop and apply skills in:

- How to use watercolour
- Application of different watercolour effects

Resources

SCIENCE

- Trays of flour or sand
- Powder paint or cocoa powder to sprinkle on top of the flour
- Marbles or pebbles or other spherical objects
- 30 cm and metre rulers

ART

- Watercolour paper (300 gsm watercolour cartridge paper works well)
- Watercolour paint
- Variety of brushes
- Pipettes
- Cling film
- Bubble wrap
- Paper towel or tissue (to dab excess paint)
- Salts (table and rock salt)
- Rice
- White acrylic paint
- Black paper or painted paper
- Chalk

KEY WORDS ART

watercolour
texture
colour
water
paper
absorb
splatter
pattern
dab
sweep
blend
pipette

Part 1a: Science investigation – meteorites

The children can simulate a meteorite hitting the surface of the Moon or the Earth by dropping a marble or other spherical object from different heights into a tray of sand or flour. This can be done as an open-ended exploration, where the children experiment with different sizes and types of marble and drop them from different heights, or as a fair test enquiry where they investigate the question:

How does the force with which the meteorite hits the surface affect the size of the crater formed?

The children can change the force with which the marble hits the sand/flour either by changing:

- the size of the marble (assuming that the marbles are made of the same material);
- the type of material (e.g. plastic, glass, metal) that the marble is made from; or
- the height from which the marble is dropped.

To support the children with measuring the craters formed, the sand or flour in the tray could be covered with a thin layer of cocoa powder or powder paint of a contrasting colour. This can be a messy activity, so might be best done outside.

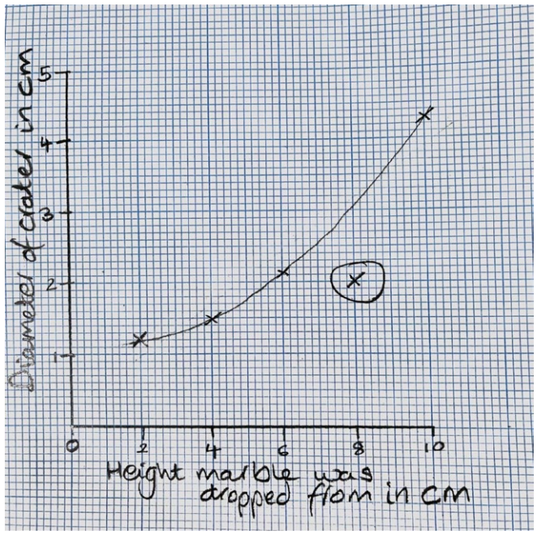
During the investigation, the children will encounter some of the challenges associated with setting up fair tests. Some key points to note are:

1. They may need help with how to measure the height from which the marble is going to be dropped, and how they will measure the diameter of the crater precisely. The layer of cocoa powder or powder paint is there to make this easier; when the marble hits the surface, the resulting crater will be in the exposed sand/flour, surrounded by a border of the cocoa/powder paint. Although it won't have a precise edge, the children can use this border as a reference point for measuring the diameter of their craters.
2. Carrying out a preliminary open-ended exploration will help the children to make decisions about what they need to control, what they are changing and how they will measure this, and what they will measure after dropping the marble.
3. This investigation is good for supporting children to recognise anomalous results and the need to repeat their readings.

RECORDING AND PRESENTING RESULTS

Ask the children to explain how the shadow is formed, using diagrams and scientific words, and explain what needs to be change

Height marble was dropped from (cm)	Diameter of crater (cm)
2	1.2
4	1.5
6	2.1
8	2.0
10	4.3



Graph to show how the diameter of the crater changes when the marble is dropped from different heights. Note that the circled X is identified as an anomalous result.

"Craters" made by marbles dropped into sand covered with a layer of brown powder paint. Covering the sand or flour in the tray with a thin layer of powder paint of a contrasting colour or of cocoa powder will support the children with measuring the craters formed. This can be a messy activity, so might be best done outside.

Children explore what happens when they change the size of the marble and the height of the drop.

Part 1b: Developing science knowledge about the solar system

The children should also carry out activities to check that they have a firm grasp of the key concepts about the solar system. Teachers should model an approximation of the relative sizes and distances involved using objects such as a large beach ball (Sun), a marble (Earth) and a poppy seed (Moon), with the beach ball at the centre of a large playground and the marble orbiting at the perimeter. In this model, the Moon (poppy seed) would be orbiting the Earth (marble) about 25 cm away from it.

Role play in the playground can be used to show children how the planets orbit the Sun, and how moons orbit planets. A useful approach is for the children to make animations or videoclips to show their understanding of the relative sizes and distances involved.

These excellent activities from the Ogden Trust help children to understand the vast dimensions involved.

Playdough Planets

Solar System in my Pocket

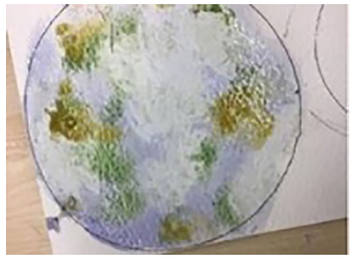
The children may find the development of a mnemonic useful in learning the order of the planets from the Sun, e.g. "My Very Easy Method Just Speeds Up Naming Planets". Some of the weblinks in the Supporting Information section would be useful sources of information for children to research the differences between the planets. Ask children to research planet facts in pairs and create Top Trump style cards, including such information as size, distance from the Sun, surface temperature, type of surface and how long the planet takes to rotate (spin) on its own axis.

"Several Circles" (1926) by Kandinsky.

Part 2: Techniques in art

The children should be given the opportunity to explore using watercolours and learn some different techniques of using watercolour to create particular effects. They should develop purpose and control when using the watercolours, cling film, bubble wrap, salts and rice. They can also contrast this with using acrylic paint. Patience and experimentation is the key with the different watercolour techniques. It is a good idea to test out the techniques first to find out which ones will be the most effective on a small piece of watercolour paper, which the children could then keep and use as a bookmark.

WHAT THE CHILDREN DO



1. Wet on wet:

- Make the surface of the paper wet with a brush and water.
- Carefully dab watercolour paint with a wet brush on chosen areas. The remaining water will run and bleed to create this effect.
- Add other paint colours to create an interesting effect, as the colours will run into each other.
- Be careful not to add too much water or too much paint colour.

2. Using cling film or bubble wrap to enhance the texture of the wet on wet effect:

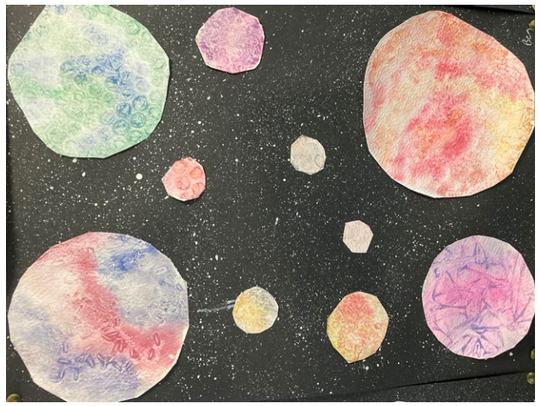
- Once paint colour has been added to the water on the paper, put a layer of cling film or bubble wrap on top. Crumple, wrinkle and press the cling film and press down on the bubble wrap, and move them over the surface to create a textured effect underneath. Let the cling film or bubble wrap dry completely before removing to reveal the effect.

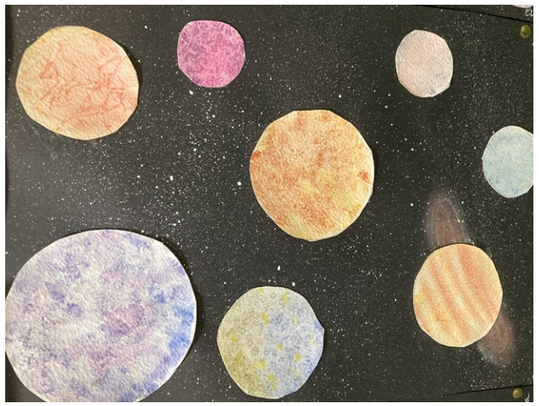
3. Using a pipette:

- Carefully paint a thin layer of watercolour paint onto the paper.
- Use a pipette to drop small amounts of water onto the paper whilst the paint is still wet.
- Leave to dry.

4.Using rice, rock salt or table salt:

- Either paint watercolour onto the paper, or paint on a layer of water and add dabs of paint (see the first technique: wet on wet).
- Place grains of rice or salt carefully onto the wet paint, making a pattern.
- Allow the paint to dry completely (the rice or salt will absorb some of the water).
- Once the paint is completely dry, shake off the rice or salt to reveal the texture created.





Part 3: Space crater watercolours

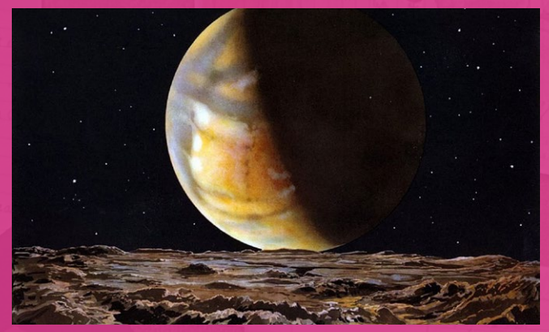
WHAT THE CHILDREN DO

1. Look at the work of some artists who have depicted space and planets in their work – for suggestions, see 'Inspirational Artists' in the Supporting Information section at the end.
2. Draw the outlines of lots of different planets on watercolour paper in varying sizes (this will give children some space for trial and error).
3. Use a variety of watercolour techniques to create different textures and effects to render the surface of the planets.
4. Choose colours carefully to create a mood for each planet. Warm colours can create a rocky or desert-like surface, while cool colours can suggest a watery or gaseous surface.
5. Look at each other's work in pairs and identify which planets their partner has chosen to represent. Discuss why they think this and what their partner has done to convey their understanding about the nature of particular planets.
6. Cut out their planets and arrange them in order from nearest to furthest from the Sun.
7. Choose their "best" planets and stick them on a piece of black paper or paper painted using black acrylic paint. This will help to create depth, contrast, and make the colours stand out. They can choose to stick them on to show the actual order of planets, or to make an interesting artistic composition.
8. Splatter white acrylic paint on the paper to create distant stars and planets (this could be done before sticking the planets onto the paper). Use chalk to suggest movement, gas, or light.
9. Create some explanatory text to accompany their displayed artwork. This could include a description of how they created the picture, which planets it showed, how they chose to arrange them, whether they are in the correct order, or definitions of some of the key words such as moon, planet, star, meteor, meteorite, asteroid, or comet.

INSPIRATIONAL ARTISTS

LUCIEN RUDAUX (1874-1947)

Lucien Rudaux is relatively unknown today, but he was an amateur astronomer and professional artist who, during the 1920s and 1930s, produced spacescapes of such accuracy that they still hold up well even today.



"Mars from Deimos" (1920) by Lucien Rudaux.

More about Lucien Rudaux and his work

WASSILY KANDINSKY (1866–1944)

Wassily Kandinsky was a Russian abstract artist. While composed as a purely abstract arrangement of various-sized circles, this canvas by the Russian artist is full of suggestions of space and the planets.

More about Vassily Kandinsky and his work

PANNAPHAN YODMANEE (BORN 1988)

Pannaphan Yodmanee is a Thai artist, whose work **Time Lapse** explores the relevance of Buddhism in our lives through a series of circular artworks. Planet or moon-like in their presentation, the works are heavily textured.

SUPPORTING INFORMATION

BACKGROUND SCIENCE

The Sun is a star at the centre of our solar system. Eight planets, including the Earth, orbit the Sun. These planets, listed in order from closest to furthest from the Sun, are: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune. Beyond Neptune is Pluto, which is classified as a dwarf planet. Planets are categorised as solid rocky planets (Mercury, Venus, Earth and Mars), gas giant planets (Jupiter and Saturn) or ice giant planets (Uranus and Neptune).

Some of the planets have moons, which are natural objects that orbit them. The Earth has one Moon, which orbits it every 28 days. The planets are all roughly spherical but, due to being different distances from the Sun, being different sizes and being made of different materials, they have different surfaces, atmospheres, gravitational field strengths and surface temperatures.

The distances between the Sun, the planets and moons in the solar system are hard to comprehend, so scaled models are often used to help us understand the vast distances involved. If we imagine the solar system as the size of a football field, the Sun would be the size of a large marble at the centre and most of the planets would be the size of grains of sand spread out across the pitch. We can use scaled models such as this to help us to understand the real distances involved.

Other natural objects in space include comets, asteroids, meteors and meteorites. A meteorite is a rock from space that lands on the surface of a planet or a moon. Meteorites hitting the Earth are usually very small, or land in the sea but, when a meteorite lands on the surface of a planet, it can leave a crater (a large hollow area in the ground).

USEFUL LINKS

Zooming in and out on this amazing web tool helps children to understand the vast scale of the universe:

Scale of the universe

Images of craters and other details about the surfaces of other planets:

Google Space

NASA images

An online impact calculator to find out how crater size varies depending on data entered:

Down2earth

Tutorials on how to create textured bookmarks to practise the techniques can be found in this tutorial:

Makoccino Watercolour DIY Bookmarks

EXPLORIFY ACTIVITIES

Planets – Jupiter

Planets

Moon

START WITH ART EXPLORIFY ACTIVITIES

Moons and planets

Sketchbook Science – what next?

Use this space to explore new ideas for science and art projects

Sketchbook SCIENCE

A set of eight creative and exciting projects that combine rigorous learning in both science and art.

Sketchbook Science encourages children to:

- Learn and apply skills of science enquiry
- Find out about a range of inspirational artists
- Develop new skills and techniques in art
- Communicate their science understanding through creating works of art

"A fun and engaging set of resources that allow the imagination to combine the wonders of art and science."
Project Teacher

"Children loved the experience – they would use their scientific language when creating their art so it was completely enriching."
Project Teacher

Primary Science Teaching Trust

Primary Science Teaching Trust, 12 Whiteladies Road
Bristol, BS8 1PD **www.pstt.org.uk**