Year 2 Science lessons pack

Why should we change the way we travel?

The Harmony Project

Year 2

Science lessons pack

ENQUIRY QUESTION

Why should we change the way we travel?

LINKED HARMONY PRINCIPLE

The principle of Adaptation

The six lesson plans in this pack can be used to deliver the science content for the Year 2 enquiry of learning *Why should we change the way we travel?*, linked to the principle of Adaptation. This science learning builds on the foundations of the National Curriculum statutory requirements relating to materials.

‘Changing the way we travel can improve our health and Nature’s health.’

Each lesson plan includes opportunities to refer to the children’s prior learning, as well as questions to use to reflect on current learning and to assess the children’s developing knowledge and understanding. In addition, lessons feature key elements that are distinctive to the Harmony approach to teaching and learning, for example: opportunities to **learn about Nature,** to **learn in Nature** and to **learn from Nature.**

A summary of each of these elements in relation to the six lesson plans in this pack is set out on the next pages.

The Harmony Project

01 - Learning about Nature

The statutory requirements of the National Curriculum set out what children need to learn about Nature – although, of course, their wider learning about Nature will extend beyond this.

As children progress through their primary education, we can map the journey that their science learning about the uses of everyday materials takes. By understanding their prior learning about materials in the EYFS and Year 1, and by looking ahead to the path their learning about materials will take in Years 3 to 6, we are better able to plan for progression.

The table below shows where the science learning about materials covered in the lesson plans in this pack sits within this journey.

	EYFS	Year 1	Year 2	Year 2	Year 4	Year 5	Year 5
ENQUIRY	**Understanding the world**	**What stories could our toys and games tell?**	**Why should we change the way we travel?**	**Why should we reduce, reuse and recycle?**	**What journey does our river take?**	**How can I be a sustainability champion?**	**How can we ensure our seas and oceans stay amazing?**
SUMMARY OF LEARNING	Children will be guided to increase their knowledge and sense of the ecologically diverse world around them. They will explore everyday objects through hands-on, engaging, multi-sensory experiences, learning more about the materials that objects are made from and their properties and uses. They will begin to recognise that some materials are natural and some are made by people	Children will distinguish between an object and the material from which it is made; identify and name a variety of everyday materials, including wood, plastic, glass, metal, water and rock. They will be able to describe, compare and group together a variety of everyday materials on the basis of their simple physical properties	Children will identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard, for particular uses	Children will continue to explore the suitability of a variety of everyday materials for particular purposes, with a specific focus on the sustainable use of materials. Within this context, children will also find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching	Children will compare solids, liquids and gases; decide how mixtures might be separated; learn that some materials will dissolve to form a solution; describe how to recover a substance from a solution; observe how materials change state when heated or cooled; explain the part played by condensation and evaporation in the water cycle; and describe dissolving, mixing and changes of state as reversible changes	Children will consolidate their knowledge of everyday materials on the basis of their properties. They will explore that some changes result in the formation of new materials, and that this kind of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda	Children will compare and group together everyday materials on the basis of their properties, and give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic
KEY VOCABULARY	object, material, natural, made by people, wood, plastic, glass, metal, water, rock, brick, paper, fabric, elastic, foil, card, cardboard, clay, rubber, wool, cotton	properties, hard, soft, stretchy, stiff, bendy, breakable, tearable, rough, smooth, shiny, dull, transparent, weak, strong, long-lasting, waterproof	absorbent, opaque, human-made, rigid, flexible, reflective, translucent, durable, reflective, (un)suitable, elastic, malleable, foam, leather, canvas, synthetic, bamboo	reduce, reuse, recycle, repurpose, source, extract, fell, gather, harvest, finite, renewable, environmental impact, single use, packaging, squash, bend, twist, stretch, expand, contract, deconstruct	solid, liquid, gas, change of state, melt, freeze, boil, condensation, evaporation, mixture, temperature, dissolve, solution, (in)soluble, filter, sieve, (ir)reversible, water cycle	thermal, electrical, insulator, conductor, (ir)reversible change, burning, rusting, new material	(non) biodegradable, pollution, lightweight, solubility, substance, buoyancy, flexibility

The table below sets out what the children's learning about the uses of everyday materials will look like over the course of the six science lessons.

Week 1	Week 2	Week 3
How are these shoes made for walking?	**Why are the different parts of a bicycle made from different materials?**	**How did John Boyd Dunlop use his knowledge of materials to solve a problem?**
Identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard, for particular uses	Identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard, for particular uses	Identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard, for particular uses; find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching
Week 4	**Week 5**	**Week 6**
How could we use our knowledge of materials and a model of a train carriage to think like a scientist?	**How has Nature inspired air travel?**	**How can our choice of materials improve travel?**
Identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard, for particular uses; find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching	Identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard, for particular uses; find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching	Identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard, for particular uses

02 - Learning in Nature

In addition to learning about Nature, a Harmony approach also provides suggestions for rich opportunities to learn in or alongside Nature, as the six science lessons in this pack demonstrate.

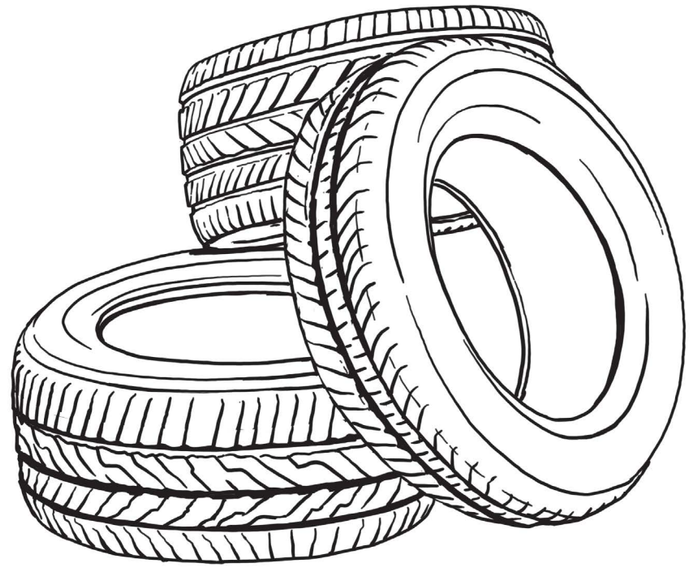
For example, the children will explore where materials come from (natural, human-made, human-made using natural materials etc), how Nature can provide inspiration for designs and materials, and how to perform simple tests within a natural setting.

As they learn in Nature, the children will also experience opportunities to develop their skills in working scientifically. Although these skills will be developed incrementally over time (as shown in Appendix A), the coverage of these six lessons is set out below.

Week 1	Week 2	Week 3
How are these shoes made for walking?	**Why are the different parts of a bicycle made from different materials?**	**How did John Boyd Dunlop use his knowledge of materials to solve a problem?**
Identifying and classifying	Identifying and classifying	Using their observations and ideas to suggest answers to questions
Scientific enquiry type: Identifying, classifying and grouping	Scientific enquiry type: Identifying, classifying and grouping	Scientific enquiry type: Comparative and fair testing
Week 4	**Week 5**	**Week 6**
How could we use our knowledge of materials and a model of a train carriage to think like a scientist?	**How has Nature inspired air travel?**	**How can our choice of materials improve travel?**
Performing simple tests	Performing simple tests	Using their observations and ideas to suggest answers to questions
Scientific enquiry type: Comparative and fair testing	Scientific enquiry type: Comparative and fair testing	Scientific enquiry type: Identifying, classifying and grouping

Working scientifically vocabulary

- compare
- identify
- observe
- suggest
- predict



03 - Learning from Nature

The third key element of a Harmony approach to learning is learning from Nature, which is linked to progression in understanding of Harmony principles. This aspect of learning supports the development of children's understanding of what it means to live sustainably.

The six lessons in this pack and the wider enquiry they are part of are underpinned by the principle of Adaptation; they build on children's prior learning in the EYFS and Year 1 and prepare them for further learning in Years 3 to 6.

The children's progression in their understanding of the principle of Adaptation, through enquiries of learning that help us to think and live more sustainably, is shown below.

	EYFS	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
ENQUIRY	Children are introduced to opportunities to explore and develop their initial knowledge and understanding about adaptation (observing animals using camouflage to stay safe, our local area, people who help us, noticing that aeroplanes are a similar shape to birds)	**Where do we live and what makes it special?**	**Why should we change the way we travel?**	**How did the Romans adapt to life in Britain?**	**How did the power of monarchs change through the Tudor period?**	**Who were the Vikings and where did they go?**	**What would it have been like to live in WWII?**
PROGRESSION: CONCEPT OF ADAPTATION		What do you like about where you live?	What are the advantages and disadvantages of different forms of transport?	What local materials did the Romans use to adapt to life in Britain?	What are your favourite sounds in Nature and how do they make you feel?	How did the Vikings travel without creating pollution?	How did people have to adapt during WWII?
THINKING SUSTAINABLY		How can we look after birds in wintertime?	What can we learn from Nature about brilliant ways to move and travel?	Were Roman structures more sustainable than ours?	What changes can we make to ensure the sounds of Nature are heard now and in the future?	How can we use our understanding of forces to design clean energy transport?	What is light pollution and how can we reduce it?
THINKING SUSTAINABLY VOCABULARY	place local family school community world change	belonging home past present future adapt improve thrive	changemaker adaptation effect consequences balance environment pollution	context connection community create contribute waste seasonal	heritage traditions culture wisdom impact	dynamic identity value engage agent of change	agency flux survive repair collaborate food security

Lesson **01**

Enquiry question:
Why should we change the way we travel?

Harmony principle:
The principle of Adaptation

How are these shoes made for walking?

NC Links

Uses of everyday materials
Identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard, for particular uses.

Working scientifically:
Identifying and classifying

Scientific enquiry type:
Identifying, classifying and grouping

Key vocabulary

Vocabulary relating to uses of everyday materials, working scientifically and thinking sustainably is highlighted within the unit introduction.

You will need

Individual whiteboards and pens

A stick and a pencil

A variety of footwear made from different materials (plimsolls, trainers, flip-flops, leather shoes, Crocs, football boots, jelly shoes, wooden clogs, wellies etc)

A copy of Resource 1A enlarged to A3, or a learning wall display based on this layout

Adapt the learning

Children requiring additional support with new vocabulary could play a sorting game prior to the main lesson, matching shoes and materials to their labels.

Challenge children to explore statements such as 'What if wellies were made from paper?' or 'What if trainers were made from metal?'

Link the learning

CLIMATE ACTION PLAN:
Adaptation and resilience;
Climate education and green skills;
Biodiversity and Nature

What do we already know?

Recall the children's prior **learning about Nature** with reference to natural materials and materials made by people from the Year 1 enquiry *What stories could our toys and games tell?* Play a game of 'True or False' by presenting the children with a statement about everyday materials and asking them to say whether they think it is true or false, explaining their reasoning.
For example:
All old toys are made from wood.
Glass is transparent.
Plastic is a natural material.
Sticks are flexible.

These could be displayed on the interactive whiteboard alongside a related image. The children could use individual whiteboards to record 'T' or 'F' before sharing what they remember about everyday materials.

To develop the discussion, focus on the statement about the stick and show the children a stick and a pencil. Ask them: *What's the same? What's different?*

Support their understanding as they distinguish between materials that are natural, materials that are made by people and objects that are made by people using natural materials.

Challenge the children to make connections between their **learning about Nature** and their developing understanding of where materials come from by asking: *How can we ensure that we will always have enough pencils?* Asking this question will help to assess what children remember about the need to use materials responsibly e.g. planting more trees or using recycled materials.

What are we learning today?

Develop the children's **learning about Nature** with reference to natural materials and materials made by people by thinking about the everyday materials that they already know and can name, and how different materials are suitable for different uses.

Focusing on their feet, ask the children: *What do our feet help us to do?* Discuss as a class the role our feet play in standing, walking, running and exercising. Ask: *Why can't we see our feet at the moment? Why do we usually wear socks and shoes?* Take time to consider the materials most socks are made from before thinking about shoes and the materials most shoes are made from. Ask: *Are socks and shoes made from different materials? Why?* Discuss this in relation to the jobs that socks and shoes do.

Begin a new learning wall, dividing the display into four columns, as shown in Resource 1A. Draw the children's attention to the socks and shoes in the first column of the first two rows.

Add the title 'Materials and their properties' to the top of the second column. Ask the children to identify the materials that socks and shoes are made from and to give their properties, drawing on the vocabulary they used to describe materials and their properties in Year 1.

Add their ideas to the second column (e.g. cotton – light, soft, stretchy; leather – natural, stiff, smooth). The learning wall can be added to as the learning sequence within this unit develops.

TEACHER TIP:
To support this discussion, it may be useful to provide a word bank alongside the learning wall on the interactive whiteboard with some of the vocabulary the children will need e.g. cotton, leather, rubber, plastic, flexible, soft, light, stretchy, natural, stiff, smooth.

How are we learning today?

Take the children on a brief walk in the school grounds to **learn in Nature**.

You may wish to combine this with a welly walk if this is part of your usual practice. Focus on 'the ground beneath our feet'.

Ask the children: *What do you notice? Is our footwear suitable to walk through this area or do we need to walk around? Why?*

Pause at features on the walk such as mud, puddles, long grass, stones and other surfaces in your school grounds.

Continue to focus on the surfaces you are walking on as you return to the classroom. If returning from a welly walk, you may wish to ask: *Why are we taking our boots off before going indoors?*

Show the children a selection of footwear (see 'You will need' section on previous page) and pass the items around. Ask the children: *What's the same? What's different?* Encourage them to think about why different materials have been used for each type of footwear. Ask: *What footwear would I wear at the beach? On a muddy walk? When running? Why are they suitable for that use or that location?* Add any new materials and their properties to the learning wall.

In pairs, the children visit different exploration stations, each set up with a different type of footwear for them to explore. Display the two questions they need to consider and respond to at each station: *What material is this footwear made from? What are the properties of this material?*

As a class, discuss each of the types of footwear the children have explored, focusing on the material the footwear is made from and the properties of that material (e.g. flexible, durable, waterproof, long-lasting, strong, flexible, reflective, lightweight).

TEACHER TIP:
Traditionally, wellies were made from rubber and some still are, but most are made from PVC, a type of plastic. School shoes are often made from synthetic materials or leather with rubber or plastic soles. Trainers may be made from synthetic fabrics, canvas or leather.

Extend the children's thinking by asking questions such as: *Why are these good materials for children's school shoes? Why does a trainer need to be lightweight? Is a trainer more flexible than a shoe? Why?*

The children choose one of the types of footwear they've explored to draw and label. Focus on the materials used for different parts of the shoe and why they are used.

STEM SENTENCES:
Wellies are made from _____.
_____ is a _____ material.
Flip-flops are made from _____.
_____ is a _____ material.
Trainers are made from _____.
_____ is a _____ material.
(e.g. Wellies are made from rubber.
Rubber is a strong, waterproof material.)

TIME TO EXPLAIN:
Focusing on their own shoes, the children tell a partner what the different parts of their shoes are made from and why. Encourage them to focus on the properties and uses of the materials used for fastening, the main shoe and the soles, providing support to help them use new vocabulary, as needed.

What have we learned today?

Encourage the children to reflect on their **learning about Nature** with reference to natural materials and materials made by people, and assess their understanding, by discussing the learning question *How are these shoes made for walking?*

Encourage the children to reflect on walking as a type of travel and on their prior learning linked to the **principle of Health** with reference to exercise and physical activity. Ask them: *Is walking good for our health? Why? Is walking good for Nature's health? Why?*

Ask the children to hold up their fingers to rate how healthy walking is out of five, with a rating of five being the healthiest.

Share the images of a human footprint and animal tracks on Resource 1B and challenge the children to guess which animal made the tracks. Draw out the learning about the **principle of Adaptation** by asking the children: *Do all animals have feet? Can we see any similarities or differences between animals' feet and our own? Do any other animals wear shoes?*

TEACHER TIP:
Linked to this learning, you could challenge the children to increase the amount of time they spend walking every day for a week. It could be as simple as walking laps of the playground or school field at playtime.

Learning wall

	What is the material and what are its properties?	Where does the material come from? (natural or made by people?)	Is this material inspired by Nature?
sock			
shoe			
bicycle			
car			

Resource 1B

Which animals made these tracks?

ANSWERS (clockwise from top left): a roe deer, a badger, a herring gull, a domestic cat and a human

Lesson

02

Enquiry question:
Why should we change the way we travel?

Harmony principle:
The principle of Adaptation

Why are the different parts of a bicycle made from different materials?

NC Links

Uses of everyday materials
Identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard, for particular uses.

Working scientifically:
Identifying and classifying

Scientific enquiry type:
Identifying, classifying and grouping

Key vocabulary

Vocabulary relating to uses of everyday materials, working scientifically and thinking sustainably is highlighted within the unit introduction.

You will need

String or rope

Handheld whiteboards and a whiteboard pen

Objects made from, or samples of, wood, plastic, metal, glass, brick, rock, paper and cardboard

A selection of bicycles

Copies of Resource 2A (one per child)

Clipboards

Adapt the learning

Children requiring additional support could benefit from working with a semi-completed diagram of a bicycle with the main components, such as frame, chain, spokes, handlebars etc, already labelled so that, where needed, children can focus solely on the properties of the materials.

Challenge children to consider an alternative material that could be used to make a strong bicycle frame and explain why.

Link the learning

CLIMATE ACTION PLAN:
Adaptation and resilience;
Climate education and green skills;
Biodiversity and Nature

What do we already know?

Sitting in a circle outside, if possible, play the following game to retrieve the children's **learning about Nature** with reference to natural materials and materials made by people from the previous lesson.

Create a line across the middle of the circle using rope or string. Write on one of the handheld whiteboards 'suitable' and place this at one end and 'unsuitable' on another and place this at the other end.

Write the name of a material (e.g. wood, plastic, metal, glass, brick, rock, paper or cardboard) on another of the whiteboards and ask the children to discuss with a partner whether it's a good choice of material to use to make shoes (suitable) or a poor choice (unsuitable).

Choose a child to place the board where they think it belongs on the line and ask them to explain their reasoning. You may wish to give them a sample of the actual material to hold while explaining.

Ask the rest of the class: *Do we all agree? And if not, why not?* Draw the children's attention to the vocabulary that they have collated so far (this will have been recorded on the learning wall) to support their responses and add any new vocabulary, as it emerges. Repeat for other materials.

Extend the learning wall by adding a title to the second column 'Where does the material come from?' and at this stage simply draw the children's attention to whether each material is natural or made by people.

What are we learning today?

As a class, briefly recap the learning from the previous lesson about the materials different types of footwear are made from linked to walking as a type of travel. Explain that in this lesson they will look at the materials that bicycles are made from linked to cycling as a type of travel.

Ask the children: *Do you have a bicycle? How do you feel when you're cycling?* In a new row on the learning wall, draw a bicycle in the first column. Explain that in this lesson they are going to explore the design of bicycles and what the different parts of a bicycle are made from.

TEACHER TIP:
Either in this lesson, or at another point in the school day, you could share with the children the book *I Love My Bike* by Simon Mole and Sam Usher, which works well to support this learning.

How are we learning today?

Take the children to the school bike shed, the Early Years outdoor play area (if there are bikes or tricycles there) or to the area where any bikes they have ridden to school in the morning are stored. Allow the children time to observe the bicycles.

Introduce or elicit from the children the names of the individual components of a bicycle, taking time to practise and consolidate new vocabulary, where needed.

Draw the children's attention to the materials these components are made from by asking: *What is the saddle made from?* (Leather, plastic, foam) *What are the properties of these materials that make them suitable for this purpose?* (Soft, durable) *What are the frame, chain, spokes and handlebars made from?* (Usually metal) *What are the tyres made from?* (Natural and synthetic rubber, which is elastic, stretchy, durable)

Discuss any other materials and their properties: *Can we see any reflective materials? What are they used for?*

You may find the *Materials vocabulary list (5 to 7 year olds)* from Explorify useful when supporting children's responses.

TEACHER TIP:
If time allows, show the children this YouTube clip about a Ghanaian company that makes bamboo bicycles. Explain that bamboo is very hard, strong and lightweight, so it can be used to replace metal in the frame of a bicycle. As bamboo stems can be harvested without chopping down the whole plant, it can be a sustainable material if it is grown and managed in an environmentally responsible way. The use of bamboo to build bikes is an example of the **principle of Adaptation** in action: bamboo is plentiful in Ghana, so it makes sense to use it instead of metal to build these bicycles.

TIME TO EXPLAIN:
Allow the children time to draw, label and write about the different parts of a bicycle and the materials that they are made from on Resource 2A. Encourage them to share and compare their observations with a partner. *Did they describe the properties of the materials in the same way?*

What have we learned today?

Encourage the children to reflect on their learning and assess their understanding by asking: *Why are the different parts of a bicycle made from different materials? Are bicycles made from natural materials, materials made by people or both? Why are these materials suitable for building a bicycle?*

Move the discussion on by asking the children: *Why is cycling a healthy choice for our bodies and minds? Why is cycling a healthy choice for Nature?*

Ask the children to hold up their fingers to rate how healthy cycling is out of five, with a rating of five being the healthiest.

Establish that walking and cycling are healthy ways to travel as they are both types of exercise and help reduce pollution.

With reference to the **principle of Adaptation**, discuss with the children why it's important for our own health and Nature's health that we travel in active ways when we can (adapting our decisions and behaviours). There is an opportunity linked to this learning to organise an event such as a Walk Wheel Cycle Trust (formerly Sustrans) Active Travel Breakfast to celebrate active ways of getting to school or a cycling event for the school community.

TEACHER TIP:
There's a good opportunity here to discuss with the children anything that is being done in your local area to encourage the use of more sustainable forms of transport, such as electric bike schemes and the introduction of cycle lanes. All these things are examples of how we are adapting in response to concerns about our own health and the health of the rest of the natural world.

Draw a picture of one of the bicycles you have looked at carefully.
Label your drawing with the materials and their properties.

materials
metal
plastic
glass
wood
rubber
fabric
leather
foam

properties
hard
soft
stretchy
elastic
strong
light
heavy
stiff
durable
long-lasting
rough
smooth
bendy
flexible
rigid
shiny
reflective
transparent
waterproof

Lesson

03

Enquiry question:
Why should we change the way we travel?

Harmony principle:
The principle of Adaptation

How did John Boyd Dunlop use his knowledge of materials to solve a problem?

NC Links

Uses of everyday materials
Identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard, for particular uses. Find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching.

Working scientifically:
Using their observations and ideas to suggest answers to questions

Scientific enquiry type:
Comparative and fair testing

Key vocabulary

Vocabulary relating to uses of everyday materials, working scientifically and thinking sustainably is highlighted within the unit introduction.

You will need

Copies of Resource 3A (one per table or pair)

A copy of Resource 3B cut into cards

Five trays with a selection of different materials (e.g. wood, metal, paper, tinfoil, cardboard, fabric, tissue paper, glass, rock, plastic, rubber)

A copy of Resource 3C (for display)

A copy of Resource 3D (for display)

Adapt the learning

Children requiring additional support could benefit from an adult-supported focus on one material at a time.

Challenge children to consider how they will ensure that they are carrying out a fair test when exploring each material.

Link the learning

CLIMATE ACTION PLAN:
Adaptation and resilience;
Climate education and green skills;
Biodiversity and Nature

What do we already know?

Start the lesson by sharing the images of bicycles on Resource 3A. Ask the children to look at the images carefully and encourage them to recall their prior learning about materials by asking: *What's the same? What's different?*

Encourage the children to identify the materials that have been used to create each bike and to say which ones are natural and which are made by people.

Recap what the children have already learned about the **principle of Adaptation** by asking: *Do all the bicycles have a metal frame? Are all bicycle baskets made from natural materials? Why has someone made a bicycle from bamboo? Why are there different types of bicycles such as balance bikes and electric bikes?*

Draw out in the discussion the fact that we can adapt or change the way we do things and make things in response to a problem or to make improvements.

What are we learning today?

Establish that, having explored the properties of materials with reference to walking and cycling in the previous two lessons, the children will be focusing on car travel in this lesson.

If you are able, take the children to an area where they can observe a car and a bicycle. If this is not possible, display an image of a car alongside an image of a bicycle. Ask the children: *What materials do you think have been used to make the car? Are these the same or different to the materials used to make a bicycle?*

Allow the children time for exploration. In pairs, they record their ideas about what they think is the same and what they think is different on a whiteboard.

As a class, discuss any similarities (use of metal, use of natural or synthetic rubber) and differences (use of glass in a windscreen, which is absent on a bike).

Ask questions such as: *Is the frame of the bike made from the same material as the body of the car? How about the seats? What about the wheels? What are the similarities? What are the differences?*

Add the children's observations about the materials used in cars and their properties to the learning wall.

Draw the children's attention to the tyres on the wheels of the car. Explain that both bicycles and cars have tyres made from rubber. In today's tyres, some of this is natural rubber and some of this is a material like rubber that humans have developed. This synthetic rubber has many of the same properties as natural rubber.

Explain that in this lesson they will be learning about the **principle of Adaptation** and how an inventor called John Boyd Dunlop invented a rubber tyre that made cycling much more comfortable. His tyre design was later adapted and used on car wheels, too. Show the children the image of John Boyd Dunlop on Resource 3C and watch the *What is a pneumatic tyre? Who was John Dunlop?* YouTube clip about who he was and what he did.

TEACHER TIP:
You may wish to share the whole video during a history lesson or simply focus on the section from 3:05 – 4:40 during this lesson. When pausing at 4:40, explain that the children will be considering what decisions John Boyd Dunlop would have had to make when he was testing the best materials for his tyre invention.

How are we learning today?

If you have tyres in an outdoor play space, there is an opportunity to learn outdoors in this lesson, exploring rubber tyres first-hand. If this is not possible, the children could explore bike tyres instead or even rubber bands.

Extend the children's **learning about Nature** with reference to natural materials and materials made by people by allowing them time to explore the properties of the tyres or rubber bands. Ask the children: *Can the rubber tyre/rubber band be squashed? Can you bend rubber? Will it twist? Does it stretch? What do you notice when you let go?*

Add a drawing of a car tyre to the first column of the fourth row on the learning wall and record the children's observations about rubber and its properties.

Extend the children's thinking to other materials they have explored by asking:

Can you show me another material that bends? Do you know another material that you can twist or stretch?

Explain that when John Boyd Dunlop was looking for the ideal material for his tyres, he needed to consider the properties of many different materials. Share with the children a list of different properties that may have been useful for him to check.

Ask them to help you to sort the cards from Resource 3B into two groups to find the properties that would be most useful when looking for a suitable material for tyres. Add the following five most important properties to the learning wall or highlight them on the learning wall if they have already been added:

- Elastic (it returns to its original shape after being stretched or squashed)
- Strong
- Durable (it can resist damage from bumps and scrapes, and does not tear easily when stretched)
- Long-lasting
- Waterproof

In small groups, the children test the five materials on the tray for each of these five properties.

Ask them to imagine that they are John Boyd Dunlop and that they are going to decide which materials are most suitable for making a tyre. Encourage the children to discuss the best ways to test for each of these properties and decide on a method as a group before they start.

At the end of this activity, invite the children to share their findings and reasoning with the rest of the class.

TIME TO EXPLAIN:
Ask each group to explain how they have sorted their materials and whether they have been able to decide which are the most suitable and least suitable.

STEM SENTENCES:
_____ is _____ and _____ .
_____ is/is not a suitable material for tyres.
(e.g. Paper is flexible and tears easily. Paper is not a suitable material for tyres.)

What have we learned today?

Encourage the children to reflect on their learning, and assess their understanding, by asking: *How did John Boyd Dunlop use his knowledge of materials to solve a problem? Where does rubber come from?*

Explain that natural rubber comes from the sap of the rubber tree. This tree is native to South America but most of the world's rubber now comes from rubber trees grown in Southeast Asia. The liquid rubber is harvested by making a cut in the tree's trunk and collecting the sap in cups. It's then treated and dried before being molded into things like tyres.

End the lesson by discussing with the children their ideas about the positives and negatives of car travel.

You might ask: *Why are cars useful? Is travelling by car good for our health? Why or why not? Is travelling by car good for Nature?*

Ask the children to hold up their fingers to rate how healthy driving is out of five, with a rating of five being the healthiest.

Link the learning to the **principle of Adaptation** by asking the children: *How are we changing cars to make car travel less damaging to our health and the rest of Nature's health?*

TEACHER TIP:
At another time in the week, there is an opportunity to link this learning about one inventor to the work of another, Percy Shaw. He invented the reflective cat's eye (Resource 3D) used on roads to mark the boundary between two lanes and keep us safe. He took inspiration from the reflective properties of real cats' eyes, an example of biomimicry, or **learning from Nature**. The *Cats and Road Safety* episode of the BBC Sounds series '30 Animals That Made Us Smarter' explores this.

Enquiry question:
Why should we change the way we travel?

Harmony principle:
The principle of Adaptation

Resource 3A

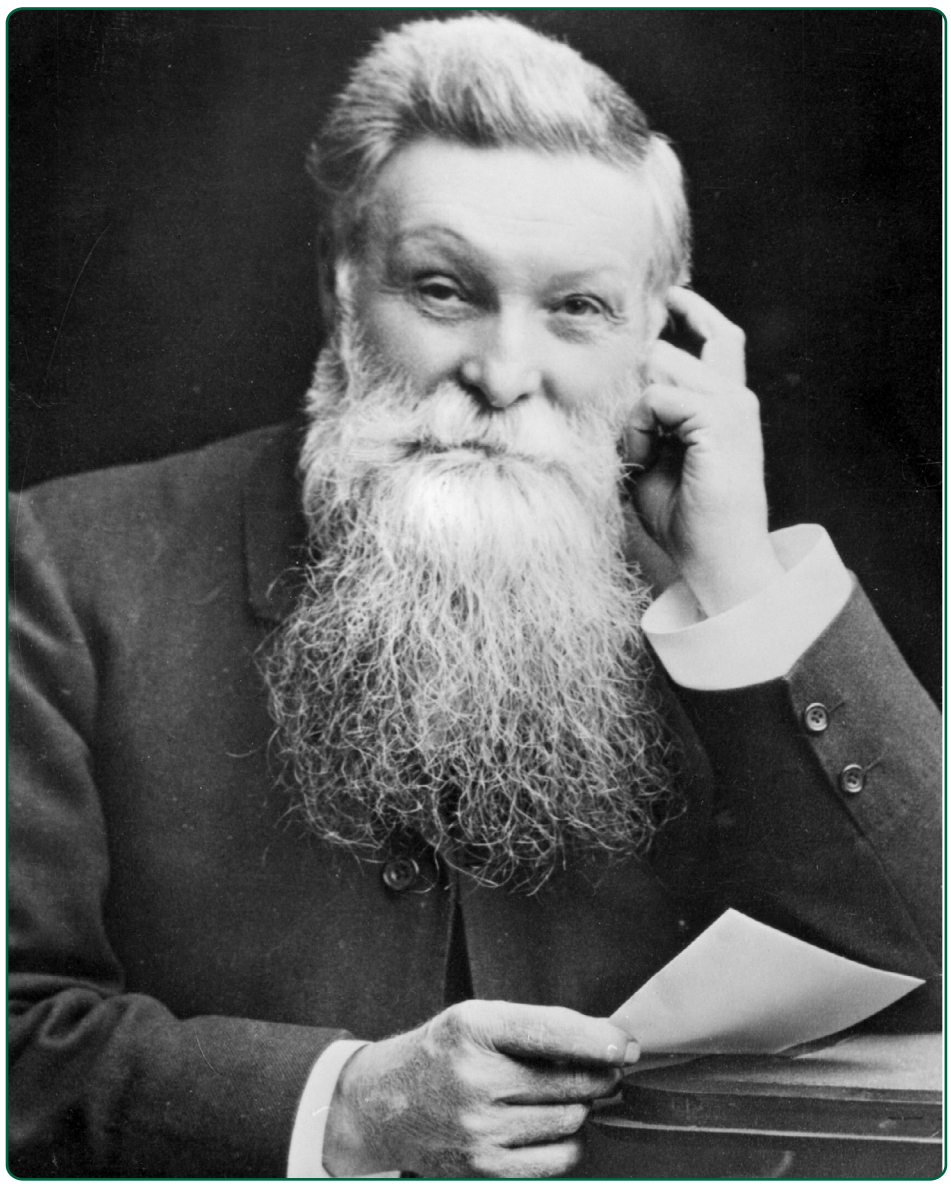
Different types of bicycles

The properties of materials

soft	hard	waterproof	absorbent
light	heavy	translucent	opaque
flexible	rigid	rough	smooth
elastic	reflective	dull	strong
durable	long-lasting	natural	made by people

Resource 3C

John Boyd Dunlop



Tyres being made in 1918

Dunlop's first bicycle tyre

Resource 3D

A cat's eye on a road

Lesson **04**

Enquiry question:
Why should we change the way we travel?

Harmony principle:
The principle of Adaptation

How could we use our knowledge of materials and a model of a train carriage to think like a scientist?

NC Links

Uses of everyday materials
Identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard, for particular uses. Find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching.

Working scientifically:
Performing simple tests

Scientific enquiry type:
Comparative and fair testing

Key vocabulary

Vocabulary relating to uses of everyday materials, working scientifically and thinking sustainably is highlighted within the unit introduction.

You will need

A set of six small play figures (one set per group)

Five trays with a selection of different materials (tissue paper, small cardboard boxes, small tinfoil trays, plastic takeaway containers, modelling clay, Lego bricks and other small construction materials)

Six hooks for the front of the carriages (stick-on hooks would work well)

String

Small watering can

Baking tray

Twig

Copies of Resource 4A (one per group)

Adapt the learning

Children requiring additional support or further challenge could be assigned roles so that all children are able to participate in the discussion confidently (speaker, engineer, demonstrator, investigator, lead questioner etc).

Link the learning

CLIMATE ACTION PLAN:
Adaptation and resilience;
Climate education and green skills;
Biodiversity and Nature

What do we already know?

To recall the children's prior **learning about Nature** with reference to natural materials and materials made by people, show a rubber object or write the word 'rubber' on the interactive whiteboard and ask the children to share what they know about it.

Share the vocabulary on Resource 3B to support the children's recall. How many properties of rubber can they think of? Probe their understanding by asking: *Is rubber a reflective material? Is rubber absorbent? Is rubber always a natural material?*

What are we learning today?

Remind the children about the types of travel they have explored so far. Ask them to recap which they thought was best for our health and for the rest of Nature's health.

Explain that the focus for this lesson will be exploring another form of travel, where lots of people travel together in the same vehicle. Ask the children: *How many vehicles can you think of that would carry lots of passengers?*

The children may suggest a variety of forms of transport such as coaches, buses, trains and planes. Explain that trains will be the focus of the learning in this lesson.

Draw an image of a train in the next row on the learning wall and explain to the children that during the lesson they will be thinking like a scientist to identify suitable materials to build a train carriage.

How are we learning today?

Start the lesson by looking at images of trains in episode 5, *Tremendous Trains*, in the BBC's Travel and Transport series. Discuss that, like a bus, a train is a form of public transport (vehicles that run at regular times on fixed travel routes that can be used by anyone). Ask the children to share their experiences of travelling by train by asking: *Have you ever been on a train journey? Where do all the passengers sit? What do you like about travelling by train? What don't you like?*

In small groups, the children explore and select the most suitable materials from the range of materials provided on their tray to create a model of a train carriage.

Clarify that their train carriage should be designed to transport six small play characters and that the children needn't include the wheels of the carriage in their consideration and model-making.

Demonstrate how you might make a model carriage using one of the small cardboard boxes on the materials tray and attach a hook to the front that can be used to pull the carriage. Place the small play characters inside. Ask the children: *What happens when I pull the carriage along the track?* Attaching a length of string to the hook, pull the cardboard carriage along the table (track).

Model an explanation as you observe what happens (e.g. the carriage changes shape because the cardboard is flexible and bendy).

The children create their own carriages, exploring a variety of materials and their properties, and deciding on the most suitable materials to create their model.

When the children have chosen the most suitable material, you may wish to take the opportunity to **learn in Nature**, taking the carriages outside to perform further tests. Explore what happens when each carriage is pulled along different natural surfaces (e.g. grass, soil or gravel), when the carriage gets wet (using a small watering can), when a strong wind blows (fanning the carriage using a flat object such as a baking tray) or when something bumps into the carriage (maybe using a twig to represent a branch from a tree). These could be set up as testing stations that each group could visit in turn. Model how the children can record their observations using the table on Resource 4A.

TIME TO EXPLAIN:
Once all groups have explored the different materials and tested their models, allow time for the class to move around each group and to hear about the most suitable materials that they have chosen for their train carriage model.

STEM SENTENCES:
This carriage is made from _____.
_____is _____,
_____and _____.
(e.g. This carriage is made from metal.
Metal is strong, waterproof and rigid.)

Collate a list of properties as the children share their findings and ask the children: *Which materials would be chosen to create actual train carriages? Would they need to have the same properties? Which would not be suitable?* You may wish to explore some images of real train carriages as a class.

What have we learned today?

Encourage the children to reflect on their learning and assess their understanding by asking: *How did we use our knowledge of materials and a model of a train carriage to think like a scientist?*

Ask the children to hold up their fingers to rate how healthy train travel is out of five, with a rating of five being the healthiest.

Share the image of a bullet train on Resource 4B to link the learning to the **principle of Adaptation**. Ask the children what they notice about the shape of the front of the train and explain that this helps it to travel faster. Display the image of the kingfisher on Resource 4C alongside it and draw the children's attention to its streamlined shape. Explain that this inspired the design of the bullet train.

Explain that this is another example of how humans sometimes copy Nature to solve human problems, especially when designing and making using different materials. The *How a kingfisher helped reshape Japan's bullet train* episode in the BBC Sounds series '30 Animals That Made Us Smarter' explores how the form of the kingfisher helped inform the design of the bullet train.

At another time, you could also listen to the *Kingfisher and bullet train* episode of the related BBC Sounds podcast series. This explores how the engineers that worked on the bullet train used the beak of a kingfisher, the wing feathers of an owl and the body shape of a penguin to solve three design problems.

TEACHER TIP:
Making links to a past or planned visit to a train or transport museum, or inviting in a train enthusiast from the school community, would enrich this learning. It would also support the children's learning in history, focusing on what actual trains are made of and how they have adapted over time.

The properties of the materials in a model train carriage

Material	Is it waterproof?	Is it strong?	Is it durable?
cardboard			

Resource 4C

What do you notice about the shape of the front of this train?

Resource 4C

What do you notice about the shape of the kingfisher's head?

Lesson **05**

Enquiry question:
Why should we change the way we travel?

Harmony principle:
The principle of Adaptation

How has Nature inspired air travel?

NC Links

Uses of everyday materials
Identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard, for particular uses. Find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching.

Working scientifically:
Performing simple tests

Scientific enquiry type:
Comparative and fair testing

Key vocabulary

Vocabulary relating to the uses of everyday materials, working scientifically and thinking sustainably is highlighted within the unit introduction.

You will need

A4 pieces of materials for the model aeroplanes e.g. tissue paper, card, fabric

Long tape measure

A start line marked out with chalk or rope

Whiteboards and pens

Adapt the learning

Children requiring additional support may benefit from a guided demonstration for the paper aeroplane creation.

Challenge children to suggest alternative materials that may be more suitable than paper to create an effective aeroplane.

Link the learning

CLIMATE ACTION PLAN:
Adaptation and resilience;
Climate education and green skills;
Biodiversity and Nature

What do we already know?

Display the images of early and modern-day bicycles, cars and trains on Resource 5A on the interactive whiteboard and discuss the similarities and differences the children notice.

Recall what the children have already learned about the **principle of Adaptation**, and make links to their learning in history by asking: *How has our footwear changed over time? How have bicycles, cars and trains changed?*

Draw the children's attention to the choice of materials and how this has changed over time.

Ask them: *How has people's learning from Nature inspired some of these changes?* (e.g. we have **learned from Nature** that we need to use more sustainable materials and that some designs inspired by Nature, such as the bullet train, are more efficient).

What are we learning today?

Move the children's **learning from Nature** on by asking them: *What living things can fly? What kind of transport do you think they have inspired?*

You could share the images of the bird and butterfly on Resource 5B to support the children's thinking. As a class, discuss their ideas and explain that in this lesson they will be learning about aeroplanes linked to flying as another type of travel. Draw an aeroplane in the final row on the learning wall.

Share the same images of the bird and butterfly alongside the image of an aeroplane on Resource 5C. Ask the children: *What is the same and what is different?* Draw out in discussion the fact that they all have wings and that the wings are thin and have a large surface.

To extend the children's **learning about Nature** with reference to natural materials and materials made by people, watch *Episode 4: Fantastic Flying Machines* of the BBC's Travel and Transport series.

Look at the image of the first aeroplane at 2:30 and ask the children: *What was the first aeroplane made from?* (wood and cloth) *Why do you think these materials were used?* Refer to the class learning wall and the properties of materials that have been identified so far.

Pause the video at 3:38 to focus on modern aeroplanes. Ask the children: *How have aeroplanes changed? What are modern planes made from?* (metal) *Why is metal a better material for an aeroplane than wood?*

TEACHER TIP:
If time allows, you may wish to watch footage of the Wright Brothers aeroplane and this short YouTube documentary film to support this learning. The section of the film between 2:57 and 4:05 explores how the Wright brothers were inspired by the wings of butterflies and birds when they designed their aeroplanes (biomimicry).

How are we learning today?

There is an opportunity in this part of the lesson to **learn in Nature**. In an outdoor space, the children sit or lie down and look at the sky to see if they can spot any birds or planes. Encourage children to share their observations about how they move across the sky.

Explain to the children they will be **learning from Nature** in this lesson just like the Wright Brothers did by exploring how designs in the natural world can inspire the design of planes.

Demonstrate how to make a very simple model aeroplane using a piece of A4 paper. You could use the the Royal Air Force Museum's *Paper aeroplane experiment* resource for ideas.

Working in pairs or small groups, the children make three different aeroplanes, made from three different materials: tissue paper, cardboard and fabric.

TIME TO EXPLAIN:
Bring the children back together during the activity to discuss any challenges that they are experiencing in making their model planes. Ask them: *Are any of the materials unsuitable for this purpose? Why?* Encourage them to reference the properties of all three materials in their explanations.

STEM SENTENCES:
The _____ is a suitable material because _____ .
The _____ is an unsuitable material because _____.
(e.g. The cardboard is a suitable material because it can be folded into a rigid shape.)

Once the model planes have been made, take the children outdoors to test them. They could see which aeroplane flies the furthest by measuring and recording their flight distances on whiteboards.

What have we learned today?

Encourage the children to reflect on their learning and assess their understanding, by asking: *Which material was most suitable for making your aeroplane? Why?*

Ask the children to hold up their fingers to rate how healthy air travel is out of five, with a rating of five being the healthiest. Explain to the children that air travel is one of the most damaging types of travel for Nature's health.

Draw out the **learning from Nature** by asking the children if they can identify how Nature has influenced the design of their paper aeroplane. Draw out in discussion the fact that birds and butterflies inspired the design of aeroplanes, as explored at the start of the lesson.

TEACHER TIP:
If the children are enjoying learning about how Nature has inspired design, you may wish to share with them some of the facts from the '30 Animals Who Made Us Smarter' podcast. The *Mantis and aircraft* episode links to the learning in this lesson.

Enquiry question:
Why should we change the way we travel?

Harmony principle:
The principle of Adaptation

Resource 5A

Past

Present

Resource 5B

What living things can fly?

Resource 5C

What is the same and what is different?

Lesson **06**

Enquiry question:
Why should we change the way we travel?

Harmony principle:
The principle of Adaptation

How can our choice of materials improve travel?

NC Links

Uses of everyday materials
Identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard, for particular uses. Find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching.

Working scientifically:
Using straightforward scientific evidence to answer questions or to support their findings

Scientific enquiry type:
Pattern seeking

Key vocabulary

Vocabulary relating to the uses of everyday materials, working scientifically and thinking sustainably is highlighted within the unit introduction.

You will need

Copies of Resource 3B (one per pair)

Adapt the learning

Children requiring additional support may benefit from a scaffolded task exploring:
- The materials that they would choose and why
- The impact that their design will have on Nature
- The element of their design that will be inspired by Nature

Challenge children to explain to the class why their design is the healthiest option to improve travel with reference to their choice of materials.

Link the learning

CLIMATE ACTION PLAN:
Adaptation and resilience;
Climate education and green skills;
Biodiversity and Nature

What do we already know?

Begin the lesson by recalling the children's prior **learning about Nature** by playing 'Odd one out'. Show the children the images of a car, a bullet train and an aeroplane on Resource 6A. Ask them to think of as many similarities and differences as they can. Prompt them to think about:
- The materials the vehicles are made from
- Whether these materials are natural or made by people
- The properties of these materials
- Whether the designs were inspired by Nature
- Whether they represent a healthy form of travel

Ask the children to decide which one is the odd one out and why. Prompt them to use the learning wall and any scientific vocabulary that has been generated during this learning sequence.

Draw out a reason for every answer and remember that when playing 'Odd one out' there is no wrong answer as long as you can give a reason for your thinking!

TEACHER TIP:
You can find current figures about zero emissions cars in the UK on the Gov.uk website. As an example, at the end of June 2024, there were 1,183,000 licensed zero emission vehicles on the road, representing 2.8% of all vehicles.

What are we learning today?

Remind the children that in previous lessons they have learned about scientists and inventors who have changed the way we travel. Explain that in this lesson they will be the inventors and their task will be to design a new vehicle (or footwear that enables active travel) that is good for our health and for Nature's health.

Watch *Episode 6: The Future of Transport*, in the BBC Transport and Travel series. Draw out some of the changes in the design of vehicles in the future and in the choice of materials that might be used to build them.

For example:
- The Maglev train has magnets instead of wheels, and hyperloop trains use electricity and air instead of diesel or petrol. Both trains are lighter and use less energy.
- Electric cars get their energy from batteries instead of petrol and diesel engines.
- The bodies of electric cars are made from lightweight materials (such as carbon fibre or reinforced plastics) instead of steel. This makes the cars lighter, which means they require less energy to run.

How are we learning today?

Before the children start work on their own designs, ask them: *Which forms of travel do you use the most? Which is your favourite way to travel? Why? Is this type of travel good for your health and for Nature's health?*

Draw the children's attention to the types of travel highlighted on the learning wall and the materials associated with them.

Establish that they will use their learning about materials and travel to design either a new vehicle that is good for our health and for Nature's health or a new type of footwear that could encourage active travel.

Explain that they will need to think about:
- The healthiest forms of travel (you could simply suggest that they focus on a shoe or car for the future)
- The most suitable materials to use in their design and why they are using them
- Where those materials come from
- Whether their design could be inspired by something in Nature

These criteria will need to be displayed and referenced during the activity.

Share Resource 3B, which lists the properties of different materials. Encourage the children to think about the properties that the materials they choose for their design will need to have. Once they have identified the required properties of each material, they should draw on their learning to select and name the most suitable materials to use.

TIME TO EXPLAIN:
Allow the children time to draw their design and label it with the materials they will use and their properties. Children should check they have thought about the criteria for the activity before presenting their design to the other children on their table.

STEM SENTENCES:
I have designed a _____ .
My _____ will be made from
_____ , _____ and _____
because _____ .
This will be good for my health and Nature's health because _____ .
Nature has inspired _____ in my design.

Invite each table to put forward one design to be judged in the 'Future Travel Final'. As a class, evaluate and vote on the designs.

What have we learned today?

Encourage the children to reflect on their learning linked to the **principle of Adaptation**, and assess their understanding, by asking: *What are the most important things to think about when designing different types of travel? What should we think about when choosing suitable materials? How can we change the way we travel to improve our health and Nature's health?*

Finish this lesson by revisiting the enquiry question: *Why should we change the way we travel?* Extend the children's learning about the **principle of Adaptation** by discussing how adaptation is going to play an important part in making how we travel in the future more sustainable.

TEACHER TIP:
Adaptation is about the future and the kind of future we want to create. When thinking about our use of materials and the way we travel, it is important to consider what we can learn from the past and the present, as well as from Nature. This helps us to think about what we might do to create a better future. Designing for the future is a key feature of a healthy education. It empowers young people to see themselves as agents of change.

Resource 6A

Which is the odd one out?

Additional image credits

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Cat's eye by Rossographer © 2010 Rossographer, licensed under CC BY-SA 2.0 (creativecommons.org/licenses/by-sa/2.0/) Source: geograph.org.uk/photo/2129631

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