Dippy on Tour

A Natural History Adventure

Resources for ages 7–11

From early 2018 to late 2020 the Natural History Museum's iconic *Diplodocus* cast, Dippy, is on a Natural History Adventure across the UK. We hope that Dippy will inspire you to go on your own adventure, exploring the incredible natural history collections and amazing biodiversity right on your doorstep!

These materials are a collection of lesson outlines and learning resources designed to accompany *Dippy on Tour: A Natural History Adventure.*

The adventure has eight episodes, one for each of Dippy's tour locations. Each episode is linked to that region's star specimen – a key natural history specimen on display – and provides learning opportunities in Natural History, Science, English and more.

Produced in collaboration with KIT Theatre.
www.KITtheatre.org

NATURAL HISTORY MUSEUM **In partnership with** Garfield Weston FOUNDATION

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Dippy on Tour: A Natural History Adventure

Introduction for teachers

These materials are a collection of lesson outlines and learning resources designed to accompany *Dippy on Tour: A Natural History Adventure*.

Dippy on Tour: A Natural History Adventure is an exploration of the UK's natural history past, present and future. Dippy, the replica cast of a *Diplodocus* skeleton that was given to the Museum in 1905, is a catalyst for exploring different aspects of the natural world along the eight-stop tour to museums and cultural hubs.

These resources provide a natural history-themed adventure for children aged 7 – 11, whether or not they visit Dippy during his tour.

The adventure has eight episodes, one for each of Dippy's tour locations. Each episode is linked to that region's star specimen – a key natural history specimen on display – and provides learning opportunities in Natural History, Science, English and more.

Postcards from Dippy's team of experts introduce the children to the main challenge of each episode. These postcards are accompanied by lesson scripts that introduce each task. These are read to the class by teachers.

> *Hello teacher, both postcards and lesson scripts use italics like this to directly communicate with the teacher who is reading the text – a little like stage directions in a play.*

The challenges require pupils to become Natural History Adventurers and are framed as training to develop the skills to graduate as Future Scientists. As they finish work on each challenge, children send an email to Dippy's team that triggers an automated response congratulating them on their work. At the end of their adventure the children will receive certificates to celebrate their achievements and confirm their graduation as Future Scientists.

Teachers can choose to use as many or as few episodes as they wish. The episodes are designed to stand alone as well as be part of a narrative.

Each lesson responds to learning objectives in two or more subject areas and uses creative, enquiry-based approaches such as role play, hypothesis, debate and research. Lessons emphasise paired or group work and build skills in social and emotional learning. While providing ideas for exciting and engaging lessons, the materials are designed for teachers to use as best fits their class and situation.

Activities could and should be broken up as is suitable for particular classes and over a period of time that works for the children.

The materials are designed to appeal to children aged 7–11. In a school context this covers a wide range of ability - some children may need more support than others and lesson ideas may need to be adapted for age or ability. The lessons, however, are designed to engage and appeal to children at their own level and are generally differentiated by outcome.

It is not supposed that all the activities will necessarily be used. Teachers should select those that seem most appropriate to their class.

Above all, we hope the adventure will provide a rich context for learning. The children will have the chance to build their understanding of the natural world as it was millions of years ago, as it is now and how it might be in the future. They will learn how animals and plants adapt to their changing environments and will engage with important issues such as the impact of technology or conservation on the natural world. Through having fun completing their activities they will learn how they can influence change for the better.

A note on maintaining the narrative of the adventure

In order to maximize pupils' engagement with the adventure, teachers are encouraged to sustain the narrative by referring back to pupils' core mission and emphasising the prestige of pupils graduating as Future Scientists.

The postcards and lesson scripts provided allow Dippy's team – rather than teachers – to introduce challenges. To this end, we recommend that teachers keep the final certificate and postcard hidden until they have completed all the episodes they require, meaning they can unveil the final message with a little fanfare at the adventure's end. The timing of this is entirely at teachers' discretion – there is no need to link it with the actual tour stops or end of the tour.

Similarly, while teachers will receive all episodes in advance, a sense of progression can be given by only revealing the postcards and challenges one at a time.

At the end of each episode in class, teachers are asked to email DippyOnTour@nhm.ac.uk to confirm completion. By including a specific subject line you will receive an episode-specific reply, congratulating pupils and providing some additional content. This is an automated email account. It's just an option to send through some documentary evidence of what happened in the episode. This will maintain the narrative, but is not required.

A note on glossaries

We have compiled a glossary for each episode. This can be used to support children's learning and to clarify the core scientific ideas in each episode.

Beginning the adventure

The adventure begins with teachers reading the introduction postcard from Lorraine, Head of Conservation at the Natural History Museum in London. She introduces children to Dippy's tour and their mission as Natural History Adventurers (we have provided an additional glossary for this introduction). Once the teacher has read this postcard they then read the postcard launching the episode number they wish to start with. After the introductory postcard has been read, episodes can be delivered in any order.

A note on visiting Dippy on Tour

If teachers do arrange for pupils to visit one of the tour stops, we suggest they take the postcard and star specimen introduction linked to that venue with them. This means that pupils can search for the star specimen on location and consolidate any learning they have done around the episode.

We hope that teachers and children alike enjoy their adventure!

Dippy on Tour: A Natural History Adventure – Episode summaries and curriculum links

Episode and page number	Core challenge	Curriculum links			
		English	**Northern Irish**	**Scottish**	**Welsh**
Episode 1: Jurassic forest Page 1	Pupils create a Jurassic forest in their classrooms.	Science – Living things and their habitats Science – Life cycle of plants Mathematics – Multiplication and Division Music – Improvising and composing Art and design	The world around us – Interdependence The world around us – Place The world around us – Change over time The Arts: Music The Arts: Art and design	Sciences: Planet Earth – Biodiversity and interdependence Biological Systems – Inheritance Number, money and measure: Number and number processes Music Art and design	Science: Skills – Enquiry Science: Range – Interdependence of organisms Maths: Using number skills – Use number facts and relationships Music: Skills – Composing Art and design
Episode 2: The big bird watch Page 20	Pupils go birdwatching in their school grounds and learn how some dinosaurs evolved into birds.	Science – Living things and their habitat Science – Evolution and inheritance English – Writing, composition	The world around us – Interdependence The world around us – Place Language and literacy – Talking and listening Language and literacy – Writing	Science: Planet Earth – Biodiversity and interdependence Literacy and English: Writing – Enjoyment and choice Literacy and English: Writing – Creating texts	Science: Range – Interdependence of organisms Science: Skills – Developing English – Strand: Writing Organising ideas and information English – Writing accurately
Episode 3: A game of snakes and antlers Page 35	Pupils play the animal survival board game *Snakes and Antlers*.	Science – Evolution and inheritance Science – Living things and their habitats PSHCE – Taking turns, co-operating, winning and losing with good grace English – Reading non-fiction	The world around us – Interdependence The world around us – Place The world around us – Change over time	Science: Planet Earth – Biodiversity and interdependence	Science: Range – Interdependence of organisms PSE: Skills – Working with others PSE: Range – Sustainable development and global citizenship

Dippy on Tour: A Natural History Adventure – Episode summaries and curriculum links

Episode and page number	Core challenge	Curriculum links			
		English	**Northern Irish**	**Scottish**	**Welsh**
Episode 4: The beaver's back! Page 44	Pupils create pamphlets exploring the issue of beavers being reintroduced to Scotland.	English – Writing, composition Science – Working scientifically Geography – Human and physical geography	Language and literacy – Writing The world around us – Place	Literacy and English – Writing: Organising and using information Literacy and English – Writing: Creating texts Science: Planet Earth – Processes of the planet Science: Planet Earth – Biodiversity and interdependence	Science: Skills – Communication Science: Range – Interdependence of organisms English – Strand: Writing Organising ideas and information Geography: Skills – Understanding places, environments and processes Geography: Skills – Communicating
Episode 5: Future maps! Page 56	Pupils learn how places change over time – from swamps to cities! And create a future map of their own.	Geography: Locational knowledge History Science Year 4 – Human impact	The world around us – Interdependence The world around us – Place	Social studies: People, place and environment Numeracy and mathematics: Shape, position and movement Angle, symmetry and transformation Art and design	Geography: Skills – Locating places, environments and patterns Geography: Skills – Understanding places, environments and processes
Episode 6: The secrets of rocks Page 66	Pupils create their own fossil models for another group to excavate.	Year 3 Science: Rocks Art and design English: Writing – composition	The world around us – Place The Arts – Art and design	Sciences: Planet Earth Biodiversity and interdependence Art and design	Science: The sustainable Earth Art and design English Strand: Writing

Episode 7: **The great school lichen hunt** Page 94	Pupils learn how animals and plants survive in extreme environments and carry out a survey of lichen in their local area.	Science: Evolution and inheritance Work scientifically	The world around us: Interdependence The world around us: Place	Sciences: Planet Earth Biodiversity and interdependence	Science: Range Interdependence of organisms
Episode 8: **Debating dilemmas** Page 103	Pupils debate dilemmas that Future Scientists may face.	Science Year 4 English	The world around us– Place The world around us – Change over time The world around us – Interdependence Language and literacy – Talking and listening	Topical science	Personal and social education: Skills Developing thinking Developing communication Science: Developing communication Science: Range Interdependence of organisms

Dippy on Tour

Dippy on Tour: A Natural History Adventure 2018–2020

Hello there,

I'm Lorraine, Head of Conservation at the Natural History Museum in London, where I help care for all of the Museum's collections.

One of our national treasures is Dippy, the world's most famous *Diplodocus*. Dippy arrived at the Museum in 1905, but now he's begun an extraordinary journey across the UK. We're calling it *Dippy on Tour: A Natural History Adventure*.

Right now climate change, animal extinctions and other problems are threatening our planet. Scientists are doing all they can to fight back, but you can help us too by becoming Natural History Adventurers.

I'm working with a team of amazing natural history experts to create a training challenge for every stop on Dippy's great journey. Each challenge will build your skills to help tackle these problems and protect the natural world.

If you prove you have what it takes, you'll graduate as Future Scientists.

We can't wait to start our adventure with you.

Lorraine and Dippy's team

Natural History Adventurers

Dippy on Tour
Future Scientist Training

School

UK

Contents

Episode 1: Jurassic forest (Dorset)

Natural History Adventurers' mission

Use imagination and creative skills to recreate lost worlds.

Episode journey

Children discover the living things that existed in a Jurassic forest and create a Jurassic forest in their classroom. They film a first-person perspective journey through their forest using a tablet or camera, and make and record Jurassic forest sounds to accompany it.

Curriculum learning outcomes

- children will learn the names of more than two living things in their local and wider environment (**Science / The world around us**)
- children will be able to identify and describe the functions of different parts of flowering plants (**Science**)
- children will understand the life cycle of flowering plants (**Science**)
- children will be able to describe the life processes of reproduction in some plants (**Science**)
- children will apply multiplication (**Mathematics**)

The postcard introduces the children to the Jurassic Coast and the fossils found along it, including the dinosaur footprints on the front of the card. It introduces the fossil Jurassic forest discovered in the cliffs of Dorset – a snapshot in stone of the sort of world where the *Diplodocus* Dippy was cast from would have lived.

The children's challenge is to create a Jurassic forest in their classroom. They will explore the animals and, in particular, the plants that lived there. If feasible they will find ferns, conifer twigs and pine cones from a nearby woodland or parkland, to make their own Jurassic forest. The enclosed resources and lesson ideas give further tips on how to transform the classroom, and challenge the children to explore the similarities and differences between ferns and the flowering plants of today.

Possible additional activities

- Children write stories set in the Jurassic forest that they have created.
- Children invite younger years to visit their Jurassic Forest with the lights off, complete with sounds and maybe even children disguised as dinosaurs.
- Children investigate fiction books for younger children with dinosaurs in them. How realistic do they think the dinosaurs are? What do we know about how dinosaurs might have looked? What evidence can we base our ideas on?

Activities

Not all activities will be relevant for all classes. The activities were developed to be broken up and used over a period of time and as is suitable for your particular class.

- Read the **introductory postcard** and discuss it with the class, using the **glossary** as required. Share the **lesson script 1** with the children. Discuss the map showing how the world looked in the Jurassic Period. What are the similarities and differences between how the British Isles looked in the Jurassic Period and today? How was the climate different? Use the picture of the Jurassic forest (**image 1**) to answer the following questions. What creatures lived in the UK at the time? What plants grew there? What plants did not exist then? This could be a class discussion or you could divide the children into groups to research the answers to their additional questions.
- The fact that one type of plant is missing from the Jurassic forest is posed as a puzzle at the end of **lesson script 1**. The answer is revealed in **lesson script 2**, so teachers can build tension by keeping **lesson script 2** hidden until pupils have come up with their answers. Children should understand that:
    - The British Isles did not exist as we now know them, as some of the land was under the sea and some was joined to Europe as a different land mass. It was also much warmer, as we were closer to the Equator.
    - Many different types of dinosaur (and pterosaur) lived back then and we can sometimes find their fossilised remains.
    - Creatures living at the time included reptiles (dinosaurs and pterosaurs), insects, scorpions and early types of birds and mammals.
    - There were no flowering plants in the Jurassic Period.

- Share **lesson script 2** with the children. This reveals that there were no flowering plants in the Jurassic Period. Look at the diagram (or a living example) of a modern flowering plant and compare it with the diagram of a fern. What differences and similarities can they see?
- Discuss how flowering plants reproduce. This may be considered revision or learning for the first time depending on the age of the children. Discuss how ferns reproduce without flowers, using research materials as appropriate.
- What would Dippy have eaten? Point out that Dippy was a herbivore. What sort of plants would he have eaten? How would his long neck have helped him? Ask the children to use the statistics they have been sent (**lesson script 3**) to work out how much food Dippy would have eaten in a year. You could photocopy this sheet for reference for the children, or model equations on the whiteboard for younger Key Stage 2 groups.
- If possible, take the children on an expedition to a nearby woodland, parkland or school grounds to search for ferns and conifers to photograph and collect. If it is not possible to carry out this expedition please skip to **lesson script 4**.
- **lesson script 3.5** introduces the children to the excursion and its rules. Show the children pictures of ferns (**pupil resource 1**) and conifers (**pupil resource 2**) and discuss what they are looking for. Point out that conifers have cones and often have flat, needle-like leaves. Take copies of these images with you to help the children remember what they are looking for.
- Following the excursion ask the children to investigate their finds using the images provided (**pupil resources 1** and **2**). What are the features of the ferns and conifers they have found? They may wish to do close observational drawings of the plants.
- Share **lesson script 4** with the children. Discuss with them how they could transform their classrooms into a Jurassic forest. If it is not feasible to attach or hang large leaves in the classroom, smaller environments could be made in boxes (individually or in groups). Ask the children to make leaves and branches with paper and card to represent a Jurassic forest and build their environment in the classroom or box. Another alternative would be to expand on computer science lessons to create their forest on computers.
- Read **lesson script 5** to the pupils and discuss the sounds that would have been heard in the Jurassic forest. Use the tips to create an authentic soundscape. Divide the children into groups to prepare and rehearse their soundscapes using percussion instruments and their voices. Orchestrate these so that one group's composition merges into the next. Record these, play them back and discuss what is most effective.
- Read **lesson script 6** to the pupils and discuss how they could film a journey through their forest. Whose viewpoint would it be from? What would make it most evocative (eg lighting and sound effects)? Online films of wildlife documentaries can be used as examples – here's a film of Sir David Attenborough describing the jungle: www.youtube.com/watch?v=H9MV5CgPgIQ& .
- Choose roles – eg director, narrator, camera operator, lighting technician and sound effects artist – and use tablets or cameras to film a first-person perspective journey through their Jurassic forest. You could use these Jurassic sound effects: nhm.ac.uk/dippy-sounds.
- Send confirmation to Dippy's team at DippyOnTour@nhm.ac.uk with the subject line **Forests**. This triggers an automated reply acknowledging receipt.

Resources required

Provided in the Natural History Museum package:

- introductory postcard
- glossary
- lesson scripts 1–6
- pupil resources 1–2
- image 1
- sound effects of the Jurassic: nhm.ac.uk/dippy-sounds

Provided by the school:

- photocopying for pupil resources (they do not need one each)
- materials for creating a Jurassic forest (card, paper, shoebox etc)
- filming device (tablet, phone, camera etc)
- percussion instruments

A note on the expedition

If this element is impossible in your case, the episode will still work effectively using only foliage crafted in the classroom.

The expedition can take place in a variety of ways and locations. For schools close to a woodland, this is the perfect opportunity for children to explore using the spotter sheets (**pupil resources 1** and **2**) to look for samples to build their forests with. Some school grounds have patches of woodland or at least a few trees and green patches where bracken might grow.

Lesson script 3.5 from Dippy's team makes it clear to children that while it is okay to select foliage such as ferns from woodlands and public spaces, they should avoid picking flowers or uprooting any plant entirely and only take a few samples.

English curriculum areas covered by Episode 1 (Key Stage 2)

The plant-hunting expedition covers:

Science Year 4: Living things and their habitats

Children should be taught to

- explore and use classification keys to identify and name a variety of living things in their local and wider environment

The comparison between Jurassic ferns and a modern flowering plant covers:

Science Year 3: Plants

Children should be taught to

- identify and describe the functions of different parts of flowering plants: roots, stem/trunk, leaves and flowers
- explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal

(This comparison could go on to explore how ferns reproduce using spores.)

Science Year 5: Living things and their habitats

Children should be taught to

- describe the life processes of reproduction in some plants and animals

*The calculation elements relating to Dippy's diet (**lesson script 3**) covers:*

Mathematics

Multiplication and division – the multiplication and division calculations related to Dippy's diet will need to be adapted to offer different versions for Upper and Lower Key Stage 2 children.

The creation of a Jurassic forest soundscape covers:

Music

Pupils should be taught to

- improvise and compose music for a range of purposes using the interrelated dimensions of music

The creation of additional foliage and elements of the Jurassic forest covers:

Art and design

Pupils should be taught:

- to develop their techniques, including their control and their use of materials, with creativity, experimentation and an increasing awareness of different kinds of art, craft and design
- to improve their mastery of art and design techniques, including drawing, painting and sculpture with a range of materials

Northern Irish curriculum areas covered by Episode 1 (Key Stages 1 and 2)

The world around us: Interdependence

Pupils should be enabled to explore:

- how living things rely on each other within the natural world

The world around us: Place

Pupils should be enabled to explore:

- how place influences the nature of life
- ways in which people, plants and animals depend on the features and materials in places and how they adapt to their environment
- features of, and variations in places, including physical, human, climatic, vegetation and animal life
- change over time in places

The world around us: Change over time

Pupils should be enabled to explore:

- ways in which change occurs over both short and long periods of time in the physical and natural world

Mathematics and numeracy

The Arts: Music

Pupils should be enabled to:

- work creatively with sound by creating musical stories, pictures, patterns, conversations, accompaniments and by investigating ways of preserving the music they have created
- sing and perform with simple instruments from memory, by ear or from notation to develop vocal and instrumental skills
- listen and respond to their own and others' music-making, thinking about, talking about and discussing a variety of characteristics within music that they create, perform or listen to

The Arts: Art and design

Pupils should be enabled to:

- engage with observing, investigating, and responding to first hand experiences, memory and imagination
- collect, examine and select resource material to use in the development of ideas
- develop their understanding of the visual elements of colour, tone, line, shape, form, space, texture and pattern to communicate their ideas

- use a range of media, materials, tools and processes such as: drawing, painting, printmaking, malleable materials, textiles and three-dimensional construction, selecting which is appropriate in order to realise personal ideas and intentions

Scottish curriculum areas covered by Episode 1 (First and Second)

Sciences

Planet Earth

Biodiversity and interdependence

I can explore examples of food chains and show an appreciation of how animals and plants depend on each other for food. **SCN 1-02a**

I can identify and classify examples of living things, past and present, to help me appreciate their diversity. I can relate physical and behavioural characteristics to their survival or extinction. **SCN 2-01a**

Biological systems

Inheritance

By comparing generations of families of humans, plants and animals, I can begin to understand how characteristics are inherited. **SCN 1-14a**

By investigating the lifecycles of plants and animals, I can recognise the different stages of their development. **SCN 2-14a**

By exploring the characteristics offspring inherit when living things reproduce, I can distinguish between inherited and non-inherited characteristics. **SCN 2-14b**

Number, money and measure

Number and number processes

I can use addition, subtraction, multiplication and division when solving problems, making best use of the mental strategies and written skills I have developed. **MNU 1-03a**

Having determined which calculations are needed, I can solve problems involving whole numbers using a range of methods, sharing my approaches and solutions with others. **MNU 2-03a**

Music

Inspired by a range of stimuli, and working on my own and/or with others, I can express and communicate my ideas, thoughts and feelings through musical activities.
EXA 0-18a / EXA 1-18a / EXA 2-18a

Art and design

I can create and present work using the visual elements of line, shape, form, colour, tone, pattern and texture. **EXA 1-03a**

Through observing and recording from my experiences across the curriculum, I can create images and objects which show my awareness and recognition of detail. **EXA 2-04a**

Welsh curriculum areas covered by Episode 1 (Key Stage 2)

Science: Skills

Enquiry

Pupils should be given opportunities to carry out different types of enquiry, *eg pattern-seeking, exploring, classifying and identifying, making things, fair testing, using and applying models.*

Science: Range

Interdependence of organisms

Pupils should use and develop their skills, knowledge and understanding by investigating how animals and plants are independent yet rely on each other for survival.

4. through fieldwork, the plants and animals found in two contrasting local environments, *eg identification nutrition, life cycles, place in environment*
6. the environmental factors that affect what grows and lives in those two environments, *eg sunlight, water availability, temperature*

Maths (numeracy): Using number skills

Use number facts and relationships

Music: Skills

Composing

Pupils should be given opportunities to:

1. improvise, compose and arrange music

during which they should:

2. explore, use, create, select and organise sounds for a musical purpose
3. develop and refine musical ideas, and evaluate their work in order to improve it
4. communicate ideas and emotions through music

Art and design

Skills

Investigating

Pupils should be given opportunities to:

1. select and record from:
   - observation
   - experience
   - memory
   - imagination
2. investigate:
   - the natural environment
   - the made environment
   - the world of imagination

using a variety of materials

3. organise:
   - reference materials
   - resources

to develop ideas themes and feelings, *eg collect information for a design project from the internet, library or local gallery about endangered species.*

Making

Pupils should be given opportunities to:

1. explore, experiment with and apply the elements of the visual, tactile and sensory language of art, craft and design
2. design and make:
   - two-dimensional images
   - three-dimensional objects and artefacts using a range of various materials for a variety of purposes

Links to Literacy and Numeracy Framework:

Oracy – developing and presenting information and ideas – listening, speaking, collaboration and discussion.

Reading – responding to what has been read – response and analysis.

Introductory postcard 1

Dinosaur footprints. Owned by and on display at Dorset County Museum.

Hello,

I'm Paul, a Research Scientist at the Natural History Museum in London. I study fossil plants.

Today Dorset's beaches are calm and peaceful places. But 150 million years ago, this was all different. Back then, you might have come face-to-face with a mighty meat-eating dinosaur like the one that made the gigantic footprints on this card. This is because Dorset's beaches were once a steamy Jurassic forest.

But how do scientists know that these beaches were a Jurassic forest? What do you think?
[Hello teacher, please have this discussion now.]

Here's the answer: we know there was a forest there because we found fossilised trees buried deep within the cliffs.

Your Natural History Adventurer challenge is to create a Jurassic forest in your classroom. To become Future Scientists, you need to prove that your imaginations are powerful enough to recreate lost worlds.

Good luck!

Paul

Natural History Adventurers

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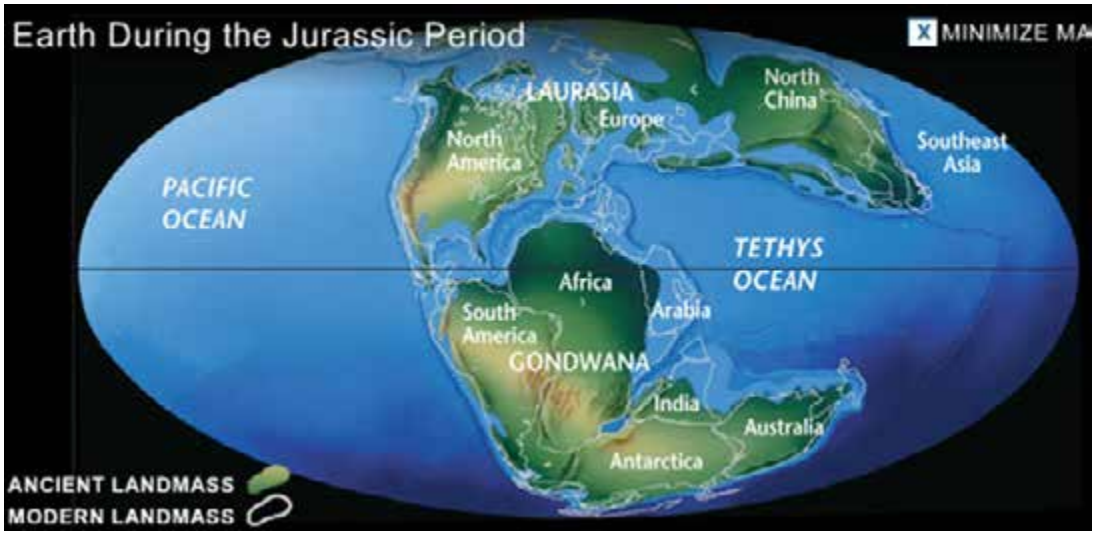
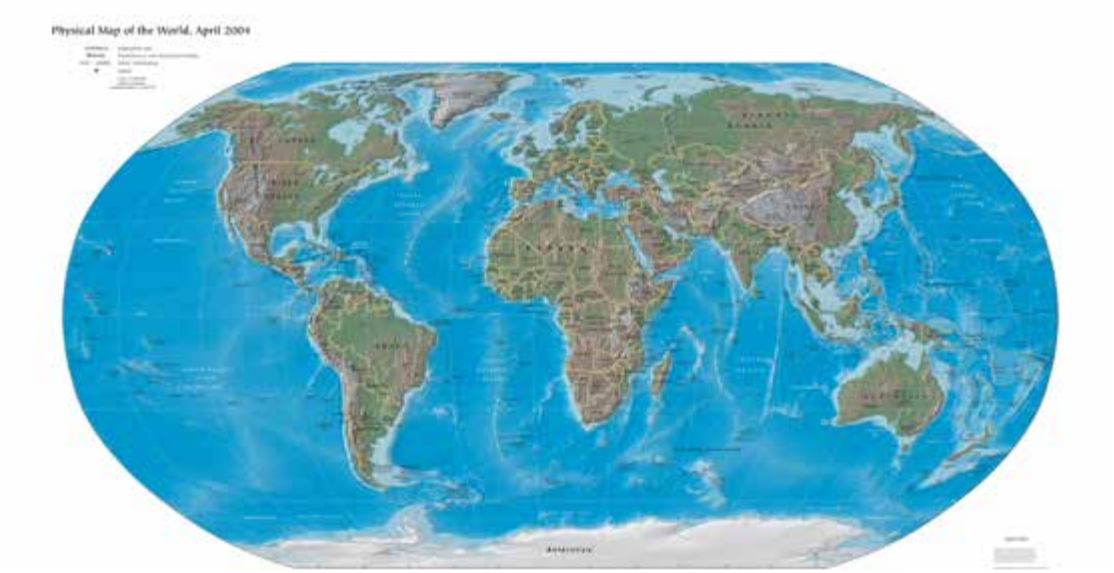
Lesson script 1

Before you create your own Jurassic forest, you'll need to know a little more about what the Jurassic world was like. Here's an image of how the world looked when Dippy was alive, around 150 million years ago. As you can see, it was very different. Can you see how South America, Africa, Antarctica and Australia were all joined together? If you look carefully, you can see the UK, much further south and closer to America than it is today. The fact that the UK is closer to the equator means that the Jurassic forest was much warmer than our forests today.

Compare the image of Earth during the Jurassic Period with this image of how the world looks today. The continents have moved apart and the UK has moved further north. If you look carefully, you can see how the east coast of South America (the right-hand side of South America on the map) still looks as if it would fit into the west coast of Africa (the left-hand side of Africa on the map), like a gigantic jigsaw puzzle. Evidence like this helped scientists understand that the continents were moving.





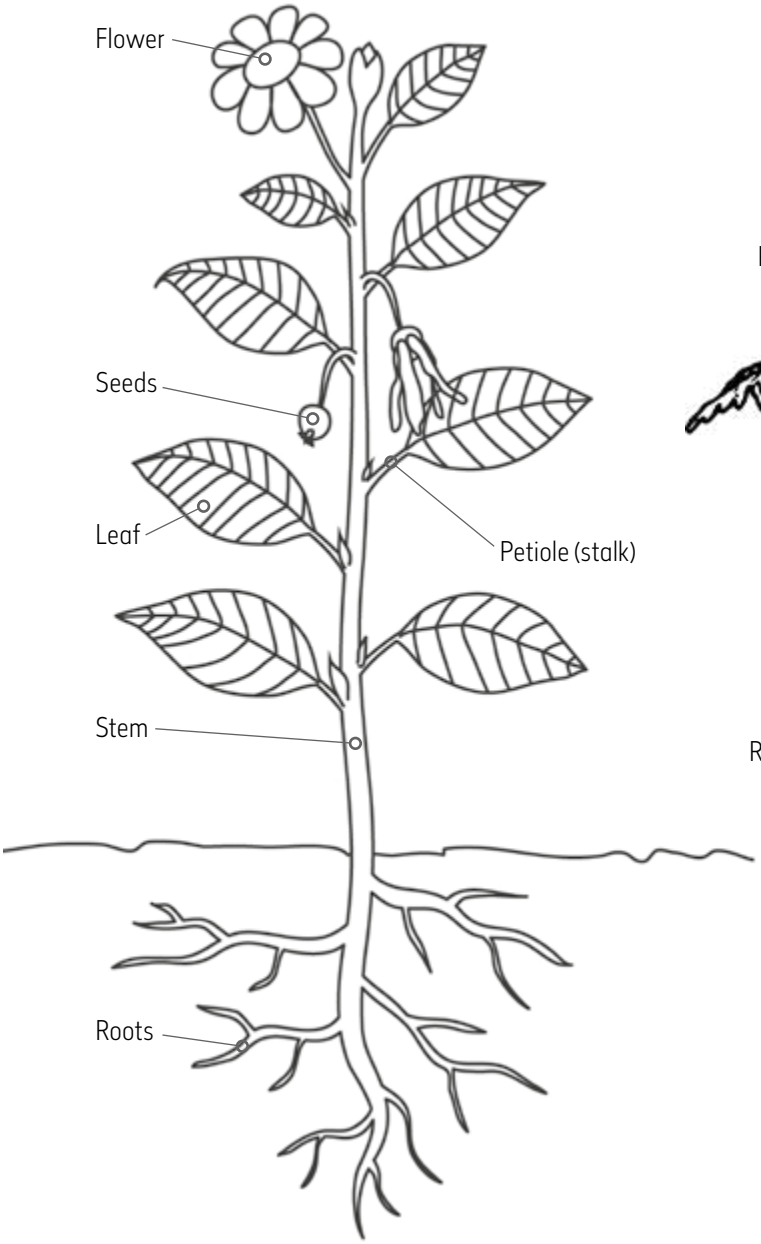
Now that you know how the world has changed, you can move on to what a Jurassic forest looked like. Take a look at this drawing of a Jurassic forest in Yorkshire. As you can see, there are some things that are similar to a forest today, but other things are very different. One thing a Jurassic forest had that today's forests don't was dinosaurs and pterosaurs. But there's one important form of life that grows in modern forests that didn't grow in the Jurassic forest. Have a look at this picture and see if you can spot what's missing.

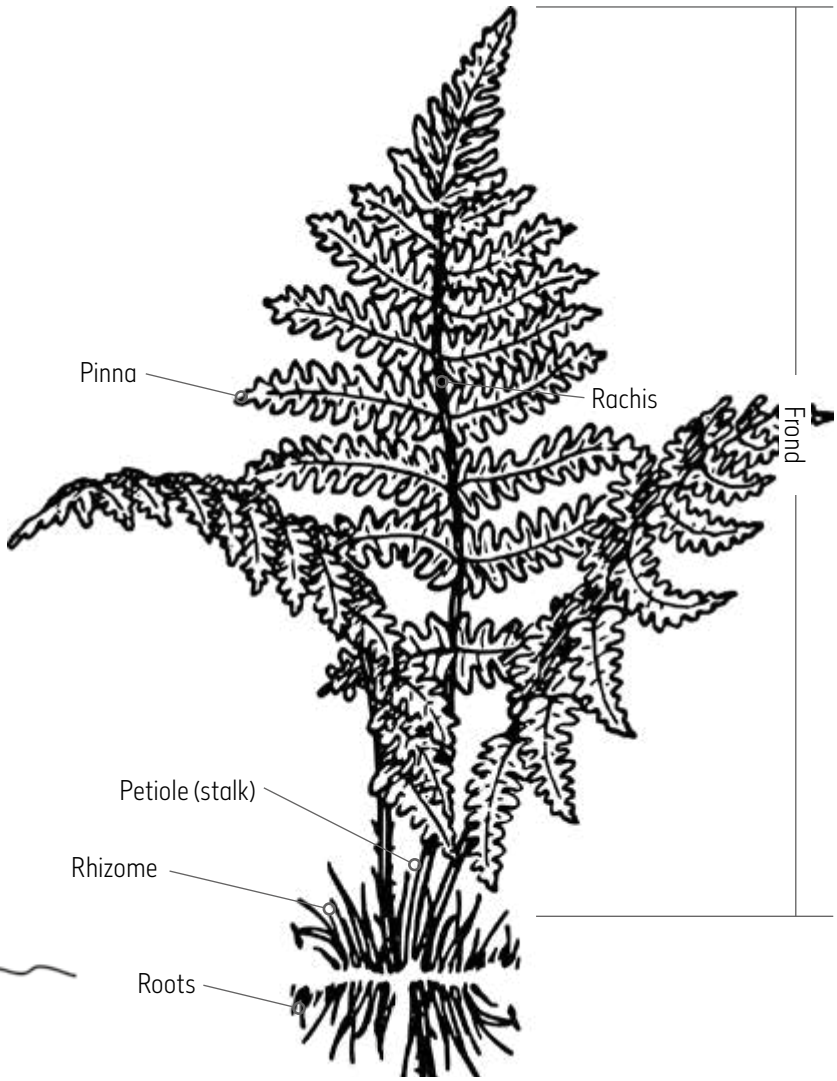
Image 1: Jurassic forest

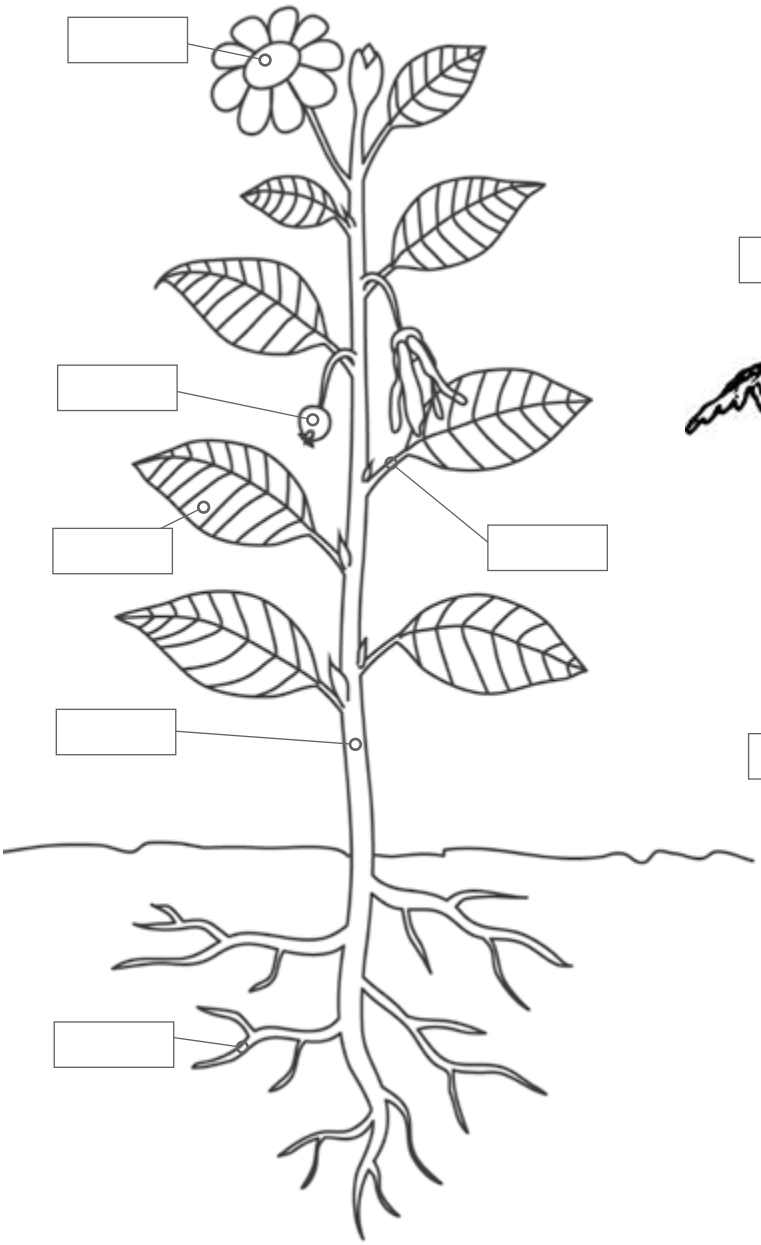
Lesson script 2

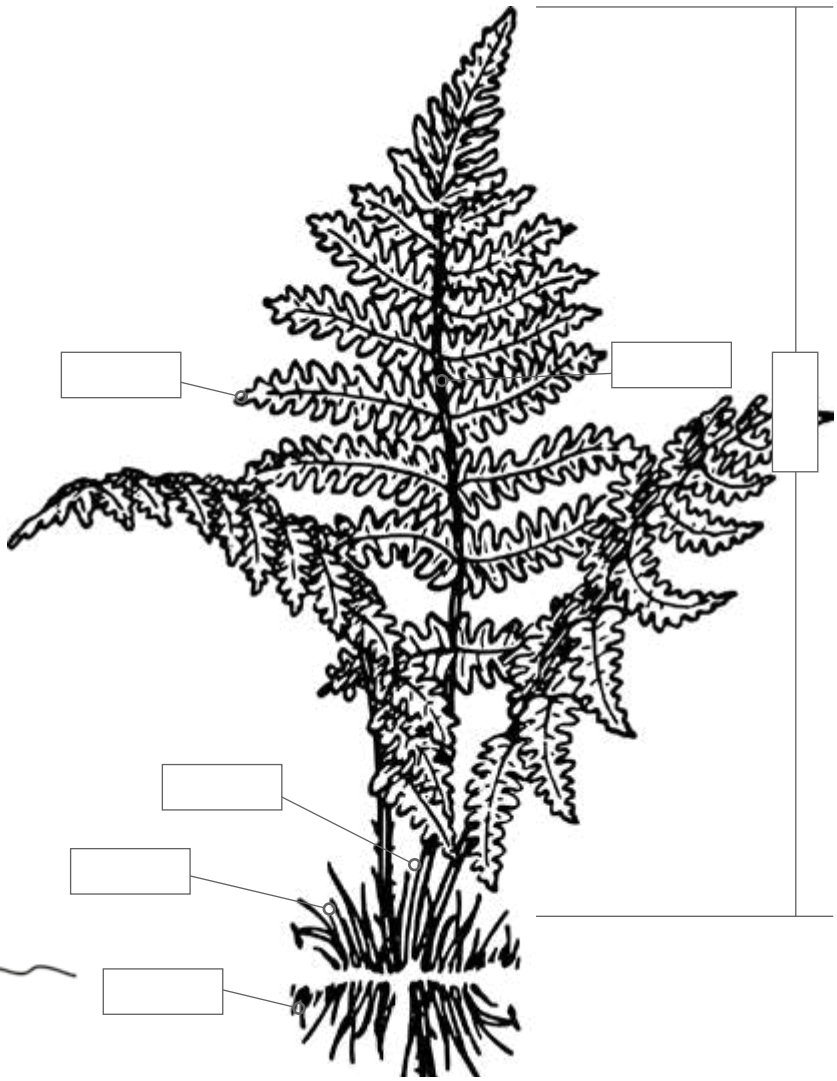
Did you guess correctly? The things that grow in our forests today but were missing from a Jurassic forest are flowering plants. Instead of plants with flowers, Jurassic forests were filled with ferns and conifer trees. This meant that life cycles in a Jurassic forest were very different from today.

Observe this diagram of a flowering plant and a fern and make a list of all the things that are the same and all the things that are different from each other. With your teacher, can you uncover the role that flowers play in the life cycle of flowering plants?









Lesson script 3

As Dippy was 26 metres long, you can imagine that he had to eat quite a lot of food.

But how much? Future Scientists need to prove that they are good with numbers too.

We estimate that Dippy was so huge he needed to eat 20 kilogrammes of vegetation every hour.
That's the same weight as a two-year-old human child!

So if we know that Dippy ate 20 kilogrammes of food per hour:

- How many kilogrammes did Dippy eat in one day?
- How many kilogrammes did Dippy eat in one week?
- How many kilogrammes did Dippy eat in one year?

Lesson script 3.5

It looks like you're going on an expedition to discover ferns and conifers in your woods – your own forest adventure!

Important: Woodland adventuring is really fun, but when you go collecting it's important that you always keep to the Country Code. The Country Code is a set of rules to protect the countryside so that everyone can keep enjoying it. There are some things you can collect from woodlands, and some things you cannot.

Here is what you can collect:

- leaves, sticks and pine cones that have already fallen off of a plant or a tree
- pick only one leaf from each plant, supplement this with photographs and drawings
- if you are out in a group take one example from each type back to the classroom as a collective, not one each

As for what you cannot collect, remember:

- in some protected areas (eg Sites of Special Scientific linterest) you cannot pick anything
- some species are protected by law and cannot be picked – as a general rule if something looks unusual or there isn't very much of it, don't pick it
- you must never pull the whole plant out of the ground because it will die
- you must not pick wild flowers
- some mushrooms and other fungi are poisonous so it's safest not to touch any of them and take photographs instead

Other things to remember in the woods:

- the woods are the home of the plants and animals and you are visitors, so if you meet any animals, do not disturb or frighten them
- don't trample on any plants
- when on expeditions, Natural History Adventurers should always work in pairs to make sure they stay safe

For further guidelines please download the Botanical Society of Britain & Ireland's Code of Conduct 2017.

Your teacher has pictures of common ferns and conifers to help you find modern plants that look like those in a Jurassic forest. Before you set off, take a moment to look at these pictures so you know exactly what you're looking for.

*Hello teacher, please hand out **pupil resource 1** and **2** now.*

Good luck on your woodland expedition. Dippy's team can't wait to see how your Jurassic forests turn out.

Pupil resource 1

Golden-scaled male fern

Male fern

Lady fern

Pupil resource 2

Scots pine

Juniper

Yew

Lesson script 4

Now that you understand a little about the Jurassic world, you're ready to create your own Jurassic forest. Here are some pictures of ferns and conifers similar to those in a Jurassic forest. Your job is to create your own ferns and conifers from paper, card and other things that you and your teacher can find. Take a look at the images and use them as inspiration for making your forest.

This is a ginkgo. It is a relative of the conifer trees that were common in Jurassic forests. Its leaves were shaped like fans. Can you make your own gingko leaves for your classroom forest?

Ginkgo tree

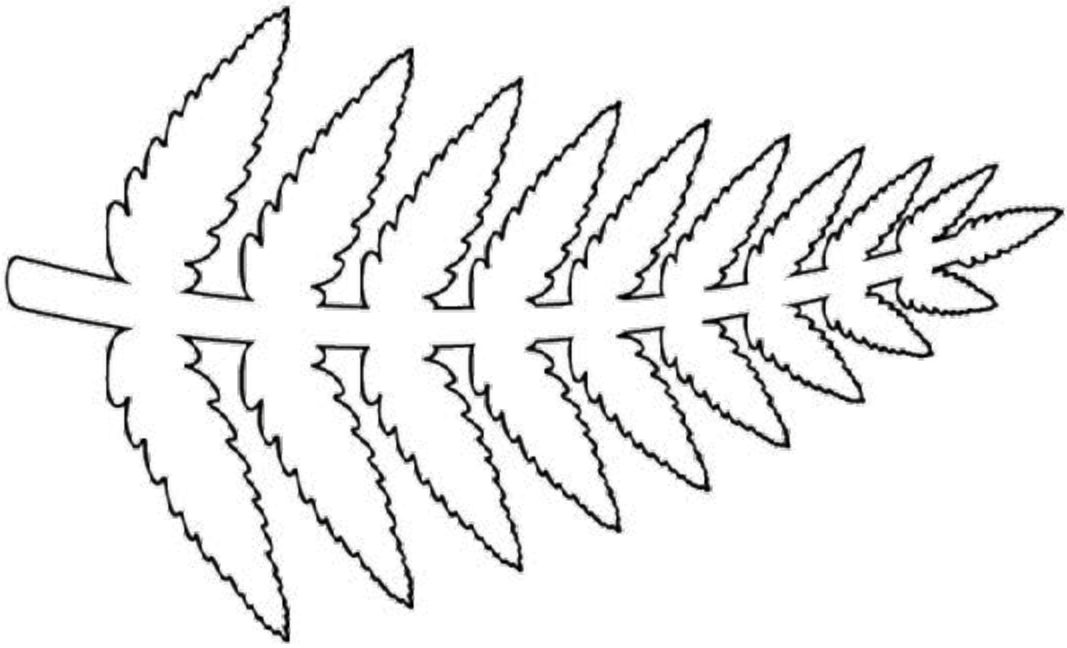
Ginkgo's fan-shaped leaves

Here are some ferns called *Dicranopteris* that grew in Jurassic forests. What sort of materials could you use to create your own ferns for your classroom forest?

Dicranopteris, a type of fern

Here is a simple outline of a conifer tree branch and a pine cone. Perhaps you can make something that looks like this. You can also colour it in.

Here's a simple outline of a fern. You could make one that looks like this and colour it in.



Lesson script 5

If you're reading this, it must mean that you have created your amazing Jurassic forest. Dippy's team can't wait to see how it looks – and sounds. All forests today are pretty noisy places, as were Jurassic forests. Of course, we don't know exactly what noises dinosaurs made, but we have some theories. Some noises we know a *Diplodocus* would have made are the thunderous, crashing sounds as it walked through the forest.

Your next challenge is to bring your forest to life by recreating the sounds in it. Your teacher has links to sounds that scientists think would have filled a Jurassic forest. You could listen to some of these now.

We've started a list of creatures who lived in the Jurassic forest and the sounds we think they might have made...

Creature	**Sound**
Diplodocus	Crashing footsteps

Your next challenge is to work out how to bring these sounds to life.

One musical instrument that humans have is their voice. Your teacher may be able to find other things to help you make your sounds. Once you have experimented with your soundscape, your teacher can record it.

Once you've done this, you're ready to put together your own Jurassic forest movie.

Lesson script 6

The final step is to film a journey through the Jurassic forest you've made.

Your movie should take us back in time to a Jurassic forest, complete with trees, plants and the sounds of distant dinosaurs.

Using a tablet or video camera, please film a first-person journey through the world. A first-person perspective is when we see the world from the point of view of one character. We see what the character in the film is seeing. Computer games like *Minecraft* use a first-person point of view – we play a character and see what they see.

Some of you can be the narrators for the journey, telling the story of what happens. Here's a film of Sir David Attenborough, one of the greatest Natural History Adventurers of them all, talking about life in the rainforest. He's the master of narration, so use him for inspiration!

www.youtube.com/watch?v=H9MV5CgPgIQ&t=30s

We also need at least one of you to be the camera operator. Who has the steadiest hands?

Finally, some of you can take turns to be directors. A director makes sure that everyone knows what they are doing and when they should do it. The director also says 'action' to tell the camera operator to start filming.

Here are some tips for creating the best films:

- once the director has said 'action' make sure that the only noises made are by the person narrating and the people making the sounds of the forest
- try and keep the camera or tablet as steady as possible
- write a short script to practice your narration
- remember to have some rehearsals before filming the final version

When you have finished, your teacher can email images and films to DippyOnTour@nhm.ac.uk with the subject line **Forests** so Dippy's team can see what you have made.

Episode 1 glossary

Conifer

A tree (or sometimes a bush) that has cones and needle-like or scale-like leaves. It is generally evergreen, meaning it keeps its leaves in winter.

Continent

One of Earth's seven major areas of land. The continents are Africa, Antarctica, Asia, Australia, Europe, North America and South America.

Dinosaurs

A group of reptiles that lived on land. Dinosaurs lived on Earth from around 231 million years ago to 66 million years ago. Most dinosaur groups are now extinct.

Diplodocus

Diplodocus was a dinosaur that lived about 150 million years ago during the Late Jurassic Period. It grew up to 30 metres long and weighed up to 20 tonnes. It ate plants and had four legs, a long neck and a long tail.

Dippy

Dippy is the name given to the Natural History Museum's cast of a *Diplodocus* skeleton. He was cast from original fossil bones discovered in the USA in 1898. He came to the Natural History Museum in 1905.

Expedition

A journey or trip that people go on for a particular reason. For example, some scientists go on an expedition to find rare fish.

Fern

A common plant that has feathery leaves called fronds and does not produce flowers.

Flowering plant

A plant that produces flowers that are used for reproduction.

Fossil

The remains or impression of a prehistoric plant or animal embedded and preserved in rock. Fossils can be the actual remains of a once living thing, such as bones or seeds, or traces of past events, such as dinosaur footprints.

Herbivore

An animal that feeds on plants.

Jurassic

The Jurassic Period was a geologic period that lasted 56 million years from the end of the Triassic Period (201.3 million years ago) to the beginning of the Cretaceous Period (145 million years ago). It is sometimes known as the Age of Reptiles.

Life cycle

The stages a living thing goes through during its life.

Pterosaurs

A group of large, flying reptiles that lived from around 228 million years ago to 66 million years ago.

Episode 2: The big bird watch (Birmingham)

Natural History Adventurers' mission

Develop field skills in animal identification and compare extinct animals with their living descendants.

Episode journey

Children take part in a 20-minute birdwatching excursion in their school grounds. Children understand the common features of a group of living things. Children discover how theropod dinosaurs evolved into birds.

Curriculum learning outcomes

- children will be able to identify and name a variety of living things in their local and wider environment (**Science**)
- children will learn to make accurate observations and tally their findings (**Science**)
- children will understand that living things produce offspring, but these may not be identical to their parents (**Science**)
- children will respond to a story about extinction by writing haikus (**English/Literacy**)

The **introductory postcard** reveals how birds are a modern kind of theropod dinosaur. The children are asked to first go birdwatching outside and identify common features that birds have. Pupils can compare the annotated diagram of a theropod dinosaur with their bird observations to identify common features.

In a follow-up lesson script the children are introduced to the sad story of the greak auk's extinction and are encouraged to write a haiku about the last auk.

Possible additional activities

- children watch birds around their own homes over a weekend and see how many different species they observe and what the most frequent visitors are
- children produce graphs and tables as appropriate to show the most frequent bird visitors to their school and home
- children set up a bird-feeding station in a suitable area of the school grounds

Activities

Not all activities will be relevant for all classes. The activities were developed to be broken up and used over a period of time and as is suitable for your particular class.

- Read the **introductory postcard** to the children and discuss it in class, using the **glossary** as required.
- Read **lesson script 1** to the children and lead an initial discussion about the sorts of birds they are familiar with and those they might observe in or around the school grounds. When would be a good time to observe birds? What behaviours would most likely help the children see as many birds as possible?
- Look at the bird-spotter sheet of common birds sent by the team (**pupil resource 1**) and get to know some likely sightings using the classroom's interactive whiteboard.
- Go through the survey sheet (**pupil resource 2**) with the children, ensuring they understand the different terms.
- Take the children out on their 20-minute big bird watch. Pupils should work in pairs, each pair with a copy of the bird-spotter sheet (**pupil resource 1**) and the survey sheets provided (**pupil resource 2**). Pupils can note the species and physical and behavioural characteristics (such as song or call).
- Bring the children back to the classroom to discuss their observations. What do they think makes a bird a bird? A key aspect of this discussion is to explore whether the characteristics they've observed apply to all birds. Flight, for example, could be challenged as a universal bird characteristic, as some birds have lost ability to fly.
- Read **lesson script 2**. Look at the image of a theropod dinosaur (**image 1**) and the image of a bearded vulture (**image 2**), and discuss visual differences and similarities between the two. Make comparative lists.
- After observing the changes between the theropods and birds, show the children the picture of the *Archaeopteryx* (**image 3**) to identify the features it shares with theropods and those it shares with a modern bird. Explain that scientists actually think of birds as a type of dinosaur.

- Introduce **image 4**, showing the skeletons of a theropod, an *Archaeopteryx* and a pigeon, and encourage pupils to create lists of features that are shared between the three skeletons. Ask children to work in pairs and hand one copy of **image 4** to each pair. Encourage pairs to draw lines onto the image to highlight similarities and differences.
- Read **lesson script 3** to introduce the next activity, about the extinction of the great auk. Show **image 5** (great auks) and read the sad story of the death of the last of its species. Discuss the story. How did it make them feel? *Note: some children may find this story upsetting – you know your children best and whether you need to scale back on the story or how you read it.*
- Ask the children to write their own haikus about the last great auk, displaying the instructions given in **lesson script 3**.
- With the class compose an email summarising their discoveries. Send this to Dippy's team of experts at DippyOnTour@nhm.ac.uk with the subject line **Birds**. This triggers an automated reply acknowledging receipt.

A note on the birdwatching trip

As with the foliage gathering in **Episode 1**, this can be adapted to meet your class's specific needs. In its simplest form it can consist of a 20- to 30-minute excursion to observe any birds living near or flying over school grounds. This is guaranteed to bring pupils into contact with common birds such as pigeons, crows, gulls, starlings, blackbirds etc. Alternatively, the excursion can be a more fully developed ornithological trip to a local bird reserve. The notes from the team include a checklist of common birds, so you can use your classroom whiteboard to zoom in on birds if close-up views prove tricky in the field.

You could also ask the children what kind of behaviours are likely to make it easier to spot birds? Being quiet and still.

Resources required

Provided in the Natural History Museum package:

- introductory postcard
- lesson scripts 1–3
- images 1–5
- pupil resources 1–2
- glossary

Provided by school:

- photocopies of bird-spotting sheet (pupil resource 1)
- copies of image 4 (bird skeletons)
- clipboards and binoculars (if available)

English curriculum areas covered by Episode 2 (Key Stage 2)

The big bird watch covers:

Science Year 4: Living things and their habitats

Pupils should be taught to:

- explore and use classification keys to help group, identify and name a variety of living things in their local and wider environment

Birds verses theropods comparison covers:

Science Year 6: Evolution and inheritance

Pupils should be taught to:

- recognise that living things produce offspring of the same kind, but normally offspring vary and are not identical to their parents

Great auk poem covers:

English: Writing – composition Lower Key Stage 2

Pupils should be taught to:

- Plan their writing by:
  - discussing writing similar to that which they are planning to write in order to understand and learn from its structure, vocabulary and grammar
  - discussing and recording ideas
- Draft and write by:
  - composing and rehearsing sentences orally, progressively building a varied and rich vocabulary and an increasing range of sentence structures

English: Writing – composition Upper Key Stage 2

Pupils should be taught to:

- Plan their writing by:
  - identifying the audience for and purpose of the writing, selecting the appropriate form and using other similar writing as models for their own

Northern Irish curriculum areas covered by Episode 2 (Key Stages 1 and 2)

The world around us

Interdependence

Pupils should be enabled to explore:

- how they and others interact in the world
- how living things rely on each other within the natural world

Place

Pupils should be enabled to explore:

- how place influences the nature of life
- ways in which people, plants and animals depend on the features and materials in places and how they adapt to their environment
- features of, and variations in places, including physical, human, climatic, vegetation and animal life

Language and literacy

Talking and listening

Pupils should be enabled to:

- tell, re-tell and interpret stories based on memories, personal experiences, literature, imagination and the content of the curriculum

Writing

Pupils should be enabled to:

- participate in modelled, shared, guided and independent writing, including composing on-screen
- discuss various features of layout in texts and apply these, as appropriate, within their own writing
- experiment with rhymes, rhythms, verse structure and all kinds of word play and dialect

Scottish curriculum areas covered by Episode 2 (First and Second)

Science: Planet Earth

Biodiversity and interdependence

I can identify and classify examples of living things, past and present, to help me appreciate their diversity. I can relate physical and behavioural characteristics to their survival or extinction. **SCN 2-01a**

Literacy and English: Writing

Enjoyment and choice

I enjoy creating texts of my choice and I regularly select subject, purpose, format and resources to suit the needs of my audience. **LIT 1-20a / LIT 2-20a**

Creating texts

I can convey information, describe events, explain processes or combine ideas in different ways. **LIT 2-28a**

Welsh curriculum areas covered by Episode 2 (Key Stage 2)

Science: Range

Interdependence of organisms

Pupils should use and develop their skills, knowledge and understanding by investigating how animals and plants are independent yet rely on each other for survival.

4. through fieldwork, the plants and animals found in two contrasting local environments, eg identification, nutrition, life cycles, place in environment

Science: Skills

Developing

2. make careful observations and accurate measurements, using digital and ICT equipment at times
4. make comparisons and identify and describe trends or patterns in data and information

English/Welsh

Strand: Writing

Organising ideas and information

- meaning, purposes, readers
- structure and organisation

Writing accurately

- language

Literacy framework

Reading – use a range of strategies to make meaning from words and sentences, including knowledge of phonics, word roots, word families, syntax, text organisation and prior knowledge of context.

Writing – write for different purposes and readers choosing words for variety and interest.

Oracy – explain, listen, contribute to group discussion.

introductory postcard 2

Great auk

Hello,

I'm Arkhat and I'm a Researcher at the Natural History Museum in London.

Today, something extraordinary is going to happen: you're all going to see dinosaurs. Not fossils but living, breathing, squawking dinosaurs. You'll need to go into the playground and look up to the sky. After a minute, you'll see a dinosaur – more commonly known as a bird.

Thomas Huxley, a Victorian Natural History Adventurer, first noticed the similarity between birds and dinosaur fossils. Scientists have since explored the idea that theropod dinosaurs didn't go extinct but evolved into modern birds. Today, all of the evidence suggests that this is true.

Your Natural History Adventurer challenge is to develop your observation skills by spotting as many kinds of birds as you can. Identifying wildlife in the world is a vital skill for Future Scientists.

Good luck!

Arkhat

Natural History Adventurers

Dippy on Tour
Future Scientist Training

School

UK

Lesson script 1

To prove that you have the nature-spotting skills of a Future Scientist, your challenge is to go into your school playground and spot as many birds as you can.

To get you started, here are some tips on spotting one of the commonest birds in the UK, the feral pigeon.

Note that there are different species of pigeon. The feral pigeon is the most common, but there are also occasional true wood doves, rock doves and turtle doves.

Here's what a feral pigeon looks like:

The pigeon flies with fast flaps of its wings, and makes a noise that sounds like 'coo'. On the ground it is quite brave as it pecks around for food. Humans can get very close to it before it flies away.

Some of you might still be finding it hard to believe that birds really are dinosaurs, but if you look at the feet of this pigeon, you might see some similarity with the feet of a *Tyrannosaurus* or *Allosaurus*.

Enjoy your bird spotting!

Hello teacher, please distribute ***pupil resources 1*** *(****bird ID card****) and* ***2*** *(****bird spotter****) to pairs of pupils – one set of resources per pair.*

Pupil resource 1: Bird ID card

Blackbird

Blue tit

Chaffinch

Great tit

Greenfinch

Robin

Starling

House sparrow

Wood pigeon

Pupil resource 2: Bird spotter

What bird did you see?	What did it look like?	What did it sound like?	What did it do?
Blackbird	Smallish black bird with an orange beak.	It made a quiet squawk as it took off.	It pecked at the ground and then flew away.

Image 1: Theropod dinosaur (*Oviraptor*)

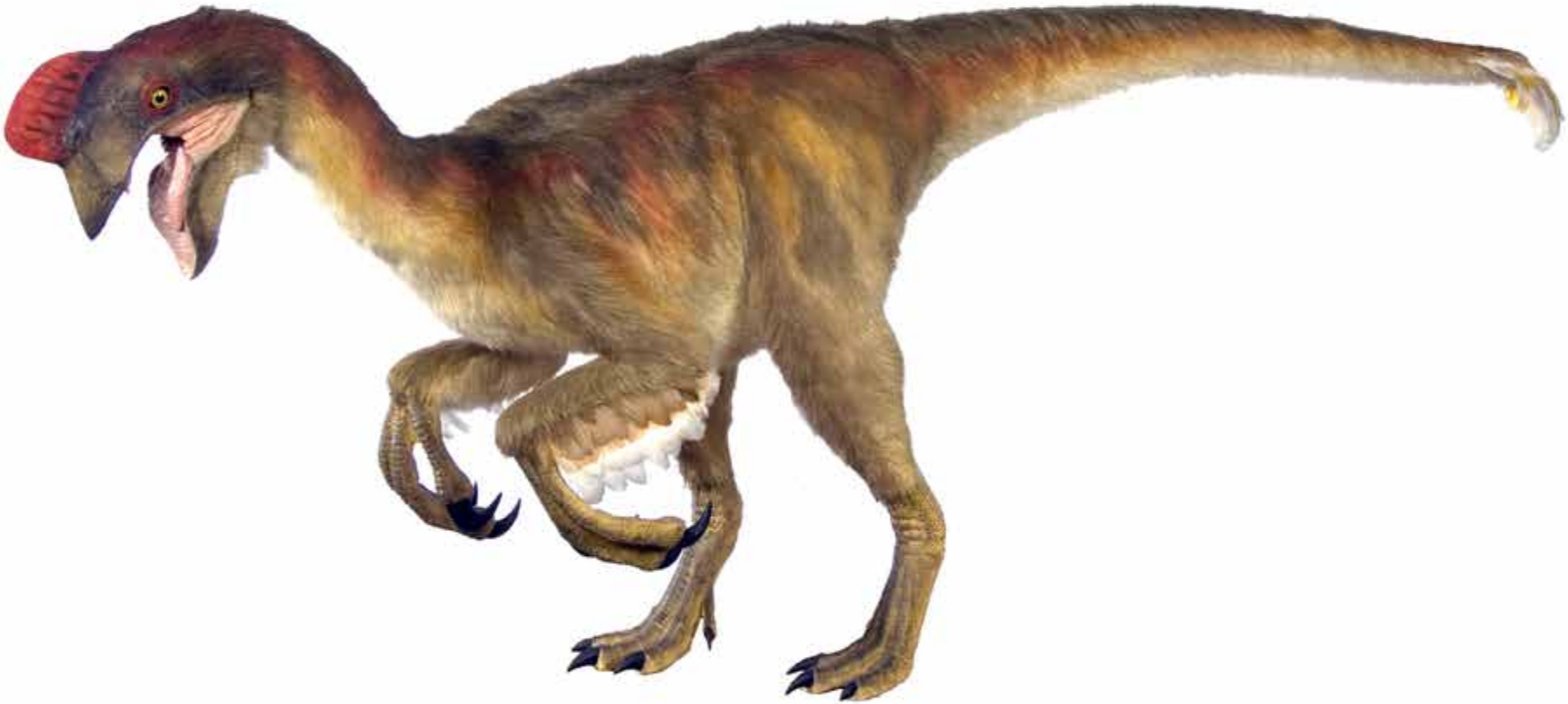
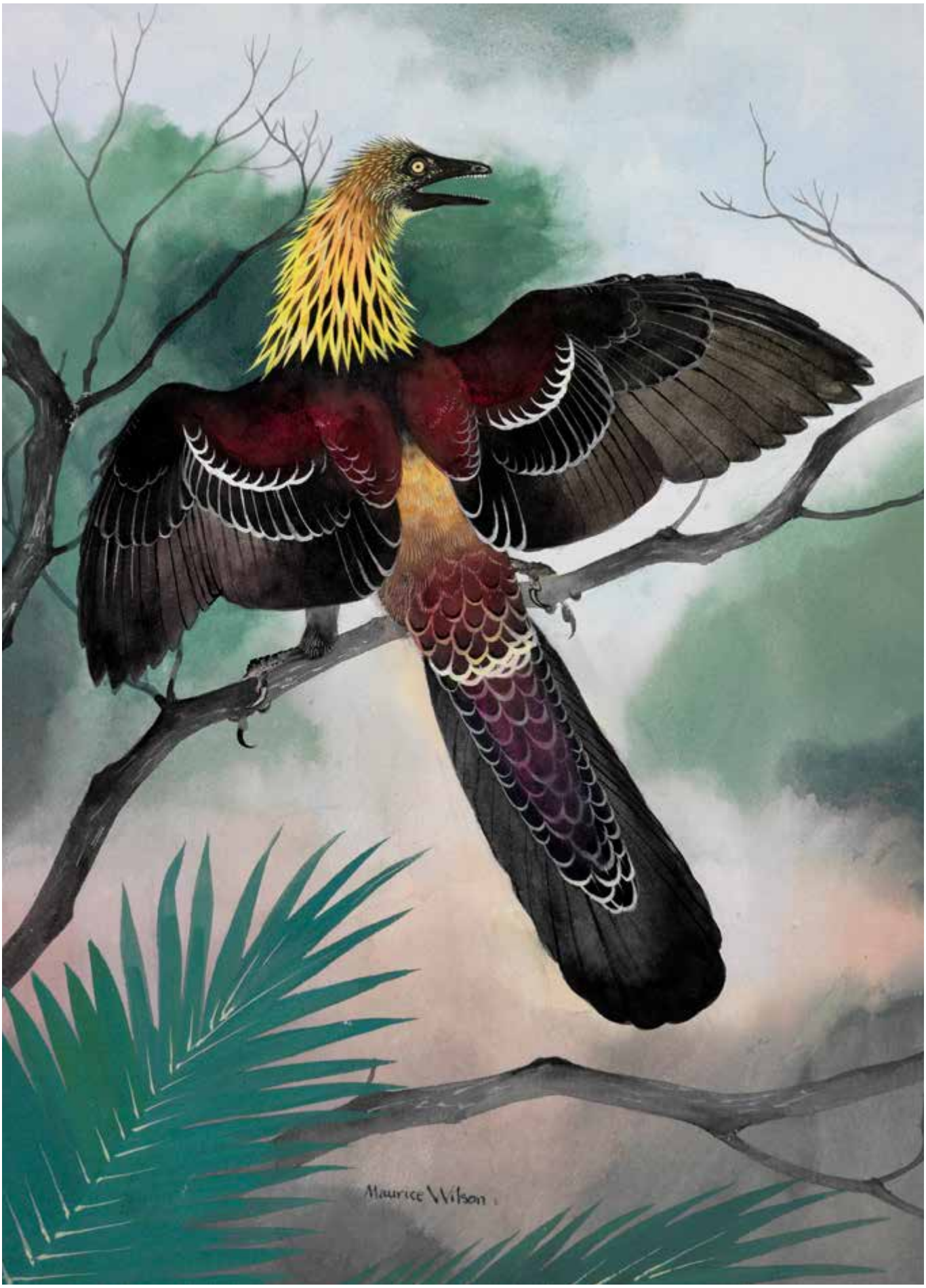


Image 2: Bearded vulture

Image 3: *Archaeopteryx*



Lesson script 2

I hope you spotted lots of interesting birds. If you spotted a white-tailed sea eagle you should drop everything and phone the Royal Society for the Protection of Birds right away. The Royal Society for the Protection of Birds is a charity that works to protect birds and all wildlife, and they love to hear about people spotting rare birds.

Some of you might still be finding it hard to believe that some dinosaurs really did evolve to become birds, so here's some more evidence. Evidence is information that scientists use to form their ideas about how the world works. Your teacher will now show you some pictures.

Hello teacher, please ask two pupils to hold up ***images 1*** *and* ***2****, showing a theropod dinosaur and the bearded vulture.*

These pictures show a theropod dinosaur and a modern bird called a bearded vulture. Take a look at the two images and see if you can come up with a list of all the differences and similarities between these creatures.

Hello teacher, please have that discussion now.

Here is a third picture that shows a creature called *Archaeopteryx*, which scientists believe was one of the earliest birds.

Hello teacher, please ask a pupil to hold up ***image 3****, standing between the other two.*

Archaeopteryx is in the middle. It evolved some of the features of a modern bird, but still has some features of a dinosaur. This shows us how species change very slowly over time. Now here is a picture of three skeletons: a theropod dinosaur, *Archaeopteryx* and a modern bird.

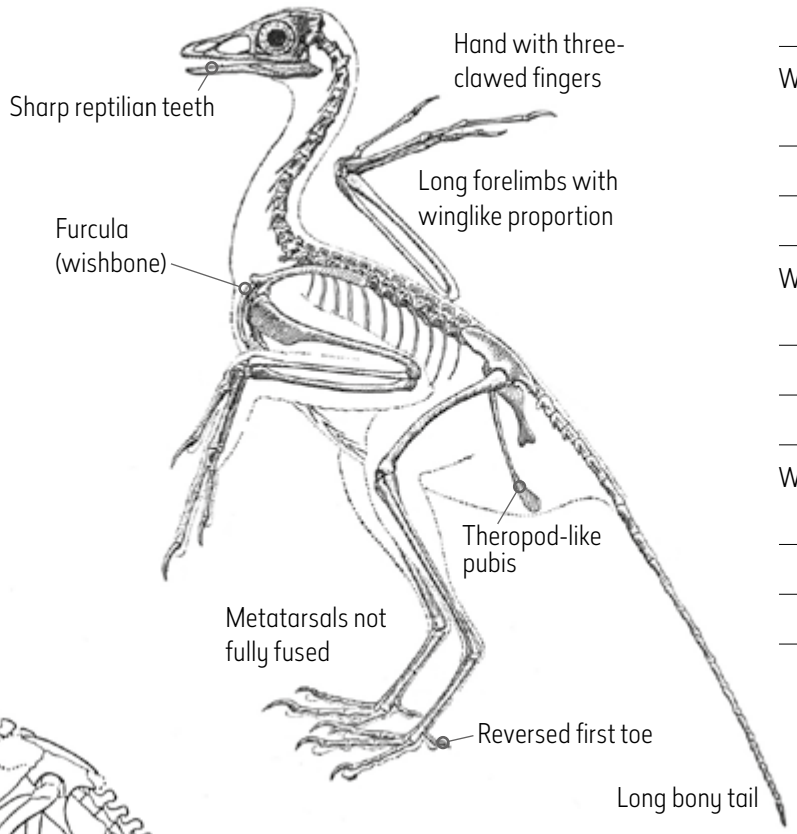
Hello teacher, hand out ***pupil resource 3****, the image with the the skeletons.*

Either working in pairs or as a class, your challenge is to identify features that are the same and those that have changed. To get you started, one feature is whether all three creatures had teeth.

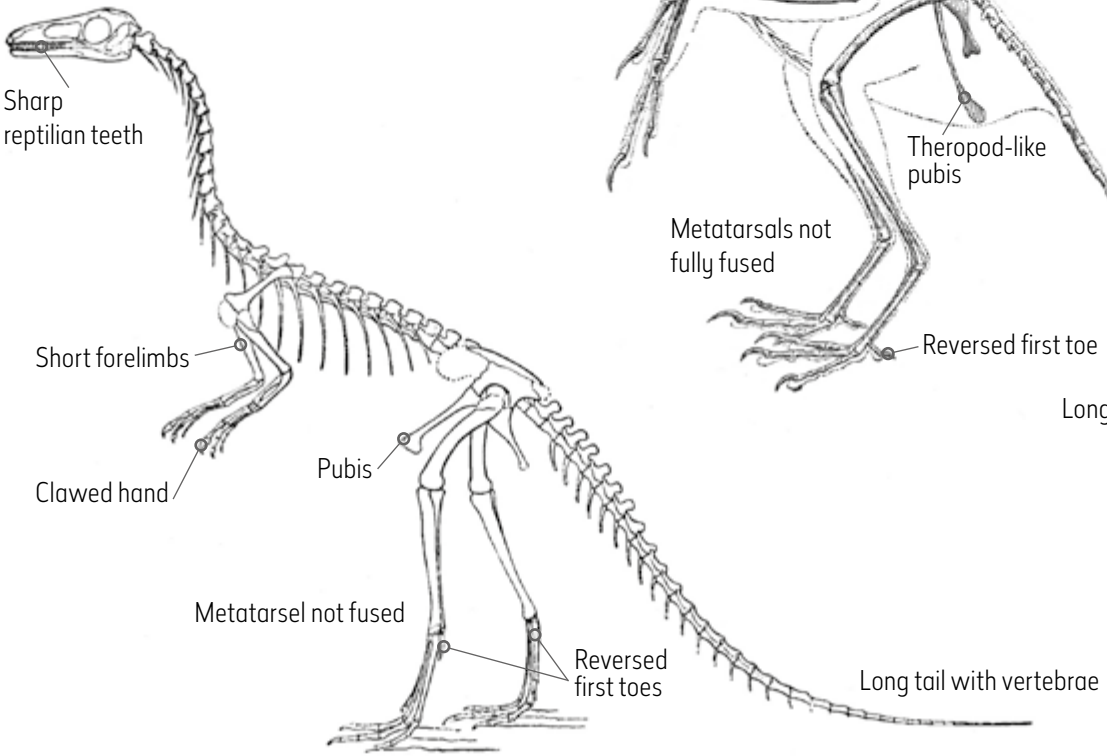
Looking at the skeletons of these creatures can help us discover that over millions of years theropod dinosaurs really did evolve into modern birds, one tiny change at a time.

Pupil resource 3: Link up the matching words

Ancesteral bird-like dinosaur
Archaeopteryx



Dinosaur
Compsognathus (theropod)



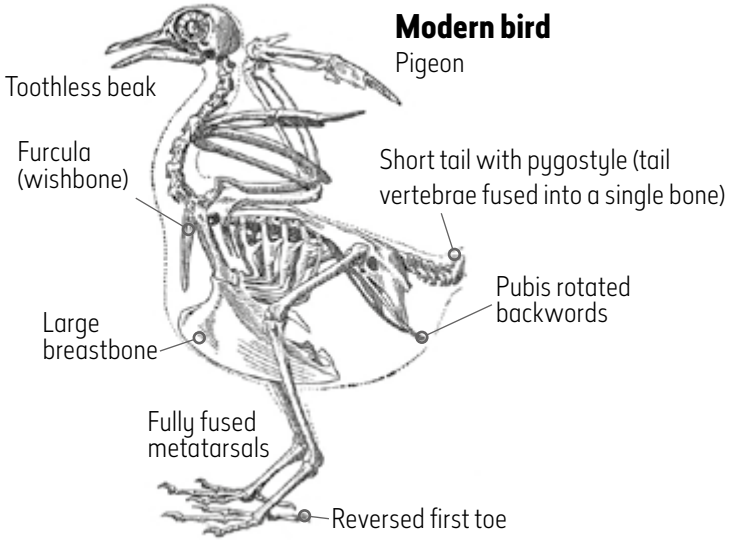
What is similar between the non-avian (non-bird) dinosaur and ancestral avian (bird-like) dinosaur?

What is different?

What is similar between the ancestral avian (bird-like) dinosaur and modern bird?

What is different?

Modern bird
Pigeon



Lesson script 3

Our natural world has always inspired artists to create extraordinary stories, poems and illustrations. It's important for Future Scientists to understand how nature can inspire us, so your next challenge is to take the following true story from nature and create some art of your own.

The last great auk

In June 1840, three Scottish sailors landed on the craggy edge of a rock known as Stac an Armin in Scotland. As they climbed it they spotted a peculiar bird that stood head and shoulders above the puffins, gulls and other seabirds.

The sailors watched as the bird, a great auk, waddled clumsily along. Even though it was elegant and quick in the water, it was slow on the land. When humans chased it, it wasn't able to fly away.

Perhaps the men enjoyed the thrill of the hunt, or perhaps they realised that the auk's meat and feathers were incredibly valuable. In any case, they kidnapped the bird and took it back to their ship. For three days, the sailors kept the great auk alive, but on the fourth day, during a terrible storm, they grew fearful and superstitious. Thinking the auk was a witch who was conjuring the storm, they killed it.

The great auk was the last of its kind ever to be seen on the British Isles. Four years later, the species vanished from the world entirely when fishermen hunted down the last pair on the shores of an island near Iceland. The men spotted the two great auks in the distance and attacked them, catching and killing the fleeing birds. The female had been protecting her nest and before leaving, the fisherman crushed the last great auk egg with his boot.

Great auk specialist John Wolley interviewed the two fishermen who killed the last great auks, and this is what they said:

'The rocks were covered with guillemots and there were the great auks… they walked slowly. Jón crept up with his arms open. The bird that Jón got went into a corner but mine was going to the edge of the cliff. It walked like a man… but moved its feet quickly. I caught it close to the edge – a precipice many fathoms deep. Its wings lay close to the sides – not hanging out. I took him by the neck and he flapped his wings. He made no cry. I strangled him.'

Haiku challenge

Hello teacher, please display this sheet on the class whiteboard.

The story of the death of the last great auks is very sad. It inspired Dippy's team to write a special poem called a haiku. What makes haikus interesting is that they don't rhyme, but are always written the same way:

The first line has five beats,

The second line had seven beats,

The third line has five beats.

Here's a great auk haiku, though surely you will be able to do much better.

The last great auk waits.

When the fishermen approach,

She stays by her nest.

Your final challenge today is to write your own haiku about the death of the last great auks.

Remember, here's how to write a haiku:

The first line has five beats,

The second line had seven beats,

The third line has five beats.

Episode 2 glossary

Archaeopteryx

Archaeopteryx means ancient wing. It is a type of bird-like dinosaur that is transitional between non-avian feathered dinosaurs and modern birds. *Archaeopteryx* is considered the first bird even though it still had teeth, a snout and claws in its wings. This means that birds can have those reptilian features.

Bearded vulture

A strange and beautiful bird that feeds on dead animal bones.

Evolution

The process by which different kinds of living things developed from earlier forms during the history of Earth. The changes between earlier and later forms result from tiny changes happening over a very long time.

Extinct

No longer existing, died out.

Great auk

The great auk (*Pinguinus impennis*), also called garefowl, was a flightless seabird that became extinct in 1844. It bred in colonies on rocky islands off North Atlantic coasts (St Kilda, the Faroe Islands, Iceland and Funk Island off Newfoundland). Its remains have been found as far south as Florida, Spain and Italy.

Guillemot

A small black-and-white seabird that looks a little like a penguin. It is very quick in the water but very slow on land.

Puffin

A small black-and-white sea bird with a large, brightly coloured beak.

Theropod

Theropods were a group of dinosaurs that had short forelimbs and grasping hands, and walked or ran on hind legs. Most of them were carnivorous. Many had feathers. *Tyrannosaurus* and *Velociraptor* were both theropods.

White-tailed sea eagle

The largest eagle living in the UK. Its wings can measure 2.5 metres from tip to tip.

Episode 3: A game of snakes and antlers (Belfast)

Natural History Adventurers' mission

Play a game to learn about various evolutionary and environmental challenges.

Episode journey

By playing *Snakes and Antlers* children understand the impact environmental factors have on evolution, and the impact environmental and human factors have on the survival of species today. Children learn what extinction means and some of the ways species become extinct.

Curriculum learning outcomes

- children learn that living things can be grouped in lots of different ways (**Science**)
- children will understand that changing environments can sometimes pose dangers to living things (**Science**)
- children will understand that living thing have changed over time (**Science**)
- children learn that animals and plants adapt to suit their environment (**Science**)
- children learn that adaptation may lead to evolution (**Science**)

The **introductory postcard** both explains why there are no snakes in Ireland and tells the story of the magnificent but extinct giant deer. The curator reveals that members of his team have created a game called *Snakes and Antlers*. The instructions explain how the game is played as traditional snakes and ladders, but that the events of the game (reasons for going down snakes or up antlers, missing a turn or going back or forward) were built around environmental factors that lead to animal extinction or successful population growth. The curator challenges the children to play the game, learning about evolution in the process.

Possible additional activities

- children research what species of animals are at risk of extinction today
- children research what action is being taken by governments and non-governmental organisations to protect wildlife around the world today

Activities

Not all activities will be relevant for all classes. The activities were developed to be broken up and used over a period of time and as is suitable for your particular class.

- Before beginning this activity make sure the game board (**pupil resource 1**) is photocopied and printed on A3 for the number of groups you have, and the pieces (**pupil resource 2**) are cut out and stuck together to form triangular playing pieces. Pupils can do the sticking if teachers prefer.
- Read the **introductory postcard** and discuss it in class, using the **glossary** as required. Ask children to think back to previous challenges (if they undertook them – if not, the discussion can be more general but cover the same points). What caused the giant deer to become extinct? What do they understand by the term extinct? How do species become extinct?
- Read out **lesson script 1**, introducing the game and its rules. In this game the children will be playing different types of creatures: mammals, amphibians, insects, reptiles, birds and fish. Make sure they know that living things can be divided into groups, or classified, and what common features members of each of these groups will have.
- Go over the rules using **lesson script 1** and divide the children into teams of five. Set them off to play the game using A3 copies of the *Snakes and Antlers* game board and playing pieces. See notes on playing the game below.
- After playing the game bring the class together to discuss what they discovered, which they can share with Dippy's friends via email. Can they agree on the three most interesting things that they learned by playing the game?
- Ask the children what species they know about that are endangered today. Why are they endangered? What can we do to look after these species?
- Capture their key observations and, together with the children, write an email to Dippy's team at DippyOnTour@nhm.ac.uk with the subject line **Snakes**. This triggers an automated reply acknowledging receipt.

Notes on playing the game

The game of *Snakes and Antlers* is a version of snakes and ladders, with the positive and negative events linked to the various environmentally driven threats and opportunities faced by species.

Children play in teams of five, the team challenge being that all players must finish the game as quickly as possible. Finishing the game means you have avoided extinction and survived to the modern day. The playing pieces are animals from different groups (birds, fish, mammals etc) that have all evolved different abilities that help them to survive. Each Creature Feature asks if your creature has an ability (such as being able to fly). If your creature has that ability, move forward – if it doesn't, move back. Have a quick conversation as a class now about the different things (called characteristics) that make animal groups such as mammals, birds, insects, fish and reptiles, different from each other.

Younger or less able children might need more help with interpreting or answering the points on the board. You might consider asking the children to raise their hand if they come to a square they need help with, stopping the class and the clock and going over the point for everyone, before resuming play. Younger children might also benefit from playing the game in pairs or threes.

Resources required

Provided in the Natural History Museum package:

- introductory postcard
- lesson scripts 1
- pupil resources 1–2
- glossary

Provided by school:

- photocopying for the game boards (pupil resource 1) and playing pieces (pupil resource 2), playing pieces
- die for the game

English curriculum areas covered by Episode 3 (Key Stage 2)

Playing Snakes and Antlers will cover:

Year 6 Science: Evolution and inheritance

Pupils should be taught to:

- recognise that living things have changed over time and that fossils provide information about living things that inhabited Earth millions of years ago
- identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution

Year 4 Science: Living things and their habitats

Pupils should be taught to:

- recognise that living things can be grouped in a variety of ways
- recognise that environments can change and that this can sometimes pose dangers to living things

PSHCE

- taking turns, co-operating, winning and losing with good grace

The follow-up activities would cover:

Lower Key Stage 2 English: Reading

- retrieve and record information from non-fiction

Upper Key Stage 2 English: Reading

- retrieve, record and present information from non-fiction

Northern Irish curriculum areas covered by Episode 3 (Key Stages 1 and 2)

The world around us

Interdependence

Pupils should be enabled to explore:

- how living things rely on each other within the natural world
- the effect of people on the natural and built environment over time

Place

Pupils should be enabled to explore:

- how place influences the nature of life
- ways in which people, plants and animals depend on the features and materials in places and how they adapt to their environment
- features of, and variations in places, including physical, human, climatic, vegetation and animal life

Change over time

Pupils should be enabled to explore:

- how change is a feature of the human and natural world and may have consequences for our lives and the world around us
- ways in which change occurs over both short and long periods of time in the physical and natural world
- the effects of positive and negative changes globally and how we contribute to some of these changes

Scottish curriculum areas covered by Episode 3 (First and Second)

Science: Planet Earth

Biodiversity and interdependence

I can explore examples of food chains and show an appreciation of how animals and plants depend on each other for food.
SCN 1-02a

I can identify and classify examples of living things, past and present, to help me appreciate their diversity. I can relate physical and behavioural characteristics to their survival or extinction.
SCN 2-01a

Welsh curriculum areas covered by Episode 3 (Key Stage 2)

Science at Key Stage 2

Activities should foster curiosity and creativity and be interesting, enjoyable, relevant and challenging for the learner. They should enable learners to initiate, explore and share ideas, and extend, refine and apply their skills, knowledge and understanding in new situations. They should allow time for thinking, peer discussion and reflection.

Science: Range

Interdependence of organisms

Pupils should use and develop their skills, knowledge and understanding by investigating how animals and plants are independent yet rely on each other for survival.

5. the interdependence of living organisms in those two environments and their representation as food chains
6. the environmental factors that affect what grows and lives in those two environments, eg sunlight, water availability, temperature

PSE: Skills

Learners should be given opportunities to:

- identify links between cause and effect

Working with others

Learners should be given opportunities to:

- work cooperatively to solve problems
- make and maintain friendships and other relationships

PSE: Range

Sustainable development and global citizenship

Learners should be given opportunities to:

- appreciate the natural world as a source of inspiration
- take an active interest in varied aspects of life in school and the wider environment
- develop a positive attitude on issues of poverty and fairness

Introductory postcard 3

Giant deer antlers on display at Ulster Museum in Belfast

Hello, I'm Dr Mike Simms, Curator of Palaeontology at National Museums Northern Ireland.

Try this: three of you lie down on the floor in a line, head to foot, one after another. The distance from the head of the first person to the feet of the third person is about the width of the incredible antlers of a giant deer!

This beautiful deer went extinct 8,000 years ago, but at least it reached Ireland in the first place. Snakes never lived in Ireland at all. Scientists believe that slithering snakes were just too slow. Britain and Ireland were once joined by a bridge of land, but the sea level rose and covered the bridge before snakes could wriggle across.

This story gave us an idea for a game called *Snakes and Antlers*.

Your Natural History Adventurer challenge is to play our game and discover how difficult it is for animals to survive on Earth.

Good luck!

Mike

Natural History Adventurers

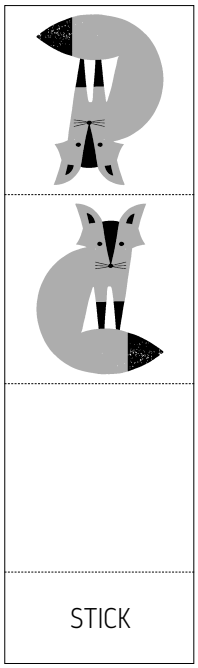
Dippy on Tour
Future Scientist Training

School

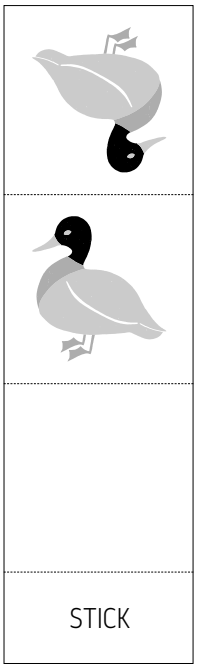
UK

43	44	**Oh no!** Your species is hunted by a newly evolved creature: humans. **Move down to 32.** 45	46	47	**Oh no!** Global warming caused by humans means your favourite food disappears! **Miss a turn.** 48	**Finish** 49 **Congratulations!** Your species has survived without going extinct – yet.
Oh no! A new animal arrives in your habitat and starts eating your food. **Move down to 27.** 42	41	40	39	**Meteorite Strike!** Many species go extinct. Your species survives – just. **Miss a turn.** 38	37	**Creature Feature!** Can your creature fly? If so, **move forward three spaces**. If not, **move back three spaces**. 36
Hooray! Your main predator goes extinct, so your population grows quickly! **Move up to 44.** 29	30	31	32	**Hooray!** Your species survives a supervolcano and your population grows when the ash cloud clears. **Move up to 46.** 33	34	**Supervolcano!** Ash from the huge eruption blocks out the Sun for two years! **Miss a turn.** 35
Creature Feature! Can your creature breathe underwater? If so, **move forward three spaces**. If not, **move back three spaces**. 28	27	**Oh no!** You run out of food due to a freezing winter. **Move down to 11.** 26	25	**Ice Age** Miss a turn 24	**Oh no!** You fail to reach a new home before the sea levels rise and cover the land bridge. **Move down to 8.** 23	**Hooray!** You become immune to a disease. **Move up to 37.** 22
15	**Hooray!** A new type of food arrives in your habitat. **Move up to 31.** 16	17	**Creature Feature!** Does your creature have a backbone? If it does, **move forward three spaces**. If it doesn't, **move back three spaces**. 18	19	20	21
14	13	12	11	10	**Creature Feature!** Is your creature covered in fur? If so, **move forward three spaces**. If not, **move back three spaces**. 9	8
Start 1	**Hooray!** Your species travels to a new land by crossing the ocean on a raft made from plants. **Move up to 15.** 2	**Ice Age** Miss a turn 3	**Hooray!** The sea level is rising, but your species reaches a new home before the sea covers the land bridge. **Move up to 19.** 4	5	6	**Creature Feature!** Does your creature lay eggs? If so, **move forward three spaces**. If not, **move back three spaces**. 7

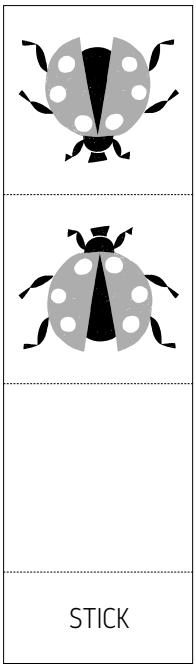
pupil resource 2: Counters



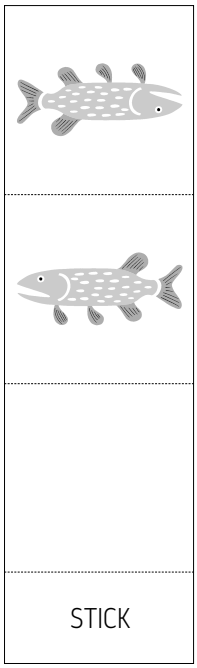
Fox
(mammal)



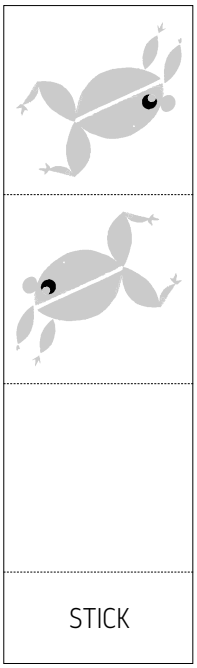
Duck
(bird)



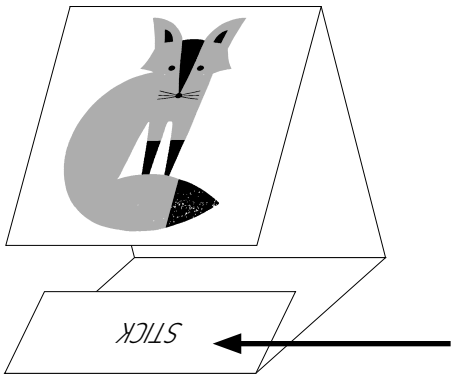
Ladybird
(insect)



Pike
(fish)



Frog
(amphibian)



- cut along solid lines
- fold along dotted lines
- add glue to flap and stick to reverse of the icon

Lesson script 1

Hello teacher, please display this on the whiteboard.

Welcome to the game of *Snakes and Antlers*. If you've played snakes and ladders before, you might find this familiar. This is a game of adaptation and survival. To win, your creature will need to reach square 49 without going extinct.

Individual play: The first player in your group to reach square 49 is the Creature Champion.

Team play: Your whole class will be playing this game in teams of five and your teacher will give you 25 minutes to play. The team with the most players at square 49 by the end of the 25 minutes will be Class Champions.

You will each use a playing token featuring a creature from a different group of animals.

The creatures are:

- fox (mammal)
- duck (bird)
- ladybird (insect)
- pike (fish)
- frog (amphibian)

Along the way, different events will happen to you. Some events will help you survive and some will make things more difficult.

Antlers: When you land on an antler, something happens to help your species survive. This means you go up another level of the game board.

Snakes: When you land on a snake, something happens that makes it harder for your species to survive. This means you drop to a lower level of the board.

Extinction Events: Ice ages, supervolcanoes and meteorite strikes are major events that threaten extinction. You'll have to miss a turn if you land on one of these events, but your species will survive (but only just). Take a moment now to talk with your teacher to make sure you know what each event means.

Creature Features: Different groups of animals have different strengths and weaknesses. Mammals, birds, insects, fish and reptiles have all evolved different abilities that help them to survive. Each Creature Feature asks if your creature has an ability (such as being able to fly). If your creature has that ability, move forward – if it doesn't, move back. Have a quick conversation as a class now about the different things (called characteristics) that make animal groups, such as mammals, birds, insects, fish and reptiles, different from each other.

How to play:

1. Each player selects a creature token.
2. The youngest player goes first.
3. Players take it in turn to roll the dice.
4. If you roll a six, you get to roll again.
5. Players take turns to move around the board.
6. Your teacher will set a timer to 25 minutes. Your team's aim is to get as many of your creatures to square 49 before the time is up. The team with the most players on square 49 by the end of the 25 minutes wins.

When you have finished playing, please email the most interesting things you discovered to Dippy's team at DippyOnTour@nhm.ac.uk with the subject line **Snakes**. Good luck!

Episode 3 glossary

Adaptation

The process by which living things change over time to become better suited to where they live. For example, amphibians, such as frogs, are born in the water. When they are born, they breathe with gills, like a fish. But as they grow up they develop lungs and can live on land.

Antlers

The branching horns that grow from the heads of animals such as deer. Antlers fall off and grow again each year.

Backbone

Also called a spine, this is the bone that runs down the back of mammals, reptiles, fish, birds and amphibians.

Bird

A warm-blooded animal with feathers, wings and a beak. Birds lay eggs and most species of bird are able to fly.

Disease

A condition that stops the body of a plant or animal from working as usual. A disease can often be recognised by signs and symptoms. For example, a cold is a common disease and its symptoms include coughing and sneezing.

Evolution/to evolve

The process by which different kinds of living organisms developed from earlier forms during the history of Earth.

Extinct

No longer existing, died out.

Habitat

The natural home of a living thing.

Ice age

A time in Earth's history when temperatures were colder and large areas of land were covered with ice.

Immune

An animal is immune if it has high levels of resistance to a disease. This means it is hard, or maybe impossible, for the animal to catch that disease.

Insect

A small animal with no backbone but six legs. Many insects have wings.

Land bridge

A piece of land that connects two larger pieces of land.

Mammal

A warm-blooded animal with hair or fur. Most mammals give birth to live young that are fed on milk produced by the female.

Meteorite strike

When a meteorite (a piece of rock from outer space) crashes into Earth's surface.

Raft

A floating object that animals can use to travel across water.

Reptile

A cold-blooded animal with a backbone. It has dry, scaly skin and lays shelled eggs on land. Examples include snakes, lizards and tortoises.

Species

A group of living things that can breed together. For example, a robin is a species of bird.

Survival

Staying alive through dangers and challenges.

Supervolcano

A very powerful type of volcano that can cause animals and plants to go extinct.

Episode 4: The beaver's back! (Glasgow)

Natural History Adventurers' mission

Show that you can understand both sides of a complex issue and persuasively communicate viewpoints to others.

Episode journey

Children discover that there are different perspectives on topics relating to the natural world through exploring the issues of rewilding beavers. Children then create pamphlets from both perspectives.

Curriculum learning outcomes

- children will identify and use scientific evidence to support ideas and arguments (**Science**)
- children will identify the audience and purpose for their writing (**English**)

Rewilding

Rewilding can mean different things. It can mean introducing extinct species to the landscape or introducing creatures into the wild that have been bred in captivity. It can also involve restoring ecosystems such as woodland, wetland and wilderness areas.

Challenge synopsis

The postcard from Dippy's team introduces the beaver specimen and explains the story of its successful reintroduction to Scotland. The children's challenge is to create pamphlets that make the case either for or against rewilding. The included resources explain this as well as how to understand complex issues. Scientists use posters to communicate their work at conferences. As Future Scientists the children will need to need to use images, layout, diagrams and persuasive writing to get ideas across quickly and effectively.

Connected learning outcomes

- children learn that there are often different points of view
- children learn about different ways of communicating factual information and opinion

Possible additional activities

- Children build their own dam in a sand tray, in the playground with a hose as a water source or in a real stream. What happens to the flow of water? What are the effects of the dam?
- Children investigate the uses of dams in both small- and large-scale projects around the world.

Activities

Not all activities will be relevant for all classes. The activities were developed to be broken up and used over a period of time and as is suitable for your particular class.

- Read the **introductory postcard** and discuss the challenge with the children, using the glossary as required. Use **lesson script 1** to talk about beavers and explain about reintroducing beavers to Scotland. Make sure the children understand that there are two valid points of view about reintroducing beavers to the UK. This is a link to Sir David Attenborough narrating beavers building their dam: https://www.youtube.com/watch?v=VuMRDZbrdXc&feature=youtu.be .
  Note, this clip is of North American beavers.
- Explain to the children that they are going to make pamphlets that explain both sides of the argument. Their pamphlets will be a folded sheet of A4, with an image on the front and words inside.
- Look at some leaflets and discover or revise the styles of writing and use of colour, fonts, layout and graphics that are used (eg headings and subheadings, bullet points, numbered points or graphs). For example: http://www.wildlifetrusts.org/sites/default/files/files/16597%20WAG%20-%20Hedgehog%2016pp%20Booklet16-7.pdf

  and

  http://assets.wwf.org.uk/downloads/wwf_legacy_brochure.pdf.
- For each point of view the writer needs to be persuasive. What are the best arguments for persuading the reader? Look at or revise techniques such as rhetorical questions, repetition etc.
- Hand out **pupil resource 1**, summarising the views of four stakeholders.
- Ask the children to write a pamphlet that represents their viewpoint. Show pupils the demonstration pamphlet (**pupil resource 2**) and then give the children a blank pamphlet template (**pupil resource 3**). Ask them to work alone or in pairs. Can they make their point of view really persuasive?
- Once the pamphlets are completed, somebody from outside the classroom (perhaps another teacher or head teacher) is invited in to view the pamphlets and ask the children questions, taking the role of a judge.
- The judge then makes a decision on whether rewilding beavers should continue based on the arguments in the pamphlets. The children can then discuss among themselves what point of view they found most convincing, and why and whether it was harder to write one view than the other.

- Take photos of the pamphlets and, with the children, compose a group email to send to Dippy's team (DippyOnTour@nhm.ac.uk) with the subject line **Beavers**, revealing the outcome of their vote. They will receive an automated response.

Resources required

Provided in the Natural History Museum package:

- introductory postcard
- lesson script 1
- pupil resources 1–3
- glossary

Provided by school:

- photocopying of stakeholder comments (pupil resource 1) and the A4 pamphlet template (pupil resource 3)
- usual writing and drawing materials

English curriculum areas covered by Episode 4 (Key Stage 2)

Lower Key Stage 2 English: Writing – composition

Pupils should be taught to:

Plan their writing by:

- discussing writing similar to that which they are planning to write in order to understand and learn from its structure, vocabulary and grammar
- discussing and recording ideas

Draft and write by:

- composing and rehearsing sentences orally, progressively building a varied and rich vocabulary and an increasing range of sentence structures
- in non-narrative material, using simple organisational devices for example, headings and subheadings

Upper Key Stage 2 English: Writing – composition

Pupils should be taught to:

Plan their writing by:

- identifying the audience for and purpose of the writing, selecting the appropriate form and using other similar writing as models for their own

Draft and write by:

- using further organisational and presentational devices to structure text and to guide the reader (for example, headings, bullet points, underlining)

Science: Lower Key Stage 2

Working scientifically

- using straightforward scientific evidence to answer questions or support their findings

Science: Upper Key Stage 2

Working scientifically

- identifying scientific evidence that has been used to support or refute ideas or arguments

Geography: Human and physical geography

Describe and understand key aspects of Human geography, including: types of settlement and land use, economic activity including trade links, and the distribution of natural resources including energy, food, minerals and water.

Northern Irish curriculum areas covered by Episode 4 (Key Stages 1 and 2)

Language and literacy: Writing

Pupils should be enabled to:

- write for a variety of purposes and audiences, selecting, planning and using appropriate style and form
- express thoughts, feelings and opinions in imaginative and factual writing
- use a variety of stylistic features to create mood and effect
- create, organise, refine and present ideas using traditional and digital means, combining text, sound or graphics

The world around us: Place

Pupils should be enabled to explore:

- how place influences the nature of life
- ways in which people, plants and animals depend on the features and materials in places and how they adapt to their environment
- features of, and variations in places, including physical, human, climatic, vegetation and animal life
- our place in the universe
- change over time in places
- positive and negative effects of natural and human events upon place over time

Scottish curriculum areas covered by Episode 4 (First and Second)

Literacy and English

Writing: Organising and using information

Considering texts to help create short and extended texts for different purposes.

Writing: Creating texts

I am learning to use language and style in a way which engages and/or influences my reader. **ENG 2-27a**

Science: Planet Earth

Processes of the planet

They learn about climate change as a natural process in time as well as the result of human activity. Through connections with collaborative studies of landscape, weather and climate in social studies they build up an integrated picture of the dynamic nature of Earth.

Biodiversity and interdependence

I can use my knowledge of the interactions and energy flow between plants and animals in ecosystems, food chains and webs. I have contributed to the design or conservation of a wildlife area. **SCN 2-02a**

Welsh curriculum areas covered by Episode 4 (Key Stage 2)

Science at Key Stage 2

Learners should be taught to relate their scientific skills, knowledge and understanding to applications of science in everyday life, including current issues. They should be taught to recognise that scientific ideas can be evaluated by means of information gathered from observations and measurements. Teaching should encourage learners to manage their own learning and develop learning and thinking strategies appropriate to their maturity. They should be taught to value others' views and show responsibility as local citizens.

Skills

Communication

1. search for, access and select relevant scientific information, from a range of sources, including ICT
2. communicate clearly by speech, writing, drawings, diagrams, charts, tables, bar charts, line graphs, videos, and ICT packages, using relevant scientific vocabulary

Range

Interdependence of organisms

Pupils should use and develop their skills, knowledge and understanding by investigating how animals and plants are independent yet rely on each other for survival.

5. the interdependence of living organisms in those two environments and their representation as food chains
6. the environmental factors that affect what grows and lives in those two environments, e*g sunlight, water availability, temperature*
7. how humans affect the local environment, *eg litter, water pollution, noise pollution*

English

Strand: Writing

Learners should be given opportunities to:

Write for a variety of purposes, including to:

- recount
- instruct
- inform
- explain
- argue/persuade
- discuss/analyse
- evaluate
- narrate
- describe
- empathise

Write in a range of continuous and non-continuous texts in a variety of forms, *eg letters, diaries, articles, stories, reports, speeches, short plays and scripts, leaflets, advertisements, posters, web pages, questionnaires, reviews, soliloquies*

Write for a range of authentic audiences, real or imagined, *eg peers, younger learners, teachers, family members, historical and fictional characters*

Organising ideas and information

- meaning, purposes, readers
- structure and organisation

Geography

Geography provides opportunities for learners to consider important issues about their environment, and to recognise how people from all over the world are linked. They are encouraged to understand the importance of sustainability, develop an informed concern about the quality of their environment, and to recognise that they are global citizens.

Skills

Understanding places, environments and processes

Pupils should be given opportunities to:

3. describe the causes and consequences of how places and environments change, *eg by season; from past to present; the need for sustainability*

Communicating

Pupils should be given opportunities to:

1. express their own opinions and be aware that people have different points of view about places, environments and geographical issues, *eg about wind farms, fair trade*
2. make decisions about geographical issues by distinguishing between fact and opinion and considering different arguments, *eg a traffic problem*
3. communicate findings in a variety of ways, eg using geographical terms, annotated photographs, maps, diagrams, or ICT

Episode 4: The beaver's back! (Glasgow)

European beaver on display at Kelvingrove Art Gallery and Museum, Glasgow © CSG CIC Glasgow Museums Collection

Hello! I'm Richard, Research Manager for Natural Sciences at Glasgow Museums.

What do you all know about beavers?

[Hello teacher, please have that discussion now.]

What you might not know is that for the first time in 500 years, wild beavers are living in Britain. This may sound like good news, but not everyone is happy about it.

Future Scientists must understand that there are different sides to each story and solutions are not always simple. Scientists need to be able to understand others' views and also persuade people through their words.

Your Natural History Adventurer challenge is to explore the beaver's story and create pamphlets that argue why bringing back beavers is a really good – or really bad – idea.

Good luck!

Richard

Natural History Adventurers

Dippy on Tour
Future Scientist Training

School

UK

Lesson script 1

Things you may or may not know about beavers:

- Beavers use swimming goggles! They have a set of see-through (or transparent) eyelids that allow them to see underwater.
- Only humans build bigger structures. The largest beaver dam in existence is located in Wood Buffalo National Park in Alberta, Canada. It stretches for 850 metres and is visible from space.
- Beaver homes, called lodges, are dome-like constructions built from branches and mud.
- Beavers don't mind the cold. They stay active throughout the winter and keep using their ponds even when the water is covered with a layer of ice.
- Beavers are one of the largest rodents on Earth. Their large front teeth never stop growing. They keep their teeth from growing too long by wearing them down by constantly nibbling on wood.

Here's a short film about beavers with David Attenborough showing just how amazing their dams are: www.youtube.com/watch?v=VuMRDZbrdXc&feature=youtu.be.
Note, this clip is of North American beavers.

Here is the story of how the beavers came back to Britain.

In May 2009, three families of beavers were released into Knapdale Forest in Scotland. These were the first wild beavers in Scotland in nearly 500 years. They had been safely captured in Norway and were looked after by vets before being safely released into a lake.

However, beavers are also living around the River Tay, Scotland, where they have been introduced without official permission, and have been the cause of some concern to local landowners!

Pamphlet challenge: Meet the stakeholders

Some people are very happy about the return of the beavers, but others are not. Here are four stakeholders, each with a different opinion about whether or not beavers should come back to Britain. A stakeholder is somebody who is interested in something because it makes a difference to their lives.

Your job is to read all four stakeholder positions and create two pamphlets. One pamphlet will be written by one of the stakeholders who is **for** the return of the beavers, and one will be written by one of the stakeholders who is **against** it.

Here are also some blank pamphlets and an example to show you how it's done.

*Hello teacher, hand out **pupil resources 1 and 2**, and show children **pupil resource 3** (the sample pamphlet).*

Pupil resource 1: Meet the stakeholders

Stakeholder 1:

Louise the farmer
(**against** bringing beavers back)

'Hi there, my name is Louise McGregor and I'm a farmer here in Knapdale. I love nature as much as anybody, but I am very against bringing back beavers.

There's a good reason why we use the phrase "busy as a beaver" and "beavering away" because beavers can cause a lot of damage in a very short time. I really worry that beavers will build dams that will flood my fields, killing my precious crops. Even if I spot the beavers' dams before my fields flood, I will have to spend lots of money clearing them away. There are other problems too: rodents such as beavers can carry diseases and I am afraid that they will spread those diseases to my sheep and cows.

I really believe that the beavers could force me to close down my farm.

Finally, I really do love the wildlife of our country – but shouldn't we help the animals that are already here, before bringing back new ones? Shouldn't we spend the money helping endangered creatures like the Scottish wildcat first?

I love animals, but the beavers will do more harm than good.'

Stakeholder 2:

Isaac the forester
(**against** bringing beavers back)

'Hello, my name is Isaac Richardson and I'm a forester working in Knapdale Forest. It is my job to make sure that the trees in the forest stay healthy and strong.

While I would be excited to see beavers running (and swimming) around Scotland again, I'm afraid the damage they would do would be too great. A normal beaver can cut down around 200 trees a year! Just imagine the damage a whole family could do to my beautiful forest!

People have told me that the beavers will stay in the part of the forest where the test is happening. But I know beavers – they are amazing at chewing through things, so I am certain they will escape and cause trouble.'

Stakeholder 3:

Shilpa the conservationist
(**for** bringing beavers back)

'Hi, I'm Shilpa Singh. I work as a conservationist in the Knapdale Valley. My job is to make decisions that protect the wildlife of the forest, so you can trust me when I say that I would never do anything to harm it.

I support the reintroduction of beavers to Scotland because scientific evidence shows that they will help all the other plants and animals. Beavers will create new wetland areas that will help species such as otters, water voles, fish and dragonflies to flourish. Beavers help humans as well, as they remove some harmful chemicals called phosphates from the water.

Finally, it was us who hunted the beavers in the first place, so it's our duty to bring them back if we can.'

Stakeholder 4:

Connor the Tourist Board Officer
(**for** bringing beavers back)

'Hello there, my name is Connor Douglas and I work for the Scottish Tourist Board. I make sure that people continue to come and visit Scotland, as this brings happiness to the visitors and brings money into Scotland.

Where I work, we believe that £127 million would be brought to Scotland by visitors coming to see the beavers. We could spend this money on better schools and medicine for Scottish people and on protecting Scottish wildlife.

The return of the beavers would also create more jobs. We'll need more hotels to look after all the visitors, and people will get jobs taking visitors on wildlife safaris. I think that if the beavers come back, everyone will be a winner!'

Making your pamphlets

Now that you've learned about the stakeholders, you need to create your pamphlets. Choose two stakeholders you just heard from and make pamphlets for them – one who is for bringing the beavers back, and one who is against it.

There are four pages in each pamphlet. You need to make sure that you use both pictures and words to convince the reader to agree with the stakeholder.

Page 1: This needs to be a picture that will catch the reader's eye. You also need to spell out your message in about four or five words, a bit like a newspaper headline.

Page 2: Here you can use the lines to explain in your own words why bringing back beavers is a good or a bad idea. This is where you need to persuade the reader to agree with the stakeholder.

Page 3: Here you can list some facts using bullet points, based on the information you have heard.

Page 4: You can put anything you like here, as long as it helps convince people that bringing back beavers is a good or a bad idea.

SAY NO TO BEAVERS!

We are a group of farmers who are against rewilding the world with beavers, because we believe that beavers will destroy our crops.

We have worked hard to build our farms and nobody knows whether or not these beavers will destroy them.

We believe that people's lives are more important than beaver's lives, and this is why we want everyone to SAY NO TO BEAVERS!

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Remember!

- Beaver dams can cause floods which destroy farmers' crops.
- Beavers can spread disease.
- Other animals in Scotland need our help more.

Episode 4 glossary

Beaver

A large, mostly nocturnal, rodent (like a guinea pig or hamster). Beavers are semiaquatic, meaning that they spend a significant amount of their time in water. They are known for building dams, using their teeth to fell and carry timber. There are two species of beaver, the American beaver and the Eurasian beaver.

Globally extinct

No longer existing, died out.

Locally extinct

Extinct in a particular geographical area.

Extinction

The process of being or becoming extinct.

Pamphlet

A small booklet or leaflet containing information about a single subject.

Persuade

To cause someone to believe or do something through your own actions or words.

Rewilding

Rewilding has several meanings. It can mean bringing locally extinct species into the wild, or bringing creatures into the wild that have been bred in zoos or wildlife centres.

Stakeholder

A person with an interest or concern in something.

Viewpoint

A person's opinion or point of view.

Episode 5: Future maps (Newcastle-upon-Tyne)

Natural History Adventurers' mission

Scientists need to be creative, imagining future worlds and solving future problems before they arise. Creating future maps helps children to develop this skill.

Episode journey

Children will consider changes in topographical features and land use, and create future maps of their local area.

Curriculum learning outcomes

- children will learn about changes to their local area
- they will understand how these changes occurred
- they will understand why they occurred
- they will understand what effect the changes had on the way people live and the wildlife in the area
- they will learn to communicate geographical information through maps **(Geography)**

Challenge synopsis

The postcard tells the story of Newcastle-upon-Tyne from the Carboniferous Period (360–300 million years ago) to the present day. To tap into young people's unfettered imagination, the team asks the children to create far-future maps of their local area.

Possible additional activities

- children write science fiction stories set in their future worlds
- children make models of land use, transport and housing of the future
- children create a timeline of how their local area has changed over time so far

Activities

Not all activities will be relevant for all classes. The activities were developed to be broken up and used over a period of time and as is suitable for your particular class.

- Read the **introductory postcard** provided and discuss it with the class, using the glossary as required.
- Read **lesson script 1** to the class, using the glossary as required.
- Show the class images and maps of their local area as it currently is, using the interactive whiteboard and/or print media. What are the physical features of the area at the moment (eg hills, rivers or coastline)? How is the land used? This might include industry (including agriculture), housing, transport and services (eg hospitals, schools, universities or libraries). Discuss how some of these features may be represented by symbols on maps (eg contour lines, ordinance survey symbols for pubs, churches etc). Is there a key to explain them?
- Compare these with older maps and images of the same area and discuss how the area has changed over time. What were the reasons for this change – (eg industrialisation, coastal erosion or the coming of the railways)? Use **image 1**, of the sample progression maps of Kensington, or **image 2**, sample maps of Newcastle, if local images are difficult to source.
- Discuss with the children how the world might change in the future. What might bring about change? Prompt them to explore human-led change, such as new technologies, increases or decreases in population and wars, and physical-led changes, such as climate (global warming) and erosion. Lead the children from considering the near future (ie the next century or two) to the massive changes that might occur over millions of years.
- Ask the children to work in pairs to create their own far-future maps of their local area showing the changes that they think will occur. You may want to give them an outline map of the area at present to trace over and change. Prompt them to consider the same headings of physical geography and land use that they considered when they looked at the area in the present. Remind them to use map-making conventions and a key.
- Come together to share and compare their maps and views of the future. Did they all believe the human race would survive? How might they have had to change or adapt to suit the new circumstances they lived in?
- Send confirmation to Dippy's team at DippyOnTour@nhm.ac.uk with the title **Maps**. This triggers an automated reply acknowledging receipt.

Resources required

Provided in the Natural History Museum package:

- introductory postcard
- lesson script 1
- images 1 and 2
- glossary

Provided by school:

- images, including maps of your local area in the past and present
- outline maps of the local area for the children to trace over, if possible

English curriculum areas covered by Episode 5 (Key Stage 2)

Geography

- pupils are competent in the geographical skills needed to communicate geographical information in a variety of ways, including through maps
- pupils should understand the processes that give rise to key physical and human geographical features of the world, how these are interdependent and how they bring about spatial variation and change over time

Geography: Locational knowledge

Pupils should be taught to:

- name and locate counties and cities of the United Kingdom, geographical regions and their identifying human and physicalcharacteristics, key topographical features (including hills, mountains, coasts and rivers), and land-use patterns; and understand how some of these aspects have changed over time

History

Pupils should note connections, contrasts and trends over time.

They should regularly address and sometimes devise historically valid questions about change, cause, similarity and difference, and significance.

Science Year 4

Pupils should:

- explore examples of human impact (both positive and negative) on environments – for example, the positive effects of nature reserves, ecologically planned parks, or garden ponds, and the negative effects of population and development, litter or deforestation

Northern Irish curriculum areas covered by Episode 5 (Key Stages 1 and 2)

The world around us (Key Stage 2): Interdependence

Pupils should be enabled to explore:

- how they and others interact in the world
- how living things rely on each other within the natural world
- interdependence of people and the environment and how this has been accelerated over time by advances in transport and communications
- the effect of people on the natural and built environment over time

The world around us (Key Stage 2): Place

Pupils should be enabled to explore:

- how place influences the nature of life
- ways in which people, plants and animals depend on the features and materials in places and how they adapt to their environment
- features of, and variations in places, including physical, human, climatic, vegetation and animal life
- our place in the universe
- change over time in places
- positive and negative effects of natural and human events upon place over time

Scottish curriculum areas covered by Episode 5 (First and Second)

Social studies: People, place and environment

By comparing my local area with a contrasting area outwith Britain, I can investigate the main features of weather and climate, discussing the impact on living things. **SOC 2-12a**

Having explored the landscape of my local area, I can describe the various ways in which land has been used. **SOC 1-13a**

I can explain how the physical environment influences the ways in which people use land by comparing my local area with a contrasting area. **SOC 2-13a**

Through activities in my local area, I have developed my mental map and sense of place. I can create and use maps of the area. **SOC 1-14a**

To extend my mental map and sense of place, I can interpret information from different types of maps and am beginning to locate key features within Scotland, UK, Europe or the wider world. **SOC 2-14a**

Numeracy and mathematics: Shape, position and movement

Angle, symmetry and transformation

I have developed an awareness of where grid reference systems are used in everyday contexts and can use them to locate and describe position. **MTH 1-18a**

I can use my knowledge of the coordinate system to plot and describe the location of a point on a grid. **MTH 2-18a**

Art and design

I can create and present work using the visual elements of line, shape, form, colour, tone, pattern and texture. **EXA 1-03a**

I can create and present work that shows developing skill in using the visual elements and concepts. **EXA 2-03a**

I can use exploration and imagination to solve design problems related to real-life situations. **EXA 1-06a**

I can develop and communicate my ideas, demonstrating imagination and presenting at least one possible solution to a design problem. **EXA 2-06a**

Welsh curriculum areas covered by Episode 5 (Key Stage 2)

Geography: Skills

Locating places, environments and patterns

Pupils should be given opportunities to:

1. identify and locate places and environments using globes, atlases, and maps, *e.g. use co-ordinates and four-figure references*
2. follow directions, estimate and calculate distances, *e.g. follow map and ground routes, calculate map-to-ground distances*
3. use maps, imagery and ICT to find and present locational information, *e.g. draw sketch maps using symbols and keys – interpret maps, and photographs including oblique, aerial and satellite images*
4. identify and describe the spatial patterns (distributions) of places and environments and how they are connected, *e.g. a line of towns in a valley, the pattern of areas affected by a tsunami*

Understanding places, environments and processes

Pupils should be given opportunities to:

1. identify and describe natural and human features, *e.g. weather conditions, types of buildings*
2. identify similarities and differences to describe, compare and contrast places and environments
3. describe the causes and consequences of how places and environments change, *e.g. by season; from past to present; the need for sustainability*

Introductory postcard 5

Megalocephalus skull, Great North Museum: Hancock© Natural History Society of Northumbria and the Great North Museum: Hancock

Hello, I'm Sylvia, Assistant Keeper of Geology at Tyne & Wear Archives & Museums.

I'd like you all to answer this question: what will the future be like? ***[Hello teacher, please have that discussion now?]***

I expect you have some intriguing ideas. While no one knows exactly what the future will be like, one thing is certain – it will be very different from today.

Fossils, such as the *Megalocephalus* skull shown on this postcard, tell us about creatures that were alive in Newcastle-upon-Tyne 360–300 million years ago.

At first Newcastle was a Roman fort and bridge. Then in the 1700s the city was a powerhouse of the Industrial Revolution. Today Newcastle is one of the largest cities in the UK, and it continues to change.

Your Natural History Adventurer challenge is to go on an imaginary journey and draw maps of how you think the place where you live now will look in the future. Imagining future worlds is a vital skill for Future Scientists.

Good luck!

Sylvia

Natural History Adventurers

Dippy on Tour
Future Scientist Training

School

UK

Lesson script 1

One thing that studying rocks and fossils shows us is how much places can change over time. As the postcard shows, the area of Newcastle was once a forest of giant horsetails and ferns (these went on to form coal deposits). In the more recent Jurassic Period when Dippy was alive several parts of Britain were actually underwater.

Your challenge is to create maps of your local area. In order to solve future problems or even to stop them from happening in the first place, Future Scientists must first use their observation and creative skills to imagine how a future world might be.

Please have a look at the images and see if you can spot the changes that have happened over time. Perhaps you and your teacher can make a list on the whiteboard.

Hello teacher, please show images of how your local area (or Kensington) used to look, and make a list of the major changes with your pupils.

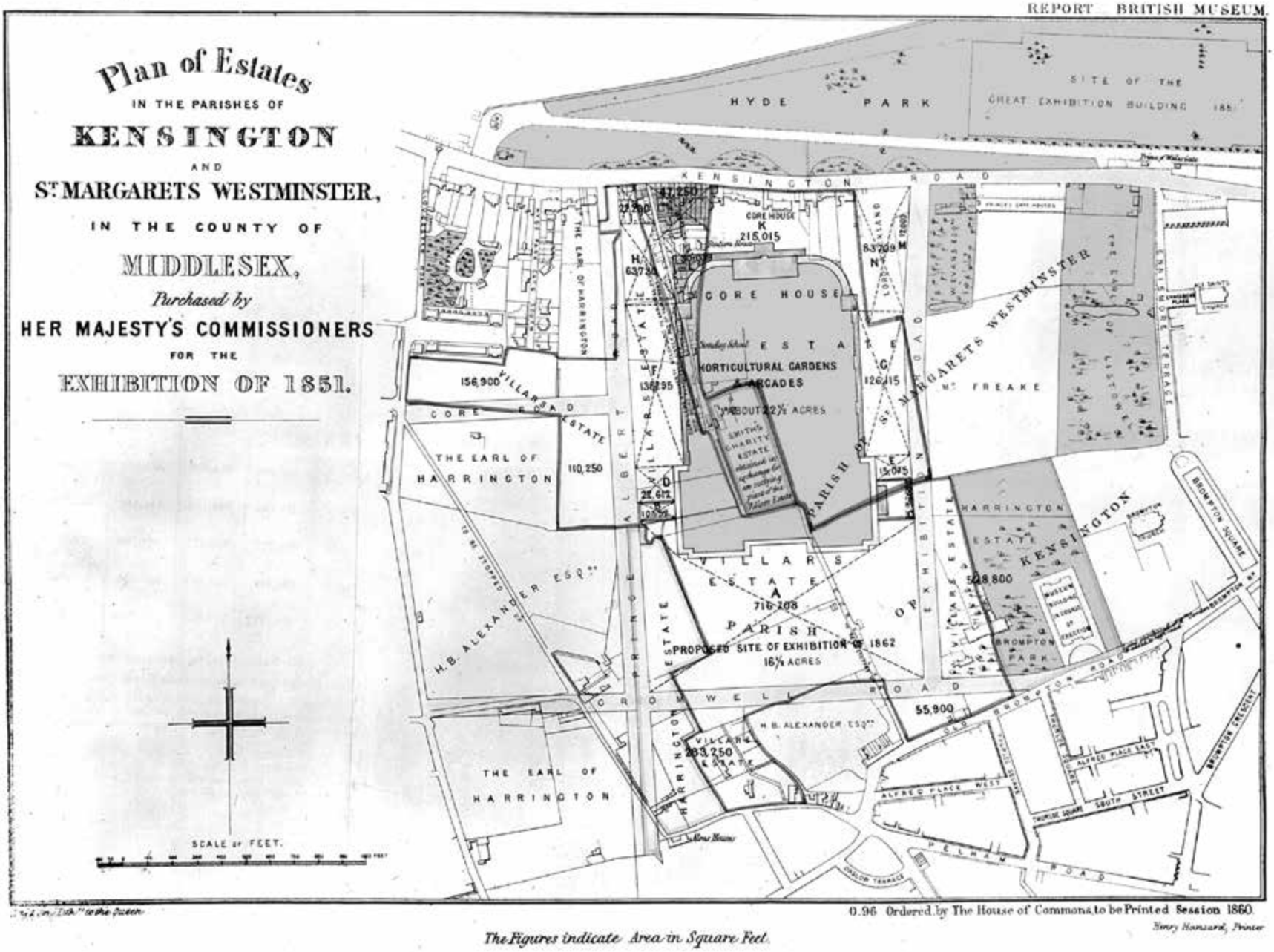
Now that you have an idea of how places change, your next task is to create your own future maps of where you live. We want you to imagine how your local area will look in the far future. If you have spotted patterns about how your local area has changed, use these as the starting point for how the area might look in hundreds, thousands or even millions of years' time.

Don't forget the different features you'll need to add to make your map a proper map. These include a scale indicator (showing the relationship between a unit of measure on the map and a unit of measure in the real world), the orientation (a compass arrow showing which way is north) and a legend or key (to define the colours or symbols used on the map).

Once you've made your marvellous maps, please take photos so you can email them to Dippy's team at DippyOnTour@nhm.ac.uk with the subject line **Maps**.

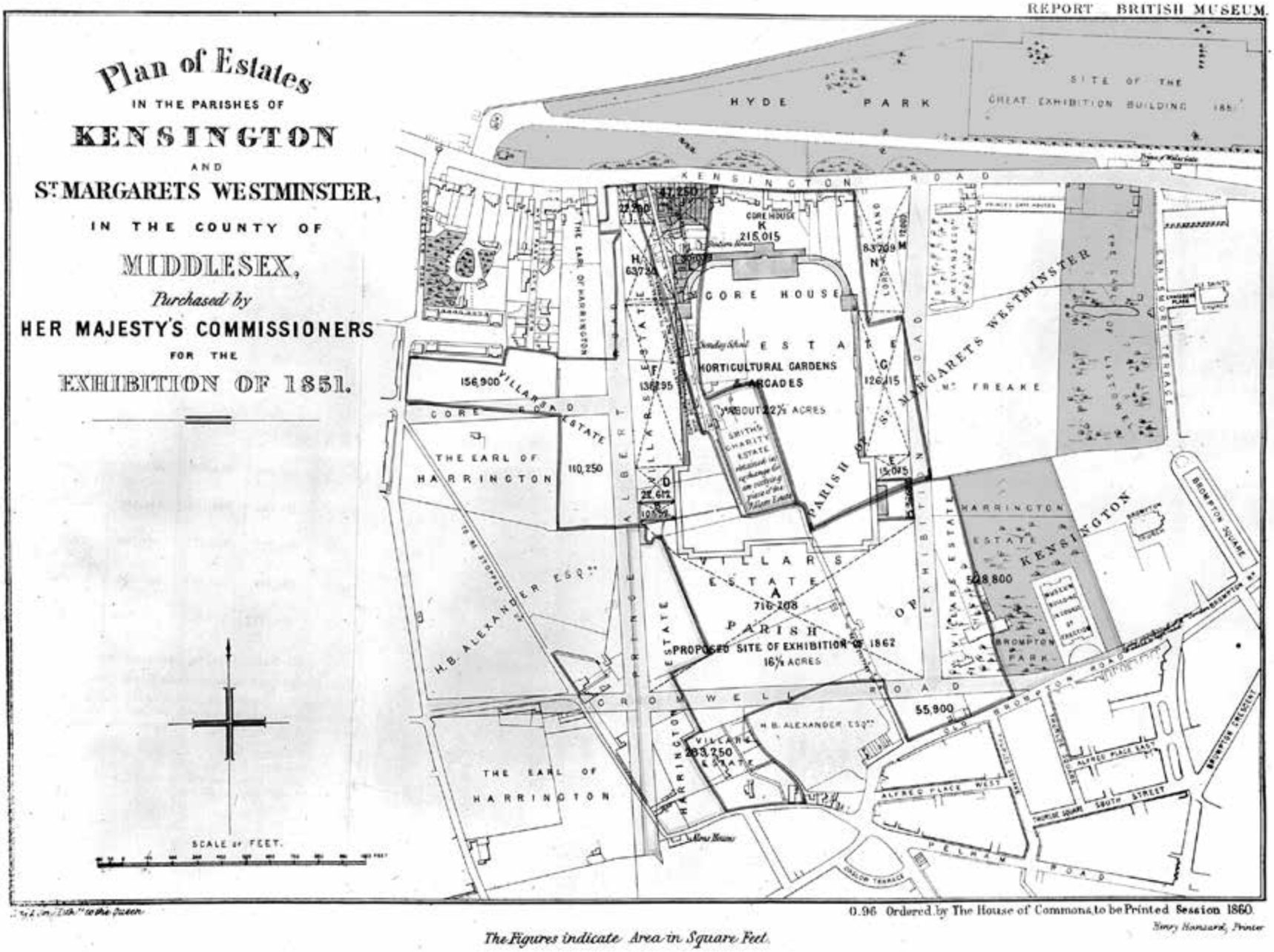
Now it's time to get map making!

Image 1: Green space in South Kensington, London, pre-1851



from the Archives of the Natural History Museum, London

Image 1: Green space in South Kensington, London, post-1851



from the Archives of the Natural History Museum, London

Image 3: Map of South Kensington, 2018

© Google Maps

Image 4: Plan of Newcastle, nd [1661?]

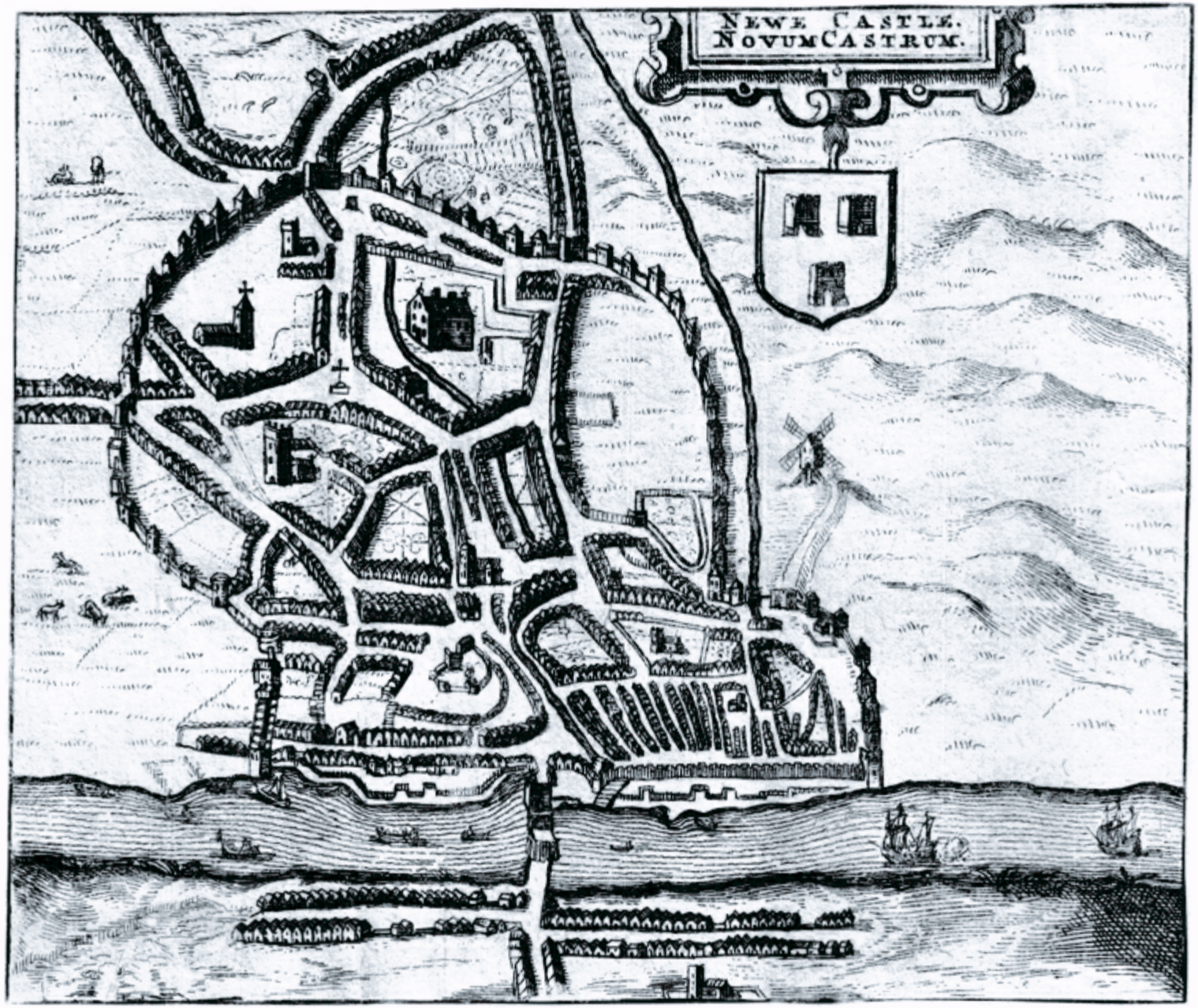
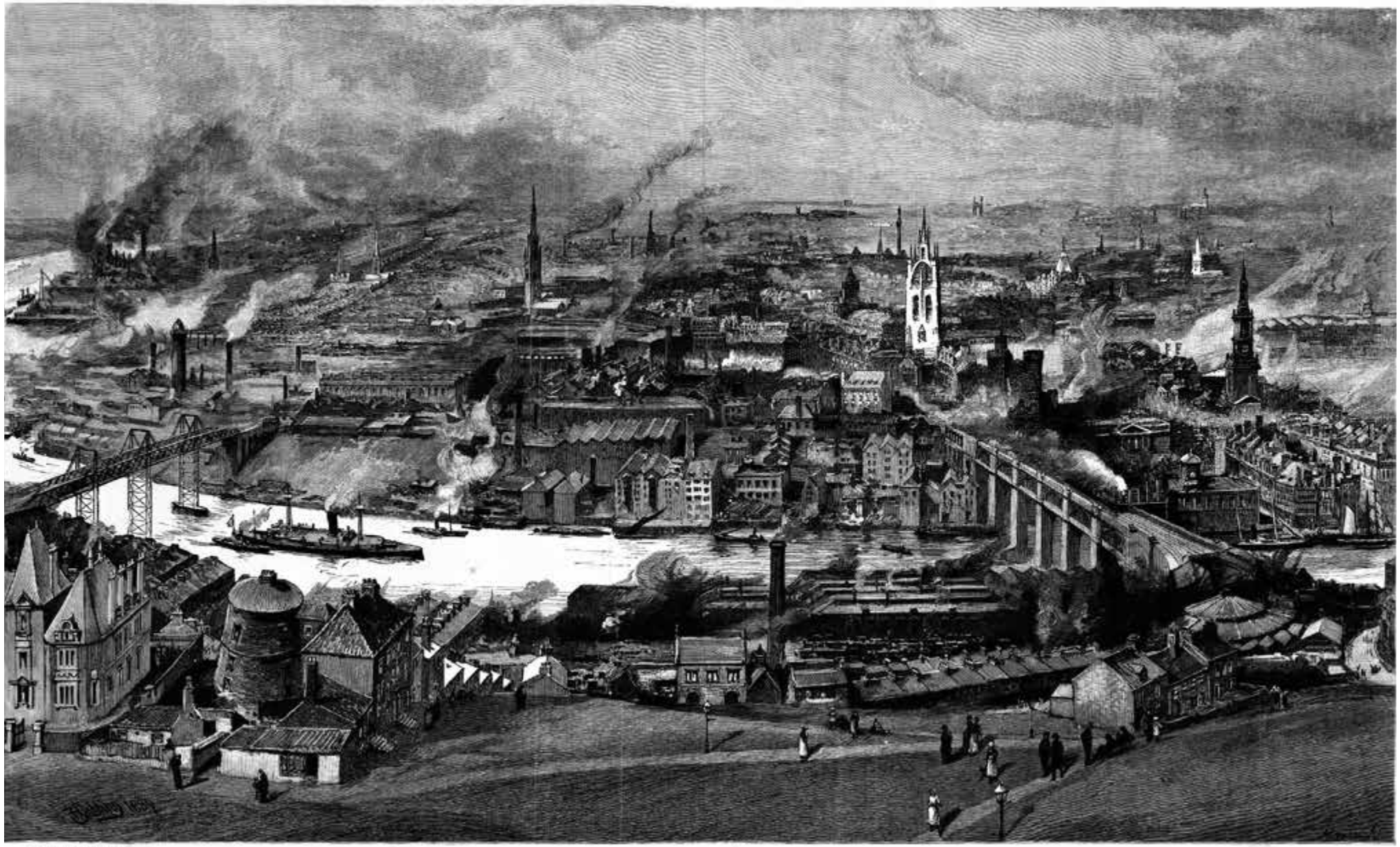


Image 5: A bird's eye view of Newcastle upon Tyne", 1889



A BIRD'S EYE VIEW OF NEWCASTLE-ON-TYNE
DRAWN BY ROBERT JOBLING

Image 6: Map of Newcastle upon Tyne, 2018

© Google Maps

Episode 5 glossary

Compass arrow

An arrow on a map that points upwards to show where north is.

Industrialisation

The widespread development of industry and technology in a country or region.

Industrial Revolution

The transition to new manufacturing processes in the period from about 1760 to sometime between 1820 and 1840. This change included moving from hand-made items to using machines, chemicals, steam power and the factory system. The Industrial Revolution marked a major turning point in history with almost every aspect of daily life changed in some way.

Map

A diagram showing areas of land including human features, such as towns and cities, and physical features, such as rivers.

Megalocephalus

Megalocephalus, meaning 'big-head' is an extinct amphibian from the British Isles. It lived during the Late Carboniferous. It was a fairly large animal, reaching around 1.5 metres in length, and had long pointed teeth and a crocodile-like lifestyle.

Scale

The relationship between a distance on a map and a distance in real life. For example, one centimetre on a map might represent one kilometre in real life.

Carboniferous

The Carboniferous is a geological period spanning 360–300 million years ago. The name means 'coal-bearing'. During the Carboniferous Period amphibians and insects were very common, with insects tending to be much larger than those that exist today.

Episode 6: The secrets of rocks (Cardiff)

Natural History Adventurers' mission

Pupils will discover the secrets of rocks – useful knowledge for Future Scientists.

Episode journey

Working in groups children will create fossils and locate them chronologically within layers of 'rock' before swapping with another group to excavate the secrets within their rock formation. Children will learn how rocks and fossils are formed and be introduced to some prehistoric life forms.

Curriculum learning outcomes

- children will learn how rocks and fossils are formed and how they are laid down in different strata (layers of rock)
- children will understand how palaeontologists excavate
- children will learn the chronology of some prehistoric life forms

Challenge synopsis

The **introductory postcard** explains how a single rock can hold incredible secrets. Children will focus on how fossils form in rocks, before creating their own fossil models. Pupils will then excavate each other's fossils, building their palaeontology skills as Future Scientists.

Possible additional activities

- Children create museum-style fossil exhibitions in their classrooms.
- Children create a chart of the periods of prehistory when different creatures lived on Earth.
- Older children might learn to use the scientific names for sections of geological time, such as the Jurassic.
- Children draw or paint scenes from when the creature they have written about was alive.
- Take the children out on a 'rock walk' to find rocks in the environment. This might include pebbles in a flowerbed or field, different rock types are used as building materials or gravestones etc. Children can try to identify the rocks and discuss what properties make them useful. This could lead to a discussion about natural building materials compared to human-made materials, such as brick, cement and concrete.

Activities

Not all activities will be relevant for all classes. The activities were developed to be broken up and used over a period of time and as is suitable for your particular class.

- Before beginning your lesson, find a pebble or piece of rock outside. You will show this when you read the **introductory postcard**.
- Read the **introductory postcard** provided and show your class the stone you discovered outside.
- Read **lesson script 1**, showing children **images 1**, **2** and **3** to introduce them to the secrets of rocks. Elicit what the children know or remember about how rocks are formed, using the **glossary** as required.
- Read **lesson script 2** to pupils and discover how much they know or remember about the formation of fossils.
- Expand on what the children have remembered by explaining or watching some short video clips online. **lesson script 2** links to a useful bitesize BBC film about fossil formation www.bbc.co.uk/guides/z2ym2p3#zgm94j6. (If the children have not studied fossils before then more time might be needed to teach this.) Ensure children understand the difference between igneous, sedimentary and metamorphic rock and understand how fossils are formed. Ask the children, from what they know, what types of rock might fossils be found in.
- Read **lesson script 3**, informing pupils that they are going to create their own models of fossils.
- Divide the class in half into Team 1 and Team 2. Then divide each team into groups of three or four. There needs to be an equal number of groups (though not necessarily children) in each team.
- Discuss the sizes that their fossils might be in reality. Explain that these fossil models will be miniature replicas (children's models need to be no larger than 4cm x 4cm x 2cm). Alternatively they could choose to model part of a creature, such as a tooth or part of a shell. If so, they must make sure they include enough of the creature for it to be identified later.
- Hand the groups pieces of paper with details of what fossil they will replicate. It would be most effective if these were kept secret. Half the class (Team 1) will make fossils using **pupil resources 1A**, **1B** and **1C** and Team 2 will make fossils using **pupil resources 2A**, **2B** and **2C**. Each group of three or four should have all three fossils. Models are best made in self-hardening clay but other modelling material or careful line drawings or watercolours, carefully cut out and placed onto card or cardboard would also work.

- When the models are made and dry, read **lesson script 4** to the class and explain that they are going to create a model of the layers of rock their fossils might have been found in.
  - Show the children the layer chart (**pupil resource 3**) and distribute two copies to each group. Explain how these differ, as fossil creatures were alive on Earth at different times, give the creature's age in millions of years and mention that they became extinct or evolved into different creatures over millions of years. For example, the trilobite was not alive at the same time as *Tyrannosaurus rex*.
  - Explain that rocks form in layers called strata (singular stratum) and that these are formed at different times and that these layers might have different colours and textures. Explain that different rock layers would have been laid down during the prehistoric periods on the chart, but for simplicity, they are going to create different layers of 'rock' and put their replica fossils in the correct layer for the geological period that they lived in.
  - Give each group a plastic box (an ice cream carton would be ideal or a classroom tray would also work), materials for their strata (this could be sand, earth, sawdust, dried peas, lentils etc) and two blank photocopied charts (**pupil resource 3**). As they create the strata for the period that their fossil would have lived in, they should place their replica fossil in that stratum and cover it up. They should fill in on their chart (**pupil resource 3**) what fossil replicas they placed in what stratum.
  - Read **lesson script 5** and inform the children that they are going to practise being palaeontologists, who find fossils in rocks. Redistribute the boxes so that each group gets one made by the other team. Ask them to carefully excavate the layers (spoons and dry paintbrushes would be useful) and to see what layers have fossils in them. Explain how palaeontologists have to work carefully to keep the layers clear and to not damage any buried specimens. When they find something buried, they should carefully excavate it, clean it and mark where they found it on the second chart (**pupil resource 3**). Bins, boxes or bags would be useful for the children to put the used layering materials in.
  - Gather the children and read them **lesson script 6** and look at **image 4**. This shows pictures of how their fossils might have looked when they were alive. Where would the creatures have lived? How might they have died? How would they have become fossilised? Make sure children realise that some of the creatures lived in water and others may have been on a beach or in a forest when they died.
  - Tell the children that they are going to choose a creature (it doesn't have to be the one they made a model of) and write its story. The story will be in three parts: first the creature's last day covering how and where it died, then how it became fossilised and finally how millions of years later someone found its fossilised remains.
  - Share the stories or display them with the models.
  - Send confirmation to Dippy's team at DippyOnTour@nhm.ac.uk with the subject line **Rocks**. This triggers an automated reply acknowledging receipt.

Resources required

Provided in the Natural History Museum package:

- introductory postcard
- glossary
- lesson scripts 1–6
- images 1–4
- pupil resources 1A–C, 2A–C, 3 and 4
- link to BBC Bitesize film on fossil formation: www.bbc.co.uk/guides/z2ym2p3#zgm94j6

Provided by school:

- a piece of rock or an interesting pebble found outside
- materials for making fossil replicas (self-hardening clay or modelling material)
- plastic boxes, spoons and paintbrushes
- materials for replicating different rock strata (this could be sand, soil, dry rice, lentils, sawdust, dried peas etc)
- photocopying for charts and pictures

English Key Stage 2 curriculum areas covered by Episode 6

The initial discussion and activities meet the following curriculum areas:

Year 3 Science: Rocks

Pupils should be taught to:

- describe in simple terms how fossils are formed when things that have lived are trapped within rock

Art and design

- become proficient in drawing, painting, sculpture and other art, craft and design techniques

English: Writing – composition Lower Key Stage 2:

Pupils should be taught to:

- plan their writing by:
  - discussing writing similar to that which they are planning to write in order to understand and learn from its structure, vocabulary and grammar
  - discussing and recording ideas
- draft and write by:
  - composing and rehearsing sentences orally, progressively building a varied and rich vocabulary and an increasing range of sentence structures

English: Writing – composition Upper Key Stage 2:

Pupils should be taught to:

- plan their writing by:
  - identifying the audience for and purpose of the writing, selecting the appropriate form and using other similar writing as models for their own
  - noting and developing initial ideas, drawing on reading and research where necessary

Northern Irish curriculum areas covered by Episode 6 (Key Stages 1 and 2)

The world around us (Key Stage 2): Place

Pupils should be enabled to explore:

- how place influences the nature of life
- ways in which people, plants and animals depend on the features and materials in places and how they adapt to their environment
- features of, and variations in places, including physical, human, climatic, vegetation and animal life
- change over time in places

The Arts (Key Stage 1): Art and design

Pupils should be enabled to:

- experiment with a range of media, materials, tools and processes such as: drawing, painting, printmaking, malleable materials, textiles and three-dimensional construction

The Arts (Key Stage 2): Art and design

Pupils should be enabled to:

- collect, examine and select resource material to use in the development of ideas
- develop their understanding of the visual elements of colour, tone, line, shape, form, space, texture and pattern to communicate their ideas
- use a range of media, materials, tools and processes such as: drawing, painting, printmaking, malleable materials, textiles and three-dimensional construction, selecting which is appropriate in order to realise personal ideas and intentions

Scottish curriculum areas covered by Episode 6 (First and Second)

Sciences: Planet Earth

Biodiversity and interdependence

I can identify and classify examples of living things, past and present, to help me appreciate their diversity. I can relate physical and behavioural characteristics to their survival or extinction. **SCN 2-01a**

Art and design

I can create and present work using the visual elements of line, shape, form, colour, tone, pattern and texture. **EXA 1-03a**

I can create and present work that shows developing skill in using the visual elements and concepts. **EXA 2-03a**

Welsh Key Stage 2 curriculum areas covered by Episode 6

Science at Key Stage 2

Activities should foster curiosity and creativity and be interesting, enjoyable, relevant and challenging for the learner. They should enable learners to initiate, explore and share ideas, and extend, refine and apply their skills, knowledge and understanding in new situations. They should allow time for thinking, peer discussion and reflection.

Range

The sustainable Earth

Pupils should use and develop their skills, knowledge and understanding by comparing the Earth with other planets, investigating materials around them and considering the importance of recycling.

4 the properties of materials relating to their uses

5. how some materials are formed or produced

Art and design

Skills

Investigating

Pupils should be given opportunities to:

1. select and record from:
    - observation
    - experience
    - memory
    - imagination
2. investigate:
    - the natural environment
    - the made environment
    - the world of imagination using a variety of materials

Making

Pupils should be given opportunities to:

1. explore, experiment with and apply the elements of the visual, tactile and sensory language of art, craft and design
2. design and make:
    - two-dimensional images
    - three-dimensional objects and artefacts using a range of various materials for a variety of purposes

Range

Making

Pupils should design and make both imaginatively and expressively:

- objects
- artefacts
- images

They should use a variety of:

- tools and equipment
- materials, e.g. paints, pencils, crayons, pastels, charcoal, inks, resistant materials, clays, sustainable materials, textiles, digital-based media etc
- processes, e.g. drawing, painting, printing, multimedia, craft processes, three-dimensional processes, digital-based processes etc

They should have opportunities to work as:

- individuals
- group members

English

Strand: Writing

Organising ideas and information

Meaning, purposes, readers

Writing accurately

Language

Grammar

Punctuation

Spelling

Handwriting

introductory postcard 6

Paradoxides davidis trilobite on display at National Museum Cardiff
© NATIONAL MUSEUM OF WALES

Hello, I'm Caroline Buttler, at the National Museum Cardiff.

Take a look at the rock in your teacher's hand.

[Hello teacher, please show pupils your rock now.]

This might just look like an ordinary rock, but like all rocks, it holds secrets. This has been on an amazing journey: it might have come from a volcano, from the bottom of the sea or even from space. This rock could be millions or even billions of years old.

Some rocks contain gold and silver, while others hide what I think is the most valuable treasure of all: fossils. Without rocks, we'd have no fossils and we'd know nothing about Dippy, other dinosaurs or any extinct or ancient animals or plants.

Your Natural History Adventurer challenge is to explore fossils and create some fossil models of your own. Understanding and sharing the secrets of rocks is a useful skill for any Future Scientist.

Good luck!

Caroline

Natural History Adventurers

Dippy on Tour
Future Scientist Training

School

UK

Lesson script 1

- **Rocks are storytellers.** When we study rocks they tell us the story of our planet. Some rocks even take us back to when Earth had only just formed. Here is a picture of the oldest rocks in the UK, found in north west Scotland and the western isles. This ancient Lewisian gneiss is almost 3,000 million years old.

*Hello teacher, please show **image 1** now.*

- **Rocks are space adventurers.** Some rocks crash into Earth after travelling through space. We call these rocks meteorites. Most scientists believe that a giant meteorite was the reason almost all the dinosaurs went extinct. Some scientists also believe that life began on Earth after tiny organisms travelled here through space inside meteorites. This would mean that we are all aliens! Here's a picture of the Barringer Crater, a huge hole in Arizona (USA) that was made when a meteorite weighing 300,000 tonnes (the same as 50,000 African elephants) and travelling at 42,000 kilometres per hour (130 times faster than a Ferrari) smashed into Earth. Have a look at that picture now.

*Hello teacher, please show **image 2** now.*

- **Rocks contain fossils.** Almost everything we know about the history of life on Earth has come from studying fossils found in rocks. The creature on the postcard is a trilobite called *Paradoxides davidis* that lived in the sea over 500 million years ago. By looking at fossils we know a lot about their lives. Trilobites had jointed legs and walked on the sea bed and many could see with a sophisticated pair of eyes. Trilobites are common fossils and this is one of hundreds of different types of trilobites we have found. Without fossils, we'd know nothing whatsoever about trilobites because they went extinct 252 million years ago, long before the dinosaurs appeared on Earth! You could think of each fossil as a postcard sent forward in time from plants and animals living long ago. Here's a picture showing a fossil trilobite, and how we think it might have looked when it was alive.

*Hello teacher, please show **image 3** now.*

Now that you know a little more about rocks, your next challenge is to take part in the Future Scientist Fossil Training Programme, where you will make some fossil models of your own.

*Hello teacher, please turn to **lesson script 2** when you are ready.*

Lesson script 2

We're going to make our own fossils. But first, do you have any ideas about how fossils are formed?
Please discuss this with your teacher now.

Hello teacher, please have that discussion now.

You had some brilliant ideas. Here's how scientists talk about fossils.

Fossils are the preserved remains of living things. There are three main types of fossil.

1) Hard body parts, such as bones or shells, can be covered in layers of sediment and slowly turn to rock as they are replaced with minerals.

2) Impressions left by living things, such as dinosaur footprints on a muddy beach, can be preserved when covered in layers of sediment and slowly turned to rock. Sediment is the name used to describe tiny particles of sand and mud that can be moved by rivers, sea and wind. The mud left behind when a puddle on a pavement dries up is an example of sediment. When layers of sediment form and are compressed they can eventually form sedimentary rock.

3) Dead animals and plants can be preserved in amber (tree sap or resin that has become hard) and also in ice, peat bogs (a wet, spongy sort of field) and tar pits (a pit filled with sticky, black tar, a little like the tarmac on our roads).

To help you understand how this third type of fossils is made watch this BBC film.
www.bbc.co.uk/guides/z2ym2p3#zgm94j6

Now you're ready to create some fossil models of your own!

Hello teacher, please move to ***lesson script 3*** *now.*

Lesson script 3

A real fossil takes many years to form – unfortunately, we don't have time to wait around for that to happen. Instead, we're going to make our own models. Your teacher has collected some materials to create your fossil models.

This challenge has three steps.

Step 1: Before you start making your fossil models, we need to split the class in half, right down the middle. If possible, try to make a gap between the two sides. The side on the left will be Team 1 and the side on the right is Team 2.

Hello teacher, please split your class now.

Step 2: Now work with your teacher to get into groups of three or four. There should be the same number of groups in both Team 1 and Team 2.

Hello teacher, please help children into groups now.

Step 3: Now, here's the sneaky bit: your teacher will give each group three fossils of extinct creatures. Groups in Team 1 will receive different fossils to groups in Team 2, and you need to keep your animals secret from the other team. For example, if Team 1 received a fossil of a mammoth, they wouldn't tell Team 2, and if Team 2 received a fossil of a *Diplodocus*, they wouldn't tell Team 1.

Hello teacher, please hand out the images of the three animals to each group now. These are ***pupil resources 1A****,* ***1B*** *and* ***1C*** *for Team 1 and* ***pupil resources 2A****,* ***2B*** *and* ***2C*** *for Team 2. You may wish to keep the illustrations of the living animals to reveal at the end.*

Keeping your fossil creature as secret as possible, please now make your fossil models using the materials your teacher has provided. When your fossil models are ready, the next challenge is to bury them.

Hi teacher, please turn to ***lesson script 4*** *when you're ready for burying.*

Lesson script 4

Step 1: Burying fossil models

Use the containers to create different layers to bury your fossil models in. These layers will represent the layers of rock in Earth's crust – although they will be made from very different things. Each group will get a picture showing the four layers you'll make inside your container.

*Hello teacher, please hand out one copy of **pupil resource 3** to each group.*

Compare the ages of your group's creatures with the ages of the four layers on your sheet. Work out what fossil needs to be buried in what layer. To help you remember all this, you can write the name of the creature onto the correct layer on the sheet. Then you can place your fossil models into your containers, building the layers as you go. Remember that your oldest fossil will be the first to go into the container.

Step 2: Model fossil swap shop

Now that you have buried your fossils in the correct layers, it's time to swap! Each group in Team 1 needs to swap their container with a group in Team 2. Once you have swapped, you're ready to begin excavating and identifying the fossils.

*Hello teacher, please turn to **lesson script 5** when you're ready to excavate.*

Lesson script 5

You should all now have a container made by another group. Your next challenge is to display your Future Scientist skills as model fossil finders.

There are some important things to remember when searching for fossils.

1) Be gentle – the fossil models you have made will be fragile, just like real fossils. Instead of a spade, you'll use spoons. Use them to gently remove each layer.
2) When you hit something that feels like a model fossil, you need to be even more careful. Take a paintbrush and gently brush away the layers until you can safely remove the fossil.
3) Once you have removed a model fossil, use the brush to make sure it is clean.
4) It might be easier if one of you searches at a time, and that you take turns to search each layer.

When you have safely removed all three fossil models from your container, your challenge is to identify them using the fossil ID sheet.

Hello teacher, please hand out the fossil ID sheet or display it on the class whiteboard now.
*This is **pupil resource 4**.*

You can also write what layer you found each model fossil in on the sheet that shows the four different layers. This well help you work out when the creatures were alive.

Once you have identified the three fossil models, write down their names on a piece of paper and give it to the group that made the container. They will give you their own piece of paper where they have tried to identify the fossil models you created. Then tell them how many of your fossil models they identified correctly.

Finally, take a 'fos-selfie' for Dippy's team, with all of you holding up one of the fossils you have created.

If you have the time, there's one last extra challenge.

Lesson script 6

After all of your model fossil exploration, you should have a pretty good idea about how your creatures look as fossils. It's time to see how they looked when they were alive. Here's a sheet with images of how all the animals used to look.

*Hello teacher, please share **image 4** with pupils now, either on the whiteboard or by handing out sheets.*

Take a moment now to look at each of the six animals and discuss how and where they lived.

Hello teacher, please discuss that now.

These creatures are all very different, but they have one thing in common: they are now extinct and we only know about them from fossils. This is the reason palaeontologists love rocks so much – fossils show us that the story of life doesn't end when a creature dies.

Now choose one of these six animals and write a story about it. This will be a rather strange sort of story because it will begin with your hero, the animal, dying. You could call your story 'The End Is Only the Beginning' or come up with your own title for your story.

You can tell your story in any way you like, but there must be three parts to it.

Part 1: The last day

In this part of your story you need to tell us about the last day of your creature's life, explaining how and where it died.

Part 2: The transformation

In this part of the story you need to tell us how the creature became a fossil. Think about the three different types of fossils and where your creature lived.

Part 3: The discovery

This is where Natural History Adventurers come in: tell the story of how the fossil of your creature was discovered and who discovered it. Perhaps you can research some famous palaeontologists, such as Mary Anning, or you can invent one of your own. Remember that fossils aren't only discovered by scientists digging down – they're also revealed on the surface when rocks are worn away by a process we call weathering.

Good luck, and remember to email your stories and your 'fos-selfie' to DippyOnTour@nhm.ac.uk with the subject line **Rocks**. This triggers an automated reply acknowledging receipt.

Image 1

When we study rocks they tell us the story of our planet. Some rocks even take us back to when Earth had only just formed. Here is a picture of the oldest rocks in the UK, found in north west Scotland and the western isles. This ancient Lewisian gneiss is almost 3,000 million years old.

Image 2

Here's a picture of the Barringer Crater, a huge hole in Arizona (USA) that was made when a meteorite weighing 300,000 tonnes (the same as 50,000 African elephants) and travelling at 42,000 kilometres per hour (130 times faster than a Ferrari) smashed into Earth. Have a look at that picture now.

USGS/D. Roddy via Wikimedia Commons

Image 3

Almost everything we know about the history of life on Earth has come from studying fossils found in rocks. The creature on the postcard is known as a *Paradoxides davidis* trilobite. It is one of hundreds of different types of trilobite that we know from fossils. Trilobites are one of the most common types of fossils we find in rocks and are more than 252 million years old. They went extinct 252 million years ago, long before the dinosaurs appeared on Earth! Without fossils, we'd know nothing whatsoever about trilobites – but thanks to fossils we know a lot about their lives. You could think of each fossil as a postcard sent forward in time from plants and animals living long ago. Here's a picture of how we think it might have looked when it was alive.

Pupil resource 1A

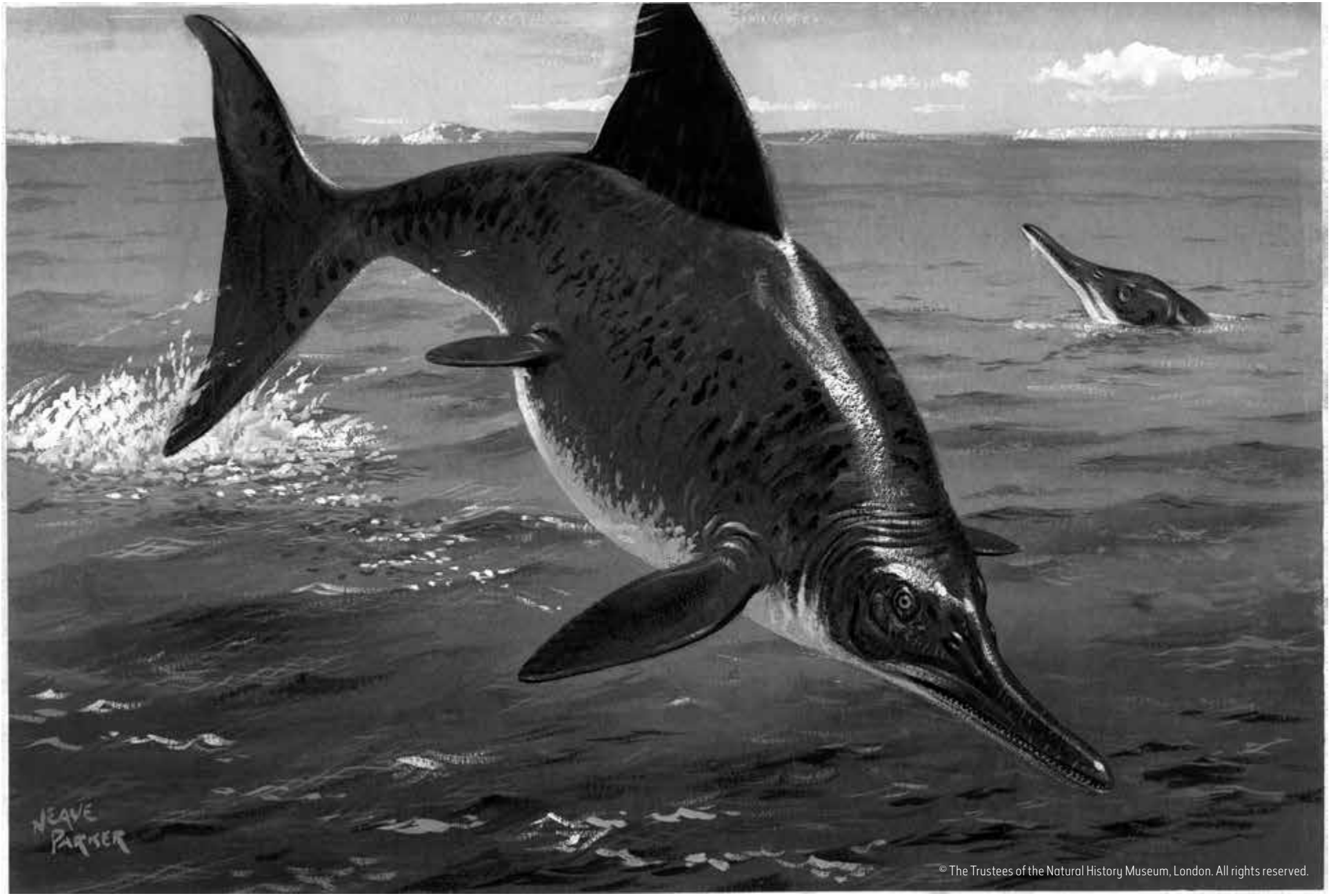
Here is an image of a trilobite fossil for you to base your model fossil on. Remember – try not to let anyone from Team 2 see what your fossil is.

Pupil resource 1B

This is an image of an ichthyosaur fossil for you to base your model fossil on. Remember – try not to let anyone from Team 2 see what your fossil is.

Ichthyosaurs first appeared **248 Million years ago**

Pupil resource 1B: Illustration of how we think Ichthyosaur might have looked

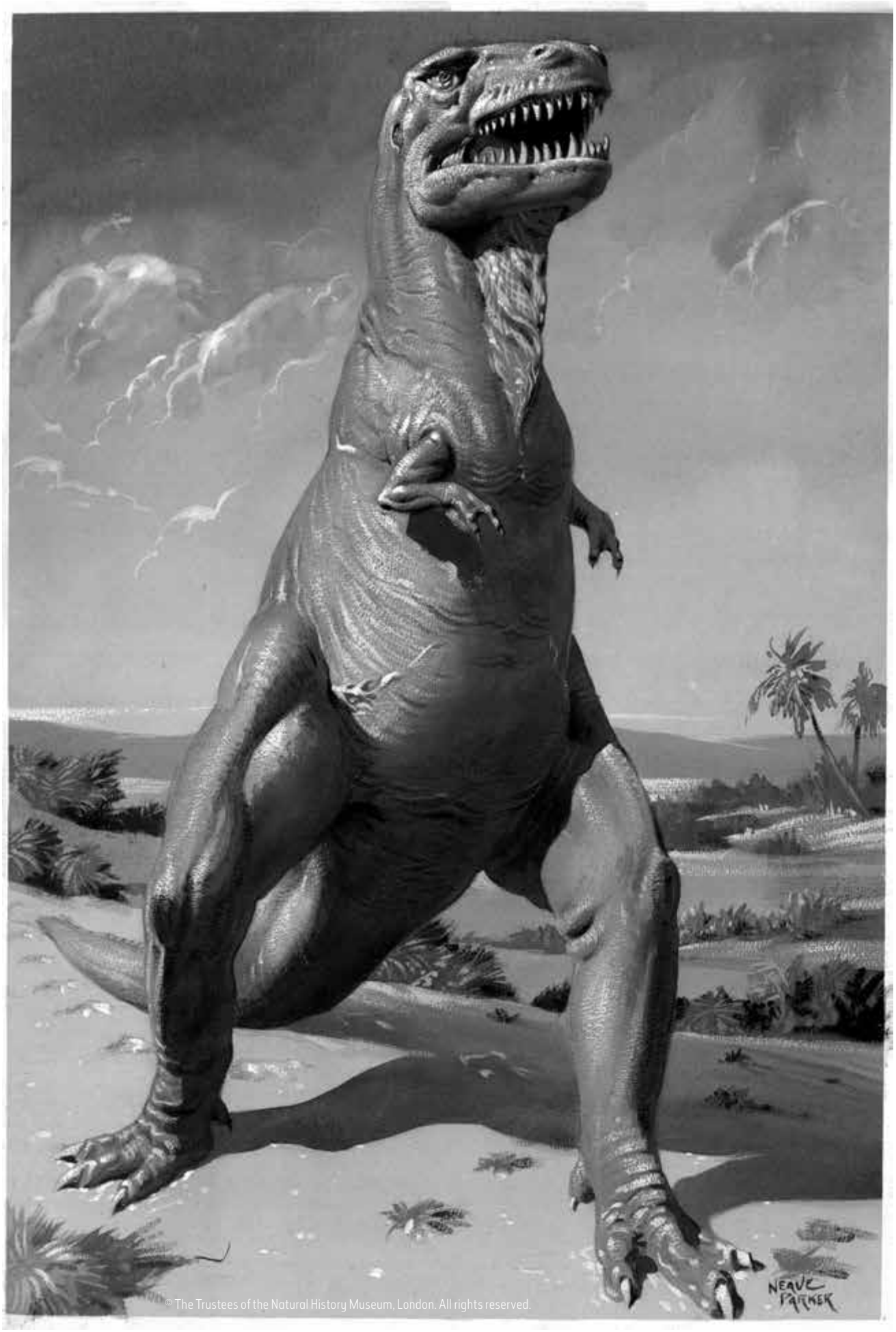


Pupil resource 1C

This is an image of a *Tyrannosaurus rex* skull fossil for you to base your model fossil on. Remember – try not to let anyone from Team 2 see what your fossil is.

***Tyrannosaurus rex* (*T. rex* for short) first appeared on Earth 68 million years ago.**

Pupil resource 1C: Illustration of how we think *Tyrannosaurus Rex* might have looked



Pupil resource 2A

This is an image of an ammonite fossil for you to base your model fossil on. Remember – try not to let anyone from Team 1 see what your fossil is.

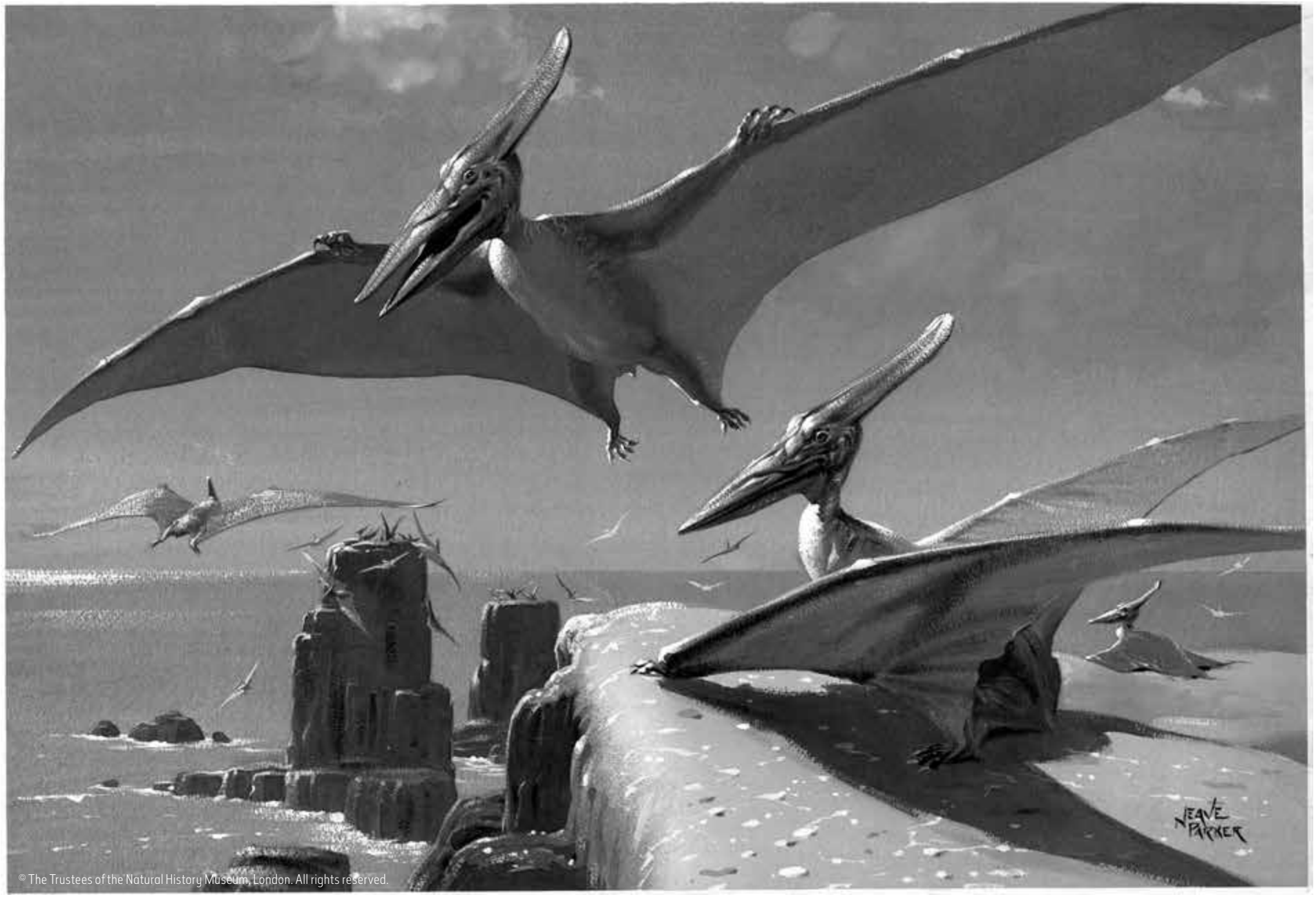
Ammonites first appeared 400 million years ago.

Pupil resource 2B

This is an image of a pterosaur fossil for you to base your model fossil on. Remember – try not to let anyone from Team 1 see what your fossil is!

Pterosaurs first appeared 228 million years ago.

Pupil resource 2B: Illustration of how we think Pterosaur might have looked

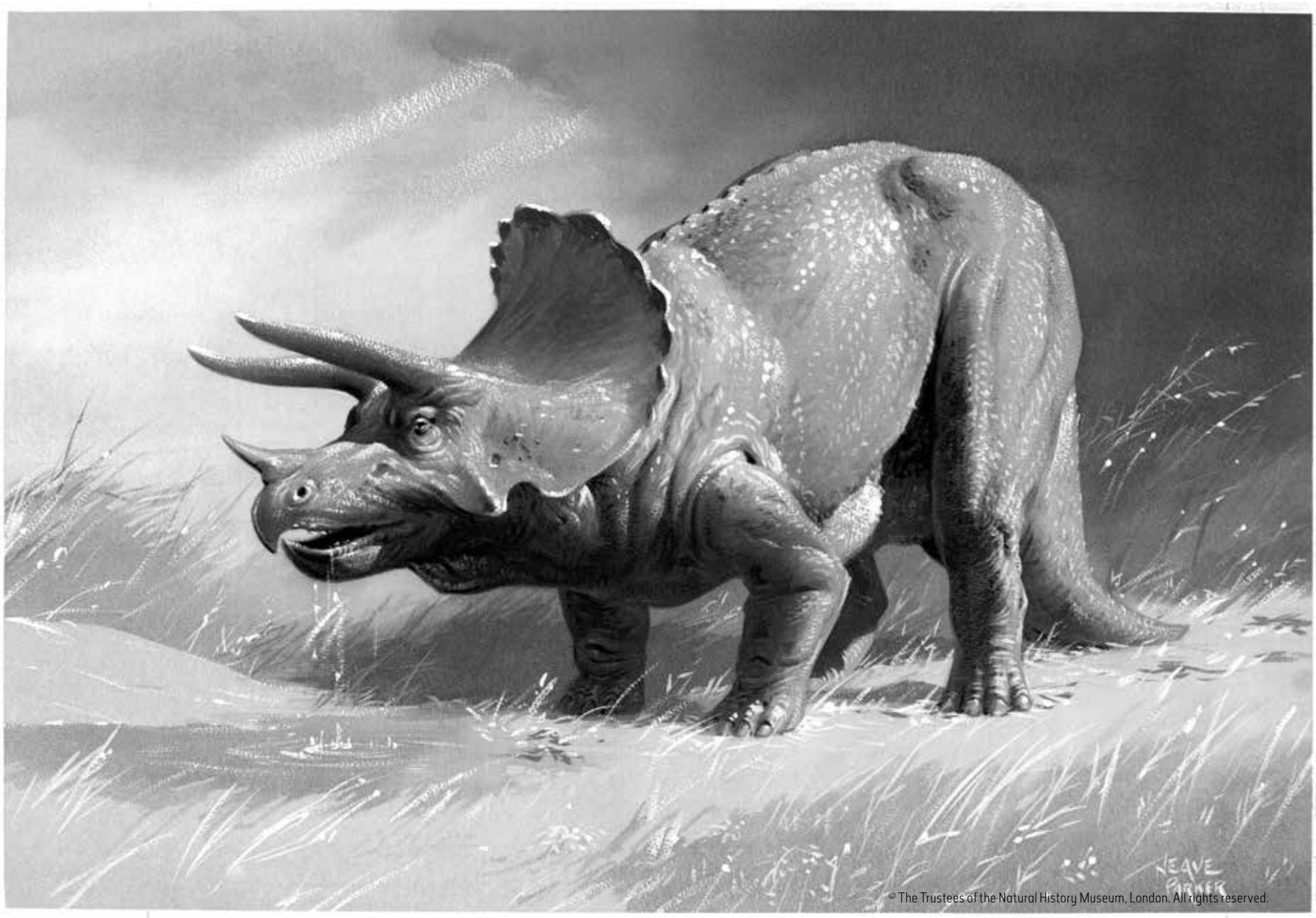


Pupil resource 2C

This is an image of a *Triceratops* skull fossil for you to base your model fossil on. Remember – try not to let anyone from Team 1 see what your fossil creature is.

***Triceratops* first appeared 68 million years ago.**

Pupil resource 2C: Illustration of how we think *Triceratops* might have looked



Pupil resource 3

This picture represents the different layers of rocks in the crust of the earth. Study the fossil creatures you have been given and see if you can work out which layer they should be found in: Layer A, Layer B, Layer C or Layer D? When you have worked this out, you can write the name of your fossil creature into the correct layer on the picture. *For example, if a creature lived 50 million years ago, you would write its name into Layer A.*

(Later on, you can add the name of the new fossil creatures you find when you excavate another group's fossil models. For this, simply write the name of the fossil creature into the layer you found it in. This will help you to work out how long ago the new fossil creature you have found was alive.)

Layer A – 100–0 million years ago

Layer B – 250–100 million years ago

Layer C – 350–250 million years ago

Layer D – 550–350 million years ago

Pupil resource 4 – Which fossil models have you found?

Trilobite

Ammonite

Dragonfly

Ichthyosaur

Pterosaur

Tyrannosaurus rex

Diplodocus

Triceratops

Mammoth

Episode 6 glossary

Trilobite

A hard-shelled creature that appeared more than 520 million years ago in Earth's ancient seas. Trilobites went extinct before the first dinosaurs appeared. The *Paradoxides davidis* trilobite was named in 1862 by the well-known palaeontologist J W Salter in the rocks of Porth-y-Rhaw, Wales. At more than 50 centimetres in length, it is one of the largest trilobites ever found.

Palaeontologist

A scientist who studies fossils.

Excavate

To remove soil carefully from an area in order to find buried remains in the ground.

Igneous rock

Rock that is formed when magma or lava from volcanoes cools and becomes solid. Granite, pumice and basalt are examples of igneous rock.

Metamorphic rock

Rock that has been changed under the influence of heat or pressure. This generally happens deep in our planet's core. Examples are marble, which is formed from limestone, and slate, which is formed from shale.

Sedimentary rock

Rock that has formed through the deposition and solidification of sediment, especially sediment transported by water (rivers, lakes and oceans), ice (glaciers) and wind. Sedimentary rocks are often deposited in layers, and frequently contain fossils. Limestone and shale are common sedimentary rocks.

Sediment

Solid fragmented material – such as sand, silt, gravel or the remains of living things – transported and deposited by water, wind or ice to form layers on Earth's surface. Over time sediment can become sedimentary rock.

Fossil

The remains or impression of an ancient plant or animal embedded and preserved in rock. Fossils can be the actual remains of a once living thing, such as bones, shells or seeds, or even traces of past events such as dinosaur footprints.

Meteorite

A piece of rock or metal that has fallen to Earth from outer space as a meteor. More than 90 per cent of meteorites are made of rock while the remainder consist wholly or partly of iron and nickel.

Stratum

(plural strata) A layer of sedimentary rock, each generally consisting of one kind of matter representing continuous deposition.

Organism

A living thing, such as an animal, plant or microbe.

Amber

Tree sap or resin that has become hard and fossilised.

Peat bog

A **bog** is a wetland that accumulates **peat**, a deposit of dead plant material, often formed from moss.

Tar pit

A pit filled with thick, sticky, black tar, a little like the tarmac on our roads. Like coal and oil, tar is a naturally occurring substance that forms from the remains of dead plants.

Minerals

A mineral is a substance such as quartz, halite or calcite that is formed naturally in rocks and inside the planet. Minerals are also found in small quantities in food and drink.

Extinct

No longer existing, died out.

Ammonite

An extinct sea creature often found as a fossil. Ammonites lived between 400 and 66 million years ago and had a thick shell, similar to that of snails today.

Pterosaur

A flying reptile that lived between 230 and 66 million years ago.

Ichthyosaur

A reptile that lived in ancient seas between 251 and 94 million years ago.

Dragonfly

Brightly coloured insects with long, thin bodies and two sets of wings. Fossils of very large dragonfly ancestors are found from 325 million years ago.

Triceratops

A large, four-legged, plant-eating dinosaur that lived between 66 and 68 million years ago. It had a huge head with two large horns, a smaller horn on its beaked snout and a bony frill above its neck.

Tyrannosaurus rex

A large, meat-eating dinosaur that walked on two legs. *Tyrannosaurus* was alive between 68 and 66 million years ago. It had enormous knife-like teeth.

Sabre-toothed tiger

A large, extinct, meat-eating mammal, related to modern cats. It had long, curved upper canine teeth.

Mammal

A warm-blooded animal that has hair or fur. Most mammals give birth to live young that are fed on milk produced by the female.

Erosion/eroded

The process by which soil and rock particles are worn away and moved elsewhere by wind, water or ice.

Erosion usually occurs alongside weathering.

Weathering

The breakdown of rocks at the planet's surface, by the action of rainwater, temperature extremes and biological activity. It does not involve the removal of rock material.

There are three types of weathering: physical, chemical and biological.

Weathering usually occurs alongside erosion.

Episode 7: The great school lichen hunt (Rochdale)

Natural History Adventurers' mission

Children will find life in unexpected places and understand how it adapts to survive.

Episode journey

Children will explore their school environment and discover how examples of life have adapted to live there.

Curriculum learning outcomes

- children will learn how life is continuously adapting to its environment
- they will learn to identify lichen
- they will graphically display data
- they will deliver scientific reports

Challenge synopsis

The team's postcard tells the story of how environments are constantly changing, and how only some living things can survive. The writer explains that they are particularly interested in lichens that have adapted to living in a huge range of different and sometimes extremely harsh environments. The children are challenged to go outside, carry out a survey of their local environment, find examples of where lichens are found and share it with the Natural History Museum as part of the Great School Lichen Survey.

Possible additional activities

- children conduct an ongoing survey of the wildlife in their school grounds
- children write stories inspired by the longevity of lichen or the places it grew (eg the things the lichen saw)
- children create lichen-inspired pictures, using paint, collage or fabric after examining the colours, forms and patterns of different lichens

Activities

Not all activities will be relevant for all classes. The activities were developed to be broken up and used over a period of time and as is suitable for your particular class.

- Read the **introductory postcard** from Dippy's team and discuss it with the class, using the **glossary** as required.
- Read **lesson script 1** to the class. This explains what remarkable organisms lichens are and introduces the Great School Lichen Survey. Share lichen-spotter sheets (**pupil resource 1**) with the class to help them begin to identify how different lichens might look. Be careful not to confuse the lichens with moss.
- Take the children around the school grounds or local area to find as many lichens growing as you can. Note down on the chart (**pupil resource 2**) where they are found, what they are growing on, what they look like and take sketches or photographs.
- Task the children to represent their findings using graphs, either individually or in groups, and present this to the rest of the class. Do the findings differ across the class? What lichen occurs most frequently? Where do you find most lichens growing?
- Send results of the survey to Dippy's team of experts DippyOnTour@nhm.ac.uk with the subject line **Lichen**. This triggers an automated reply acknowledging receipt.

Resources required

Provided in the Natural History Museum package:

- introductory postcard
- lesson script 1
- pupil resources 1–2
- glossary

Provided by school:

- photocopying for individual charts

English curriculum areas covered by Episode 7 (Key Stage 2)

Science: Evolution and inheritance

Pupils should be taught to:

- recognise that living things have changed over time and that fossils provide information about living things that inhabited the Earth millions of years ago
- recognise that living things produce offspring of the same kind, but normally offspring vary and are not identical to their parents
- identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution

Pupils might **work scientifically** by: observing and raising questions about local animals and how they are adapted to their environment; comparing how some living things are adapted to survive in extreme conditions, for example, cactuses, penguins and camels. They might analyse the advantages and disadvantages of specific adaptations, such as being on two feet rather than four, having a long or a short beak, having gills or lungs, tendrils on climbing plants, brightly coloured and scented flowers.

Northern Irish curriculum areas covered by Episode 7 (Key Stages 1 and 2)

The world around us (Key Stage 1): Interdependence

Pupils should be enabled to explore:

- 'me' in the world
- how plants and animals rely on each other within the natural world
- interdependence of people and the environment
- the effect of people on the natural environment over time
- interdependence of people, plants, animals and place

The world around us (Key Stage 1): Place

Pupils should be enabled to explore:

- how place influences plant and animal life
- ways in which living things depend on and adapt to their environment
- features of the immediate world and comparisons between places
- change over time in local places
- positive and negative effects of people on places

The world around us (Key Stage 2): Interdependence

Pupils should be enabled to explore:

- how they and others interact in the world
- how living things rely on each other within the natural world
- interdependence of people and the environment and how this has been accelerated over time by advances in transport and communications
- the effect of people on the natural and built environment over time

The world around us (Key Stage 2): Place

Pupils should be enabled to explore:

- how place influences the nature of life
- ways in which people, plants and animals depend on the features and materials in places and how they adapt to their environment
- features of, and variations in places, including physical, human, climatic, vegetation and animal life
- our place in the universe
- change over time in places
- positive and negative effects of natural and human events upon place over time

Scottish curriculum areas covered by Episode 7 (First and Second)

Sciences: Planet Earth

Biodiversity and interdependence

I can explore examples of food chains and show an appreciation of how animals and plants depend on each other for food. **SCN 1-02a**

Through carrying out practical activities and investigations, I can show how plants have benefited society. **SCN 2-02b**

Welsh curriculum areas covered by Episode 7 (Key Stage 2)

Science: Range

Interdependence of organisms

Pupils should use and develop their skills, knowledge and understanding by investigating how animals and plants are independent yet rely on each other for survival.

They should be given opportunities to study:

4. through fieldwork, the plants and animals found in two contrasting local environments, *e.g. identification,nutrition, life cycles, place in environment*
5. the interdependence of living organisms in those two environments and their representation as food chains
6. the environmental factors that affect what grows and lives in those two environments, *e.g. sunlight, water availability, temperature*
7. how humans affect the local environment, *e.g. litter, water pollution, noise pollution*

Introductory postcard 7

Scorpion fossil on display at Touchstones Rochdale

Hello, I'm Jessica Britch, Estate Ranger for the Woodland Trust at Smithills Estate in Bolton

As an Estate Ranger I undertake practical conservation, site management works on site, community and volunteer engagement alongside the monitoring, data collection and condition assessments of wildlife on the Estate.

Today, most scorpions like the one on this postcard live in warm places, such as deserts and tropical forests. But millions of years ago they scuttled around right here in the UK. This one was discovered in Rochdale, Lancashire. Rochdale was once a steaming hot scorpion swamp! Now it is surrounded by rolling hills, and the area continues to change.

Scorpions have adapted to live in a wide range of environments and can be found almost all over the world. Luckily only one species remains in the UK and it's harmless. Other living things have adapted to survive extreme changes in the environment – one example that you can see is lichen.

Your Natural History Adventurer challenge is to show us your skills as wildlife detectives. We're sending you on a quest to find mysterious lichens that can live in some inhospitable places.

Good luck!

Jess

Natural History Adventurers

Dippy on Tour
Future Scientist Training

School

UK

Lesson script 1

Lichens *[pronounced lie-kens]* are amazing.

You walk past them every day. There might even be one above your head on the roof right now. Yet most people have no idea what they are. Please put your hand up if you have an idea of what a lichen is.

Hello teacher, please explore that question now.

A lichen is not just one life form (or organism) – it's actually composed of two life forms: a fungus (similar to a mushroom) and an alga (similar to seaweed or the green stuff in ponds) that lives inside the fungus. The fungus and the alga work together to stay alive, like a team. The alga provides food through photosynthesis like plants, while the fungus provides protection from the extreme environment.

Lichens are the some of the oldest life forms we know of – scientists have found fossil lichens that are more than 410 million years old. Anything that has existed on our planet that long is clearly a great survivor, and some lichens live for a very long time.

They can be found almost anywhere on the planet, from icy mountaintops to dry, hot deserts, and even in toxic rubbish heaps where nothing else will grow. Scientists estimate that six per cent of Earth's surface is covered in lichen. That's 30 million square kilometres – an area three times as big as the USA.

One reason lichens can survive anywhere is that they don't need roots like flowering plants do. As long as they are able to get some sunlight and water (from mist or occasional rain) they can grow. Lichens also protect their algal partner by creating a substance that acts like sunscreen or a raincoat, offering extra protection.

Lichens have thrived in human cities. They grow on concrete pavements, brick walls, wooden and metal fences, glass and even painted surfaces such as postboxes.

One place we will almost certainly find lichen is outside the school. So your next challenge is to go on a quest for lichen – nature's toughest survivor.

To get you started, here are some places to look:

- walls
- tree trunks
- pavements
- rooftops (look up, but don't go climbing)

If you have tablets or cameras you could use these to take photos of the lichen you find.

Use the results of your survey to create graphs. What type of lichen appears the most in the school grounds? Do different lichen appear more often in different environments (eg in damp or dark areas, in sunlight, in trees or on rocks)?

Work individually or in groups to represent your data on a graph, and present your findings to the class.

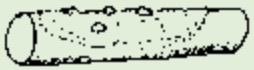
Good luck on your lichen quest, and remember to email your findings to Dippy's team at DippyOnTour@nhm.ac.uk with the subject line **Lichen**.

Pupil resource 1

Which lichen did you see?	What did it look like?	Where was it growing?	Please sketch it here or take a photo.

❹ Crusty lichens

Closely attached so that you can't remove them without taking bark



Now look at the fruiting bodies

Are the fruiting bodies rounded?

OR

Elongated to star-shaped?

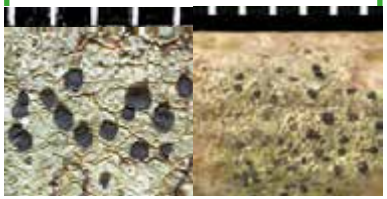
OR

With paler margins like jam tarts

Lecanora

Dark colour throughout like wine gums.

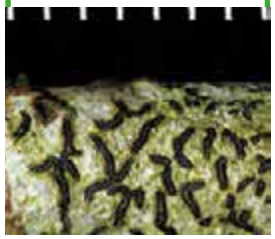
Lecidella and ***Amandinea***



OR

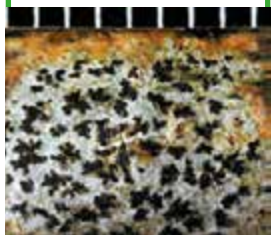
The margins are raised and lip-like

Graphis



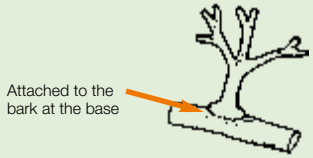
Fruiting bodies have no raised margins

Arthonia



Which lichens can you find?

Start here - which of these 3 types of lichen can you find?



Bushy lichens

Branched and shrubby only attached from the base

How many different bushy lichens did you find? .

.....

Go to ❷ to try and name your lichens.

Leafy lichens

Leaf-like lobes that are closely or loosely attached from the lower surface

How many different leafy lichens did you find?

.....

Go to ❸ to try and name your lichens.

Crusty lichens

Closely attached so that you can't remove them without taking bark

How many different crusty lichens did you find? .

.....

Go to ❹ to try and name your lichens

❷ Bushy lichens

Branched and shrubby only attached from the base

Now look at the branches

Are the branches rounded in cross section?

OR

Flatten in cross section?

Branches rounded and same colour all round

Usnea

Nitrogen-sensitive

OR

Branches greenish on the upper surface and white below

Evernia

Nitrogen-sensitive

Branches grey-green all round

Ramalina

❸ Leafy lichens

Leaf-like lobes that are closely or loosely attached from the lower surface

Now look at the colour

OR **OR** **OR**

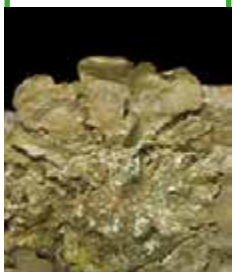
Yellow to greenish

Xanthoria

Nitrogen-loving

Olive-brown

Melanelixia



Apple-green

Flavoparmelia

Grey

- now look at the lobes

OR

Lobes thin like a leaf and solid when cut?

OR

Parmelia has white lines on the surface of rounded lobes

Physcia has small lobes with whiskers along the margins

Lobes swollen and hollow when cut.

Hypogymnia

Episode 7 glossary

Lichen

Not a single organism but a stable partnership between a fungus and an alga (such as a seaweed). Like all fungi, lichens require sugar as a food source. This is provided by algae that make food by photosynthesis. Both fungi and algae benefit from existing together. Lichens have adapted to live in very different environments. You can find lichens everywhere from sea level to the top of alpine peaks, and hot deserts to the cold of the Arctic and Antarctic.

Adaptation

The process of change by which an organism or species becomes better suited to its environment.

Fungus

Any member of the fungi family, including mould and mushrooms. Fungi cannot photosynthesise – make their own food – they must obtain food to survive.

Seaweed

A type of algae found in seawater.

Algae

A diverse group of organisms. They tend to be green in colour and use photosynthesis to create food.

Scorpion

A small, eight-legged animal from the same group as the spider (the arachnids). Scorpions have two pincers, similar to those of a lobster, and a tail with a venomous stinger attached. Scorpions have evolved over the past 430 million years and have adapted to a wide range of environmental conditions – scorpions are found on all continents, except Antarctica.

Arachnids

A group of small animals that are similar to insects but have four pairs of legs. Arachnids include spiders, scorpions, ticks and mites.

Adaptation/adapt

The process by which living things change over time to become better suited to where they live.

Organism

A life form.

Photosynthesis

The process used by plants to convert light into energy (food).

Episode 8: Debating dilemmas (Norwich)

Natural History Adventurers' mission

The scientists of the future will face many tricky problems and dilemmas. Different people will have different ideas about what to do next, so Future Scientists need be able to debate and argue their positions. This requires them to be good at both speaking and listening, and to understand the difference between a persuasive argument and statements backed up by scientific evidence.

Episode journey

Children consider and debate ethical dilemmas relating to scientific progress. They learn to put their cases clearly and provide evidence-based arguments to support their point of view.

Curriculum learning outcomes

- children will choose evidence to support their viewpoints **(Science)**
- children will improve communication skills **(English)**
- children will become more aware of ethical issues in science
- children will develop their skills in constructing an argument
- children will understand the value of discussion in the scientific process

Challenge synopsis

The postcard introduces the concept of debate and the activity introduces children to a series of dilemmas that Future Scientists are likely to face.

Possible additional activities

- With older children you may want to look at some of the sources of information. You could discuss what makes a reliable source, what statements are backed by scientific evidence and what are opinions, as well as whether arguing from two opposing positions is the best way of looking at the evidence.
- You could link to **Episode 4** and consider the audience that certain statements might have been written for.
- Use the additional debate prompts (**pupil resource 2**) to continue discussions.
- Have pupils suggest their own questions for debate and research the spectrum of opinion.
- Ask the children to have a silent debate by inviting them to write comments beneath a variety of prompt statements for and against the debate topic on A3 sheets of paper around the classroom. This will allow quieter children to contribute. A silent vote could also take place with the children tallying what side of the debate they agree with.

Activities

Not all activities will be relevant for all classes. The activities were developed to be broken up and used over a period of time as is suitable for your particular class.

- Read the **introductory postcard** to the children and discuss some of the issues. Was hunting mammoths the right thing to do? What led to the demise of the mammoth? Would bringing mammoths back to life in the world be a good thing? Discuss the challenge and how some dilemmas do not have clear right and wrong answers, especially when there isn't enough research for a clear answer.
- Read **lesson script 1** to the class.
- Introduce some of the present and future problems, as well as the dilemmas facing scientists. These could be recent topical or local concerns, or you could use the list of topics in **pupil resource 2**. Discover how much the children already know about the topic. List points that they bring up or that you feel are important to begin with. You might want to choose just one area and explore it together as a class, or put up a variety of debate statements on A3 sheets of paper around the classroom and encourage the students to populate these with their current knowledge.
- Model a debate with a statement such as: *should we ban plastic bags?* Put the debaters into two teams, one team argues for the statement and the other argues against it. Stress that the children don't have to personally agree with the statement, they just have to see how well they can persuade the audience to agree with them by coming up with great arguments.
- Practise coming up with good, persuasive arguments both for and against the proposition.
- Divide the children into two teams. Introduce the statement: ***we need to use pesticides to grow enough food*** and allocate each team to either argue for or against. (For younger or less able children you might want to have a class discussion rather than a formal, competitive debate.) Alternatively, you could ask the children to have a silent debate by inviting them to write comments beneath a variety of prompt statements for and against the debate topic on A3 sheets of paper around the classroom. This will allow quieter children to contribute.

- Give each team the briefing sheets (**pupil resource 1**). Ask them to sort through the statements, selecting content for and against the statement. Ask them to consider what evidence might be paired as counter-arguments and what evidence doesn't support either side of the debate (this doesn't mean that the statements are not relevant or great science).
- Ask the pupils to prepare their case and decide who will say what in the debate, reminding them that they don't have to personally believe in the argument, but have to find as many good arguments as possible to try and persuade their audience. (The **glossary** explains specific language used in the dilemma topics.)
- When all the teams are ready call them together and ask each group to put forward their arguments.
- You could do a pre- and post-debate opinion poll with the children – has the debate challenged or changed their opinions?
- After both teams have spoken, ask the class to vote whether to accept or reject the proposition.
- Send the result of each debate through to Dippy's team at DippyOnTour@nhm.ac.uk with the subject line **Debate**. This triggers an automated reply acknowledging receipt.
- As a follow up activity with older children you may want to look at some of the sources of information. You could discuss what makes a reliable source, what statements are backed by scientific evidence and what ones are opinions. Or you could discuss what made it a winning debate – did it all came down to the science or was it how the arguments were presented? Scientists have different opinions but will be strongly influenced by scientific evidence, or be unwilling to decide until there is adequate evidence. What influences the pupils?

Resources required

Provided in Natural History Museum package:

- introductory postcard
- lesson script 1
- pupil resources (1–2)
- glossary

Provided by school:

- photocopying for debate briefing sheets
- access to the internet for research

English curriculum areas covered by Episode 8 (Key Stage 2)

Science Year 4

Pupils should:

- recognise that environments can change and that this can sometimes pose dangers to living things

English

In Years 3 and 4, pupils should become more familiar with and confident in using language in a greater variety of situations, for a variety of audiences and purposes, including through drama, formal presentations and debate.

In Years 5 and 6, pupils' confidence, enjoyment and mastery of language should be extended through public speaking, performance and debate.

Northern Irish curriculum areas covered by Episode 8 (Key Stages 1 and 2)

The world around us (Key Stage 1): Place

Pupils should be enabled to explore:

- how place influences plant and animal life
- change over time in local places
- positive and negative effects of people on places

The world around us (Key Stage 1): Change over time

Pupils should be enabled to explore:

- ways in which change occurs in the natural world
- how people and places have changed over time
- positive change and how we have a responsibility to make an active contribution.

The world around us (Key Stage 2): Interdependence

Pupils should be enabled to explore:

- how they and others interact in the world
- how living things rely on each other within the natural world
- interdependence of people and the environment and how this has been accelerated over time by advances in transport and communications
- the effect of people on the natural and built environment over time

The world around us (Key Stage 2): Place

Pupils should be enabled to explore:

- how place influences the nature of life
- ways in which people, plants and animals depend on the features and materials in places and how they adapt to their environment
- features of, and variations in places, including physical, human, climatic, vegetation and animal life
- our place in the universe
- change over time in places
- positive and negative effects of natural and human events upon place over time

The world around us (Key Stage 2): Change over time

Pupils should be enabled to explore:

- how change is a feature of the human and natural world and may have consequences for our lives and the world around us
- ways in which change occurs over both short and long periods of time in the physical and natural world
- the effects of positive and negative changes globally and how we contribute to some of these changes

Language and literacy (Key Stage 1): Talking and listening

Pupils should be enabled to:

- participate in talking and listening in every area of learning
- listen to, interpret and retell, with some supporting detail, a range of oral and written texts
- take turns at talking and listening in group and paired activities
- express thoughts, feelings and opinions in response to personal experiences, imaginary situations, literature, media and curricular topics and activities
- think about what they say and how they say it
- speak audibly and clearly, using appropriate quality of speech and voice
- devise and ask questions to find information in social situations and across the curriculum
- read aloud from a variety of sources, including their own work, inflecting appropriately to emphasise meaning

Language and literacy (Key Stage 2): Talking and listening

Pupils should be enabled to:

- participate in group and class discussions for a variety of curricular purposes
- know, understand and use the conventions of group discussion
- share, respond to and evaluate ideas, arguments and points of view and use evidence or reason to justify opinions, actions or proposals
- describe and talk about real experiences and imaginary situations and about people, places, events and artefacts
- prepare and give a short oral presentation to a familiar group, showing an awareness of audience and including the use of multimedia presentations
- identify and ask appropriate questions to seek information, views and feelings
- talk with people in a variety of formal and informal situations
- use appropriate quality of speech and voice, speaking audibly and varying register, according to the purpose and audience
- read aloud, inflecting appropriately, to express thoughts and feelings and emphasise the meaning of what they have read

Scottish curriculum areas covered by Episode 8 (First and Second)

Topical science

I have contributed to discussions of current scientific news items to help develop my awareness of science. **SCN 1-20a**

Through research and discussion I have an appreciation of the contribution that individuals are making to scientific discovery and invention and the impact this has made on society.
SCN 2-20a

can report and comment on current scientific news items to develop my knowledge and understanding of topical science.
SCN 2-20b

Welsh curriculum areas covered by Episode 8 (Key Stage 2)

Personal and social education: Skills

Developing thinking

Learners should be given opportunities to:

- identify links between cause and effect
- distinguish between 'facts', beliefs and opinions
- form personal opinions and make informed decisions
- use appropriate techniques for personal reflection

Developing communication

Learners should be given opportunities to:

- listen carefully, question and respond to others
- express their views and ideas confidently through a range of appropriate methods
- contribute to class discussions and take part in debates

Science: Developing communication

Learners develop their communication skills across the curriculum through the skills of **oracy**, **reading**, **writing** and **wider communication**.

In science, learners communicate ideas, information and data in a variety of ways depending on the nature of the task, audience, purpose and the learners' own preferences. Communication can take a wide variety of forms, including the use of IT at times, and with increasing maturity should show progression in the use of scientific terminology, symbols and conventions and a more logical, systematic approach.

Science: Range

Interdependence of organisms

- how humans affect the local environment, e.g. litter, water pollution, noise pollution

Introductory postcard 8

Bones of West Runton mammoth in storage at Norwich Castle Museum

Hello, I'm Sandra Knapp, a Researcher at the Natural History Museum.

The woolly mammoth is a famous extinct creature. This amazing specimen – found in north Norfolk – is the largest almost complete mammoth skeleton ever found. Mammoths became extinct around 3,600 years ago because of a changing climate and being hunted by humans.

Had humans not hunted mammoths for food, their own families might have died from starvation.

It's still a challenge to make sure everyone on Earth is fed. In order to produce enough food for everyone we need to use science to decide whether to use pesticides – chemicals that kill bugs and other pests – on crops. Pesticides stop the pests eating or damaging crops so there's more food for humans. But some of the chemicals used may also be poisonous to humans, insects and other creatures, so what is the right balance?

Your challenge is to investigate and debate this or other challenges for the future.

Good luck!

Natural History Adventurers

Dippy on Tour
Future Scientist Training

School

UK

Lesson script 1

Your next challenge is to have debates about some of the trickiest dilemmas that Future Scientists will face.

Debating is a very important skill for all Future Scientists because, like everyone else, scientists have to influence people and debating skills help them to do this. A good way to develop your debating skills is to argue for something that you don't actually believe. Let's try something before we get onto the debates. I'd like to ask someone who really likes football to put their hand up now.

Hello teacher, please choose someone who has their hand up.

Ok, hello person-who-really-likes-football, you are person A. Could you quickly tell the class why you like football so much?

Hello teacher, please facilitate this.

Thank you. Now I'd like someone who really doesn't like football to put their hand up.

Hello teacher, please choose someone who has their hand up.

Hello person-who-really-doesn't-like-football, you are person B. Could you tell us all why you don't like football?

Hello teacher, please facilitate this.

Thank you. Now I'd like both person A and person B to have a debate, but there's a twist! I'd like person A (who likes football) to argue that it is the worst sport ever and I'd like person B (who dislikes football) to argue that it is the best sport ever. Person A, you can start your argument now.

Hello teacher, please chair this small debate now.

Excellent, I hope that has shown you how it is possible to argue for something you do not believe. Now, we have one last thing to look at: the golden threads of a good debate. These are five things that will help you to become excellent debaters:

1) **Using evidence:** You need to choose the best facts to make a strong argument. As Future Scientists it is important to understand the difference between a persuasive argument and statements supported by scientific evidence.
2) **Delivery:** Being able to speak with the right speed, rhythm and body language to make your audience listen to you.
3) **Listening:** Listening carefully to the other side's argument and using what you hear to develop a strong response (called a counter-argument).
4) **Planning:** Deciding before you speak what points you are going to make and writing them down as notes.
5) **Humour and charm:** If you're interesting, or funny if appropriate, people will listen to you.

Finally, it's ok to show passion when you debate, but remember to never be rude. As soon as you start being rude, the other person automatically wins the debate without even trying.

When you have finished email Dippy's team at DippyOnTour@nhm.ac.uk with the subject line **Debate** to tell us all what happened.

Pupil resource 1 (with sources)

We need to use pesticides to grow enough food.

We need to grow more food to feed a growing population. The number of people in the world is growing with numbers expected to reach 9.6 billion by 2050.

Food and Agriculture Organization of the United Nations (a)

Over the next 35 years the growing global population will demand more food than has ever been produced in human history!

Global Food Security (UK cross-government programme on food security research) (a)

The threat of climate change is putting pressure on food production around the globe. Higher temperatures and changes in rainfall will impact on crop quality and quantity. We need pesticides to ensure we have enough food despite environmental changes.

World Food Programme

Pesticides can reduce the cost of food production by reducing crop loss. Even with pesticides, between 26 and 40 per cent of the world's potential crop production is lost each year – pesticides can help protect crops and reduce waste.

Global Food Security (UK cross-government programme on food security research) (b)

Studies show that the benefits of a diet containing fresh fruit and vegetables far outweigh potential risks from eating low residues of pesticides in crops.

Western Farm Press (local farming organisation)

Pesticides are a fundamental part of modern food production. Our food crops have to compete with 30,000 species of weeds, 10,000 species of insect pests and countless diseases. Without crop protection, these natural pests would reduce our food supply by around a third.

Pesticides in Perspective (a)

Pesticides must be safe or they wouldn't be produced and allowed to be used by the government.

UK Government Food Standards Agency

There are regulations on the levels of pesticides in crops. You'd have to eat more than 150,000 servings of carrots containing pesticides at the maximum levels every day before suffering any harm!

Pesticides in Perspective (b)

Biological controls can be used to kill pests, rather than using harmful chemicals.

BBC Bitesize

Scientists are researching new ways to create healthier soils that could help produce healthier crops and reduce the need for pesticides. Adding friendly bacteria to the soil could help make stronger plants.

Scientific American (magazine)

Smart technology such as automated watering and fertilising systems can be used to increase harvests, rather than resort to more chemicals that pollute the planet.

The Economist (magazine)

Farmers in the Netherlands can grow 10 times as much produce in greenhouses under optimal conditions than they could grow in the field.

National Geographic (magazine)

Aquaponics such as Bioaqua Farm grow vegetables and farm fish in a closed loop system. This means that the plants filter the water for the fish and the waste from the fish provides nutrients for the plants. These systems don't require pesticides or fertilisers and use 95 per cent less water than traditional farming.

Bioaqua Farm (the biggest aquaponic trout farm in Europe)

Meat and dairy alternatives and even lab-grown meat may help make food production more efficient and increase the amount of food being produced.

Visual Capitalist (media website)

Crops can be cross bred with their ancient relatives to produce high-yielding and disease-resistant seeds. These can help crops become more resilient against pests and climate change.

The Royal Botanic Gardens at Kew (scientific institution)

There is enough food produced globally to feed the world's population but food isn't distributed equally because of poverty and inequality.

The Guardian (newspaper) (a)

Farming today is more complex than ever before. The unpredictability of the weather, control of pest and weeds, market price development, scarcity of natural resources. To rise to this challenge, farmers need new technologies and solutions.

BASF (pesticide manufacturer)

Pesticide residue can stay on fruit and veg, which might be bad for our health.

Journalists opinion, The Guardian (newspaper) (b)

Evidence shows that the world-wide deaths due to acute pesticide poisoning number about 200,000 per year. Agricultural workers in particular at increased risk for pesticide illnesses.

Al Jazeera (independent news network)

EU scientists have found evidence that pesticides are linked with brain damage.

Journalists opinion, The Independent (newspaper)

Britain's soils are under threat of becoming infertile in the next 40 years! Scientists have found that intensive farming, including heavy use of pesticides causes the soil quality to degrade. In the long term this means that it is harder to grow crops, as the soil can become infertile due to a loss of biodiversity.

Journalists opinion, The Guardian (newspaper) (c)

Soil contamination can make crops unsafe for consumption, which can mean there are lower crop yields.

Food and Agriculture Organization of the United Nations (b)

Researchers found that pesticides previously thought not to harm bees actually do.

Nature (scientific journal)

Pesticides can impact on the environment, contaminating soil, water and other vegetation. In addition to killing insects or weeds, pesticides can be toxic to other creatures including birds, fish, beneficial insects and other plants.

Pesticide Action Network UK (registered charity) (a)

The first point to remember is that no responsible scientist will ever guarantee you zero risk. We can and do operate at minimum risk. For example, the independent regulator controls the amount of tiny traces of residue in our food by setting maximum residue levels (MRLs), which are well within safety limits. As a result the Food Standards Agency (FSA) reassures us there are no concerns or they would take immediate action.

Crop Protection Association

Scientists have found that pesticides have a negative effect on populations of bees and other pollinating insects, contributing to a global decline in numbers.

Pesticide Action Network UK (registered charity) (b)

Researchers found twice as many honeybees in fields not treated with pesticides.

Nature (scientific journal)

UK researchers found that honeybees are more resistant to pesticides than wild bees.

Nature (scientific journal)

We need pollinators as more than 80 per cent of the world's flowering plants need them to reproduce.

Bug Life (registered charity)

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World Food Programme

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Pupil resource 1 (without sources)

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Over the next 35 years the growing global population will demand more food than has ever been produced in human history!

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Pesticides can reduce the cost of food production by reducing crop loss. Even with pesticides, between 26 and 40 per cent of the world's potential crop production is lost each year – pesticides can help protect crops and reduce waste.

Studies show that the benefits of a diet containing fresh fruit and vegetables far outweigh potential risks from eating low residues of pesticides in crops.

Pesticides are a fundamental part of modern food production. Our food crops have to compete with 30,000 species of weeds, 10,000 species of insect pests and countless diseases. Without crop protection, these natural pests would reduce our food supply by around a third.

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EU scientists have found evidence that pesticides are linked with brain damage.

Britain's soils are under threat of becoming infertile in the next 40 years! Scientists have found that intensive farming, including heavy use of pesticides causes the soil quality to degrade. In the long term this means that it is harder to grow crops, as the soil can become infertile due to a loss of biodiversity.

Soil contamination can make crops unsafe for consumption, which can mean there are lower crop yields.

Researchers found that pesticides previously thought not to harm bees actually do.

Pesticides can impact on the environment, contaminating soil, water and other vegetation. In addition to killing insects or weeds, pesticides can be toxic to other creatures including birds, fish, beneficial insects and other

The first point to remember is that no responsible scientist will ever guarantee you zero risk. We can and do operate at minimum risk. For example, the independent regulator controls the amount of tiny traces of residue in our food by setting maximum residue levels (MRLs), which are well within safety limits. As a result the Food Standards Agency (FSA) reassures us there are no concerns or they would take immediate action.

Scientists have found that pesticides have a negative effect on populations of bees and other pollinating insects, contributing to a global decline in numbers.

Researchers found twice as many honeybees in fields not treated with pesticides.

UK researchers found that honeybees are more resistant to pesticides than wild bees.

We need pollinators as more than 80 per cent of the world's flowering plants need them to reproduce.

Pupil resource 2

Other debates you may want to follow up with:

Should we build houses on green spaces?

Should we grow all our own food?

Should farm animals be kept inside all the time?

Should we have parks in cities?

Should we allow cars to drive near schools?

Should we eliminate insects in cities?

Should we ban plastic bags?

Should we allow people to go into unexplored rainforests?

Episode 8 glossary

Adaptation/Adapt

The process by which living things change over time to become better suited to where they live.

Agrochemical

Chemical products, including pesticides, used in agriculture (the farming and breeding of animals and plants for food and other products).

Aquaponics

The combination of raising fish alongside growing plants in a process that doesn't require soil. The fish waste provides a food source for the plants, and the plants naturally filter the water for the fish.

Bacteria

Small living organisms. Bacteria are so small that they can only be seen through a microscope. Some types of bacteria can cause disease.

Biodiversity

The number of different plants and animals in an ecosystem.

Climate change

A change in global or regional climate patterns, in particular a change apparent from the mid to late twentieth century onwards and attributed largely to the increased levels of carbon dioxide in the atmosphere produced by the use of fossil fuels.

Crop

Plants that are grown on a large scale commercially, particularly cereals, fruits or vegetables.

Debate

A competitive argument where two or more people explore a question or statement, arguing for or against it. At the end of the debate the audience usually votes to decide who won.

Discussion

Exploring a topic through conversation without the competitiveness of debate.

Dialogue

Sharing ideas, opinions and evidence to gain deeper understanding of a topic and reach a connected viewpoint.

Dilemma

A difficult choice between two things with serious outcomes.

Ecosystem

A community of plants, animals and microorganisms living together.

Evidence

Facts or information that has been tested by experts who specialise in that topic.

Extinct

No longer existing, died out.

Food security

People are considered food secure when they have adequate access at all times to sufficient, safe and nutritious food to maintain a healthy and active life.

Global climate change (global warming)

The recent increase in the planet's temperature that is believed to be caused by the increase of gases, such as carbon dioxide, in the atmosphere. The increase of these gases is linked to human activity.

Industrialisation

The development of industry and technology in a country or region on a wide scale.

Laboratory

A room or building equipped with scientific equipment to carry out tests and experiments.

Mammoth

A large, extinct elephant. Most mammoths were covered in thick hair and were able to survive cold temperatures.

Pesticide

Chemicals used to kill insects or other organisms harmful to crops, plants or animals.

Pollinate/Pollinating

To move pollen onto a plant to allow the plant to reproduce.

Population

A group of plants or animals living in a particular place.

Potential

The possibility of becoming real or happening in the future.

Published scientific research

Science research will not be published unless it's been examined by other scientists to make sure the experiments have been carried out well.

Technology

The use of science to solve problems often involving the invention of machines.

Vegetarian

A person who does not eat meat or fish.

Final postcard

Hope, the blue whale skeleton, now on display in Hintze Hall at the Natural History Museum in London

Dear Natural History Adventurers,

We've been blown away by everything you've done for *Dippy On Tour: A Natural History Adventure*. You've shown us the perfect mix of imagination, exploration and dedication.

On this card is Hope, a 25.2-metre blue whale skeleton. Hope now welcomes visitors to the Natural History Museum in London, as Dippy did in the past.

Blue whales were once hunted to the edge of extinction by humans, but they were also one of the first animals humans decided to try to save – definitely a moment of hope.

By coming on this adventure with us, you've also given us hope that people will carry on exploring and protecting the natural world.

We're proud to announce that you have all graduated as Future Scientists – we've sent over your official certificates.

Keep going on your own adventures in our natural world.

Dippy's team

Natural History Adventurers

Dippy on Tour
Future Scientist Training

School

UK