NATURE-BASED
ACTIVITIES
FOR PARENTS

LINNAEUS
AT HOME

A GUIDE TO
EXPLORING NATURE
WITH CHILDREN

Acknowledgements

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Inspired by Carl Linnaeus

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Facing page: Carl Linnaeus paper doll, illustrated in 1953.

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LINNAEUS AT HOME

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“If you do not know the names of things, the knowledge of them is lost too”

- Carl Linnaeus

A bust of ‘The Young Linnaeus’ by Anthony Smith (2007).

Introduction

Who was Carl Linnaeus?

Carl Linnaeus was one of the most influential scientists in the world, but you might not know a lot about him. Thanks to Linnaeus, we have a naming system for all species so that we can understand how different species are related and can start to learn about the origins of life on Earth.

As a young man, Linnaeus would study the animals, plants, minerals and habitats around him. By watching the natural world, he began to understand that all living things are adapted to their environments and that they can be grouped together by their characteristics (like animals with backbones, or plants that produce spores).

This book is designed to build your confidence and provide some ideas on how to explore the natural world with your children, just like Carl Linnaeus might have; starting from a place of curiosity and delving deeper.

Linnaeus Inspired Values

Carl Linnaeus was boldly curious about the natural world. He believed that it was the human purpose to discover everything that was ‘out there’, understand more about it, and create an order in a world that may seem like chaos.

Our Linnaeus Inspired Values have been created by taking an in-depth look at what makes Linnaeus an inspirational character in history. These values are values to live by, but they also help to ensure that Linnean Learning continues to produce relevant resources.

Our three Linnaeus Inspired Values are:

- Going outside and **exploring in nature** makes us happy and healthy
- Our understanding of the natural world requires **recording and sharing**
- **Learning about life** on Earth is vital to sustaining its future

Disclaimer: The Linnean Society of London is pleased to provide this educational resource, and believes it to be suitable for its intended use. However, we recommend that all users read through each activity thoroughly to make sure it is fit for their purpose, and be cautious of all possible risks to themselves, others and the environment. The Linnean Society of London does not accept any liability for injury or damage howsoever caused by the use of this resource.

Contents

Five beetles of the *Cetonia* genus, illustrated in Olivier, *Entomologie ou histoire naturelle des insectes* (1808).

Pitfall Traps

Background

Learning points:
How to make an effective and safe trap, and what species live outside your home

Key words
- Trap
- Insects
- Classification

Preparation
Take a look at some pictures of potential creatures you might find (see next page)

Difficulty Rating:
Easy

Preparation time
30 minutes

Running time
Days

Context
A small pitfall trap is a simple method for catching ground-dwelling creatures such as beetles and woodlice. These traps are a great way of seeing what small creatures live in your local surroundings, and it doesn't harm the creatures in any way - as long as you check it regularly, are careful with creatures and put them back afterwards.

Unlikely to be caught in your pitfall trap - a plains zebra (*Equus quagga*), illustrated in Saint-Hilaire & Cuvier, *Histoire naturelle des mammifères* (1726).

Activity

Linnaeus Inspired Value
Exploring in nature

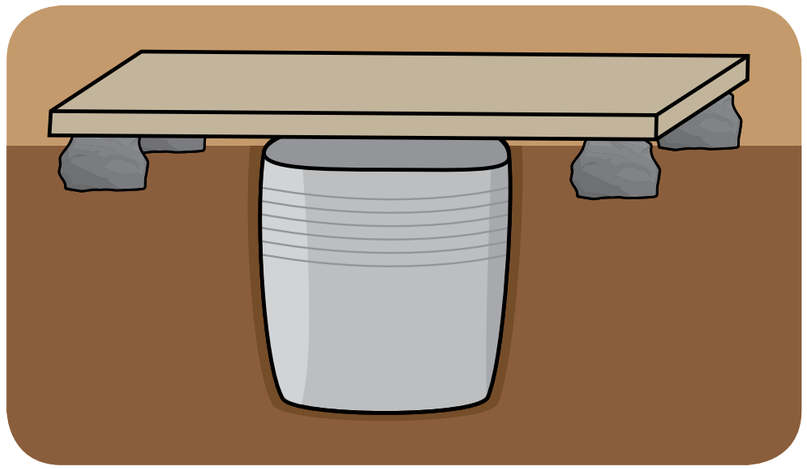
Equipment required
- Soft ground
- Lidded tin can or similar
- Some small rocks
- Board or slate

1 Dig a hole the size of the can, making sure your can fits neatly into the hole, with its rim level with the ground.

2 Once the can is in place, position four rocks around it and balance a board or slate on top. This will provide a dark space, protected from rain and debris, which will attract ground-dwelling creatures.

3 If heavy rain is forecast, or you will be unable to attend to your pitfall trap, you should put the lid on the can so that creatures don't get caught inside and drown.

If you've found a bug but need help identifying it, take a look at Page 53 for some advice.



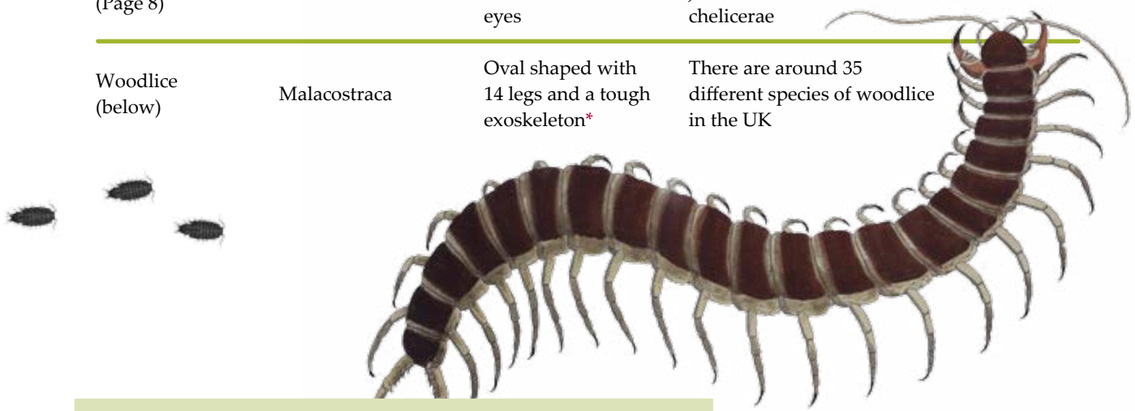
Careful!

- Make sure you check the pitfall trap at least once a day, removing any creatures you find there.
- Remember to take care with your creatures and place them back in their usual habitat.
- Finally, fill in any holes after you've used them.

Pitfall Traps

Creatures you might find in your pitfall trap

Name	Scientific class*	How to identify	Interesting fact
Ants (right)	Insecta	Small slim body with big heads and bottoms	Ants form societies and can communicate by producing subtle smells
Beetles (Page 4)	Insecta	Oval bodies with hardened front wing-cases	Beetles are the most varied of all Insects, with over 350 thousand different types
Centipede (below)	Chilopoda	Long segmented body - each section has one pair of legs	No centipede has 100 legs as they always have an odd number of pairs of feet
Millipede (Page 31)	Diplopoda	Each body segment has two pairs of legs	Unlike centipedes, millipedes are mostly vegetarian
Spiders (Page 8)	Arachnida	An 8 legged creature with 6 - 8 eyes	Spiders have special muscled jaws which are called chelicerae
Woodlice (below)	Malacostraca	Oval shaped with 14 legs and a tough exoskeleton*	There are around 35 different species of woodlice in the UK



How to take your investigation further...

Every species is different and they prefer different things. For example, some creatures will prefer living in damp, wet places, but others may prefer a drier, warmer environment.

Investigate what creatures fall into your trap on different days and during different seasons. A good way of seeing trends is to keep tallies of all the creatures you see so you can compare them.

Does the type of creature you attract change when you add small bits of food as bait?

Ants (top of the page), illustrated in Merian, *Metamorphosis Insectorum Surinamensium* (1726).

British woodlouse, *Cylisticus convexus*, illustrated in Webb and Sillem, *The British Woodlice* (1906).

Great Scolopendra centipede, *Scolopendra gigantea*, illustrated in Shaw & Nodder, *Naturalist's miscellany* (1789).

House spiders and wasps, illustrated in Blackwall, *History of Spiders* (1861).

Bug Hunting

Background

Learning points:
What species live outside your home, how to care for different species and how to keep good records

Key words
- Biodiversity
- Classification
- Arthropod

Preparation
Take a look at some pictures of potential creatures you might find (see next page)

Difficulty Rating:
Easy

Preparation time
10 minutes

Running time
1 hour

Context
What is a 'bug'? The word doesn't actually refer to any specific group of creatures - it actually combines lots of different ones together.

The word 'arthropod' is used for a very large group of creatures that include insects, spiders and animals like crabs. Snails on the other hand aren't insects or even arthropods, we call them Molluscs.

In science, the term 'true bug' is used for a special group of insects called Hemiptera (half-wing), like shield bugs. For the purposes of this book, we'll use the term bug to refer to any small creatures you might find!

A bee and snail from Castelnau, *Histoire naturelle des insectes* (1850), and Reeve, *Elements of conchology* (1860), respectively.

Bug Hunting

Activity

Linnaeus Inspired Value
Exploring in nature

Equipment required
- Notepad +/ camera
- Sheet / tray
- Magnifying glass

Start by looking around bushes, at the base of trees and among flowers and weeds. If you are in a woodland area, try turning over any small rocks or logs; you may be able to find some centipedes, spiders or woodlice.

Place a sheet or tray under a bush or tree and shake a branch - the bugs will fall from the branches and onto your sheet or tray.

Have a look at some flowers - can you see any bees, hoverflies or butterflies?

If you have time, you could set up some pitfall traps around your home (see Pitfall activity on Page 5)

If you've found a bug but need help identifying it, take a look at Page 53 for some advice.

Careful!

- Depending on where you live or where you hunt for bugs, there may be some creatures that do not want to be disturbed. Be careful and avoid any creatures that you don't recognise.

A common orb-weaver spider, *Araneus quadrata*, illustrated in Blackwall, *History of Spiders* (1861).

Bug Hunting

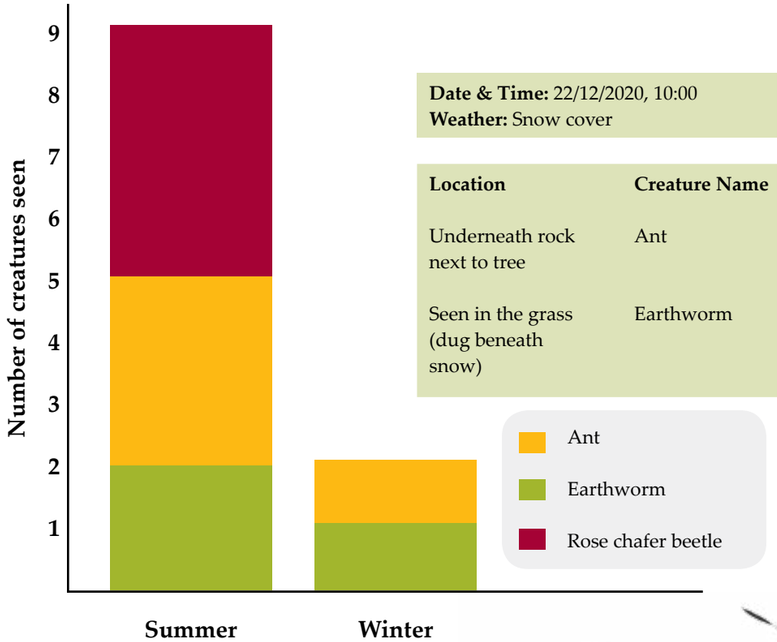
Tally-up!

Keeping good records of biodiversity* is vital for scientists to understand how species are coping with threats like climate change.

Here is an example of a log to keep track of what you find, and to compare one season to another.

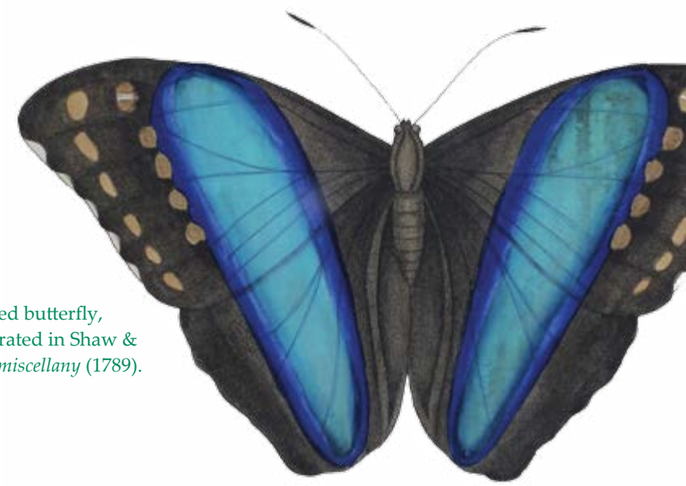
Date & Time: 22/07/2020, 10:00
Weather: Rained overnight, sunny day today

Location	Creature Name	Quantity
Underneath rock next to tree	Ant	4
"	Rose chafer beetle	3
Seen in the grass	Earthworm	2



Date & Time: 22/12/2020, 10:00
Weather: Snow cover

Location	Creature Name	Quantity
Underneath rock next to tree	Ant	1
Seen in the grass (dug beneath snow)	Earthworm	1



The Great blue-banded butterfly, *Morpho achilles*, illustrated in Shaw & Nodder, *Naturalist's miscellany* (1789).

Tulips, illustrated in Thorton, *Temple of Flora* (1812).

Plant Hunting

Background

Learning points:
The importance of plants, what plants live around your home and the names of different plant groups

Key words
- Biodiversity
- Plants
- Classification

Preparation
Think about what plants are, what they do for us, and also what we do not classify as plants (e.g. mushrooms)

Difficulty Rating:
Easy

Preparation time
0 minutes

Running time
1 hour

Context
Plant blindness is the name given to the phenomenon of not seeing or noticing the plants that exist in your own environment.

Do you pay attention to the trees, the grasses in the park, the moss at the foot of a tree, or creeping vines on fences, walls and buildings?

The Plant Kingdom is huge - there are around 391,000 different species of plants in the world[1] and we need plants to survive. Plants feed us; they are used in our medicine, clothing, furniture and in cosmetics. They provide oxygen for us to breathe.

Go outside and take a look at all the different types of plant you can spot. The guide on the next page will help you classify them.

[1] According to Royal Botanic Gardens Kew's State of the World's Plants 2017

Heather, *Calluna vulgaris*, illustrated in Fuchs, *De historia stirpium* (1542).

Plant Hunting

Activity

Linnaeus Inspired Value
Exploring in nature

Equipment required
- Notepad +/ camera
- Soft bag
- Magnifying glass

If you focus on discovery, rather than what you know, a plant hunt is a really exciting adventure. Take lots of pictures, make lots of notes and then make use of a variety of tools to identify what you find.

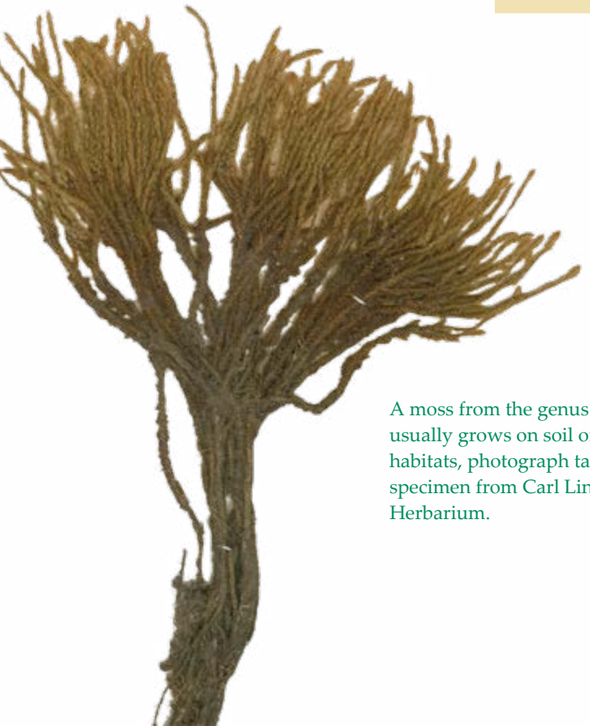
Have a look on Page 53 for advice on identification tools. For plants, we recommend an app called NatureGate. You can enter details like where you are, the shape of the leaves, the colour of the flowers and the app will work out which species the plant could be.

The guide on the opposite page is a (relatively) simple way of classifying the broad group to which any plant belongs. Field guides are documents or apps that can help you quickly identify any species. We've listed our favourites on www.linnean.org/field-guides.

Did you know?

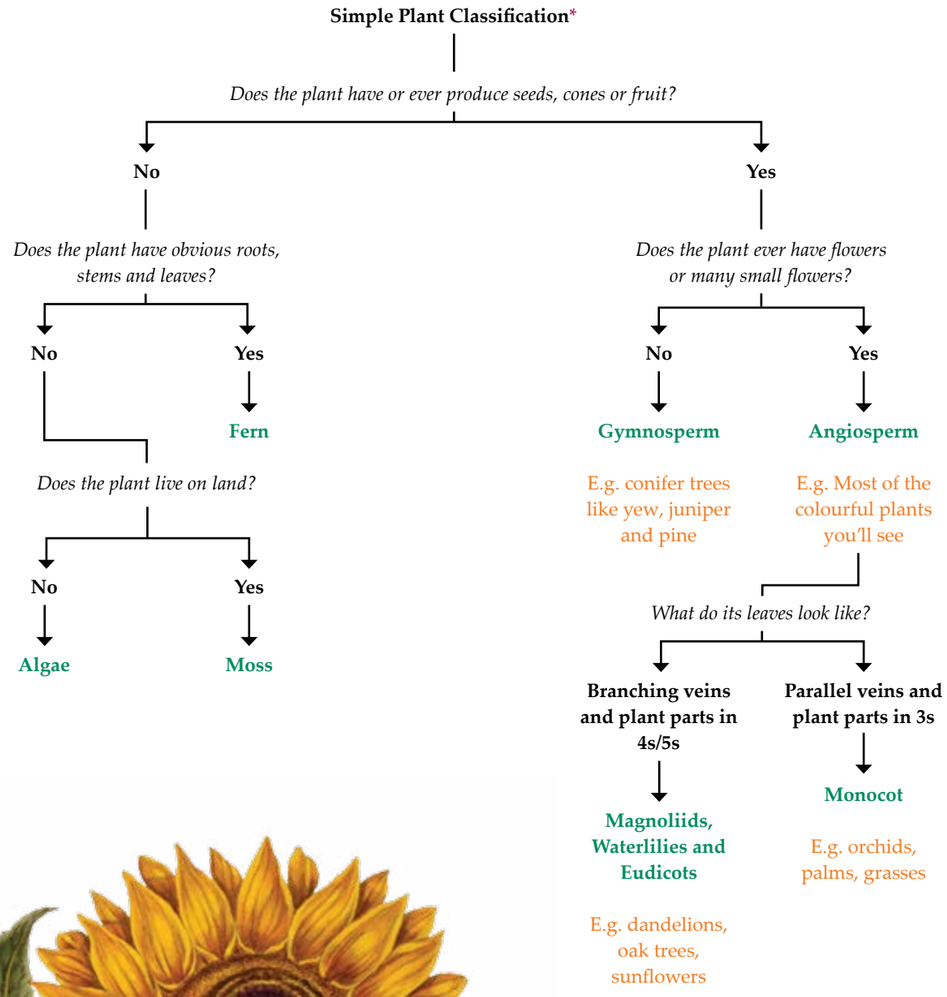
Carl Linnaeus developed a system for classifying plants based on the flowers reproductive parts. This was a very simple way of grouping plants with similar features, but unfortunately it fails to group plants that are truly biologically related.

Since then, botanists have worked hard to create a new system for ordering the Plant kingdom. It turns out that this isn't easy and the use of DNA analysis has revealed groupings that aren't visually obvious.



A moss from the genus *Bartramia* that usually grows on soil or rocks in many habitats, photograph taken of the specimen from Carl Linnaeus' personal Herbarium.

Plant Hunting

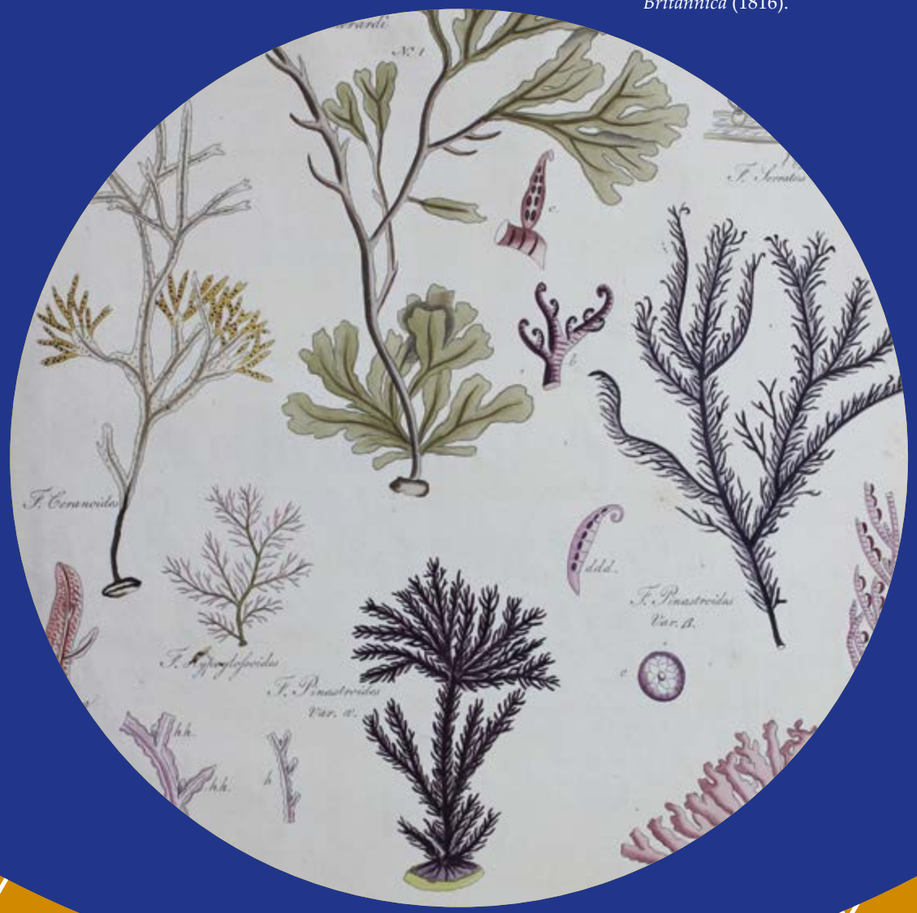


"What a lovely bunch of eudicotic angiosperms" doesn't have quite the same ring to it.

A Sunflower, *Helianthus*, illustrated in Miller, *Illustratio systematis sexualis Linnaei* (1777).

"In natural science the principles of truth ought to be confirmed by observation."

- Carl Linnaeus



Species of brown algae (*Fucus*), illustrated in Stackhouse, *Nereis Britannica* (1816).

Pond Dipping

Background

Learning points:
How to perform a pond dip, what species live around you, how to care for different species, and the names of different animal groups

Key words
- Biodiversity
- Insect
- Amphibian
- Life cycles
- Aquatic plants

Preparation
Be prepared to get wet and/or slimy!

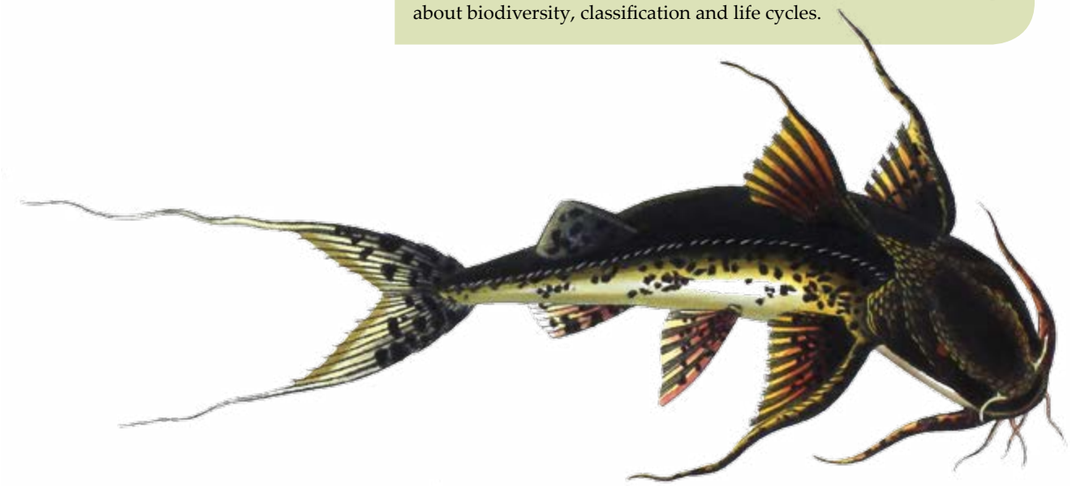
Difficulty Rating:
Medium

Preparation time
10 minutes

Running time
1 hour

Context
A healthy pond should be full of plant, animal and microbial life. Pond dips are a great way for you to explore what lives in the water.

Ponds are important habitats for different organisms and can be an endless source of interest, as well as a valuable resource for learning about biodiversity, classification and life cycles.



The giant devil catfish, *Bagarius yarrelli*, illustrated in the *Transactions of the Zoological Society* (1839).
You might need a bigger net.

Pond Dipping

Activity

Linnaeus Inspired Value
Exploring in nature

Equipment required
- Pond net, fine kitchen sieve or tights on the end of a stick!
- Containers
- Magnifying glass or camera with zoom
- Spoon or tea strainer

1 At the pond, fill your containers half up with pond water and put them away from the edge of the pond.

2 Use the net to sweep a figure of eight pattern in the pond. Try to avoid the sediment at the bottom of the pond and the weeds at the top, as these will make finding creatures in your net harder. Try dipping in sheltered spots - perhaps near the edge - as more bugs live there.

3 Sweep briefly for 10-15 seconds, then take the net out of the water to your largest container.

4 Turn the net inside out into the container - you may need to swish the net under the water to remove particularly stubborn bugs!

5 Use a spoon or tea strainer to examine your catch, moving interesting creatures to smaller containers.

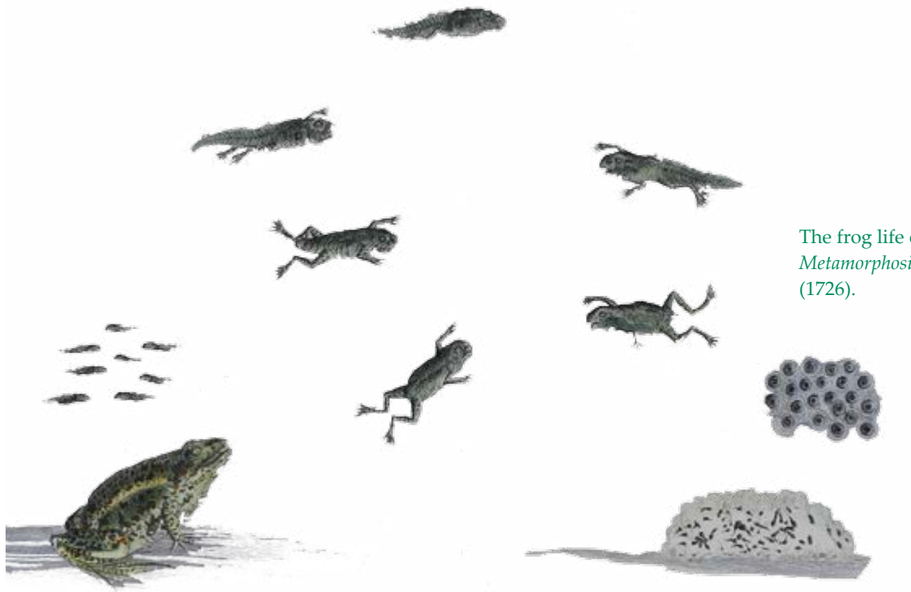
Identification can be carried out by the pond using a field guide (www.linnean.org/field-guides) or by using an app like iNaturalist (Page 53). It can also be done later at home using photographs you have taken with research from books or online.

How to make a bug sing on the top of your nose, illustrated in Figuier, *Les insectes* (1875).

Pond Dipping

Careful!

- We don't need to tell you to keep eyes on children at all times, but it's also very important to keep their hands out of their mouths, eyes and faces in general.
- Provide plenty of water for the bugs and keep them cool or they will die.
- Always treat any creature carefully and place them back where you found them. Leave any spawn in the pond.



The frog life cycle, illustrated in Merian, *Metamorphosis Insectorum Surinamensium* (1726).

How to take your investigation further...

Record what creatures you find with as much detail as you can.

Things to take note of:
- The date
- Exact location
- Method of capture
- Weather conditions
- Species caught and how many
- General site information such as size, shape and place of pond and surrounding environment (e.g. open field vs woodlands, in the shade etc.)

Three robins, illustrated in Gould, *Birds of Europe* (1837).

Bird Feeders

Background

Learning points:
How to make a feeder, what birds eat and the diversity of birds

Key words
- Birds
- Adaptation
- Habitat

Preparation
Check local websites to find out which birds are found in your local area. Is there a bird watching club nearby?

Rating:
Medium

Preparation time
1.5 hours

Running time
Ongoing

Context:
Do you know a wood pigeon from a collared dove, a magpie from a crow, a wren from a sparrow?

You may have many different kinds of birds that live in habitats all around you, but they might not come into view if you don't have any food or shelter to offer... until now.

This simple bird feeder will hopefully entice a few new birds to your area. Have a think about where you could place the feeder (just make sure you ask permission!).

Indian eagle-owl, *Bubo maximus*, also illustrated in Gould, *Birds of Europe* (1837).

Bird Feeders

Activity

Linnaeus Inspired Value
Recording and sharing

Equipment required
- Yoghurt pot
- String
- Scissors
- Mixing bowl

Bird cake recipe
- Good quality bird seed
- Raisins
- Peanuts
- Grated cheese (optional)
- Solid fat

1. Carefully make a small hole in the bottom of the yoghurt pot using scissors.

2. Make a loop of string and push it through the hole, tying a large knot on the inside of the pot. Make sure the loop is big enough to hang your bird feeder.

3. Allow the solid fat (like lard or vegetable shortening) to warm up to room temperature, but don't let it melt. Cut it into small pieces and put it into the mixing bowl.

4. Add the other ingredients a bit at a time, and mix them together with your fingers. Keep adding the seed/raisin/cheese mix and squish it until the fat holds it all together.

5. Fill the yoghurt pots with the bird cake mix, and put them in the fridge to set for an hour or so.

6. Once they've set, hang the feeders from a tree, fence or bird table - keep the yoghurt pots attached.

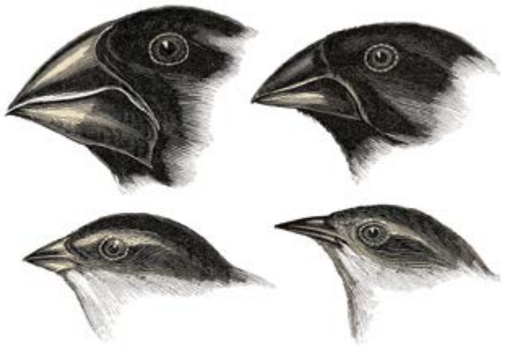
Keep a tally of the birds that come to visit your feeders. You may wish to take some photos of the birds at the feeder and identify them using the iNaturalist app (Page 53) or another chart available online at www.linnean.org/field-guides.

Cinnamon-bellied flowerpiercer, *Diglossa baritula*, illustrated in Gray, *Genera of Birds* (1844–1849).

Careful!

- If you have children with nut allergies ensure they do not handle the bird cake mixture. Alternatively, you could alter the mix to avoid nuts.

Bird Feeders



Food for thought:

Charles Darwin's '*Theory of Evolution by Natural Selection*' was formed, in part, by his observations of birds on the Galapagos islands.

He realised that the beaks of birds tended to be perfectly suited to their diet. He noticed that birds with long beaks were able to tear apart the flesh of a cactus, while shorter-beaked birds tore at the base and ate insect larvae as well.

Another example is that birds that prey on fish tend to have scooping beaks, while nectar-eating birds have long thin beaks.

Take a look at the beaks on this page - can you work out what they mostly eat?

Clockwise from the top-left: Darwin's Galapagos finches, illustrated in Darwin's *Journal of Researches... - 'The Voyage of the Beagle'* (illustrated edition released in 1890).

Indian eagle-owl, *Bubo bengalensis;*
Spotted kingfisher, *Actenoides lindsayi;*
Red-billed streamertail, *Trochilus polytmus;* all illustrated in Gray, *Genera of Birds* (1844–1849).

One last thing...

Why not take part in the RSPB's Big Garden Birdwatch? It's the world's largest wildlife survey!

Eastern chipmunk (*Tamias striatus*) depicted with nut, illustrated in Catesby, *Natural History of Carolina, Florida and the Bahama Islands* (1731-1743).

Squirrel Feeders

Background

Learning points:
How to make a feeder, what squirrels eat and what species live around your home

Key words
- Habitat
- Conservation
- Food chains

Preparation
Ask around to find out where local squirrel populations can be found

Difficulty Rating:
Easy

Preparation time
20 minutes

Running time
Ongoing

Context:
Squirrels! Not only are they a fun thing to say, squirrels are also a great way to think about biodiversity, competition between species and conservation.

In the UK, the once-abundant red squirrel (*Sciurus vulgaris*) came under threat when grey squirrels (*Sciurus carolinensis*) from North America were introduced in the 1870s.

This shows that the introduction of a new species to an area may sound positive in theory, but can have devastating consequences in reality.

Squirrel Feeders

Activity

Activity type
Recording and sharing

Equipment required
- A pine cone
- Solid fat
- Chunky peanut butter
- Rolled oats
- Crushed peanuts
- String

1 Ensure that the pine cone is free of any loose dirt or debris, and that it is completely dry. You may wish to leave the cones near a radiator for a few days to dry them out entirely.

2 Allow the solid fat (like lard or vegetable shortening) to warm to room temperature, and mix it with the peanut butter.

3 Spread this mixture all over the pine cone, making sure that you get it in between the cone scales. The mixture will act as a glue, but is also attractive to squirrels as it is.

4 Once the cone is well covered with the peanut butter 'glue', roll the cone in a mixture of oats and crushed nuts. Use your fingers to press the oats and nuts into the peanut butter layer.
Now you have a squirrel feeder!

5 Allow the cone to dry slightly, then use a piece of string to hang it from a tree or bush - preferably in clear view of a window.

6 Observe and record the number of squirrels visiting your feeder - it's easiest to do this from inside the building, so don't you disturb the feeding animals.

Pine cone, *Pinus strobus*, illustrated in Society of Gardeners, *Catalogus Plantarum* (1730).

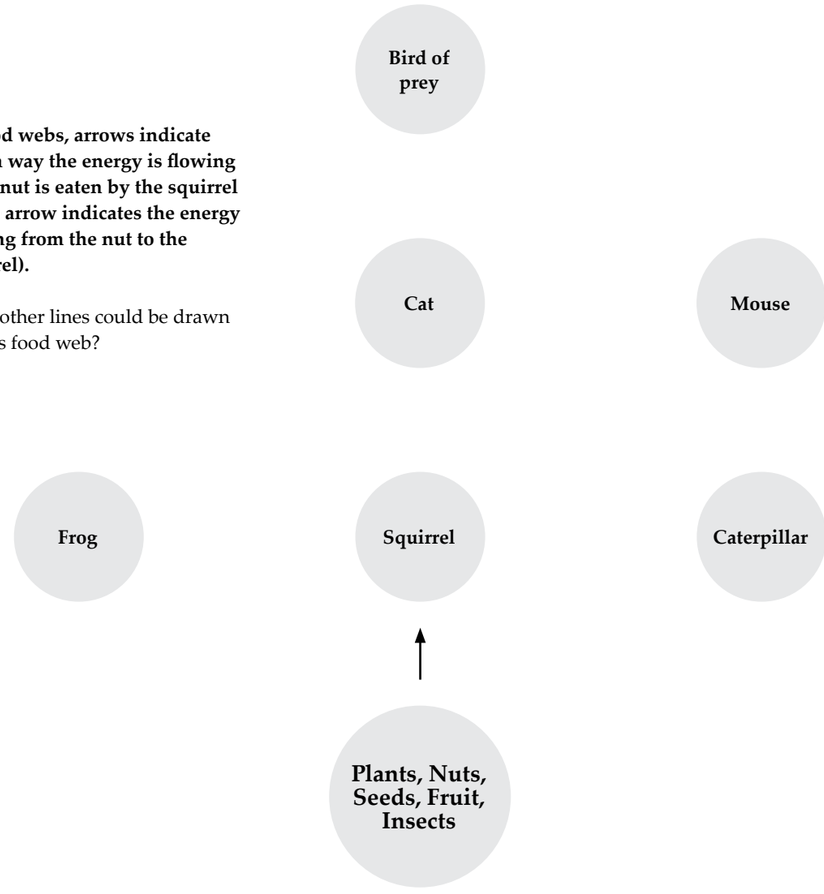
Squirrel Feeders

Careful!

- If you have children with nut allergies ensure they do not handle the squirrel cone mixture. Alternatively, you could alter the mix to avoid nuts.

In food webs, arrows indicate which way the energy is flowing (i.e. a nut is eaten by the squirrel so the arrow indicates the energy moving from the nut to the squirrel).

What other lines could be drawn on this food web?



How to take your investigation further...

Have a think about what food chains may exist in your local environment. Take a nature walk, taking note of any animals and plants that you see and try to create a food web like the one above.

Lepidoptera displaying mimicry, illustrated in *Transactions of the Linnean Society, Volume 23* (1862).

Nature-Friendly Spaces

Background

Learning points:
How changing environments affect animals, what species live around your home and the names of different animal groups

Key words
- Habitat
- Sustainability
- Biodiversity

Preparation
Take a look at common animal species in your area, and research what environments they like

Difficulty Rating:
Medium

Running time
Ongoing

Context
By making the environment around your home more nature-friendly, you can support a variety of wildlife and boost biodiversity in your area. A nature-friendly space is one that has safe environments for all sorts of animals to move through, live in, or find food and shelter.

If you don't think any space around your home is suitable for wildlife, have a look at Page 33 for some inspiration on what plants can grow inside your home, or could you get in contact with a local park to see how you could boost wildlife there?

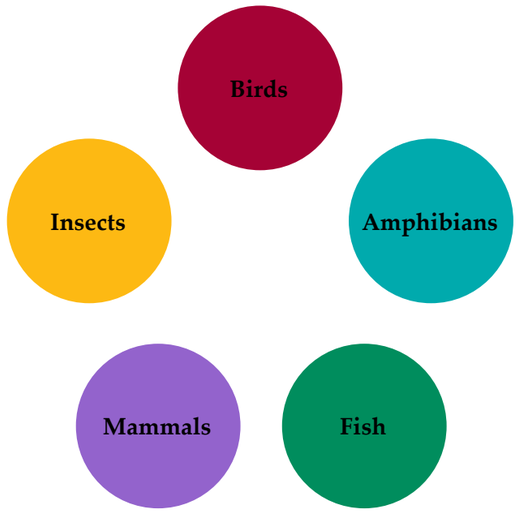
Why not watch this video about how Linnaeus studied the behaviour of a raccoon that lived nearby?
www.linnean.org/video/raccoon

Activity

Linnaeus Inspired Value
Learning about life

Have a think about what kind of animals you'd like more of around your home - some are easier than others!

Once you've decided, research which environments they thrive in and get started.



Reptiles

What about reptiles? There are only a few species of wild reptile in the UK, and your nature friendly garden probably isn't the best place for them to live.

Butterflies:

Butterflies flock to sun-loving flowers that produce lots of pollen and nectar. They are also attracted to brightly coloured flowers - particularly blues and yellows.

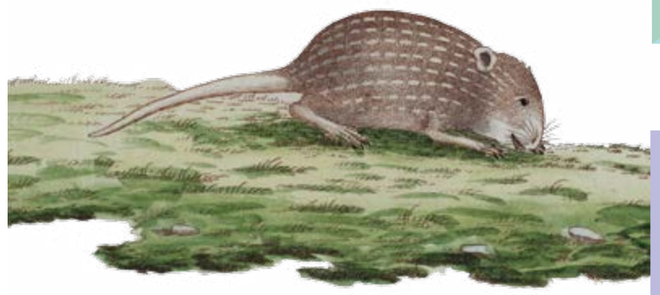
Could you plant any new flowers?

Here are some good ones:
Bluebell, busy lizzie, chives, chrysanthemum, cornflower, daisy, forget-me-not, heather, honeysuckle, hydrangea, lavender, mint, onion, pansy, primrose, parsley, phlox, thyme and *Verbena bonariensis*.

Fish and Amphibians:

A small pond or water feature can be a fantastic habitat for so many living things.

Amphibians will find their way into your pond given time, but you'll need to purchase the fish.



Mammals:

Mammals are a bit trickier. Hedges are a lovely habitat for hedgehogs (obviously) as well as small mice.

You can also get bat boxes to place up in trees. Bats prefer their boxes as high as possible to keep away from predators.

Birds:

You can make or buy a simple bird house to hang on a tree or against a wall.

Or have a go at making our bird feeder on Page 21.

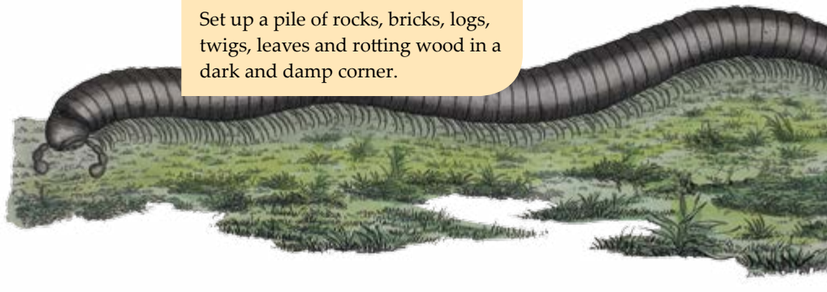
Facing page:
Atlas moth, *Attacus atlas*.

Above and below:
Striped mouse, *Lemniscomys striatus*; Millipede, *Julus*.

All illustrated in Shaw & Nodder, *Naturalist's miscellany* (1789).

Insects and other bugs:

Set up a pile of rocks, bricks, logs, twigs, leaves and rotting wood in a dark and damp corner.



“If a tree dies, plant another in its place”

- Carl Linnaeus

The succulent *Stapelia*, illustrated in Thornton, *Temple of Flora* (1812).

Indoor Plants

Background

Learning points:
The diversity of plants and the needs of different plants

Key words
- Habitat
- Environment
- Plants

Preparation
Dedicate a space in your house (and heart) for a new plant

Difficulty Rating:
Easy-Medium

Preparation time:
Variable - see overleaf

Running time
A lifetime

Context:
Research shows that having plants in the house can have a positive effect on happiness, mental health and wellbeing, as well as improving the air quality of your home.

Not only that, but having plants in the house and knowing what they are called, their preferred environments and the habitats they provide for other organisms is a great way to inspire curiosity in your children.

Why not watch this video about how Linnaeus managed to grow Europe’s first banana plant for the Royal family of Sweden?
www.linnean.org/video/bananas

Activity

Linnaeus Inspired Value
Learning about life

Questions you must first ask yourself:

- How much space do you have?
- How much light does this space receive?
- What is the temperature and humidity of the space?
- How much time do you have to give to the plant?
- What do you want to grow (style or substance)?

Growing from seeds:

Growing plants from seeds allows you to see the process as it happens in the wild. In essence, you are acting as a seed disperser; just like a prickly seed taking hold on a fox's fur, you are taking a seed and dropping it into a new location.

Here are some great plants you can grow from seeds (they're all edible too!)

Tomatoes **Carrots**

Chives **Cress**

Radishes **Marigolds**

Growing from cuttings (and creating your own clone!):

Growing a whole new plant from a cutting (propagation*) is a little bit miraculous. There is an art to taking a cutting and you may have a few that just don't work.
Iff you're interested in becoming a cutting connoisseur, we found a great guide - visit www.linnean.org/LAH/cutting for more info.

Here are some great house plants that are known for springing to life pretty easily from a simple cutting.

Aloe vera ***Pilea***

Spider plants **Jade plants**

Sedum merganium **Zygocactus**

Facing page:
Mixed seeds, illustrated in Köhler, *Medizinal Pflanzen* (1887).

Left:
Orchid, illustrated in *Transactions of the Linnean Society* (1833).

Growing a plant from the shops:

Plants that are adapted to foreign environments need very specific conditions to grow beyond their roots and so there is no shame in buying a plant fully grown from a shop.

Here are few easy to manage, but glorious to behold, plants; perfect to buy from a shop.

Sarracenia purpurea **Orchids**

Sansevieria **Devil's Ivy**

Succulents ***Calatheas***

Roots of *Iris germanica,* illustrated in Poiteau & Turpin, *Flora Parisiensis* (1808).

Making Roots

Background

Learning points:
Plant structures and plant development

Key words
- Seeds
- Root system
- Nutrients

Preparation
Know that roots can grow to a certain extent from beans without soil

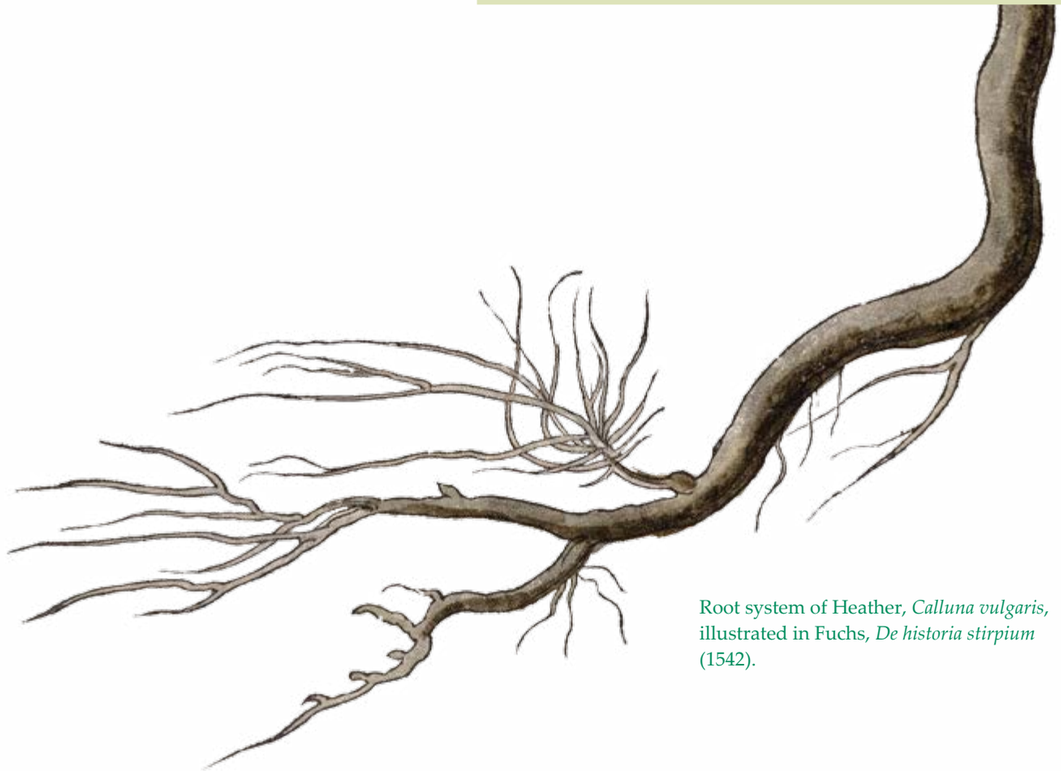
Difficulty Rating:
Easy

Preparation time:
15 minutes

Running time
1 week

Context
If you're not quite ready for a full plant, why not explore the wonders of nature on a smaller scale.

Most seeds contain enough energy within them to start growing on their own for a while without soil or other nutrients. You can use this special ability of seeds to watch roots develop without getting messy.



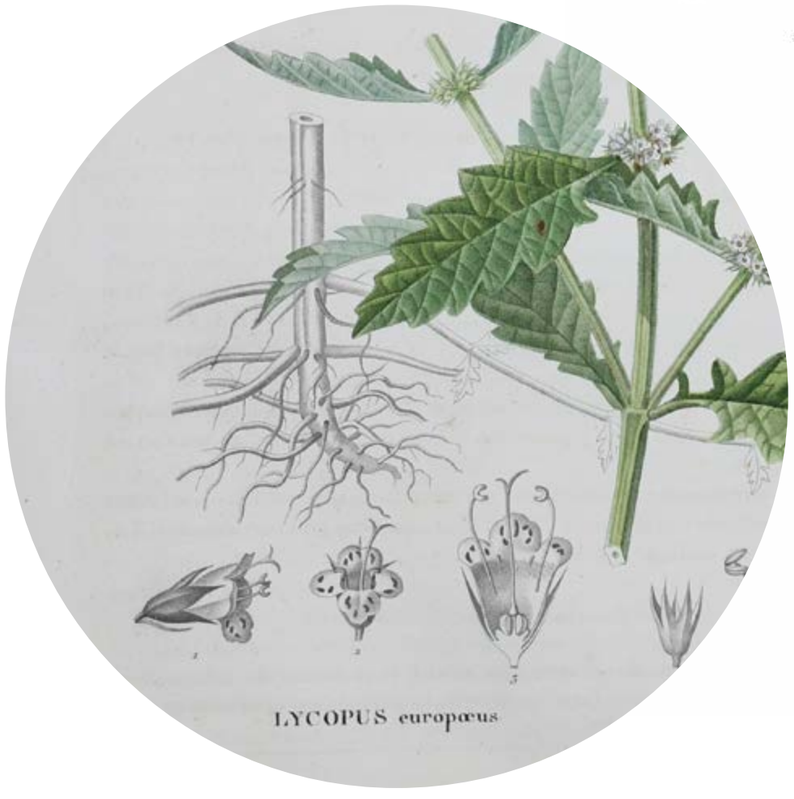
Root system of Heather, *Calluna vulgaris,* illustrated in Fuchs, *De historia stirpium* (1542).

Activity

Linnaeus Inspired Value
Learning about life

Equipment required
- Jam jar or similar
- Sand (optional)
- Cotton wool balls
- Butter beans (dried from the supermarket is fine, not canned!)
- Water

1. Weight the bottom of the jam jar with some sand (optional).
2. Fill the jar past half way with cotton wool balls, and gently compress them.
3. Press a butter bean down the side of the jar, making sure it doesn't hit the bottom.
4. Water gently until the cotton wool balls are damp but not soaked, and place the jar on a sunny windowsill.



Top tips!

Keep an eye on the moisture level and top up with water when necessary.

Within 2-3 days the bean should have germinated, and you'll begin to see roots and shoots. Eventually the plant will develop leaves - make sure the jar doesn't topple over at this stage!

Once you've finished watching the development of the plant, take it out of the jar and gently remove the cotton wool balls. You should be able to examine the root system that has developed. If you have access to a magnifying glass try looking at the root hairs.

Facing page:
Utricularia minor, (upside down) and the root system of *Lycopus europaeus*, both illustrated in Poiteau & Turpin, *Flora Parisiensis* (1808).

How to take it further...

You could keep a bean diary. This could take the form of descriptions, drawings, measurements and/or photographs of the observations. You could also transplant the developing beans into pots with soil and put them into a garden or on a windowsill.

Evening Primrose, *Oenothera fraseri*, from Curtis, *Botanical Magazine* Volume 40 (1814).

Colourful Carnations

Background

Learning points:
The functions of different parts of a plant and that plants can take up water and minerals from the roots and the stem

Key words
- Transport
- Vascular
- Photosynthesis

Preparation
Have a think about the functions of the different structures in plants, such as the root, stem and leaves.

Difficulty Rating:
Easy

Preparation time:
20 minutes

Running time
2-3 days

Context
Carnations belong to a large group of plants that we call vascular* in that they have tubes for moving water and minerals through the plant. This tubular system allows plants to take in nutrients from the roots and transport them upwards.

Carl Linnaeus described the carnation in volume one of his book, *Species Plantarum*, in 1753.

Colourful Carnations

Activity

Linnaeus Inspired Value
Learning about life

Equipment required
- White carnations
- Food colouring - try to get a range of strong colours
- Vases, empty bottles or jars
- Water

1 Fill each vase around a quarter full of water.

2 Add a reasonable amount of food colouring (15-20 drops) to each vase — or more if your vases are large.

3 Cut the carnations to fit the vases — make sure you trim the stems at an angle.

4 Add the carnations to each vase and leave them for at least 24 hours.

Colourful Carnations

Top tips!

At the end of the experiment examine the whole plant carefully, including the stem, leaves and petals. The petals of the carnations should have changed colour due to the transport of the dyed water up through the stem and into the petals.

The process of water uptake and transport is vital to all vascular* plants' survival.

Pontic rhododendron,
Rhododendron ponticum, illustrated
in Thorton, *Temple of Flora* (1812).

How to take this investigation further...

Try the experiment again, but this time carefully cut down the middle of a carnation stem, from around two thirds of the way up, splitting it in half. Put each half stem into a different food colouring — what happens this time?

“A herbarium is better than any illustration; every botanist should make one”

- Carl Linnaeus

The Siberian larkspur, *Delphinium grandiflorum*, from the Linnaean herbarium

Pressing Plants

Background

Learning points:
Field skills, what species live around your home and how to keep good records

Key words
- Classification
- Herbarium
- Plants
- Specimens

Preparation
Research ‘Carl Linnaeus’s Herbarium Cabinet’

Difficulty Rating:
Medium

Preparation time:
1 hour

Running time
~ 3 days

Context
The Linnean Society of London is home to an extensive herbarium, which is a collection of plant specimens preserved for the purposes of identification, research and education. These collections are crucial for ongoing research on plant biodiversity.

In order for a herbarium specimen to be of use to a researcher, it needs to be displayed in such a way that all of the plant’s key structural parts can be seen and studied.

Why not watch this video about Linnaeus’ special herbarium cabinet?
www.linnean.org/video/herbarium-cabinet

Activity

Linnaeus Inspired Value
Recording and sharing

Equipment required
- Tape measure
- Pencils
- Pressing: heavy flat object (heavy books or bricks on top of card)
- Paper card
- Blotting paper or other absorbent paper (newspaper is fine)
- PVA glue or fine tape
- A4 paper

1 In dry weather, collect a whole plant, including the root system; one which is healthy, has average-sized leaves and flowers, and which is no bigger than an A4 sheet of paper.

2 Record the following: the date the plant was collected, the location it was found, the dimensions of the plant, and its colour, using a colour chart, like the one made by James Sowerby (lower image).

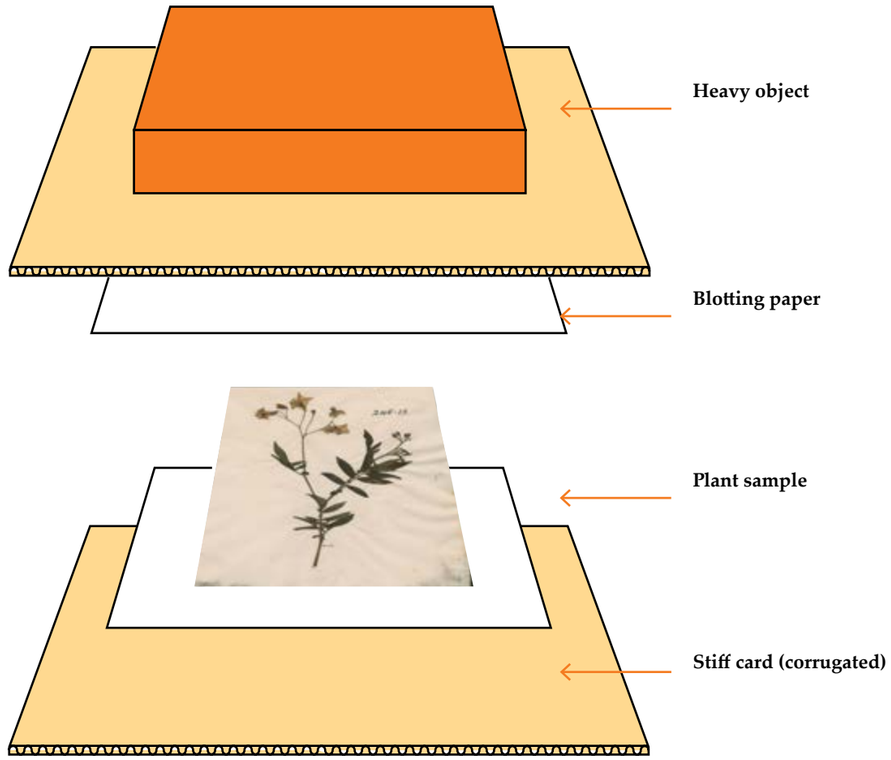
3 Remove any excess soil attached to the specimen and place it on top of blotting paper that has been laid on top of a solid flat surface. In the following order, place on top of the plant another piece of blotting paper, one sheet of stiff card (corrugated or other), and then a heavy object such as a book or brick.

4 Ensure that pressing occurs in a warm, dry and well ventilated room. Check on the plant every 24 hours. The drying process can take from 3 days up to 3 weeks depending on the specimen.

5 Once dry, attach the plant to an A4 sheet of paper by sparingly using PVA glue and tape. Write the information recorded when the specimen was collected onto the paper on which the plant has been mounted. Finally, title the herbarium specimen with its species name.

How to take the investigation further...

Once you have produced several herbarium sheets and researched their classifications, you can begin to group them in folders according to their genus, family or other classification.



A herbarium specimen (Potato, *Solanum tuberosum*) from Carl Linnaeus's collections and a colour chart produced by James Sowerby, *A New Elucidation of Colours* (1809).

Solanum tuberosum
Potato
05 / 04 / 1702
Potato field, Uppsala, Sweden

Plant illustrations in the *Botanical Journal of the Linnean Society, Volume* 45 (1920).

Drawing Nature

Background

Learning points:
The importance of accuracy when sharing information, and identifying structure and function

Key words
- Art
- Natural History
- Illustration

Preparation
Take a look at some online natural history illustrations by artists like Maria Sibylla Merian and Francis Bauer.

Difficulty Rating:
Easy

Preparation time:
10 minutes

Running time
Ongoing

Context
Before cameras were invented or easy to use, drawing was a huge part of documenting nature. Some scientists were amazing artists too, or they would hire local artists to draw the animals and plants they discovered.

Artistic skill continues to be crucial for scientists to communicate their ideas with impact and clarity.

A blank space... perfect for drawing in.

Activity

Linnaeus Inspired Value
Recording and sharing

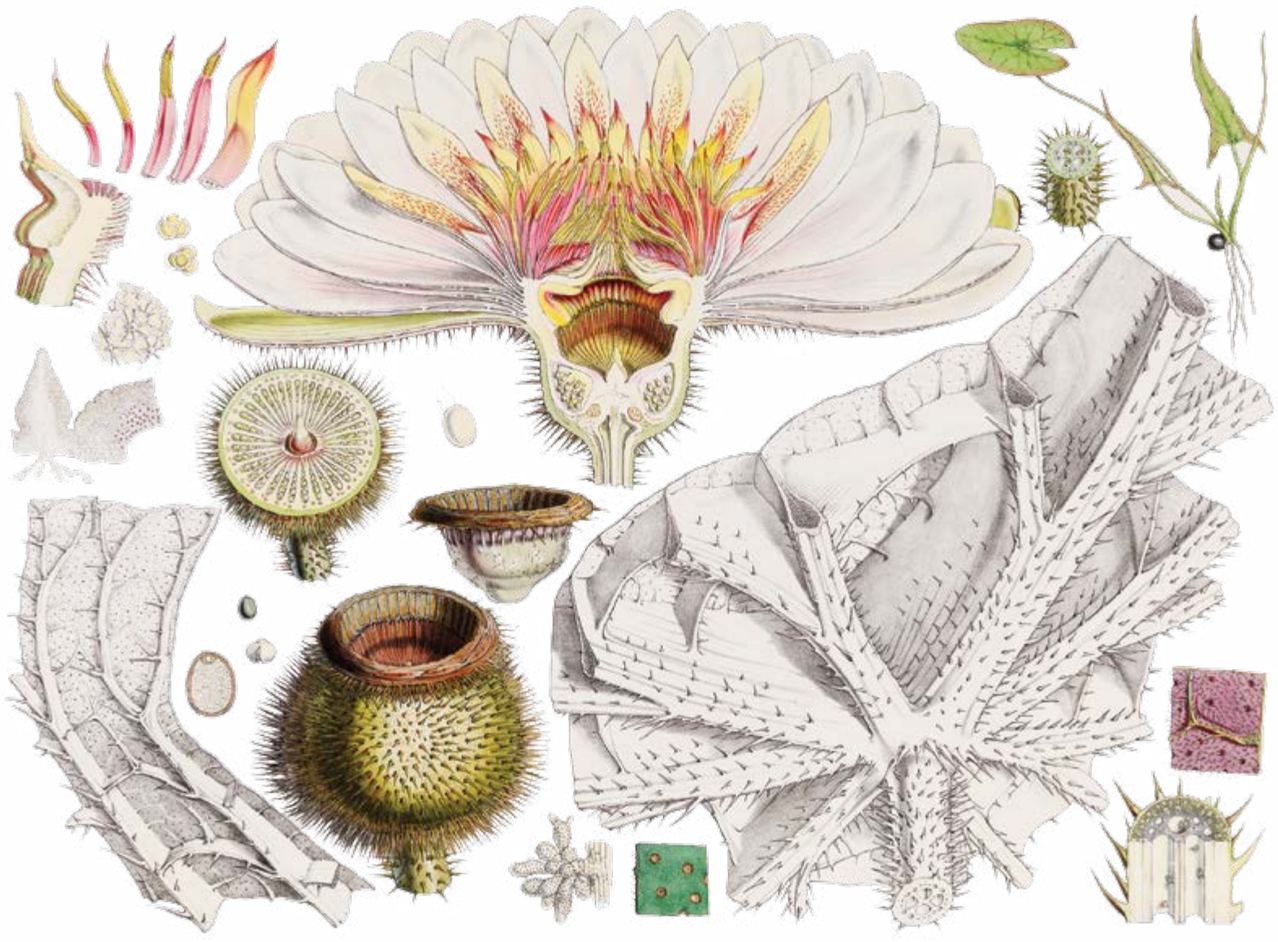
Equipment required
- Paper
- Art materials

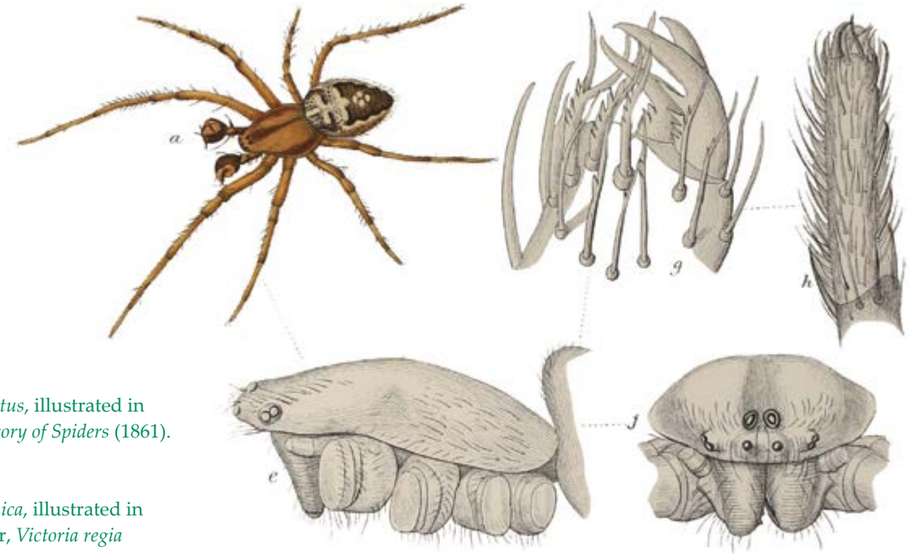
First you'll need something to draw. Why not do a pond dip, go on a bug hunt or make a pitfall trap (pages 17, 9 and 5)?

Another idea is to take a photograph of a living thing like a nice flower or animal and sketch from that.

Good nature illustrations help the viewer to understand more about the specimen. The images on these pages show tiny structures of the specimens and give more detail than we could see with the naked eye.

For plants, you can use tweezers or scissors to reveal structures hidden inside the plant.





Araneus quadratus, illustrated in Blackwall, *History of Spiders* (1861).

Facing Page:
Victoria amazonica, illustrated in Fitch & Hooker, *Victoria regia* (1851).

The Royal Society of Biology has a competition for specimen drawing in schools (for 7-18 year olds) that you could enter. Search 'the Nancy Rothwell Award' for more information.

The Linnean Society also regularly runs competitions which explore how art and science can work together. Check out Pages 61-67 for more information.

Pachystachys coccinea and *Caligo idomeneus,* illustrated in Merian, *Metamorphosis Insectorum Surinamensium* (1726).

Identifying Nature

Background

Learning points:
Field skills, new scientific names, how things are related and what biodiversity is

Key words
- Identification
- Classification
- Biodiversity

Preparation
Watch our video about Naming Nature to learn a little about the classification of animals and plants.

Difficulty Rating:
Easy

Preparation time:
Hunting time, downloading an app

Running time
Ongoing

Context
The world is full of amazing living things and all of them have names. You can call things by their common name (which will be different in English or French or Cantonese) or you can name them with their scientific name (which is written in Latin, and is used by everyone).

There are many useful guides which we have listed on our website here: www.linnean.org/field-guides.

This section is dedicated to the iNaturalist app, which can help you identify anything you see when you go out exploring. iNaturalist can also be accessed on a computer.

Once you upload a photo, the app will try and figure out what the species is. If it can't manage it by itself, you can ask the community of naturalists to help you get the right iD!

You can also use the app to see what other naturalists have found in places near you.

Why not watch this video about naming nature?
www.linnean.org/video/naming-nature

Activity

Linnaeus Inspired Value
Learning about life

Equipment required
- Camera
- iNaturalist app / computer

1 Download the iNaturalist app from Google Play or the AppStore (or visit inaturalist.org)

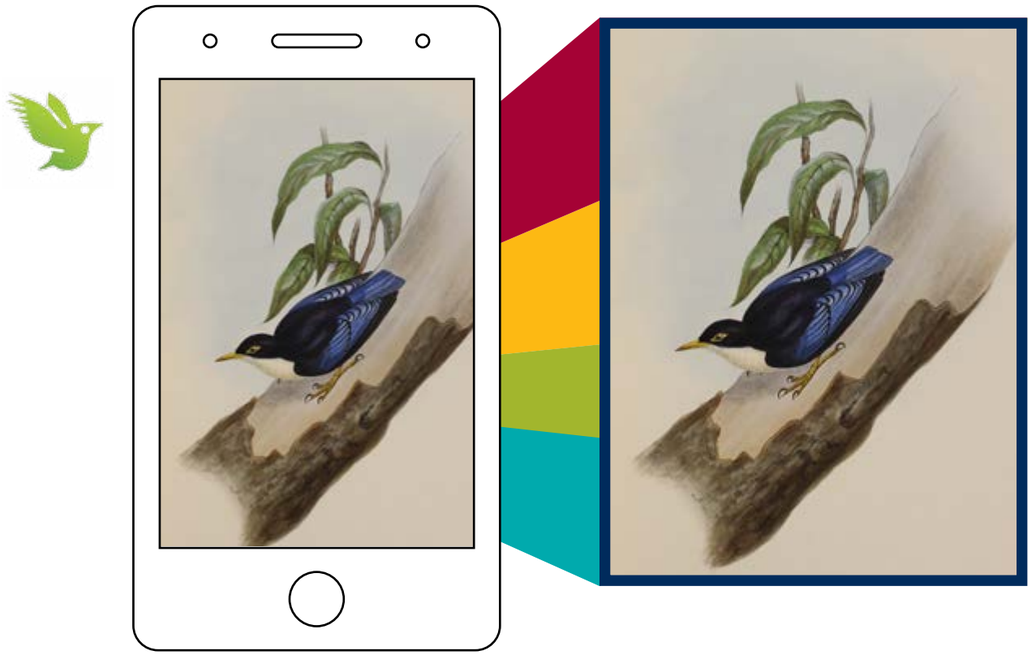
2 Go out and explore! Take pictures of trees, other plants or animals

3 Upload the photo to the app, add notes and a location where you saw it, as well as if the animal/plant is in captivity or was cultivated (grown to be used).

4 The app will try to suggest what the species is. If the app can't work it out, the community of app users will help.

Facing page:
Linnaea borealis, illustrated by Gwatkin, 1855-1939.

Below:
Sitta azurea, illustrated in Gray, *Genera of Birds* (1808).



Other features

Explore what other people have seen nearby. Click onto the Explore tab to open a map of the UK (and beyond).

If there are no species identified in your area then it's a great opportunity for you to start hunting!

Linnaea borealis

Kingdom: Plant
Family: Caprifoliaceae
Common name: Twinflower

Formally described in 1753 by Carl Linnaeus, whom the genus was named after.

Fox, *Vulpes vulpes*, illustrated in Saint-Hilaire & Cuvier, *Histoire naturelle des mammifères* (1726).

Explore OneZoom

Background

Learning points:
How things are related, what biodiversity is and how many living things exist

Key words
- Identification
- Classification
- Biodiversity

Preparation
A good grasp on the different groupings of animals and plants

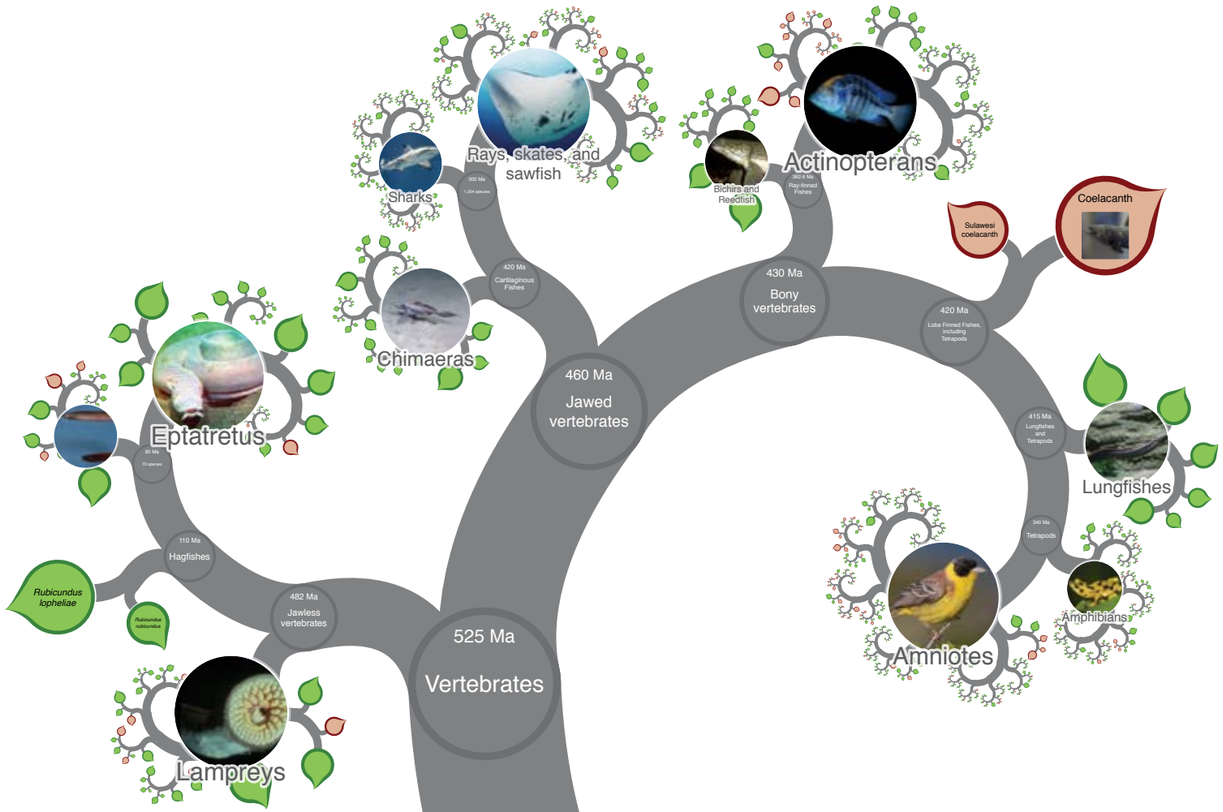
Difficulty Rating:
Medium

Preparation time:
Take time to explore the Tree and understand what the branches mean

Running time
Ongoing

Context
OneZoom is a freely available Tree of Life, connecting all species together in a spiraling beanstalk that shows evolutionary history. It is a great way of visualising all life on Earth. Of course, this is a big subject, so it's good to have a play around and learn the best way to show this to children.

Our guide hopes to give you some examples of ways that you can explore OneZoom to gain new information about planet Earth's vast Tree of Life.



Activity

Linnaeus Inspired Value
Learning about life

Opening guide:

1 Visit www.onezoom.org/linnean

2 Click on the settings icon in the bottom right and change the tree shape to 'Balanced'.

OneZoom contains LOTS of scientific words to describe different organisms and groups. The trick is to look for the pictures and common names that you recognise down the branches rather than worry about what all the words mean.

When fully zoomed out, you should have a view of all life on Earth. You can see that life divides into 'Eubacteria' and 'Archaea and Eukaryotes'. All life that you can see with your eyes are Eukaryotes, so don't worry about the other two.

As you zoom further in, you get to 1500Ma - Eukaryotes. This is 1500 Million Years Ago - 1.5 billion years ago. You can see that down one branch are Plants (among other less well known things), and the Animals and Fungi can be found down the other branch.

What this means is that Plants and Animals are both descended from ancestors that lived 1500 Million years ago.

Here's an analogy for you:

Introducing the Hat family, who are known for wearing hats, and the Scarves family, who are known for wearing scarves.
You would never imagine that they're related because they are so different. I mean, they're similar in some ways, they have the same kind of skin, and they eat the same food, but they wear different clothing.
New research has found out that in the past, they actually belonged to the same family who didn't wear any hats or scarves at all.

That's basically what happened with Plants and Animals. Plants and Animals have very different cells now, but 1500 million years ago organisms existed that connected them both.

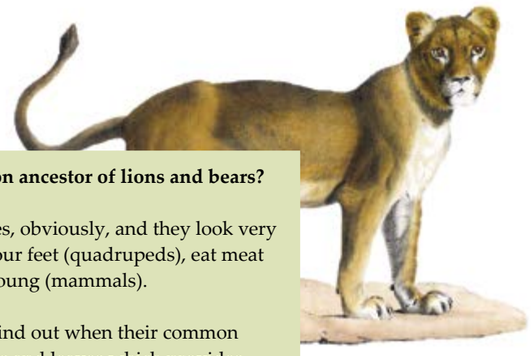
Activity 1: Without using the search-bar, find *Homo sapiens*.

Keep zooming inwards, following the Animal line and asking if we are more closely related to one side of the tree or the other.

For example, when you get to Nephrozoa, one side shows a bird and the other shows a ladybird - which do you think we're more closely related to?

Left image:
The "great oak", a family tree of animals; from Haeckel, *Anthropogeny: Or, the Evolutionary History of Man* (1874).

Explore OneZoom



Activity 2: When was there a common ancestor of lions and bears?

Lions and bears are different creatures, obviously, and they look very different. However, they both have four feet (quadrupeds), eat meat (carnivorous) and give birth to live young (mammals).

Use the common ancestor tool to find out when their common ancestor lived. You can click on circles and leaves which provides more information from different sources like Wikipedia.
In this case, Google '*Dormaalocyon latouri*' to learn more about what the ancestor of lions and bears might have looked like.

At the top of the page is a barbary lion, *Panthera leo*, illustrated in Saint-Hilaire & Cuvier, *Histoire naturelle des mammifères* (1726), which is cautiously watching a brown bear (left), *Ursus arctos*, illustrated in Orbigny, *Dictionnaire d'histoire naturelle* (1849).

How to take the activity further...

Use the common ancestor tool to find out when lots of common ancestors existed and use your artistic skills to draw what they might have looked like. You could then create a family tree - be sure to label it with an estimated time stamp (e.g. 120 Ma).

Entry into the 2018-19 BioMedia Meltdown Competition by Ellie from Chestnut Grove

BioMedia Meltdown

Learning points:
How art can be used to interpret and emote complex concepts and how understanding artistic and scientific methods can enhance learning

BioMedia Meltdown is a project that encourages young people to take a broader interest in biology by introducing life science concepts through an artistic lens.

Linnean Learning delivers BioMedia workshops to 11-14 year olds in schools, libraries, hospitals and other community groups all over London. While the workshops are limited to Greater London, the competition is open to individual entries from all over the UK.

There is also a full free activity book, like this one, available online at www.linnean.org/biomedia-book.

If your child would like to enter the competition, or if you would like to find out more details about workshops in London, visit www.linnean.org/biomedia.

Art is a fantastic way to learn about nature, communicate ideas and express emotions.

To create a BioMedia Meltdown entry, all you need to do is find a scientific topic that interests you and find a way to communicate a key message through an art form.

Example:

The crab on the opposite page was created by Ellie from Chestnut Grove School to show the symbiotic relationship between a Spider Crab and algae; the crab gains camouflage on the ocean floor and in return provides a home for the algae.

The judges of the competition wrote "This print clearly shows the relationship between these two organisms and the benefits that the crab receives from the interaction. The use of colour, symmetry and surrounding shapes is wonderful.".

Linnean Learning has produced a great series of videos about how art and science can work together. Enjoy!
www.linnean.org/video/art

Fungi

Evolution

Infographics

Felting

Adaptation

Plaquards

Sculpture

Food chains

Pollination

Anatomy

Drama

What could you create?
#BioMedia

Extinction

Graffiti

Heredity

Painting

Songs

Environment

Dance

Plants

Climate change

Variation

Stop Motion

Photography

Entry from Greenford High School, Southall, London

Phoenix bursting into flame, illustrated in Jonston, *Historiae naturalis de avibus* (1657).

Special Species

Learning points:
How new species are named, insights into paradoxa and different habitats

Context:
Carl Linnaeus developed the binomial* naming system which created a two-word name for all living things - *Homo sapiens* are humans, *Felis catus* are common cats, *Canis lupus* are wolves, *Delphinapterus leucas* are beluga whales.

Many species names were created by combining Latin or Greek words together to describe the species. *Coccinella septempunctata* is the name of the common ladybird, with seven (‘*septem*’) spots (‘*punctus*’). *Rhinoceros unicornis* literally means nose-horn single-horn. *Bellis perennis* is the common daisy that is considered beautiful (‘*bellis*’) and lives for more than two years (‘*perennis*’).

Why not watch this fun video about mythical creatures and how to make them?
www.linnean.org/video/mythical

A species of longhorn beetle (*Cerambycidae*), illustrated in the *Proceedings of the Zoological Society London* (1866).

Special Species

Every species has its own unique scientific name that is chosen by the individual or team that discovers it. The name usually reflects something about the species itself.

Linnean Learning is looking for new species created by your child's imagination. We want a good drawing, a clever name and well-thought-out characteristics linked to its habitat.

1 Visit www.linnean.org/specialspecies to create a new species

2 Draw your new species

3 Create a scientific and common name

4 Think about its characteristics and why this species might have them.

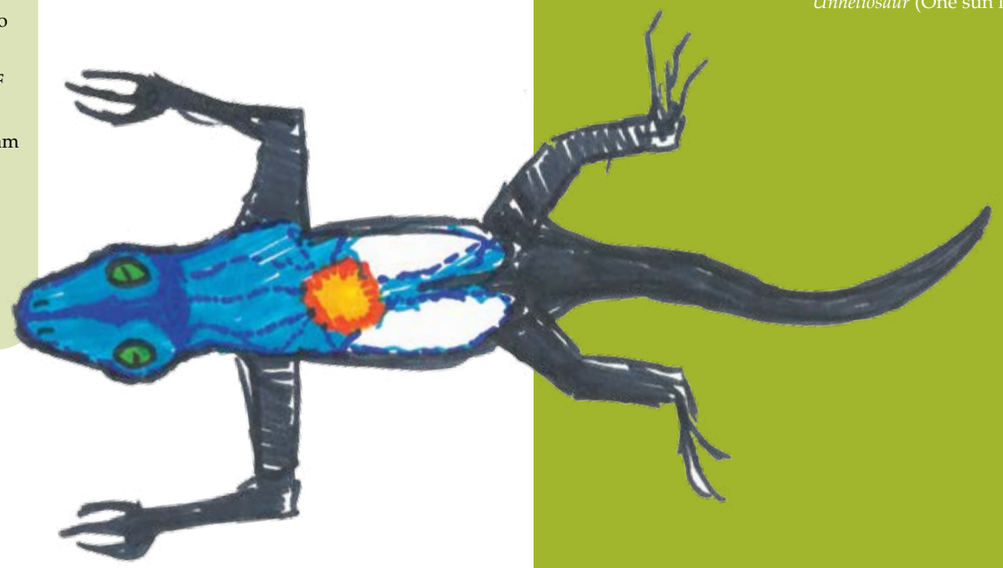
5 Write down a short paragraph giving the reasons for its adaptations and describe its habitat (aim for around 50 words).

6 Send your picture, scientific and common name and paragraph to us at learning@linnean.org or to Linnean Learning, Linnean Society, Burlington House, Piccadilly, London, England, W1J 0BF

All entries will receive a message back from the Linnean Learning team and you could be in with a chance to win a 3D printed animal too.

All information and more guidance can be found on our website: www.linnean.org/specialspecies

Winners will be posted on our @LinneanLearning social media.



Four very special species

Clockwise from above:
Magnadonta necrosaur (big teeth, death lizard)
Rhodobrachiarchnus (red-arm spider)
Muri flavipyro (Yellow-fire mouse)
Unheliosaur (One sun lizard)

A cheeky baboon, *Mandrillus sphinx*, illustrated in Shaw & Nodder, *Naturalist's miscellany* (1789).

Key Word Glossary*

Adaptation The evolutionary process where an organism becomes better suited to its habitat. See page 23 about Darwin's finches.

Amphibian A class of species that are aquatic at their infant stage followed by a lung-breathing adult stage. An example is a frog which starts off as a tadpole.

Arthropod A large group of species with hard skeletons on the outside of their body plan. They include insects, spiders, crustaceans and others.

Binomial Nomenclature The two-name system of naming (i.e. saying *Homo sapiens* rather than 'Animalia Mammalia Primates Hominidae *Homo sapiens*').

Biodiversity The range and amount of species that exist within an area. Biodiversity loss is the extinction or local reduction of a species.

Botany The scientific study of Plants. People who study plants are called Botanists.

Classification The process of arranging species into groups according to their similarities and evolutionary relationships.

Conservation The action of protecting and preserving a species, environment or ecosystem from damage or destruction.

Environment The surroundings and conditions of a given area, i.e. the school environment, the Amazon environment, the global environment.

Eudicot A plant that produces more than one cotyledon (a coteyledon is the first leaf to emerge from a seed). A monocot produces one cotyledon.

Evolution The process by which characteristics of species change over time to respond to new environmental challenges.

Exoskeleton A skeleton on the outside rather than on the inside. The main function is to provide support and protection for the animal's body.

Extinction When the population of a species reaches zero, usually due to changing conditions or through competition with another species.

Field Guide A document that helps the user to the identify species. Field guides are usually specialised to particular environments or groups of organisms.

Fungi Fungi are a Kingdom of species that are separate from Animals and Plants. Familiar fungi are mushrooms, truffles and yeast.

Habitat The natural home or environment of an animal, plant or other organism. Habitats can change due to environmental challenges.

Herbarium A collection of sheets of dried plant specimens, arranged based on their taxonomic group.

Key Word Glossary*

Identification The process of learning what species any given organism is. To identify something requires it to have already been named and classified.

Illustration A visual representation of a concept, object or process designed to explain, describe or convey a message.

Insect A group of arthropod species with six legs and generally one or two pairs of wings.

Investigation Any activity that sets out to solve a question in a systematic way that will produce an answer or give evidence to a theory.

Learned Society A learned society is an organisation that brings together people who are actively involved in the study of a specialist subject.

Life cycle The process that any given species goes through from birth to death. This can involve change in body structure, activities, habitat and more.

Mammal A class of species that, in most cases, has hair or fur, gives birth to live offspring, produces breast-milk and is warm-blooded.

Microbes A term given to a broad range of organisms that require a microscope to be seen on an individual level. This includes bacteria and viruses.

Mycology The study of Fungi. A mycologist specialises in the study of Fungi.

Natural History The study of nature, predominately living organisms including animals, algae, fungi and plants and their habitats.

Nutrient A substance that provides nourishment that is required or beneficial for healthy life or growth.

Organism An individual animal, plant, fungus or single-celled life form.

Photosynthesis The process in which organisms can harness the sun's radation (energy) to produce energy that it can use. In plants, the process produces sugar.

Plants The Plant Kingdom of species have different cell structures to animals and fungi, including a thick cell wall and chloroplasts for photosynthesis.

Propagate The ability or action of breeding new specimens from cuttings of a parent. This is used widely in plants.

Root system A network of fibrous structures coming from the base of a plant, usually in soil or earth, that provide stability and absorb water and nutrients.

Seeds A unit of reproduction that is produced by a plant which is capable of developing into another plant.

Key Word Glossary*

Species A group of closely related organisms that are usually capable of breeding and producing fertile offspring.

Specimens An individual animal, plant, or object that is used for study or display. Specimens are important for research and communicating ideas.

Sustainability The assessment of whether a process or resource will be able to continue constantly, or be available in the future at our current rate of usage.

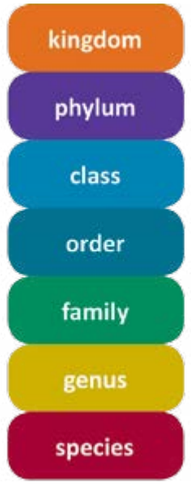
Taxonomy The science of placing species in appropriate groups and giving them names.

Transport The movement of something from one place to another. In plants, water is transported from the roots to the leaves through the stem.

Trap A way of capturing an organism. Traps should cause as little stress to the organism as possible.

Vascular Vascular means hollow tube. Vascular plants have good transport of nutrients through these special tubes.

Zoology The study of animals. People who study animals are called Zoologists.



The Linnaean Classification System

This is the way we classify animals, with the Kingdom at the top which contains all different types of animal, and then smaller and smaller groupings until you reach an individual species.

You can remember this structure using this mnemonic:
Kittens **P**refer **C**od **O**ver **F**resh **G**rey **S**ardines.

A common dog or wolf has the full scientific name: Animalia Chordata Mammalia Carnivora Canidae *Canis lupus*. Linnaeus made it popular to write just the last two words in a scientific name, i.e. *Canis lupus*.

The full scientific name for humans is Animalia Chordata Mammalia Primates Hominidae *Homo sapiens*. From this, you can see that humans belong to the same class as dogs, as we are both mammals.

Carl Linnaeus at various stages of life illustrated as usual with his favourite plant, *Linnaea borealis*, the twin flower.

1. Hollander, original by Hoffman (1737);
2. Tangé and Bernigeroth (1897);
3. Haagen-Nilsson, original by Scheffel (1739);
4. Haagen, original by Per Krafft (1774);
5. Haagen, original by Roslin (1905);
6. The winning portrait from the 2018 Linnaeus' New Portrait Competition, drawn by Leo (10) from William Tyndale School, London.

The Linnean Society of London

Communicating nature since 1788

The Linnean Society of London is the world's oldest active biological society. Founded in 1788, the Society takes its name from the Swedish naturalist and taxonomist Carl Linnaeus (1707–1778), whose botanical, zoological and library collections have been in its keeping since 1829.

The Society encourages the debate, discussion, observation and conservation of natural history, including disciplines such as taxonomy, evolutionary biology and ecology.

Linnean Learning was established in 2009 to enable the Society to share its collections and wealth of scientific knowledge with wider audiences, including students and the general public, in order to inspire and engage the next generation with the natural world and biological sciences as a whole.

EXPLORE

the natural world
right outside your door

From a young age, Carl Linnaeus was encouraged to explore in nature, be curious, take notes, share his findings and learn more about **LIFE**.

This book will help you build confidence within nature so that you can encourage your own children to go out and explore the natural world.

www.linnean.org/learning

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