SECONDARY LESSON PLAN

Plants Pollinators People:
Gardens and health (Science/PSHE)

The need to protect our planet from climate change and species loss is now fully embedded in the public conscience, including that of children and young people. The scientific evidence supporting the need for humans to reduce our negative impact on the planet is clear and overwhelming.

This lesson plan provides teachers with the opportunity to integrate Science lessons around pollinator plants and their importance for a healthy planet, with an exploration of how plants and pollinators link to human health and wellbeing in line with PSHE studies.

This lesson is best done when weather is good and plants are in flower, late May to early September.

LEARNING OBJECTIVES

For students to learn:

- How insects (and other species) pollinate plants, to support the plants' reproduction through collecting nectar (identify and understand process, understand the reproductive parts of plants).
- How the population of pollinating insects (and other species) attract other animals/ organisms, supporting the creation of ecosystems (identify, describe, understand).
- How within an ecosystem, different relationships (ecology) are built to sustain life and the health of the individual species within that environment (explore, understand).
- How through understanding the way ecosystems support other life, we can learn how relationships are important to human health (explore, compare, understand).
- How humans are part of the natural world, and the positive impact we can have on it (explore, understand and synthesise).

CURRICULUM LINKS

Science: KS3

- The interdependence of organisms in an ecosystem, including food webs and insect pollinated crops
- The importance of plant reproduction through insect pollination in human food security

Science: KS4

- Living organisms may form populations of single species, communities of many species and ecosystems, interacting with each other, with the environment and with humans in many different ways

PSHE: KS3 and KS4

Compulsory subject:

- Health education

PRE-LESSON PREPARATION

The lesson has been designed to be differentiated across KS3-4. It provides a series of activities. You can choose to leave out an activity or adapt the Activity Resources (sheets marked **AR**) to suit your students.

Factor in the size of the garden into your decision-making process about what sized groups you want the students to work in. Include in your timings how long it will take to get from classroom to garden and back again.

Provide sufficient copies of the Activity Resources (**AR**) and Supporting Materials (**SM**) for students to have one each or work in pairs.

Room set-up

Activity 1 takes place in the classroom, which can remain arranged as usual. The other activities in this lesson plan are intended to be carried out in your Superbloom garden.

Additional resources needed

- Clipboards, 1 per student
- Colouring pencils, one set per student
- Magnifiers – *optional*
- Camera – *optional*

ACTIVITY 1

Introduction

Explain how the lesson will explore ecosystems, species interaction (ecology) and lessons from observing the natural world for human health.

Suggested duration: 10 minutes

Pack resources: **Activity Card 1 | AR1 | AR2 | SM1**

ACTIVITY 2

Your garden's ecosystem

Spend time observing the garden and noticing the different life that exists there, plants, insects and perhaps other life across Kingdom, Phylum, Class and Order. Hypothesise how far the different species travelled to be in the garden, including humans, and how large the garden's ecosystem might be.

Suggested duration: 20 minutes

Pack resources: **Activity Card 2 | AR3 | AR4 | SM1**

ACTIVITY 3

Species' interaction

Observe the different wildlife species as they interact with their own species and others. Use a simple diagram to describe the web of interaction that is happening in the garden.

Suggested duration: 10 minutes

Pack resources: **Activity Card 3 | AR5 | SM1 | SM2**

ACTIVITY 4

Competition v. Cooperation

Identify examples of competition of cooperation between humans and other species in the garden.

Suggested duration: 10 minutes

Pack resources: **Activity Card 4 | AR5 | AR6 | SM1 | SM4**

ACTIVITY 5

Are gardens good for us?

Students mark their level of relaxation after time spent outside. Discuss how we can use observations of nature, ecology, and different species to think about how we can keep ourselves healthy and well mentally and physically.

Suggested duration: 10 minutes

Pack resources: **Activity Card 5 | AR2**

IDEAS FOR ADDITIONAL ACTIVITIES

- Using the wellbeing thermometer on **AR2** will provide data that could be transferred into charts and graphs to support science and maths
- **SM5** describes the amazing adaptations bees have made through evolution in order to collect pollen - students could hypothesise about how a non-pollinating insect or even a mammal might evolve to collect pollen and nectar from flowering plants
- **SM6** can be used to stimulate discussion about how different animal species develop a mutualistic relationship that supports their own wellbeing and survival

ACTIVITY CARD 1

Pack resources: AR1 | AR2 | SM1

Introduction
(10 minutes)

In the classroom, explain how the lesson will explore ecosystems, species interaction (ecology) and what can be learned about human wellbeing from observing the natural world.

Use the list **AR1** to introduce key words and ensure foundational understanding.

You'll find weblinks to useful resources about gardens and wildlife on **SM1**.

Before you go outside into the garden, ask each student to record their personal relaxation level on **AR2**.

IMPORTANT: Take **AR1** and **AR2** on clipboards into the garden for the next activities.

ACTIVITY CARD 2

Pack resource: AR3 | AR4 | SM1

Your garden's ecosystem
(20 minutes)

Spend time observing the garden and noticing the different wildlife that exists there; plants, insects and other life across Kingdom, Phylum, Class, Order, Family, Genus and Species.

Begin by observing at a distance and noticing if any larger animals are coming into the garden.

Then get closer and note all the smaller animals within the garden.

Using **AR3**, ask students to note down the different species they observe, writing the names of species they recognise and drawing or photographing the ones they don't.

Next, focussing on the species students listed on worksheet **AR3**, ask them to hypothesise how far each species has travelled to be in the garden, including humans, and write each species' name in one of the circles on the diagram provided on **AR4** (each ring represents a distance they may travel to reach your garden). The aim of this activity is to give students an idea of the size the garden's ecosystem might be.

You'll find weblinks to useful resources about gardens and wildlife on **SM1**.

ACTIVITY CARD 3

Pack resources: AR3 | AR5 | SM1 | SM2

Species' interaction
(10 minutes)

Using the species listed on **AR3**, ask students to complete the simple diagram on **AR5** to record the types of interaction they observe taking place between (or within) species in the school's garden.

They should use the the colour key provided, drawing lines in coloured pen/pencil between species to indicate types of interaction taking place in your garden.

KEY:
Red – Feeding where one species benefits only (e.g. bird eats worm)
Blue – Feeding where both species benefit (e.g. bee feeds on flower and flower gets pollinated)
Yellow – Other interaction or energy transfer

If observation in the garden is not possible, ask students to complete the diagram to test their existing knowledge of interaction types between species that are likely to visit the garden. You may prefer to use the list of Superbloom flowers and the insects they attract provided on **SM2**.

Discuss.

You'll find weblinks to useful resources about gardens and wildlife on **SM1**.

ACTIVITY CARD 4

Pack resource: AR5 | AR6 | SM1 | SM4

Competition v. Cooperation
(10 minutes)

How have humans supported the creation of your garden's ecosystem?

Using the students' completed **AR5** worksheets, ask them to identify examples of competition or cooperation between humans and other species in the garden to complete worksheet **AR6**. Use the examples on **SM4** as a starting point.

You'll find weblinks to useful resources about gardens and wildlife on **SM1**.

ACTIVITY CARD 5

Pack resource: AR2

Are gardens good for us?

(10 minutes)

Get the **AR2** sheets out again and ask students to mark their level of relaxation after having spent some time outside in their garden.

Hopefully, they will feel more relaxed than when they marked it earlier back in the classroom, and this can be used to begin a discussion about how we can use our observations of nature, ecology, and different species to think about how we keep ourselves healthy and well mentally and physically.

Prompts

Just like plants, human beings need:

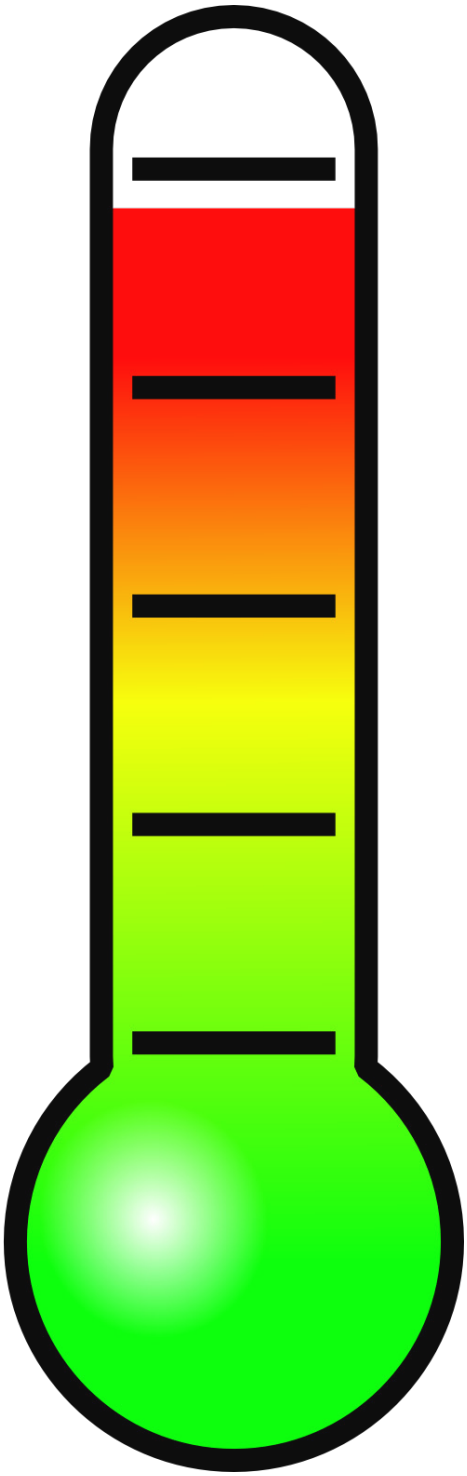
• sunlight • water • nutrients • air • warmth • room to grow

AR1 KEY WORDS IN ECOLOGY

ORGANISM	any living thing, such as animals and plants
PLANT	an organism that uses sunlight to make food for itself
INSECT	a small animal with six legs
SPECIES	a way of grouping living things that could mate with each other
ECOSYSTEM	the connections between animals and plants and the world they live in
ECOLOGY	the study of animals and plants and the world they live in
POLLINATOR	an animal that moves pollen from one flower to another
PROPAGATION	growing new plants from the plants we have already
COMPETITION	when two organisms are trying to win against each other
COOPERATION	when two organisms are helping each other
EVOLUTION	changes in animals and plants that take place over a long time

AR2 RELAXATION THERMOMETER

Mark on the thermometer how relaxed you feel right now.



NOT RELAXED

VERY RELAXED

AR3 IDENTIFYING SPECIES

Start by observing the garden from a distance and then move closer to the plants so that you can see different insect species.

Write the names of the species that you see and recognise here:

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

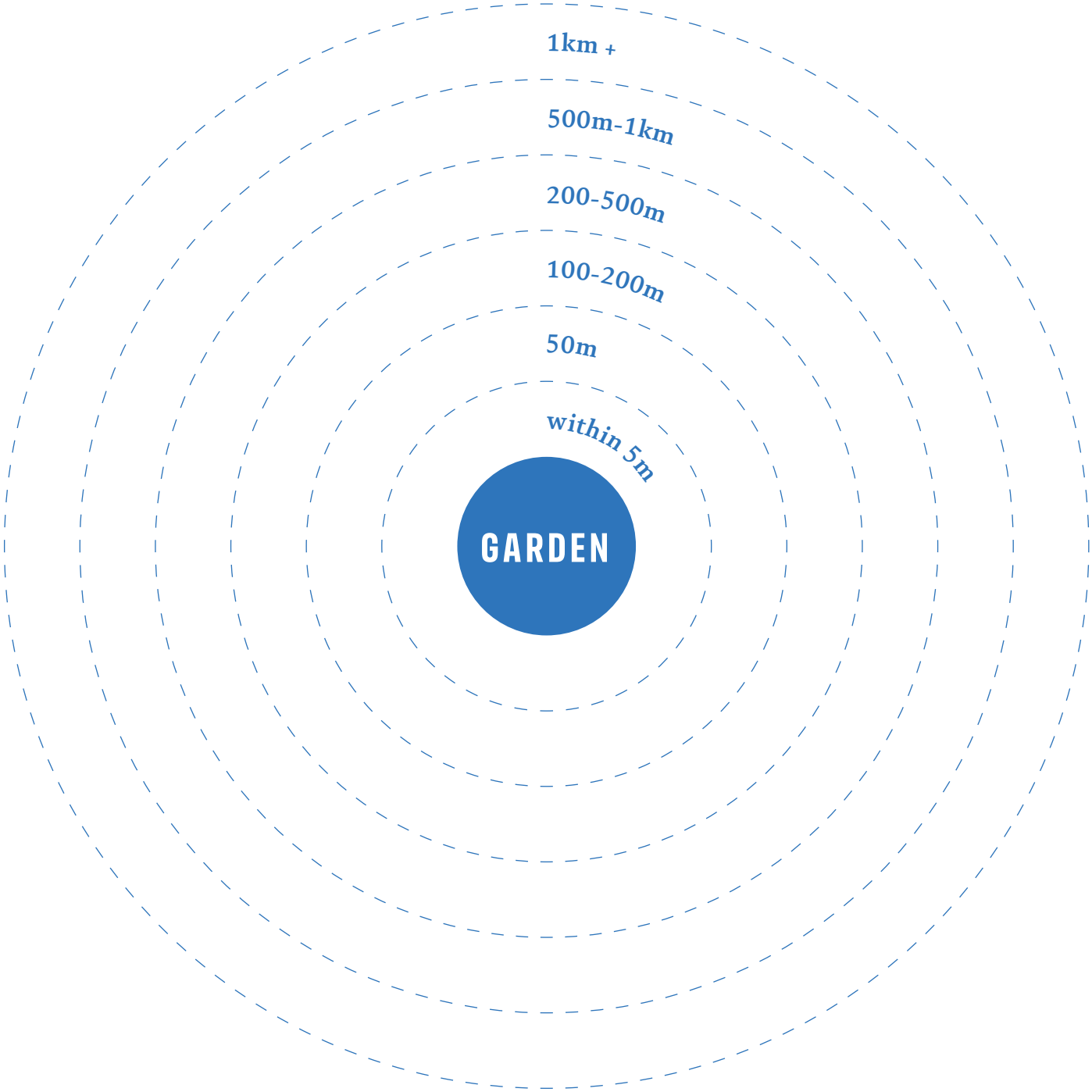
10. _____

Draw a sketch of any that you don't know the names of that you can investigate later. You could also take photographs if you have a camera with you.

AR4 HOW BIG IS YOUR GARDEN ECOSYSTEM?

Using the names of the species you collected on worksheet AR3, hypothesise how far each species travelled to be in the garden, including humans, by writing the species in one of the circles, which represent the different distances they may travel to reach your garden.

This will give you an idea of how big your garden's ecosystem could be.



AR5 SPECIES' INTERACTION

Complete this simple diagram to record the types of interaction taking place between species in your school's garden.

Draw lines to show the different types of interactions between species using the colour key provided.

Don't forget to include humans as one of the species in your garden.

KEY

RED	Feeding where one species benefits only (e.g. bird eats worm)
BLUE	Feeding where both species benefit (e.g. bee feeds on flower and flower gets pollinated)
YELLOW	Other interaction or energy transfer

SPECIES 1	INTERACTION TYPE	SPECIES 2

AR6 HUMANS IN THE GARDEN ECOSYSTEM

What role have humans played the creation of your garden's ecosystem?

Can you identify examples of competition and cooperation between humans and other species in your garden?

COOPERATION:

Consider the interactions between species that may benefit from your school's actions in creating and maintaining the garden. One example might be watering the plants you have planted.

COMPETITION:

What actions have you or your school taken to create the garden that might affect insects and wildlife negatively?

SM1 WEB RESOURCES ABOUT GARDEN WILDLIFE

https://bna-naturalists.org/ The British Naturalists' Association has lots of resources on wildlife in the Britain including very good ID guides with good imagery to help identify the species in your garden.

https://www.buglife.org.uk/ Buglife have a good range of resources in relation to UK insects. Their identification guide can help you identify an insect through a description tool. Additionally, you could get involved in their campaign to monitor insect populations.

http://wlgf.org/index.html The Wildlife Gardening Forum has a whole host of resources about gardening and wildlife. Their resources have a great deal of information about the lifecycle and behaviour of wildlife found in UK gardens. They have resources specific to garden ecology and food webs in UK gardens.

https://www.wildlifetrusts.org/ The Wildlife Trusts website has great information about protecting and promoting wildlife. Additionally, you could find your local Trust who often have educational engagements that your school could access.

The BBC bitesize resources also have excellent resources related to this topic.

SM2 SUPERBLOOM FLOWERS & INSECTS

Information about some of the flower varieties being planted in the Tower of London's moat and the pollinator species they attract.

Flower name	Description	What does it attract?
Blue Flax	Lovely flowers attractive to smaller pollinators which can be supported by its delicate petals.	**Pollen beetle** *(Brassicogethes aeneus)* – A tiny beetle which feeds on pollen and nectar of many plants. Particularly common in fields of flowers or in meadows where populations can flourish.
Californian Poppy	A bright and bold flower popular among many smaller insects.	**Western Honey Bee** *(Apis mellifera)* – The most common bee worldwide, with the majority living in hives as domesticated livestock because of their capacity to produce honey. Versatile pollinators which are able to visit almost any flower and consume nectar all year round.
Catchfly	Beautiful flowers which are attractive to a range of pollinators including butterflies.	**Large Skipper** *(Ochlodes venata)* – A very common butterfly in grassy areas and wherever nectar is available. The caterpillars eat grasses and the adult male butterflies find perching positions high up from which to monitor their territory.
Cornflower	This flower is extremely valuable for pollinators as it's large and bushy, making it easier to land on for flying insects, whilst offering loads of nectar and pollen.	**Red-tailed Bumblebee** *(Bombus lapidaries)* – These magnificent creatures will fly all spring and summer long with the queens emerging early to find new nests in which to lay eggs that hatch as worker bees. As with many other bumblebees, the queens nest underground often in old mammal holes, in stones or in walls. Providing them with the right places to nest is just as important to bumblebees as getting enough nectar from flowers.
Corn Marigold	This is an excellent flower for pollinators because it's bright, large, open and easily accessible.	**Green-veined White** *(Pieris napi)* – A white butterfly with green veins on the underside of the wings. The caterpillars need to feed on crucifers (plants with four petals or leaves growing in a cross) and can do really well in towns and cities. The adult butterflies feed on a range of plants, including Corn Marigolds.
Dill	Visited by many pollinators including hoverflies and soldier beetles.	**Common Red Soldier Beetle** *(Rhagonycha fulva)* – called soldier beetles because many have colouring similar to regimental uniforms. These are versatile insects which often prey on smaller creatures while also feeding themselves on flower nectar and pollen.

SM2 SUPERBLOOM FLOWERS & INSECTS

Flower name	Description	What does it attract?
Fairy Toadflax	Delicate flowers perfect for small solitary bees and wasps.	**Ruby-tailed Wasp** *(Chrysis ignita)* – With a glittering ruby tail and metallic green bodies, these small wasps lay eggs in the cells of other bees and wasps. The adults visit flowers to feed on the nectar and pollen and are very efficient pollinators of smaller varieties of flowers.
Paper Daisy	These large papery flowers make excellent landing boards for small and large insect pollinators.	**Peacock** *(Aglais io)* – A large and beautiful butterfly which can be seen feeding from flowers. The caterpillars eat nettles and do well in gardens where small corners are allowed to go wild.
Poppy	Its red flowers are perfect feeding stations for all types of insects including bees, butterflies, and wasps.	**Common Wasp** *(Vespula vulgaris)* – A well known black and yellow insect which loves eating flies, aphids, caterpillars and other insects. The adult wasps feed and collect pollen from plants for themselves and their young back in the nest. They play an important role in plant pollination.
Pot Marigold	A very common plant grown in towns and cities which is loved by wildlife, including pollinators and other beneficial insects (and slugs and snails!).	**Chequered Hoverfly** *(Melanostoma scalare)* – A distinctive hoverfly with a slim chequered body. It's found near lush vegetation and is attracted to open flowers. The young larvae will eat lots of different smaller insects and like to live in leaf litter.
Red Orache	This flower is mainly pollinated by the wind, but it's also popular with smaller pollinators and other invertebrates.	**Ichneumon Wasp** *(Netelia testaceus)* – This highly specialised wasp uses tall plants as resting posts whilst they look for prey.
Tickseed	A fantastic flower for smaller pollinators that require more specialised feeding.	**Common furrow bee** *(Lasioglossum calceatum)* – These bees like to nest in soils in a variety of habitats. They collect pollen and nectar for themselves and their young, often visiting smaller plants. This bee plays an important part in the pollination cycles of many plants.
Viper's Bugloss	A favourite flower of many butterflies and moths because its delicate flowers are best suited to insects with a long tongue (proboscis)!	**Narrow-bordered Five-spot Burnet** *(Zygaena loniceraee)* – A common day-flying moth that lives in grasslands and gardens.

SM3 POLLINATOR FACTS

In the UK the majority of pollination is carried out by bees (wild solitary bees and bumblebees, as well as domesticated honeybees), flies (including hoverflies and bee-flies), butterflies, moths, wasps and beetles.

BEES

Bees will generally travel under a mile to collect food but will travel up to 5 miles if necessary.

Bees can fly at speeds of up to 20mph, but only about 12mph when fully laden with pollen.

When bees locate a good source of food, they communicate its location with other members of the hive by performing a dance - a round dance if the source is under 50m away, or a waggle dance if the source is over 50m away. This dance is a series of figure of eight turns and returns accompanied by the release of chemical scents that provide information about distance, location and quality of the food source.

BUTTERFLIES

Painted Lady butterflies migrate from tropical Africa to the UK and back each year over successive generations. They fly at an altitude of 500m at speeds of up to 30mph.

SM4 EXAMPLES OF COOPERATION AND COMPETITION BETWEEN HUMANS AND GARDEN SPECIES

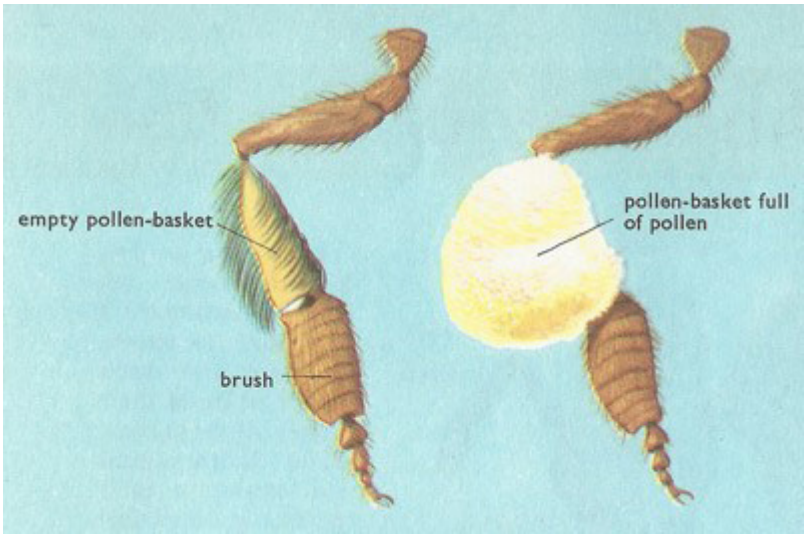
Ecosystems are built on subtle interactions between different species, including humans. It is only relatively recently that we have become aware of the complexity of these inter-relationships and are able to make better-informed decisions when taking actions that may affect ecosystems.

Consider which species attracted to the garden might impact other species in ways similar to how humans impact an ecosystem.

Here are examples of species' interactions that can affect your garden's ecosystem:

- In planting the garden, you have cooperated with the school's environment by introducing certain plant species.
- The plants you've planted will attract pollinators, so you are encouraging cooperative relationships between plants and pollinators.
- In changing the school's grounds to create your garden, you may have had an impact on other plant species which were already growing there or would have colonised the area. This will have an impact, as different species of plants are attractive to different animal species.
- To create your garden, the existing soil will have been disturbed in some way and this will have an impact on the life living in this soil. As with all change, this will benefit some species and negatively impact others. Mycorrhizal mutualism between plants and fungi is formed by approximately 65% of all known land plant species - many plants depend on this symbiosis for their nutrient supply.
- The seeds of some plants are dispersed by wind, but others rely on animals to disperse them, so animal species can impact what plants grow in an area.
- Ants will actively 'farm' aphids. They carry aphids onto new plants to feed on, so that they can collect the honeydew that aphids secrete. Honeydew is a food source for the ants.

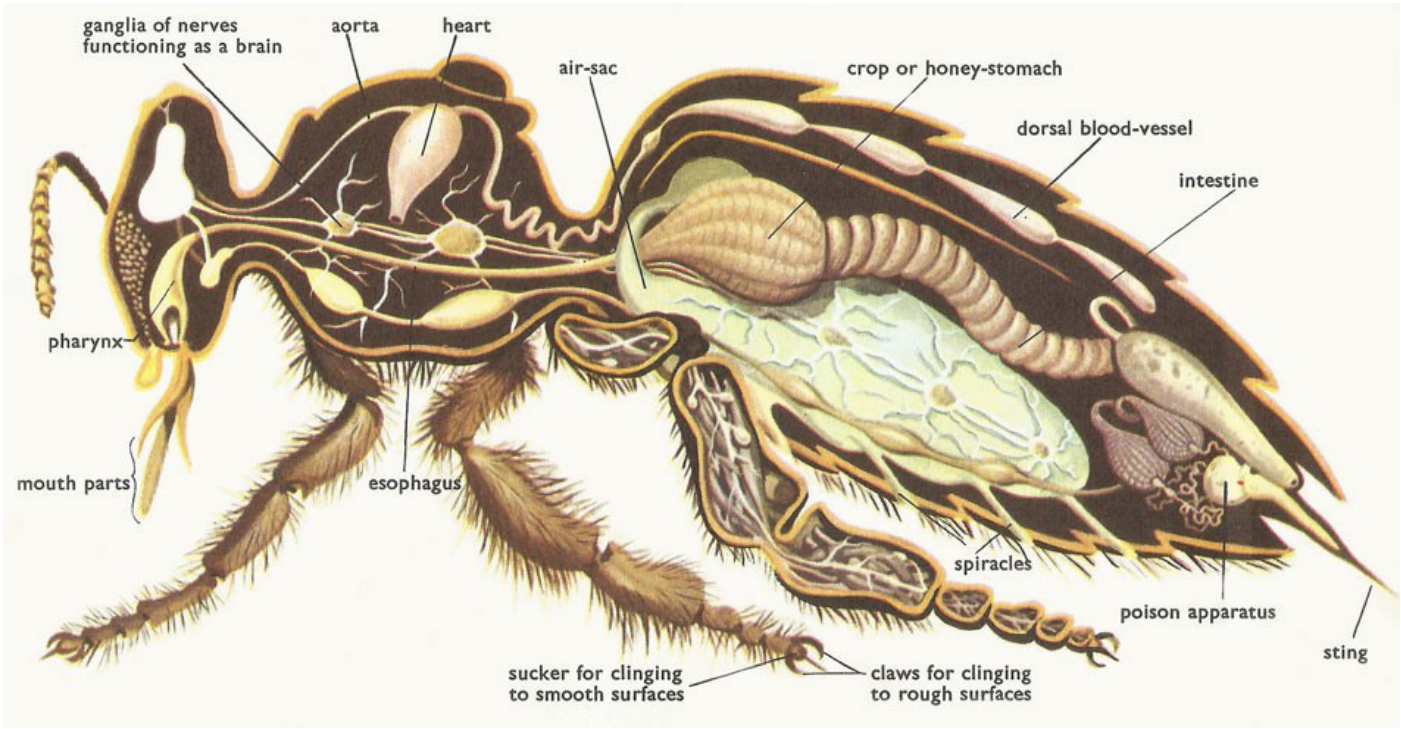
SM5 BEE ADAPTION



Here are two diagrams showing adaptions that bees have evolved to enable them to collect and transport pollen and nectar.

The first one shows a pollen basket on the rear pair of a bee's legs. The 'basket' is actually made up of specially adapted hairs called 'scopa'. Some types of bee have scopa on their abdomen instead.

This illustration shows the honey stomach that bees use to store nectar and pollen, which is later regurgitated in order to feed young bees or to make honey.



SM6 MUTUALISM

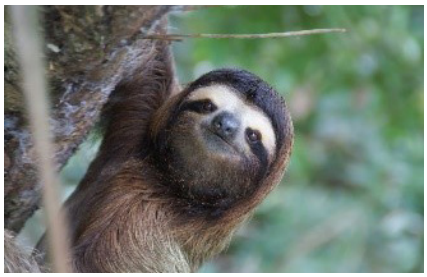
Each of the species on the left-hand side has a mutualistic relationship with one on the right-hand side, but which one? Draw a line between the species which you think have adapted to help each other.

FLOWER

ANEMONE

APHID

SLOTH



SLOTH MOTH

ANT

CLOWN FISH

CROCODILE

PLOVER BIRD

BEE

SM6 MUTUALISM - ANSWERS

Each of the species on the left-hand side has a mutualistic relationship with one on the right-hand side, but which one? Draw a line between the species which you think have adapted to help each other.

FLOWER

APHID

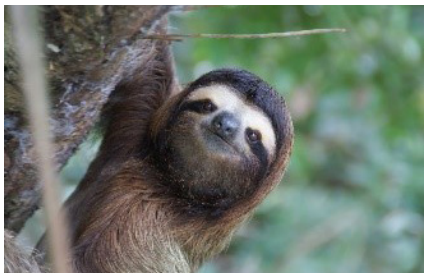
SLOTH MOTH

CLOWN FISH

PLOVER BIRD

ANEMONE

SLOTH



ANT

CROCODILE

BEE

SM6 MUTUALISM - ANSWERS

FLOWER – BEE

Flowers are pollinated (part of their reproductive cycle) by bees who get food (nectar) from the flower.

APHID – ANT

Aphids produce honeydew which ants eat. In return, ants protect the aphids from predators and will take them into their nests for shelter in the winter - some ant species literally farm aphids!

SLOTH MOTH – SLOTH

A sloth moth eats microorganisms and other parasites on the sloth's fur keeping the sloth healthy. The sloth moth gets to lay its eggs in the sloth's faeces as part of its reproductive cycle.

CLOWN FISH – ANEMONE

The Clown Fish has evolved a thick mucus layer to protect it from the anemone's stingers. The Clown Fish is protected from other fish who are stung by the anemone. Having a fish live so close by provides a major source of nutrients for the anemone via the clown fish's faeces.

PLOVER BIRD – CROCODILE

The Plover Bird climbs into the mouth of the crocodile and eats food caught between the crocodile's teeth. The crocodile gets its teeth cleaned, which protects them from infection and tooth decay.