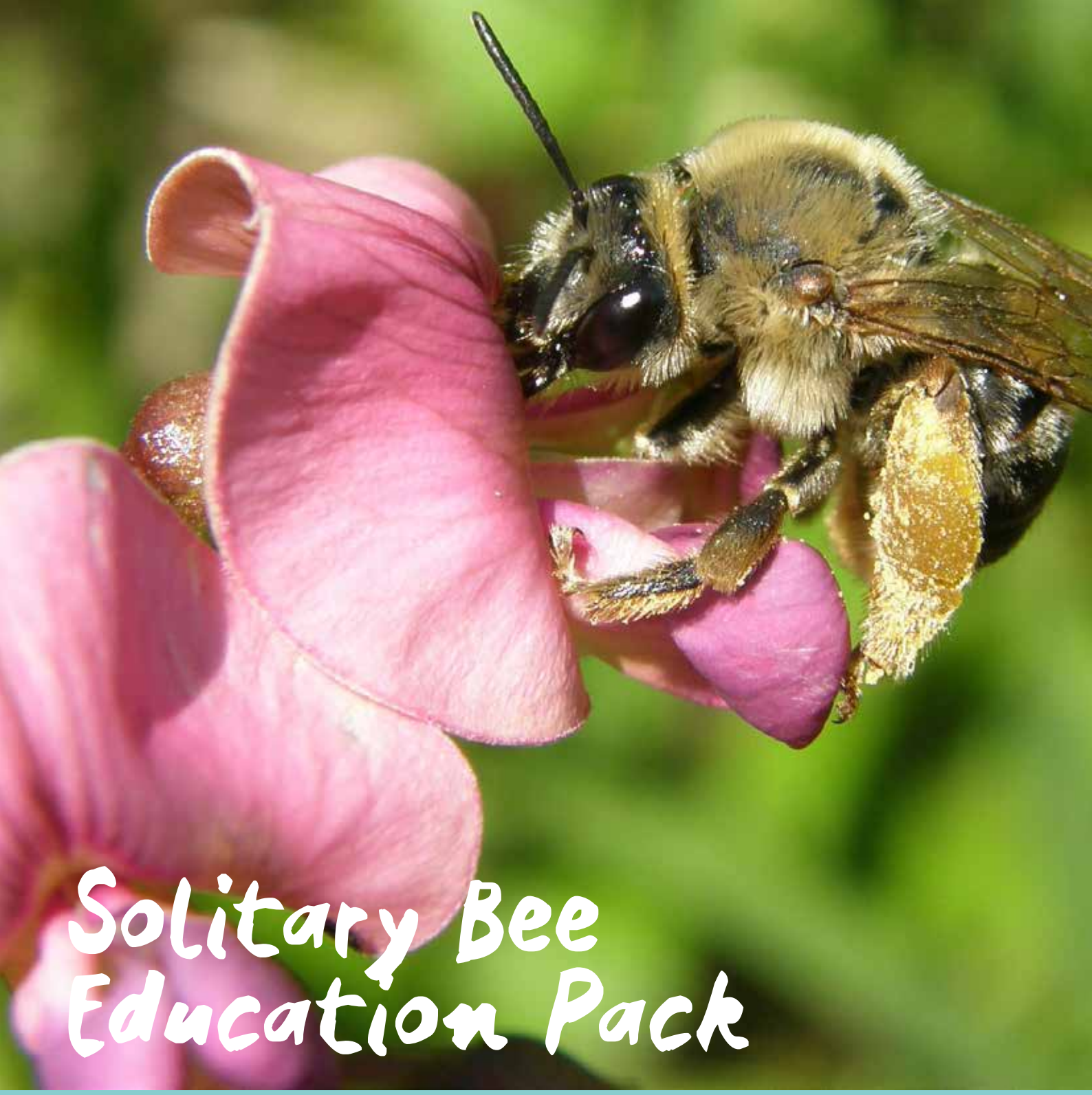


Solitary Bee Education Pack

The Wheal Buzzy Project

Cornwall
Area of Outstanding
Natural Beauty

HERITAGE
FUND

Funded by the National Lottery Heritage Fund
and Cornwall AONB Partnership

What can be found in this pack?

Information regarding bees, the different types of bee, curriculum-based activities and additional resources which support the Wheal Buzzy Project inside the classroom and beyond. Providing key facts to increase knowledge about solitary bees and how they differ from other bee species in Cornwall. Their lifecycle, role in pollination, the wider environment and resources to embed learning. Suggestions or ideas for activities you could carry out school or elsewhere to benefit these amazing insects.

The Wheal Buzzy Education Pack is aimed at years 1 – 8 (Key stage 1 to the lower end of Key stage 3). Imbedding the core subjects of English and Maths within the science-based content of the pack, activities and resources within the pack also cover key skills found within design and technology. Information about how they link with the National Curriculum can be found within the teaching notes associated with the topic suggestion and ideas for your school.

Contents

What is the Wheal Buzzy Project?

Wheal Buzzy is an integral part of the Cornwall Area of Outstanding Natural Beauty (AONB).

Wheal Buzzy is a unique project targeted at the plight of Cornish Solitary Bees. Approximately 270 species of Bee are found in the UK and Ireland, 250 are solitary and Cornwall is known to have at least 186 different species.

Bees in general are under threat, particularly our solitary bees, their habitat is at an increasing risk of loss and in the greater part is incredibly fragmented. There are isolated pockets of some of the 120 species which can often be found near old mine sites on the Cornish coast and moorlands.

Wheal Buzzy is about creating space and awareness for these amazing pollinators. This pack is designed as a standalone resource, and can be used both within the classroom setting or beyond.

Bee facts

Across the world we know that there are about 25,000 different species of Bee and many more which we have yet to find. For instance, a new species of Bee was discovered in Cornwall in 2018 – *The Andrena Ampla*. Little is known about this species at this point, results from further research are expected to be released during 2020.

Most Bees are actually Solitary. Unlike Honey and Bumble Bees they do not live in social colonies. Some species may build their nests close to each other, yet Solitary bees work as individuals—they are highly independent, and incredibly efficient pollinators.

What is Pollination?

Pollination is when Pollen is transferred from one flower to another.

Learning point

Pollen is a fine powder which is found inside a flower —it is used in plant reproduction. In order for plants to reproduce the pollen needs to be transferred between flowers through the process of pollination

There are two main types of pollination;

Wind Pollination

Some types of pollen are light enough to be moved from flower to flower by the wind. This type of pollen often causes hayfever.

Insect Pollination

Many flowers have bright colours and give off sweet smells, which attract insects such as solitary bees to help in their pollination.

An insect is called *a pollinator* if they move pollen from flower to flower, helping the plant to reproduce

Pollination → Seed → New plant

In Europe (including the UK) the *majority of pollination* is carried out by insects, such as solitary bees

Here in the UK we have at least approximately

270

different species of bee

250

of these being solitary

In Cornwall we know that we have approximately

186

different species of bee recorded

159

of these being solitary

Threats

Solitary Bees (as are many pollinators) are under threat from a number of external factors including;

1. Climate Change

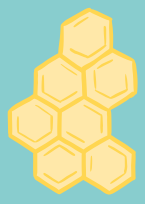
2. Intensive or modern agricultural practices

The biggest change to the natural habitat of solitary bees has been the loss of flower rich meadows. Since the 1940's traditional hay meadows have been converted into intensively managed field systems with the application of chemical fertilisers to "improve" grassland and silage production. Fields are now being cut up to three times a year for feed, resulting in a monoculture of species, which differs considerably from the flower rich habitats needed by our pollinators, commonly associated with traditional hay meadows.

Bees are facing a sharp rate of decline in Cornwall

The Cornish Bumble Atlas considers that 30% or 8 of the Bumble Bee species are either extinct or declining. Many solitary bee species are likely to have had similar rates of decline. There has not been a complete review of the declines in solitary bee speices, but the author estimates 7-8 species of solitary bee have become extinct in cornwall with 19 species have not been recorded since 1991. Some species are increasing in Cornwall. Young bee investigators are needed to find out what changes in the future for these important creatures.

In Cornwall we have...



1 honey bee...

25 bumble bee species...

163 solitary bee species...

... of these

8 are aerial or hole nesters

104 ground nesting and mining bees

39 species are listed as scarce or declining

48 (including bumble bee cuckoos). Cuckoo Bees don't actually carry out any pollination, and like true bees will also nest in cavities and the ground

Honey bee

In the UK we have a single honey Bee species *Apis Mellifera*. Domesticated Honey Bees typically live in a hive in large social groups. The social structure of honey bees can be described as Eusocial which involves a reproductive division of labour often referred to as a caste system

The Queen

The primary purpose of the Queen is to populate the colony. There is only one sexually developed female in a hive and therefore the Queen will be the only female who will reproduce. She is easy to identify as she is larger than any other bee in the hive.

Workers

These are female bees, who are not sexually reproductive. They are responsible for looking after the needs of the hive and providing food for all.

Drones

This is a male bee and unlike other honey bees they do not have a sting, nor do they collect pollen. Their sole purpose is to reproduce with the Queen. They rely upon worker bees to provide them with food (the energy which they require to reproduce).

Bumble bees

1 Queen bees **hibernate over winter** and wake up in the spring

2 On waking up the Queen **needs to feed on flowers** close by, as well as find a spot for her nest

8 The new Queen goes into hibernation before **emerging the following spring**

New Queens and Males leave the nest

7 The young queen eats as much food as she can **in preparation for hibernating** over the winter months. The old Queen, the males and the female workers bees have come to the end of their life

3 Now that she has eaten and found her nest site, she makes **pollen loaf** (food for her young) and a **nectar pot** (food for herself) and begins to lay her eggs

4 This first batch of eggs will grow into the **female worker bees,** who take over looking after the nest. The worker bees' job is to collect pollen and bring it back to feed the growing larvae

5 During mid/late summer the Queen will lay more eggs. Some grow into **male bees** and **others into new queens**

6 Once grown the young queens and males **will leave the nest** to find new mates

Solitary bees

Solitary bees such as the ***Orange Tailed Mining Bee*** have quite a different lifecycle from both honey and bumble bees. Many are active for a shorter period, about 5–6 weeks. Different species are active in different months often dependent upon which of their preferred flowers are available.

1 Males **emerge from the nest in early April,** patrolling the nest and nearby trees

2 A week or so later the females emerge. **Courtship and mating** then occurs

3 The female **creates a nest tunnel** in bare soil on a sheltered bank

4 **Individual cells within the nest** are filled with pollen and nectar) and eggs layed (see cell diagram)

Larvae

Pupa

5 Eggs hatch and **develop into larvae**

6 The **larvae pupates** and overwinters as an adult

Solitary Bees are a very diverse group of insects

They can be split into families including.

Mining Bees (Andrena)
Tormentil Mining Bee

Leaf Cutters (Megachile)
Coastal Leaf Cutter

Furrow bees or Sweat Bees (Lassioglosum)
Common Furrow or Sweat Bee

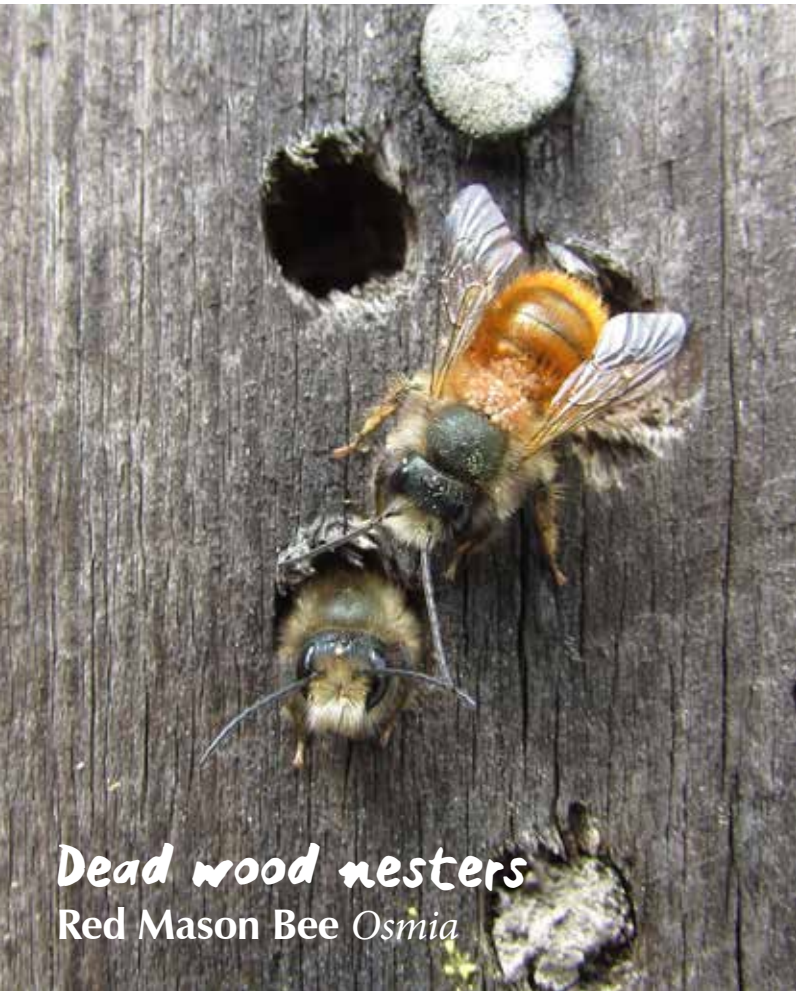
Mason bees (Osmia)
Gold Fringed Mason Bee

Nomad bees (Nomada)
Tormentil Nomad Bee

Oil bees (Macropis)
Yellow Loosestrife Bee

Nest requirements

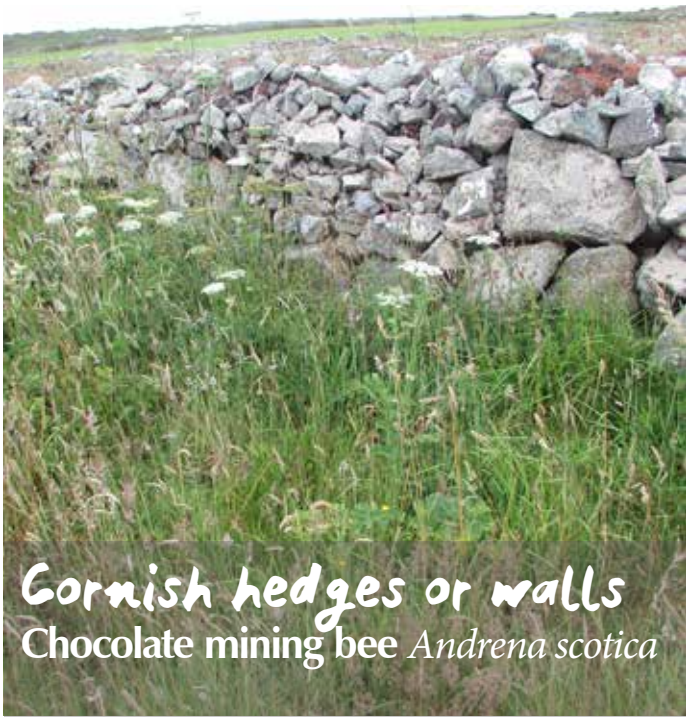
Solitary bees are a rich group of species using different places to nest. Nest habitat requirements include



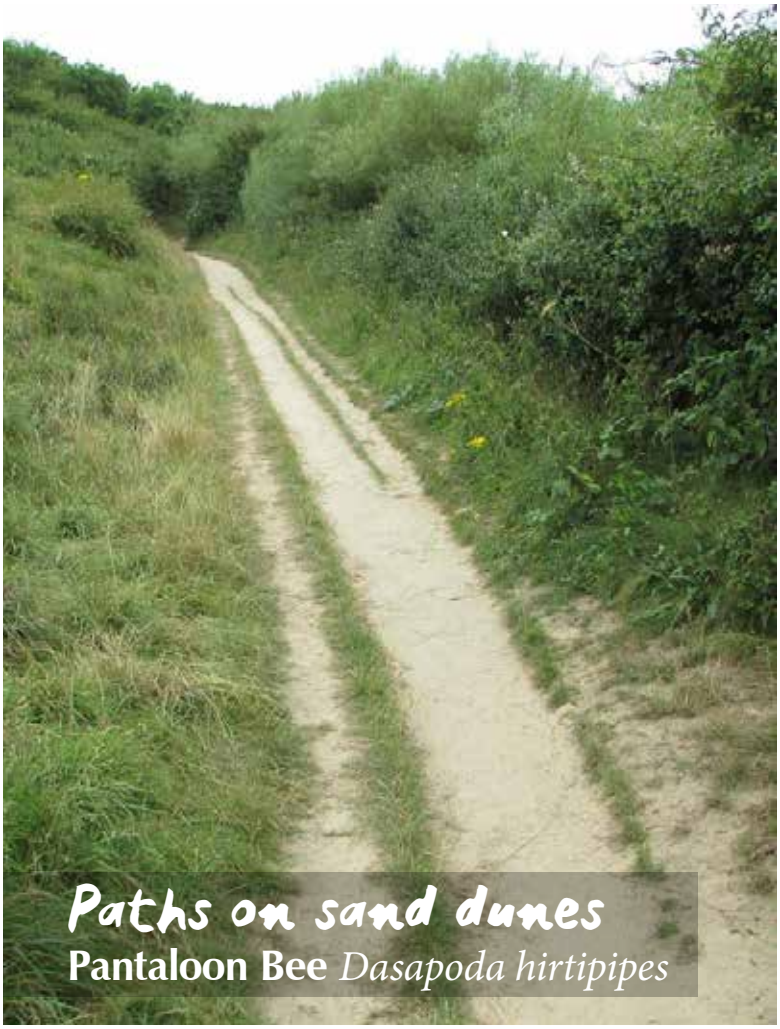
Dead wood nesters
Red Mason Bee *Osmia*

Hollow stem nesters

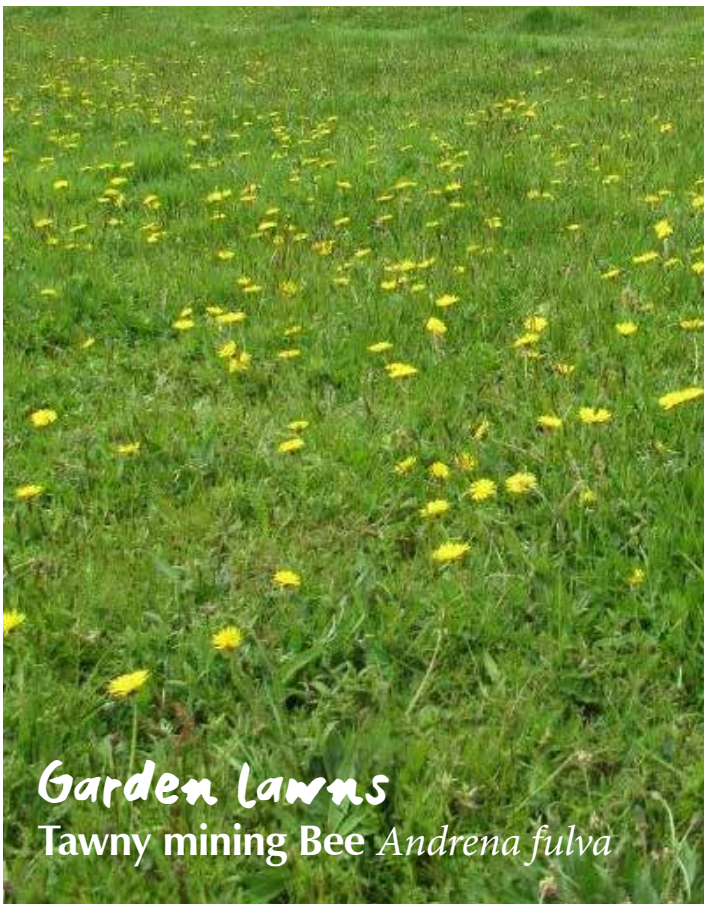
Soft cliffs or clay banks
Long Horned mining Bee *Eucera longicornis*



Cornish hedges or walls
Chocolate mining bee *Andrena scotica*



Paths on sand dunes
Pantaloon Bee *Dasapoda hirtipipes*



Garden lawns
Tawny mining Bee *Andrena fulva*

Mouse or vole nests
Early Bumblebee *Bombus Pratorum*

Snail shells
Gold-fringed Mason Bee
Osmia aurelenta

→ Other species are less fussy and can be found in a variety of places, **usually in south facing, sheltered, un-shaded banks** with some areas of bare soil.

Solitary bees can be found nesting in a number of different places, be it brick walls, purpose-built bee nests or holes in the ground. They all have one common denominator, their generic structure, like this example of a Red Mason Bee nest

1 **Individual cell** made in a nest tube either lined **with leaves** or **mud**. The Red Mason Bee will lay a single egg on pollen bread.

What is Pollen Bread? Pollen bread is a mixture of nectar and pollen and provides the energy for the larvae once they have hatched from the egg

2 **Cells are layered repeatedly** and sealed with mud. The males are generally in the outer cells with the females behind (they are last to leave the cells)

3 Once hatched the individual **larvae** feed on the pollen bread prior to forming **a cocoon**

4 Larvae spend some time as a cocoon prior to transforming into **adult bees**

5 Once in adult form **the bees will dig their way out** of the nest cells and begin the lifecycle once again.

Larvae

Adult bee

Wool Carder Bee Nesting Requirements

As mentioned, many Solitary Bee species are very particular in their nesting requirements. In some cases, these can be quite complex. It is an area which scientists are only just beginning to understand.

1 Wool Carder Bees require wool from Hogweed or other hairy plants to line the cells in the nest.

2 They will collect nectar from specific types of plant, such as Marsh Woundwort. This helps to give them energy and provide food for their young.

3 The Bee collects pollen from Greater Birdsfoot Trefoil, which becomes a part of the pollen loaf

4 Wool Carder Bees protect their nests from diseases and parasites by collecting oil from Yellow Hawkweeds.

5 Nests need to be the right size. Spaces found beneath slate tiles on roofs are often ideal

6 The bee needs the right temperature, this may mean the bee is looking for a roof facing a specific way.

Most Bees are Polyectic (Collect Pollen from a variety of Plants). There are however a number who specialise in collecting pollen from one genus or species (occasionally from a few geni or species) These bees will need abundant flowers from their preferred food source within easy access of the nest, estimated to be within less than 900m.

Learning point

Ask students to compare the nesting requirements of Wool Carder Bees, with the generic nest structure of the nest. What are the similarities? Are there any differences?

Why not observe Solitary Bees at home or in your school grounds? What flowers are they feeding on? Do individual bees species visit different plants? Do individual plant species have more than one type of bee on them?

Flowers and habitat

Quantity of Flowers - Solitary Bees require a lot of plants in order to live

Some bee species may need over 1000 flowers to raise just one larva. Scientists estimate that **somewhere in the region 17,000 flowers are needed** for a viable population of Long-horned Bees. Loss of wildflower meadows through monocultural (intensive) agricultural systems has an effect upon bee populations **predominantly through cutting or overgrazing of the flowers.**

Quality of flowering plants

Rare bee species **can be more specific to certain genus of flower,** i.e. The Daisy (Composite), Pea family (Legumes). Both have specialist bee species associated with them.

A smaller number of bees **will specialise on one species of plant** such as the Large Scabious Bee whose preference is Field Scabious.

Like us, Bees need a balanced diet;

- Sugars/Carbohydrates (Nectar (Toast)) for energy and flight and,
- Protein (Pollen (Beans)) for larval development.

Some plants have high protein content in their pollen, particularly the legume family. These are important for larval or brood development for many of the rare specialised solitary bees.

Continuity of flowers and habitats

Solitary mining bees may need **suitable quality and quantity of flowers for over 5-6 weeks,** this may mean several plant species or even habitats are needed.

Spring bees and summer bees

Some Solitary Bees are s**pring flying woodland edge species,** whilst others benefit **from late flowering grassland and heathland habitats.** Those Grassland species which flower last face a greater degree of threat and habitat loss as well as their associated pollinator species.

Flower structure

Flower structure influences species diversity. Deep flowers such as mint family exclude certain species. Flat open flowers such as daisy family suit certain other species.

Forage distance

"Doorstep" foragers and smaller bee species **will forage closer to their nest** than their larger counterparts. Continuity of flowers and associated features need to be within 100-500m in order for populations to be viable. In contrast **larger bees need landscape scale resources to sustain viable populations,** potentially foraging through kilometres of quality habitat. The north coast of Cornwall provides ideal foraging for the larger bees because of the range of habitat connectivity along the coast.

Glossary

Caste
- a class of society, social status or system

Climate Change
A change in the world's climate

Courtship
Specialised behaviour in animals which leads to mating

Eusocial
A complex social structure – individuals living in a colony with individual functions. One or more females producing young, and the non-breeding individuals caring for the young

Forage
Looking for or searching for food

Germination
- to start developing or growing

Heathland
A habitat often containing heather and other plants associated with sandy soil. A great habitat for insects

Hibernating
A period of inactivity, especially over the winter months

Improved grassland/meadows
Fields which have been treated with Fertiliser and or pesticides to increase food production for livestock

Intensive (modern) agriculture
Farming which aims to produce as much as possible, usually with chemicals

Larvae
The young bee once it has hatched from the egg

Legumes
A large family of plants, most species shelter nitrogen fixing bacteria

Mating
Paring for reproduction

Monoculture
The Continuous growing of one type of crop

Nectar
A secretion in plants, which is high in sugar (energy)

Pollen Bread
A mixture of nectar and Pollen used to feed the newly hatched larvae

Polyectic
The collection of more than one type of pollen type of pollen.

Pupae
An insect in a non-feeding stage between adult and young

Reproductive
The ability to produce young of the same species

Species
A group of closely related individuals, grouped together because of their similarities

Unimproved grassland/meadows
Grassland which hasn't been reseeded, fertilised or drained - often full of flowers and wildlife

Woodland clearings
An area with in a wood which is free of trees and supports other plants

Woodland Rides
An open section of pathway through a wood.

Produced on behalf of Cornwall AONB's Wheal Buzzy Project by Charlotte Goodship; Wheal Buzzy Project Officer

Additional content and photos;

Patrick Saunders – Kernow Ecology

Trythal Primary School – Students and Staff

Teaching notes

These notes are designed to provide guidance as to how the topic suggestions provided within the resource section of the pack link in with the key learning objectives as set out within the National Curriculum

Collect some seeds. Grow some plugs (wildflowers)

Through gathering wildflower seeds pupils will need to develop skills in wildflower identification, and even in some cases the identification of seed type associated with shape of the seed. Investigating the growth of wildflowers will enable pupils to observer changes over a period of time, through carrying out simple comparative tests and varying their growing conditions, pupils will be able to observe changes over time. Gathering and recording data to answer questions associated with the question; 'What conditions provide the best growing environment for wildflowers?'

Create a wildflower area within your school or elsewhere

Creating a wildflower area within the school setting is a great opportunity to develop an area where students can observe changes over a period of time, as well as linking with other topic suggestions. Such as collecting seeds and growing wildflower plugs as well as potentially creating a designing a bee house. Including designing a bee house investigating where to site this and also letter writing.

Investigate a Solitary bee Species

Through using secondary information sources, including the information found in this pack. Pupils will be able to investigate the life cycle of Solitary bees and explore how they differ from Honey and Bumble Bees. Pupils could pick from species mentioned in this pack and others listed at the rear of the resource pack Using the Bee trumps pupils could work together to investigate different species of bee, develop an appropriate scoring system. We've scored the examples based on size, the number of different habitats they are found in and the numbers of flowers they visit.

An extension or separate topic suggestion could be to explore; Why do Bees Hibernate? What is Hibernation? How is overwintering as a pupa different from hibernation?

Solitary Bee resources

These have been designed to work in conjunction with the topic suggestions within the pack, and as a way of providing prompts and aiding learning as part of the topic suggestions above.

Grow some wildflowers

Suggestions on ways that pupils can experiment when growing wildflowers from seed collected or potentially bought

Simple advice on creating wildflower areas within your school

A how to guide to creating a wildflower area, and what pupils could be looking for and observing – it's not just a space for pollinators there is the potential for so much more.

Solitary Bee Challenge

Two different games which illustrate the very real challenges that our bee species face, **the first improved or unimproved,** designed to

illustrate the challenges bees face with the loss of wildflower meadows through intensive farming and other threats. This game should encourage pupils to question why this loss of habitat is occurring, and actions which could eb taken to protect them.

The second 'How far a solitary Bee can carry pollen'

Solitary bees are incredibly hard workers in their short life span. Working to provision the nest with everything their young may need on the journey to adult hood, this game is designed to illustrate just how hard they have to work, encouraging pupils to think about the adaptations that solitary bees may need to make in order to successfully provide for their young. Sometimes the amount of food need for a bee is not readily available, what affect may this have on bee populations – linked with the ongoing loss of wildflower meadows.

Design your own Solitary Bee Top trump

A fun way to investigate about other species of Solitary bee, use creativity and also embed literacy and numeracy

Jigsaw 1 and 2

Depending upon the age of the learner this is a fun way of recognising two different species of bee, whilst insuring that pupils are able to develop the key spatial and life skills associated with recognising colours and shape.

How to make seed bombs

A fun and creative way of encouraging pupils to create space for nature whatever your age.

How to make an insect hotel

Whilst insects need food to survive they also need shelter to live in and raise their young, this is a great activity bringing a number of elements of the curriculum into pupils learning. Team work, maths, literacy and design as well as observation once complete

Design a Solitary Bee & Identify the parts of a Bee

Both of these activities will encourage pupils to identify and name the key body parts associated with solitary bees

Solitary bee word search

Some of the key words associated with Solitary Bees, names of species their preferred food and their basic ecology

Solitary Bee anagram

Why not encourage pupils to wrote about Solitary Bees, using this a as a prompt it could be a poem or anything, this activity is all about literacy

Smellie Cocktails

A question which often arises when talking about solitary bees is how they know where their food source is? Honey Bees are known to find their food source through communicating with other through the waggle dance. This activity not only illustrates how solitary bees are thought to find their food, but will encourage pupils to think about what plants may make the sweetest smelling cocktails using observation skills, thinking about what will work and what wont work as well as exploring the natural environment.