

# Land, water and bees – don't take us for granted: Bees and their pollinating partners

## Teacher notes

### The issue

The Earth's resources are limited, but the human population is growing fast. How can we ensure food security – adequate safe, healthy food – for everyone?

Bees are vital in many ecosystems, including those on which humans rely. In recent years bee populations in this country and around the world have declined. Research has suggested a number of contributory factors:

- varroa mite infections spreading through honeybee hives and passing on viruses
- habitat destruction (for example loss of wildflower meadows and scrubland with flowering weeds) reducing bees' food supplies
- overuse of pesticides, including neonicotinoids, which are still the subject of research but have been shown to have deleterious effects in the lab
- all of these factors might interact – for example, a bee with a viral infection might be less able to survive pesticide exposure.

Scientists warn that 71 of around 267 bee species are threatened and more than 20 have already become extinct. Data are vital if we are to preserve them. This practical investigation involves collecting data on bees locally, with the opportunity to compare results from other seasons.

## Introduction



### Did you know?

One in every three mouthfuls that we eat depends on pollination by bees, including such different foods as apples, coffee, beans, oilseed rape, almonds and strawberries.

When bees forage for food they are collecting pollen, which is a source of protein, and nectar, a source of carbohydrate, to take back to the hive to feed other bees. As they move around, they transfer pollen from one flower to another, hence their importance as pollinators.

Insects pollinate about a third of crops globally. The causes of the decline in pollinator populations are likely to be multifactorial, with environmental factors, pests, diseases and human activity all interacting with insect populations.



The numbers and diversity of wild bees have declined sharply in the last 30 years. Honeybee (*Apis mellifera*) numbers, too, have suffered from a number of diseases, such as the mite *Varroa destructor*, which carries viruses that can destroy entire colonies, and has spread around the world in three decades.

In the 2015 Great British Bee Count volunteers recorded more bees in school grounds than any other habitat, including parks, gardens, allotments and roadside verges.

## Research informing the investigation

A great deal of research, both academic and commercial, has been carried out into pollinator decline and its suspected causes, such as the effects of habitat loss and neonicotinoid pesticides. In 2010 the Wellcome Trust set up the Insect Pollinators initiative, nine projects investigating the causes and consequences of the recent decline in honeybees and other pollinating insects. Links to the initiative and other research will be found in the Research background section below.

## Assumed prior learning

- Reproduction in plants, insect pollination, the structure of a flowering plant, seed and fruit formation.
- The **interdependence** of organisms in an **ecosystem**, including food webs and insect pollination.
- The importance of **biodiversity** in preserving ecosystems.

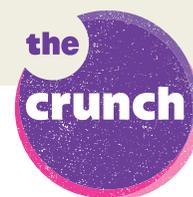
## Learning objectives

- Recall the structure of a flowering plant.
- Understand that pollination is necessary for the sexual reproduction of plants and that insect pollination is vital for a large proportion of crops grown and eaten by humans.
- Understand that organisms in an ecosystem are interdependent, and understand the concept of a food web.
- Investigate the bee population in a local area.
- Understand some basic sampling techniques and the importance of randomisation in selecting areas to survey.

## Activities

### Aim

This investigation aims to provide an understanding of the importance of pollinators in ecosystems and an awareness of the decline in pollinator numbers. It teaches a very basic outdoor survey technique and an awareness that there are different species of bees.



## Introductory activities

The student activity sheet contains some background information that explains the real-world context and the purpose of the practical investigation. This sheet could be provided as a homework reading task before the lesson for some classes. The investigations can also be contextualised in starter activities, so if you prefer you can hand out the student activity sheet in class and refer students directly to the practical instructions.

At the start of the lesson, review the concept of a food web and the importance of insect pollinators, including the biology of plant reproduction. You could choose an example that happens to be a food crop and from there challenge the class to think of as many foods that rely on pollination as possible. The Crunch website [thecrunch.wellcome.ac.uk/schools](http://thecrunch.wellcome.ac.uk/schools) includes an introduction to Bees in the ecosystem, with a link to a video created by the Department of Environment, Food and Rural Affairs, 'Bees' needs'.



Help students to understand that bee numbers are declining and ask why they think that might be – if they don't suggest it, you can bring up the idea of food webs again and ask them what bees eat, then talk about habitat destruction. Some students may have heard of the debate about the use of neonicotinoid pesticides, or of colony collapse disorder (entire hives of bees dying over winter) or the varroa mite.

## Practical investigation: surveying local bee numbers



### Safety

Carry out a risk assessment with the students; ask what hazards they can predict and how to control them. Plan what students should do if they are stung, and what you should do if a student has a serious allergic reaction.

Check whether any students have allergies to bee or wasp stings. Ensure that you are familiar with your school policy on administering medicine to students, whether this is a student's own adrenalin injector for life-threatening allergy, or antihistamine cream for trivial stings. (CLEAPSS guidance leaflet PS 87 *Bees and beekeeping* may be helpful.)

Visit the site in advance to assess hazards (terrain, water, toxic plants, litter, etc.) and plan accordingly. Check school policy on excursions if you plan to leave the school grounds.

Make sure that students are reminded a day in advance to bring sunscreen and/or a peaked cap for the activity.

**Planning:** The survey requires a dry day and will yield highest bee numbers if carried out on a sunny day in spring or summer.

Pick an area in advance that has plenty of flowering species – depending on the season and the area, the flowers of flowering currant, lavender, cotoneaster, clovers, buddleia, common knapweed or ivy are all popular with bees. You might want to choose two different areas, one sunny, one shady, or with different types of vegetation. If you use the school grounds, you could obtain and enlarge the site plan to show students where they will be working, and add survey results afterwards to make a record that can be reused for comparison in future years. If the survey is repeated annually, make sure you choose a similar date each year.



Assign a separate area of 0.5 × 0.5 m to each student or pair of students. This is an opportunity to explain why and how random sampling is used in science.

**After the survey**, compare the results in the class. Then combine the individual tallies into a set of class results.

Depending on the findings, the class might decide to plant more bee-friendly plants or to provide bee hotels to help them survive the winter months.

## Additional activities

- Set a homework task in which students carry out the same survey at home (in a park, a garden or scrubland) and compare the results.
- Carry out the survey again in another season to compare the species and numbers of bees seen at different times of the year.
- Scale up a school site plan and add survey results and photos to start a longitudinal study that can be continued by later classes in future years.
- Play the Food web game (provided on The Crunch website, [thecrunch.wellcome.ac.uk/schools](http://thecrunch.wellcome.ac.uk/schools)).
- Investigate The mysterious case of the disappearing honeybee (provided on The Crunch website).
- Make a pollinator-friendly garden or bug hotel.



A set of topical play scripts and supporting resources from the Theatre of Debate is available on The Crunch website:

*The Fat of the Land* – Adam Hughes

*The Super Safe Environment Compound* – Elinor Roos

*Fields and Fields and Fields* – Jonathan Hall

*The Chicken Temptation* – Judith Johnson

*Feed Me* – Rhiannon Tise.

*The Super Safe Environment Compound* and *Feed Me* are especially relevant for this topic.



## Answers to questions in student activity sheet

1. Students should be able to suggest areas with a lot of flowering plants – remind them that weeds are flowers too, and often attract more bees than some garden flowers bred for visual appeal to humans. If recent building has occurred nearby students may realise that flower (and bee) habitats have been lost.
2. Any sensible suggested reasons for differences between sun and shade, for example, or between different types of flowers (e.g. bees are warmer and more active in sunshine, flowers give off more scent in sunshine, bees can see some flowers better than others, bees prefer flowers with a lot of nectar, ...).
3. Any sensible suggested reasons for randomisation: for example, if the results were used to estimate total bee population, then picking only the sunniest spots (with the most bees) will yield results that are higher than the true value when multiplied up for the entire area. Reasons in favour of picking a 'good' spot: for example, if you want to know how many bee species frequent this area, you will be more likely to see most or all of them in a busy area.



## Research background

Klein AM *et al. Proceedings of the Royal Society B: Biological Sciences* (2007) 274:303–13

Neonicotinoid insecticides. Godfray HCJ *et al. Proceedings of the Royal Society B: Biological Sciences* (2014) 281:0558

[rspb.royalsocietypublishing.org/content/281/1786/20140558](http://rspb.royalsocietypublishing.org/content/281/1786/20140558)

Bees and climate change

Cressey D *Nature News* (9 July 2015)

[www.nature.com/news/climate-change-crushes-bee-populations-1.17950](http://www.nature.com/news/climate-change-crushes-bee-populations-1.17950)

Wellcome Trust Insect Pollinators Initiative

[www.wellcome.ac.uk/news/2010/news/wtx059955.htm](http://www.wellcome.ac.uk/news/2010/news/wtx059955.htm)

[blog.wellcome.ac.uk/2011/03/28/protecting-the-pollinators-part-1/](http://blog.wellcome.ac.uk/2011/03/28/protecting-the-pollinators-part-1/)

Great British Bee Count (Friends of the Earth)

[www.foe.co.uk/page/great-british-bee-count-2015-results](http://www.foe.co.uk/page/great-british-bee-count-2015-results)

