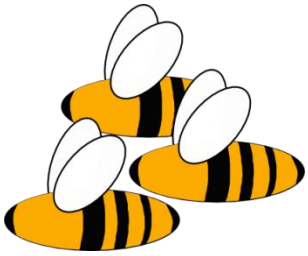
Be a Bee



Help! We need to collect enough nectar and pollen for our hive to last through the winter!

I'm hungry! Can you help me find some flowers and collect nectar to eat? I also need to find somewhere safe to nest and I'll need pollen to feed my baby bumblebees.

An activity for learning about bees, pollination and food security.

England & Wales version.

From the Biodiversity and Ecosystem Service Sustainability (BESS) research programme.

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biodiversity & ecosystem service sustainability

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Lydia Bach & Siân de Bell being bees

1. INTRODUCTION

Be a bee participants forage amongst different species of ‘flowers’ collecting ‘nectar’ with their ‘honeybee’ or ‘bumblebee’ before returning to fill the ‘hive’ or ‘nest’. Participants discover that they transfer ‘pollen’ between flowers, with fruit produced if the pollen matches.

The basic activity has been designed with 7-11 year old participants in mind to carry out in approximately ten minutes at an event such as a science festival. The activity can also be used in a classroom setting to support learning on identifying organisms, reproduction, food security and evolution. There are plenty of extension ideas on page 16.

Honeybee participants help to fill the hive with nectar before winter arrives. Bumblebee participants could be asked to deliberately collect pollen as well as nectar to make bee bread and feed their ‘baby bumblebees’. Both the honeybee and bumblebee version of the activity can also be run with teams competing to fill cells in the hive or to produce the most baby bumblebees. Each new bumblebee that grows up might release another participant from the team’s nest to forage.

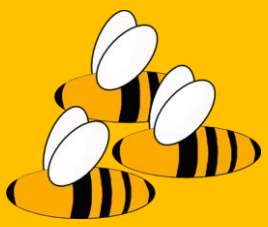
BESS & NRG BESS researchers can request some of the materials for loan from the Directorate. The BESS Directorate would appreciate being informed each time this activity is run in any context until April 2017. Please email laura.harrison@york.ac.uk

10+ mins

5-7 years

7-11 years

11-14 years



This symbol indicates honeybee only content.

This symbol indicates bumblebee only content.

2. LEARNING OUTCOMES & CURRICULUM LINKS

Key learning outcomes from the activity:

- Honeybees and bumblebees visit flowers and drink nectar to give themselves energy. They also carry the nectar in their stomach back to their hive or nest to feed their young.
- Plants need to get their pollen to another plant of the same species so that they can reproduce, but plants can't walk!
- Some flowering plants have evolved to attract bees with nectar and extra pollen for the bees to eat. The flowers advertise this with bright petals.
- When bees visit a flower some of the pollen gets stuck in their hair. When they visit more flowers some of this pollen can get rubbed off. If the pollen is from the same species of flower and it lands on the stigma then pollination can result and the plant will produce seeds.
- Honeybees make honey from the nectar and store lots of it in the hive to help their colony last through the winter.
- Bumblebees only make small amounts of a substance a bit like honey, which they eat themselves and don't store for a long time.
- A lot of what we eat depends on or is helped by bee pollination.

Additional learning outcomes through discussion:

- Honeybees are mainly looked after by beekeepers. Bumblebees are wild.
- Flowering plants have evolved to attract bees. Those flowers that were more successful at attracting bees because they had bright petal advertising and produced nectar were pollinated more often, so produced more seeds.
- Many bees groom pollen that has got stuck on their hair into special baskets on their legs so that they can carry lots back to the nest.
- Honeybees and bumblebees also take pollen from flowers back to their hive or nest and use it with nectar to make bee bread to feed to their young.
- There is only one species of honeybee in Europe. There are 24 different bumblebee species in the UK, but only eight are commonly found.
- Honeybees have short tongues, so they prefer to eat from flower species that have open flowers. Different bumblebee species have different lengths of tongue, so some bumblebee species will prefer flower species that are open while other bumblebees can specialise on flower species that have more tight closed flowers that are harder to get into.
- Bumblebees are declining because of a lack of the right type of flowers and places to nest. Honeybees are declining mainly because of diseases.
- Both bumblebees and honey bees are also exposed to pesticides used to protect crops from pest insects. Pesticides are very toxic to bees, and even at very low levels they affect bees' ability to collect and bring home food. Scientists disagree about how much pesticides are harming bee populations, compared to the harm caused by diseases and loss of flowers.

Tips for different age groups to link with the England and Wales National Curriculum.

Scotland & Northern Ireland versions also available.

This section is for researchers who are interested in what children are likely to be learning at state-maintained schools or who will be working with a particular age group. Within a group of the same age you are likely to encounter a wide range of abilities and needs. Teachers will vary their teaching styles and materials to enable all students to understand the main content.

5 – 7 year olds learn to describe what animals, including humans, need to survive and how animals and plants depend on each other. Ask them why the bees are visiting the flowers. Ask what they think would happen to us if there were no bees. You could also ask what they had for lunch or dinner yesterday and see if anything would be gone without bees. Use photos and videos to bring the game to life and explore habitats by asking where they have seen bees and if they have grown any food at home or in school. You might include an activity to help them to identify and distinguish honeybees from bumblebees.

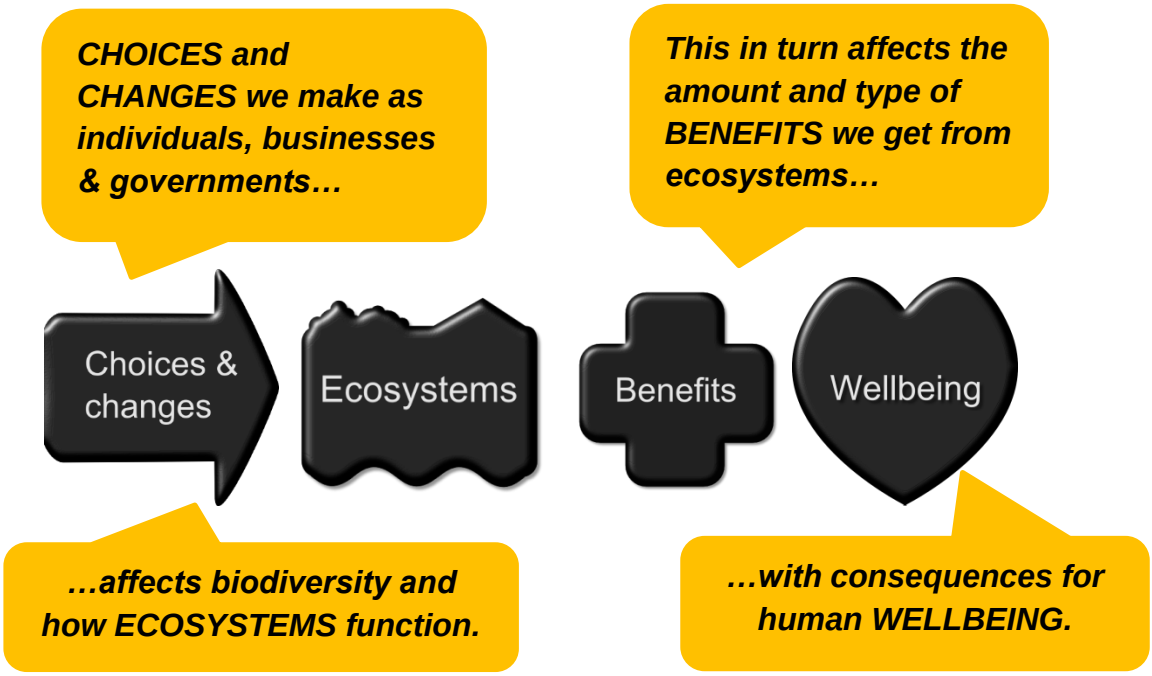
7 – 11 year olds learn to describe the basic process of reproduction in plants and the differences in life cycles between a mammal, an amphibian, an insect and a bird. They also learn to recognise that environments change and that this can cause dangers to living things. National Curriculum guidance states they should explore examples of positive and negative human impact on the environment. You could discuss different pressures on bee populations and ask participants to predict what will happen to us if bees became extinct. This age group also learns to identify and name animals and plants, so you could use simple keys for bumblebee and plant species. You could also explore where the fruit you are using is grown and the time of year that it is in season.

11 – 14 year olds need to know about the 'importance of plant reproduction through insect pollination in human food security' and 'the importance of biodiversity'. This activity is likely to be rejected as too 'childish' by some in this age group, so be ready with questions about their own experience, discussion points, ethical debate or alternative materials. At this level state-maintained English and Welsh schools must also cover:

- the interdependence of organisms in an ecosystem, including food webs and insect pollinated crops as examples
- how organisms affect, and are affected by, their environment, including the accumulation of toxic materials

- the role of variation in enabling living things to survive in the same ecosystem.
- that changes in the environment may leave individuals within a species, and some entire species, less well adapted to compete successfully and reproduce, which in turn may lead to extinction
- how human and physical processes interact to influence, and change landscapes, environments and the climate; and how human activity relies on effective functioning of natural systems

A way of talking about ecosystem services for 11 years +



3. MATERIALS & PREPARATION

Materials for your activity area:

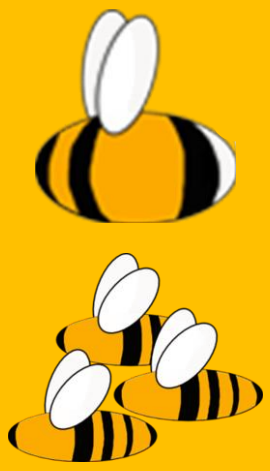
- **Table** at least 1 m x 0.5 m or you could use the floor.
- Level **space** of at least 4 x 4 m in which to place flowers, or place them on other stands and locations around the venue.
- **Water** (quantity depends on the number of flowers & participants).
- **Plastic squeezy bottle** with wash nozzle to refill your flowers *(~£5),* or a 10 ml plastic oral syringe.
- Empty plastic **container** to quickly dispose of used glittered water from your hive/nest between games.
- **Paper towels** for any spills.
- Hand wipes.
- A small whiteboard and pens or noticeboard to record fruit produced, % of the hive filled, number of baby bumblebee's produced and/or time before winter (optional). *(~£10 - £25)*
- Yellow food colouring in the water (optional). This can help participants to see if the flower contains nectar *(~£1).*
- Waterproof bee design plastic table cover (optional). e.g. 'Baby Shower Busy Bee's Tablecover' from Amazon *(£2.49) * Available for loan to BESS researchers.*
- Bee wings and deeley boppers for you and your helpers (optional)! Check that the headband is suitable for adults! *(£4 - £10) *Available for loan to BESS researchers.*
- Real flowering plants in pots that correspond with the species your flowers represent and/or to demonstrate anthers and stigmas (optional, risk assess use and do not use lillies!).
- Colour prints of your plant species, honeybees, bumblebees, hives and bumblebee nests (optional).
- Fruit that are produced by your pollinated flowers for display, prizes or treats OR bee & fruit stickers (optional – assess risk).

Be prepared for glitter and water to get everywhere!

Overlaps tend to result in the fabric unwinding!

If your loop fabric has a non-furry margin (Korbond brand), this can imitate the division between thorax and abdomen.

Expect to carry out bee & flower repairs and to need spares during the activity!



Making bees can be tricky, so have some pre-made in case of frustration!

Making the bees ** available for loan to BESS researchers*

- 2.5 or 5 ml **plastic oral syringes**, available from pharmacies or online *(~£2 for 10).*
- **Self-adhesive black hook and loop tape** (Velcro®) in 2 cm width e.g. 'Korbond stick on Hook and Loop' in the craft section of WHSmith or '3M Scotch Fasteners' in the fastening section of WHSmith ~£2 per 50cm length.
- Self-adhesive white hook and loop tape (optional for bumblebees)
- **Self-adhesive felt** in yellow, gold, brown and/or white. e.g 'Craft Factory sticky-back A4 felt' *(~£1 per sheet).* The yellow hook and loop tape marketed as cable ties is too stiff and the sellotape brand is hook only.
- Fine, small yellow and/or black elastic bands (optional).

1. Measure the circumference of your plastic oral syringes using string or by wrapping the loop fabric around the syringe and marking it.

2. Cut a strip of black loop fabric to this length, cut to a shorter width if desired and stick around the syringe end. The loop fabric is better at picking up the pollen glitter and more likely to stay in place than the felt.

3. Continue to add strips of different widths of black loop and yellow/brown/gold/white fabric to form stripes until you reach the plunger end of the syringe. You could approximate the stripe patterns and colour of European honeybees and bumblebee species groups.

4. Storing each of your bees wrapped in yellow and black fine elastic bands will help the fabric to stick.

If time, each participant could also make their own bee. Consider pre-cutting widths of fabric and providing stripe patterns for different species groups.

Making the flowers ** available for loan to BESS researchers*

- **Thin coloured A4 card** for the petals in different colours according to the number of species of plants you want to use (see below), or flexible thin coloured plastic sheets.
- Self-adhesive covering film (optional). *(~£4.50 for 5 m)*
- **Self-adhesive felt** in yellow, gold, brown and/or white e.g 'Craft Factory sticky-back A4 felt' *(~£1 per sheet).* The yellow hook and loop tape marketed as cable ties is too stiff and the sellotape brand is hook only.
- **FINE glitter** with colours according to the number of species of flowers. e.g 'Glitz fine finish traditional colours glitter tubes 3 g (Pack of 6)' from WHSmith, use red for pink flowers *(£3.99).*
- **Plastic centrifuge tubes** OR any containers with an internal diameter that is between 5 to 15 mm wider than the diameter of your oral syringe plus **two** layers of the loop side of the velcro®.

- **Small pebbles** or other non-absorbant material to weigh and fill most of the volume of the tubes.
- **Plastic beakers** in which to sit the centrifuge tubes OR blu-tac® the tubes.
- Sand or pebbles to weight the beakers (optional).
- Green tissue paper or paint to cover the plastic beakers (optional).

1) Use tubes/containers with a diameter such that your bees can still fit inside when a layer of felt (or loop fabric) is stuck to the inside, but that bees are likely to touch the felt/fabric and transfer glitter.

2) Decide how many species of plants to use and which colours:

White – almond, apple, blackberry, cherry, coffee (bee pollination helps), kiwi fruit, mango or plum.

Pink – apple, cashew, mango or peach/nectarine (bee pollination helps).

Yellow - *Cucurbita* species (squash, courgettes, pumpkins etc), *Brassica rapa* (turnip/canola) or tomato (bee pollination helps).

Blue/purple – Borage (oil from seed in herbal supplements) or lavender.

Green – wind-pollinated e.g. maize or self-pollinated e.g. wheat. Do not include 'nectar' and you may not want to include glitter.

For younger children or little time per participant keep things simple with 1- 3 crop plants that are familiar. For older children or with more time you could include less familiar crops, garden plants and wind or self pollinated species.

Using spare flowers or changing the felt/fabric on the flowers at the stand is helpful to avoid confusion with the glitter.

Some of the glitter is bound to fall into the nectar. You could discuss the protein that bees get from pollen.

3) Decide how many flowers you need and whether they will be in a particular area or scattered around the venue. You will need at least one flower of each species near the hive/nest in addition to those in the foraging area.

4) Measure the inside circumference of your centrifuge tubes. Cut a strip of the self-adhesive felt or loop fabric to this length and stick this to the **inside** of each centrifuge tube just below the rim.

5) Cover both sides of your coloured card with film or laminate.

6) Measure the **outside** circumference of your centrifuge tubes/containers. Draw a flower shape onto the coloured card so that the base of the shape will fit snugly over the top of your tubes. Repeat on different coloured card until you have the desired number of flowers of different species.

8) Add marbles, pebbles (assess risk if under 5s are attending) or other material to fill up part of the tube. This helps to weight the tubes and prevent too much nectar being extracted at once. Fill to a level so that the first part of the bee is likely to touch the glitter smeared fabric

9) If using plastic beakers to hold your tubes, cover them in green tissue paper and weight with pebbles or sand.

10) Add water or coloured water to each of the flowers (except any green flowers) so that there is just a few ml above the level of the pebbles, but so participants must put the first fabric part of their bee into the tube.

11) Once your flowers are in position and filled with 'nectar' smear glitter of the appropriate colour onto the felt around the inside of the flower.

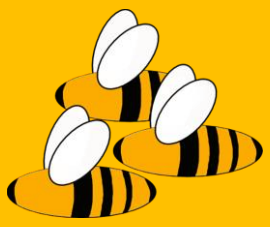
Paul Richards

Making the hive ** available for loan to BESS researchers*

- **Plastic tubes** for the cells**.** e.g. microcentrifuge tubes
- A **cardboard box** appropriate for the height of your cells and expected number of participants e.g Hobbycraft paper mache hexagon box (£2.79) for a science festival with a few participants at a time.
- **Yellow card**.
- Adhesive tac (e.g. **blutac**®)
- Small **elastic bands**.
- New small-celled **bubblewrap** (£3.99 for 3 m WHSmith)
- Brown, orange and/or yellow acrylic **paint** (optional).
- **Self-adhesive covering film** (~£4.50 for 5 m WHSmith)
- Sticky-back plastic (e.g **sellotape**®) and/or glue.

1. Paint your box yellow and then use bubblewrap to print a honeycomb pattern in orange or brown.
2. Semi-waterproof your box by covering with self-adhesive film.
3. Bundle groups of your 'cells' together with elastic bands and blu-tac to the base of the box.

4. Stick bubble wrap onto yellow card and cut to fit snugly within the box over the top of the cells. Cut out sections in the cardboard so that the tops of the cells poke through.



If using both honeybees and bumblebees in your activity, make sure that there are far more cells in the honeybee hive than in the bumblebee nest, because bumblebees do not store for more than a few days at a time.

Making the bumblebee nest

Some evidence suggests most commercially available bumblebee nests are rarely colonised by bumblebees. See: http://planetearth.nerc.ac.uk/news/story.aspx?id=975

Using pre-made boxes might encourage the idea that these are the 'answer' for bumblebee conservation, rather than improvements to habitat.

Filling up brood cells could result in baby bumblebees (yellow pom-poms) or more adult bumblebees for team members to use in foraging.

- A **plastic dish** e.g Petri dish or larger. Participants can shake their collected pollen into this and mix in some nectar to make bee bread. You might want to stick some loop side of the hook and loop tape to the dish to help the glitter rub off.
- 10 or fewer plastic **tubes** or other small containers (optional).
- A cardboard box (optional).
- Earth, dried grass, leaves and/or woodchips (optional).
- Yellow pom-poms (possibly with painted black stripes) for 'baby bumblebees' e.g. 'Hobbycraft pack of 100 12 mm yellow pom poms' (£1.80) OR bumblebee stickers (optional).
- **Prints and/or video of some wild bumblebee nests.**

You could mimic an underground or ground level nest by placing dried grass, earth or woodchips around a plastic dish where participants deposit nectar and pollen to make 'bee bread'. You could also add tubes to be the brood cells. Remember that you may need to empty or replace the dish and brood cells regularly. The nest could be contained within a cardboard box if you need to reduce mess and easily move it.

Participant activity: Show participants a film and photos of a bumblebee nest. Participants could be encouraged to search for an appropriate place for a bumblebee nest within the activity area and then to build their nest using materials they find or are provided with.

Setting up the activity

The hive/nest area(s)

- At least one helper (the queen bee?!) needs to be in this area with one or more hive(s) and/or nest(s), at least one flower of each species and the bees.
- You will need to either have some spare flowers or be able to easily change the felt on the inside of the flowers next to your hive/nest.
- Have squeezy bottles of water, small containers of glitter, spare bees and spare flowers ready.
- Display any handouts and your computer/tablet for films far enough away from your hive and flowers to avoid spills!
- If you are having teams and relays you could to tape a line to the floor next to the nest/hive. Participants must stay behind the line until they are released to go foraging.

Paul Richards

The foraging area

If you are running this activity at an event with various activities you could ask to leave your flowers on other stands and other spaces around the venue. It will also encourage participants to visit other activities. Make sure that the flowers are secured and that the stand holders know that they contain water! Otherwise you will need a separate foraging area for your flowers. You will need to check the flowers and fill up the nectar regularly during the event.

Accessibility

Consider accessibility needs and adaptations:

- Are you able to place your flowers and hives at different levels and bring them to participants?
- Could your foraging area be easily negotiated by someone using a wheelchair or quickly adapted?
- Have you thought about how you might describe the activity to someone with a visual impairment?
- Could participants who have difficulty manipulating the bees be assigned an adult 'worker bee' helper for the participant to direct during foraging?

Some wind pollinated plants without nectar are visited by bees to collect pollen, so you will need to decide whether adding green glitter to your green flowers will be confusing or not.

It is best not to add glitter to the flowers on your stand unless you intend to explain pollination at the start of the activity.

Risk assessment tips

These are a few points to consider when completing your risk assessment.

- How will you mitigate trip and slip hazards? How will you prevent spills and mop them up quickly if they do occur? How can you encourage participants not to run?
- Could you and your helpers be injured by lifting, particularly if using a lot of water and moving tables? How will you prevent this?
- Could any of your equipment fall?
- Are parts of your real plants poisonous or spiky and at eye height?!
- How will you or other responsible adults be supervising children using the bees during foraging? Can you clearly define the limits of the foraging area? Will you be able to prevent water spilling throughout the venue or others being poked by bees?! Will you be able to prevent children shooting water at each other?! What other hazards are in the foraging area?
- Are there hazards from water and electrical equipment in the same area?
- How will you keep fire exits clear and prevent 'bottlenecks' of people within the venue or within your activity area?
- Do you have enough space for waggle dances?!
- Will you be handing out food in an environment where there may be chemicals or soil (consider other activities)? Will participants be supervised sufficiently so that they do not eat it until later and after handwashing?!
- Is any of your food a common allergen?
- Do you have any small parts (e.g. pebbles, marbles) or food that could be a choking hazard if young children are likely to attend?
- Will any adult helping with your activity be left alone with a child or vulnerable adult without a supervising parent or teacher? If yes DBS screening will be needed for this adult. Who will be taking children to the toilet and generally supervising them?

Photography and consent

Please check and follow your institution's or event's policy regarding photography and filming of children, young people and vulnerable adults. Also check your institution's guidelines on the Data Protection Act. The directorate has some good practice guidance for BESS researchers about photography of children. The BESS Directorate follows University of York advice, so will not publish photographs of children on the web without written consent from a parent or guardian and will not share photographs of children between institutions.

4. RUNNING THE ACTIVITY

These suggestions are for a stand at a science festival:

1) Ask people approaching your stand if they would like to 'be a bee'. Give them a honeybee or bumblebee and explain the task, describing (or for honeybees, dancing) where they can find the flowers if it is not obvious.

2) Suggest participants practice collecting a small amount of nectar from a flower on your stand first (ideally this flower should not have any pollen glitter on it). Ask them to return to the hive/nest when their bee is about three quarters full (probably only after 1 - 3 flowers). Demonstrate where the plunger will be when their bee is nearly full.

3) When participants return to the hive/nest say that you think their bee could visit one last flower. Ask them to try to collect nectar from a flower on your stand and then encourage them to look to see if they have transferred any pollen. If it is the correct colour pollen for the flower then a fruit is produced (actual, sticker or on scoreboard). You can also ask if they noticed any glitter pollen rubbing off as they visited flowers.

If you are playing a competitive team game your participants will want to visit their hive/nest as quickly as possible and go out again to visit more flowers. Emphasise to children that they can't run – their bees need to be looking for flowers and not wasting energy! You could gather the group at the end of the game to ask if they noticed the glitter and to talk about pollination. You could also make pollen collection part of the game and discuss pollination at the start.

4) Ask participants to squirt their nectar into the cells of the hive or nest. If they were a honeybee explain that they have helped increase the chance that the colony survives the winter and you could add to a running score. You might also hand out something honey related or add to a beekeeper's score. If they were a bumblebee you can explain that they have helped a new bumblebee grow up. You could show or hand out a baby bumblebee, add to a bumblebee score or show that a new adult bumblebee has been produced for the next participant.

5) Follow up with discussion and information hand-outs.

6) Top-up the flowers, empty the hive and replace or clean over-glittered flowers and bees!

Discussing pollination at the end of the activity helps avoids the misconception that the bees are 'trying' to pollinate the flowers.

Younger children can find it difficult to extract nectar from the flowers unless the tube is fastened down or a helper holds the flower.

Depending on interest levels and age you could talk more about pollination (e.g. how do you think plants have sex?), parts of plants and how bees use pollen as well as nectar.

Extension ideas

Give some of the participants **solitary bees** that do not go back to a nest. Discuss other pollinating insects with the group and look at some photos. You could also ask participants to research other pollinators, such as fig wasps, bats and Cacao pollinating midges.

Show participants film of **waggle dances**. On returning to the hive each participant can perform a dance or point to show their team mates where the best patch of flowers is. This could be a relay.

Some bumblebees could be made into **long tongued species** by adding plastic tubing to the syringe ends. Modify some of the flower species so that only long tongued bumblebees can reach the nectar. This idea works well where many participants are foraging at once, so that nectar is frequently running out. It would provide a good starting point to discuss natural selection. With some modification to the flower materials, participants could be encouraged to discover that it is quicker and easier to **rob flowers** by making holes in the side of the flowers or using holes already there.

Introduce **bee bread** by encouraging participants to mix their nectar and glitter in a dish at the hive or nest. Show photos and film of grooming into pollen baskets.

Include a **wind-pollinated or self-pollinated** flower species with small green petals and no nectar. Look at some grass flowers under the microscope. This could also lead into activities about how non-flowering plants reproduce.

Some participants could be **farmers or gardeners** who take actions to try to get as much fruit as possible. They could spend money/time providing nesting sites or flowers on the edges of their field to support bees when their crop is not in flower. There could also be **spider predator participants or models** on the flowers who need to be avoided! With a large group of participants this could be developed into a more complex game where groups or individuals are given a mission to complete.

The activity period could be one season with the **flower species and quantities changing over time**. The **weather** could also change, perhaps with more participants needing to stay in on cold days and buzz to keep the colony warm on.

5. FURTHER RESOURCES

British Bumblebee identification: http://www.nhm.ac.uk/nature-online/life/insects-spiders/identification-guides-and-keys/bumblebees/index.html

How bee kind is your garden? http://beekind.bumblebeeconservation.org/finder

Bumblebee facts and children's activities at http://bumblebeeconservation.org/

Solitary bees film: https://vimeo.com/129712987

Photographs and film at http://www.arkive.org/ e.g.

http://www.arkive.org/small-garden-bumblebee/bombus-hortorum/image-A23395.html
http://www.arkive.org/large-garden-bumblebee/bombus-ruderatus/image-A3107.html
http://www.arkive.org/buff-tailed-bumblebee/bombus-terrestris/video-00.html

Paul Richard's invertebrate photos: https://www.flickr.com/photos/invertimages/

Well done! Please let the BESS Directorate know how your activity went and any comments you might have for improving the activity or instructions:
laura.harrison@york.ac.uk

Acknowledgements

This activity was designed, developed and/or piloted by BESS researchers & NRG BESS early career researchers: Lydia Bach (Queen's University Belfast), Siân de Bell (University of York), Debbie Coldwell (Sheffield University), Dr Lynn Dicks (Cambridge University), Dr Laura Harrison (University of York), Zoe Holden (Cranfield University), Phoebe Morton (University of York) Dr Bryony Norton (Sheffield University), Kate Orgil (Sheffield University), Paul Richards (Sheffield University), Jennifer Wickens (University of Reading) & Victoria Wickens (University of Reading).

Paul Richards

BESS researcher profiles

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Profile – Dr Briony Norton

Briony is a post-doctoral researcher at the University of Sheffield. She works on the F3UES BESS project.

Looking for invertebrates in winter, using a 'pooter' and a sieve.

I am an urban ecologist. Ecologists study plants, animals and how they interact with their environment. I do this in 'urban' areas, so in cities and towns, which is where most of us live. I am particularly interested in invertebrates in cities and towns. Most invertebrates are insects, for example bees, flies and beetles. Some other small creatures such as millipedes and spiders are also invertebrates. There are more invertebrates in the world than any other kind of animal, so we're interested in how well they are surviving in cities, why some things are coping well and others aren't, and also what they're doing in the city that we really need. For example, bees and butterflies are pollinators, which means they help plants reproduce and survive into the future. People need plants for food in particular but for lots of other reasons as well, so that means we really need the help of bees, butterflies and other pollinators.

One of the reasons I like my job is that I get to do lots of different things. In summer, we spend lots of time outdoors, looking at bugs, collecting insects, identifying and measuring plants and taking lots of other measurements, for example about temperature and air quality. Then we spend time in the lab, identifying things we've collected using a microscope. Finally, I spend lots of time at the computer entering data, doing analysis, writing about what we've done, and then planning our next trip out into the field. I get to work with lots of really interesting people and I get to wear jeans to work!

One of my favourite things in the world is a good story, especially one with a mystery in it. I studied lots of different things at school and university, but the stories I liked the best were the ones I learnt in my ecology classes. The best thing is that every story in science is a mystery – even the things we think we know the most about turn out to have hidden surprises for us. As a scientist, you get to help unravel some of those mysteries.

I was particularly interested in studying ecology because I found plants and animals really interesting. When I was at school I mostly learnt about plants and animals on TV or in books, but you can get outside and start making your own observations as soon as you want.

Measuring wind speed and air temperature.

Profile - Jennifer Beth Wickens

Jennifer is an NRG BESS member and a PhD student from the Centre for Agri-Environmental Research (CAER) at the University of Reading.

Pollinators, such as bees and hoverflies, are amazing! They pollinate many of our fruits, vegetables and wildflowers and are incredibly diverse. It concerned me that widespread reports suggested many pollinators were in decline from threats such as habitat loss and degradation.

As part of an international project STEP (Status and Trends of European Pollinators, http://step-project.net/) I am exploring broad strategies to support bees and hoverflies in agriculture through the use of flowers. I have been surveying pollinators using hand nets along transects in calcareous grasslands, our richest biodiversity hotspots in the UK, and sampling pollinators in farmland. I installed several experimental wildflower strips into farmer field margins. The aim was to explore if the addition of the flower strip could compensate landscapes low in floral resources. It was predicted the flower strips would support the common pollinators and some rarer species too. Driving around the countryside, I have been mapping the landscapes and then digitalising this to better understand from an insect point of view what flowers are available as the season progresses. This information aims to help farmers in supporting their pollinators and better target mitigation strategies.

At school I took Biology, Chemistry, Maths and Geography. Having not decided which part of nature to focus on, these subjects allowed a variety of options to remain open from microbiology and organisms to whole ecosystems. I find it exciting to test hypotheses and then write about it to share with others what had been discovered. In my spare time I love to go walking in the countryside and thoroughly enjoy wildlife photography.

Photographs by Jennifer Wickens: Buff-tailed bumblebee (Bombus terrestris) (left) and sown experimental flower strip (right).

Profile – Dr Lynn Dicks

Lynn holds a BESS fellowship at Cambridge University.

My name is Lynn Dicks. I work on conservation of insects that pollinate flowers. Wild bees are the best pollinators, although flowers can also be pollinated by flies, wasps, beetles, butterflies and moths. I try to work out exactly what wild bees need in farmland, and use this information to help farmers, businesses and the Government take action to help pollinators. For instance, how many flowers does a queen bumblebee need throughout the summer to feed her colony? The answer is up to 200,000 flowers!

I hope my work means that wild bees will stop declining, and that crops that need to be pollinated – like strawberries, raspberries and beans - will always produce good fruit.

Biology was my favourite subject at school. I love asking questions, and developing theories to try and understand how the world works. In my kind of biology (which is called ecology), the questions are all about the natural world. For me, the big questions at the moment are: “Why have bees declined?” and “How can we stop them declining?” But there are some bigger, even more fascinating questions, like “Why are there so many species on Earth?”

Conservation science also involves philosophy and ethics. We have to ask: “Why should we care about all these species?” And “Whose job is it to look after them?” This makes it really challenging, but it means that my job involves a lot of writing, speaking, persuading and advocating.

In my spare time, I monitor bumblebees in my local wood for the Bumblebee Conservation Trust (doing my bit for a national monitoring scheme). I also teach people about bumblebees, and play piano in a jazz orchestra.

Profile - Paul Richards

Paul is a Research Technician in the Animal & Plant Sciences Department of the University of Sheffield. He works on the F3UES BESS project.

I am helping to collect and identify the invertebrate animals that are using different green spaces in towns. The urban aspect of the BESS project (F3UES : http://bess-urban.group.shef.ac.uk/) is considering how the variety of plants and wildlife in urban areas effects people and their environment. We have used nets and big vacuum cleaners to extract the tiny animals that live, unseen, around us. We have taken hundreds of samples from around Bedford, Milton Keynes and Luton. We have also planted some meadows of our own with different types of grasses and flowers and these have been mown to give different heights of plants. I have been counting the bees and other insects that use the meadows to see how these pollinators use them.

I'm particularly excited by the BESS project because it gives me a chance to show how important the little animals are to people. Even though they may never have even seen them.

I have been interested in insects since I was at primary school where I started off by rearing caterpillars. Since then I have photographed and tried to identify any small creatures that I've seen. I wanted to take my love for wildlife further, so studied Biology, Chemistry and Art & Crafts at A' level before obtaining a degree in Zoology. At that time I also started volunteering in museums, working on insect collections and developing my identification skills. I undertook many technical tasks including taxidermy and model making, for which my A' level art proved helpful. Having found work in that field, I remained as a Curator of natural history, for over 25 years. I now split my time between research and field ecology where I survey for protected species such as bats, reptiles and newts. My passion for unseen invertebrates is now expressed through identifying, mapping and publishing and I have the privilege of passing on my knowledge by teaching courses to anyone who will listen!
https://www.flickr.com/photos/invertimages/

Profile - Dr Rosalind Shaw

Ros is a post-doctoral researcher at the University of Exeter. She is working on the Wessex BESS research project.

I have always been fascinated by the natural world and like nothing better than being in the great outdoors. Studying Biology and Geography really helped develop this. I am interested in how different parts of the world are all linked together, so I have worked on lots of projects that connect how people manage or change their environment and the natural world. These projects have all been based around plants and the animals that eat or use them! I have worked on rare mountain willows that are eaten by sheep and deer and how that affected both the willows themselves but also the insects that eat and pollinate them.

At the moment I am working on farmland looking at whether having high biodiversity chalk grasslands in the landscape changes the amount of insects that help farmers. I am looking at both pollinators who can increase crop yield of insect pollinated crops such as strawberries and oilseed rape, and natural enemies of insect crop pests. There are lots of insects that eat other insects that can damage crops! By learning about how biodiversity in the grasslands changes the number of beneficial insects in crops hopefully we can support both farmers and plants and insects.

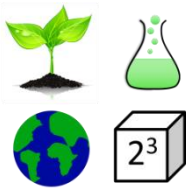
The practicalities of my job mean that I get to spend a lot of time out counting plants and insects in the summer followed by a lot of time in the lab spent identifying insects in the winter, combined with analysing data and designing experiments.

Photographs by Rosalind Shaw.

Profile – Victoria Jean Wickens

Victoria is an NRG BESS member and a PhD student from the Centre for Agri-Environmental Research (CAER) at the University of Reading

It's a bug eat bug world out there. I'm working to promote the beneficial insects which protect the food we love to eat. One way I am doing this is by increasing the number of flowers in the countryside to support predatory beetles early in the spring. *Did you know:* One out of every four animals on Earth is a beetle?



During my A-levels, I went for a broad choice by studying Biology, Chemistry, Geography and Maths. My teachers encouraged me to do what I love most, and for me that was biology! But maths gave me a head start at University, it really is a skill for life and I would take it again.

At University, I joined the Bio Society and went on all the field trips to join in the practical opportunities with experts leading the way. I saw the very big (like elephants) and the very small (like ants), but it was when I discovered the colourful range of beetles and other curious predators when I really found my zone.

Where am I now? I am at a leading University for agricultural research and exploring new ways to boost natural enemies which eat pests in crop fields. I am investigating if flower rich margins designed for bumblebees can also attract and increase numbers of predators (but not pests!) in order to reduce the use of chemical control methods. Without this important research, we may have to pay more for lower food variety and quality in the future.

A research life also has many other benefits. For example, enjoying a wild meadow as my office in the summer, touring the UK to talk about my research and going abroad to learn about cutting edge science. Honestly, there is no other place I would rather be!

From left to right: Greenfly pests on wheat, ladybird hunting greenflies on wheat, me hunting aphids and ladybirds in wheat, local wild clustered bellflower and sown common knapweed nearby wheat. Photographs by Victoria Wickens.

Profile - Zoe Holden

Zoe is a BESS funded PhD student at Cranfield University.

My main interest in science is in the environment. Most of my work is based around how we use the world around us, and how we use nature to help us in our day to day lives. Bees help us grow food and flowers, trees help us have clean air to breath and soil can help us get clean drinking water. I am interested in how we can protect the environment, so that it can keep benefiting us!

My project is looking at the different ways that people make laws and plans about how we should look after nature in order for it to be able to keep helping us forever. I'm finding this out by talking to the people that look after the environment, and the people that make the laws and rules about the environment. A lot of my work I do from my desk, but as my work is part of a large project I like to get out and help my work friends with their work too. You can read more about what I do in my blog at http://zoeholden.blogspot.co.uk/