

Lessons on Bees and Plant Pollination (Grades 2-6)

Materials

PVC Quadrats
Bee Pictures
Native Habitat Worksheets
Clipboards
Pencils

Objective

To teach students about native pollinators, primarily bees, and their importance. At the end of the lessons students should be able to identify the difference between bees and other types of pollinators, understand how pollination works and learn about important bee habitat.

Introduction

One of the most important animals that we are trying to protect and bring back are native plant pollinating insects like bees. Many bees are dying or leaving because of habitat loss.

Insect Identification

Who knows how to identify an insect?

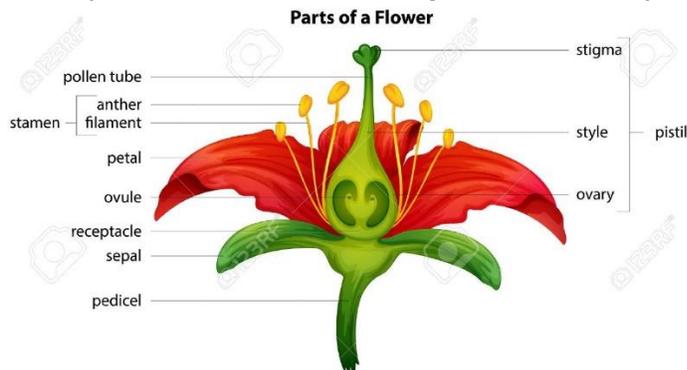
Three Body Parts: Head, Thorax, and Abdomen
6 legs (3 pairs)
Antennae
Wings (usually)

Look at a picture of a bee and ask students “*Is a bee an insect?*” (yes it is)

In order for a plant to grow fruit it needs two things: (1) a flower, and (2) a way to pollinate it.

(The transfer of pollen from one flower to another in order to fertilize the flower to grow into a full seed bearing fruit)

Show picture of flower anatomy and describe parts of the flower.



Pollination

What is pollination? Ask students to define term.

Show picture of pollen grains on a stigma. The purpose of pollination is reproduction – in a plant, that means making seeds to propagate the next generation. Show picture of flower in cross-section.

In general, plants prefer to cross-pollinate – to have their pollen land on the stigma of another flower of the same species. Since plants are rooted in the ground, how do they accomplish this?

The first plants in history were pollinated using the wind. This process is not as effective, as a lot of the pollen is wasted when it doesn't land in the right place. Wind-pollinated plants have to produce massive amounts of pollen.

Later, the flowering plants burst onto the scene and became highly successful. They have evolved a very clever solution – using insects to transfer their pollen! How do plants persuade the insects to help?

By advertising, by communicating with them!

- 1) Colorful petals. Some flowers, eg. lupine actually change the color of their petals after they have been pollinated to tell the bees not to waste their time visiting them.
- 2) Nectar rewards – Nectar is essentially sugar water with some amino acids and vitamins. It is a reward for the bees' services. It is an energy source to fuel the flight of the bees, as well as for nourishing their larvae.
- 3) Nectar guides (show pictures)
- 4) Fragrance
- 5) UV signals (show pictures)
- 6) Electrical signals

Exercise: Have the students pollinate a real flower!

Let the children be bees and to pollinate several lilies that you have placed apart around the classroom. First put on an antenna headband and pretended to be a bee, and demonstrate pollination with a Q-tip. Then ask the students to do this. It's good to have a couple of helpers stationed at the flowers to make sure that the kids know what they're doing as bees.

Lilies are perfect for this activity since their parts are large and easy to see. It is best to purchase these a few days in advance, to allow for the flowers to fully open and the anthers to release pollen. Trader Joe's usually has a ready supply of lilies with anthers intact (many florists actually mutilate the anthers to avoid pollen staining!). Get at least 2-4 stalks (they are sold in bunches anyway) - this way, you can send your little 'bees' buzzing all over. Make sure the lilies are kept in water in a cool place. Also keep them in water while transporting them.

Bee Adaptations

Our most important pollinators are bees. They have special anatomical and behavioral adaptations for the job. Let's talk a little about these adaptations.

Vision

Bees see well in the yellow, blue, violet and ultra-violet (UV) range. They don't see red well. (Show picture of electromagnetic spectrum comparing bee and human visual sensitivities) So, red flowers are generally not attractive to bees, but to birds.

Body hair

(Show picture) Bees are hairy creatures. What's more, their hairs are branched, making it easy for pollen to adhere to them. When a bee flies, some electrons are stripped off their body, making them slightly positively charged. Pollen grains have a slightly negative charge. So when a bee gets close to pollen, the grains are actually attracted to them, and jump onto them!

Pollen-carrying structures

'Pollen baskets' or **corbiculae** (show pictures) Honey bees and bumble bees have these. **Scopae** or special long hairs (show pictures) on underside of the abdomen or on hind legs.

Tongues

Different species of bees have different lengths of tongue to gather nectar from different flowers. Nectar is essentially sugar water with some amino acids and vitamins. It is an energy source for the bees to fuel their flight and to feed to their young. It is a reward for the bees' services.

So you see, bees and flowers have a mutualistic relationship – they help each other out in a mutually beneficial way.

Many gardeners like to have butterflies visit their gardens. We all love butterflies – they are beautiful. But butterflies are only 'accidental' pollinators. They do not gather pollen since their young do not feed on pollen. Occasionally when they sip nectar at a flower, some pollen might accidentally rub off on them and get transferred to the next flower.

Flower Dissection

Cut in half a large flower like a lily to show the different parts of a flower to students, see if they can identify the parts they just learned. Take a Q-tip and act like a bee by getting some pollen on the tip and transferring it to the stigma to show the act of pollination.

Types of Bees and Where They Live

Bees are a very important insect for pollination. While a lot of flying animals such as birds and butterflies are also pollinators, bees actually collect pollen on purpose allowing them to transfer pollen from flower to flower even better than a butterfly who only gets pollen on them on accident.

Here in California we have many different types of native bees.

Most of us are familiar with the honey bees. They are not native to California, but were introduced from Europe. They are still the most common bees that visit our garden and do the bulk of the pollination. They produce the honey that we so enjoy, and that they live as a colony in a hive with what we call 'social insects' with distinct division of labor among the hive members.

Most of our native bees, however, are not social, but solitary. They do not live in a communal hive - each female builds her own nest and provides for her own young.

We do have a group of somewhat social bees - the bumble bees. They do live in a common nest (which is usually an abandoned rodent burrow), but their community is not as well organized and structured as the honey bees.

The majority of our native bees are solitary bees. We will not go into detail about the various species, but will discuss them briefly on their different nesting behavior:

70% of the solitary bees nest in the ground. They dig burrows and line them with different kinds of materials, depending on the species. The female will lay an egg on the pollen and nectar that she has fashioned into a moist lump called a 'bee bread' (this is what the bee larva will feed on when it hatches from the egg). She partitions that cell off and starts another cell. Each burrow can hold several cells.

Some native bees nest in hollow plant stems. The female leaf-cutter bee uses the round pieces of leaves that she's cut to line and partition the cells. The wool carder female lines her brood chambers with soft plant fibers that she has scraped off leaves and stems. The mason bees use mud to partition and plug their nesting chambers.

The large carpenter bees actually excavate their own cavities in wood, and partition the cells with the chewed up bits of wood moistened with their saliva. These plugs actually look like particle boards!

It is very difficult to tell the small bees apart unless you capture them and look at them under a microscope. However, with practice, one can tell the larger bees by their size, appearance, and sometimes behavior. Another useful distinction is how the bee carries its pollen load:

- The honey bees and bumble bees have 'pollen baskets' on their back legs into which they pack the pollen when they forage.

- The female leaf cutter bees are hairy on the underside of their abdomen. The pollen sticks to this patch of hair, sometimes giving the bee a golden underbelly.
- There are some native bees that collect pollen on the brushy stiff hairs on their back legs. These are useful features to help us identify the bees.

Bees and Native Habitat

After the students have an understanding of the different types of bees and what type of habitat each one needs to survive, break the group up into teams of two. Each team will have their own quadrat which will be placed in different areas around a garden to represent different habitat types. Each team will also get a habitat assessment worksheet to fill out at their site to see if it is a good habitat for native bees. Give the students 5 minutes to discuss with their partner and assess the habitat. Next, have each student sit quietly for 5 minutes observing their habitat to see if any pollinators come and visit.

After the 10 minutes is up, allow each group to present to their classmates what they found in their habitat as well as if it could support native bees.