Buzzy Buzzy Bee!

Lesson Adapted from *Food, Land, People*

**Description**
Students learn about pollination through a game where they enact honeybees and apple trees, and they explore flowers.

**Guiding Question**
How do plants reproduce?

**Big Idea**
Plants and bees depend on each other.

**Learning Objectives:**
- The student will learn the process of plant pollination
- Describe the relationship between bees and flowers
- Understand the effects of various conditions on pollination

**Materials**
- Dry beans
- Paper bags or cups (2 different kinds)
- Trays to count beans on
- White board to graph results on
- Headbands or necklaces for each student with pictures of bees and apple trees - and a hat for the apple producer
- Picture of anatomy of a flower *Appendix A*
- Flowers for dissection
- Paper, tape, pencils

**Vocabulary:**
Pollination - The transfer of pollen from the anthers of a flower to the stigma of another flower
Pollinator – an agent that delivers pollen from one flower to another
Flower – The plant part that holds the reproductive organs
Pollen – a powder produced by the flower than contains male gametes
Nectar – a sweet solution secreted by flowers
Bee – insect of superfamily Apoidea, it is a pollinator
Beehive – where bees live
Queen – A fully developed female bee, one per hive
Drone – a male bee that mates with the Queen bee
Worker Bee – All female bees that are not the queen and do all necessary tasks for the hive
Fruit – The plant part that forms from a pollinated flower and holds the seeds

Add flower vocabulary for older students:
Pistil – the middle part of the flower which holds the stigma, style, and ovary (carpel)
Ovary (carpel) – Part of the plant that holds the egg
Style – the stalk that connects the stigma and the ovaries
Stigma – the top flat part of the pistil that pollen sticks to the flower has been pollinated
Stamen- the part of the flower producing pollen
Filament – the slender stalk that supports the anther
Nectary – produces sweet liquid to attract insects
Petal – The part of the flower that is usually colored

Introduction (5-10 mins)

Ask students to tell you what they know about bees and pollination. Why it is important to people?

➔ Bees drink nectar
➔ Pollen sticks to the bees furry bodies
➔ Bees pollinate plants
➔ Without pollination, the plant won’t create a fruit
➔ Without fruit (that has seeds inside) a new plant cannot grow
➔ People need plants to survive
➔ Bees make honey in the hive

Relate back to plant parts. Remind students function of flower and that fruit grows from this. If plant grows and flowers and no bees or butterflies are around to pollinate it, nothing happens and it dies and cannot reproduce.

Bees are one of our most important pollinators. Explain that honeybees are insects that live in colonies. In the colony live three kinds of honeybees: queen, drone and worker (see Supporting Information).

Explore: Flower Dissection (5-10 mins)

Have students partner up or break up into groups with adults. Have the students use hand lenses to study the parts of the flower. Ask them take apart the flower and try to identify all the parts seen on the diagram. Now that they know the parts of the flower, they can pretend to be bees!

Engage (20 mins)

Play a game with students to dramatize how flowers are pollinated. Each student plays the role of an apple tree, a bee, or the apple producer. Students can wear headbands/necklaces to differentiate the roles. Designate one student as the apple producer who owns the orchard. Give the apple producer the hat.

1. There are 10 apple trees and they wear the 10 headbands/necklaces of with pictures of apples trees. Other students are bees and wear headbands/necklaces with pictures of bees.
2. Give each apple tree one of each of the two different bags/cups. Each apple tree holds about 30 pieces of popcorn or beans (more than enough to accommodate the total number of bees) in one bag or cup. Have the trees hold the other empty cup/bag in the other hand.
3. To play, each Buzzy Bee buzzes and flies from one tree to another. The bees take one piece of popcorn/bean from the tree they visit and place it in the bag/cup of another tree. They receive another piece of popcorn/bean from that tree.
4. One minute represents one growing season. Allow only one minute for the bees to fly from one tree to another, leaving and receiving a piece of popcorn/bean. On a designated signal, the Buzzy Bees return to their hive, leaving piece of popcorn/bean in the bag of the last tree they visited.
5. The apple producer tells the trees to count the number of new pieces of popcorn/bean in their bag, deposited by the bees. Tell students the popcorn pieces represent the number of apples they can grow in their tree for this season. Each popcorn/bean represents a blossom pollinated and fertilized by the bees.

6. After each tree has counted its popcorn/beans, have the tree individually tell the apple producer its total. (They will use the popcorn/beans in the next growing season.) The producer writes each total in a visible place and totals the number of “apples” produced by all the trees. Optional: Older students can graph the total number of apples produced each growing season on their graphs or copy all the growing seasons onto their graph at the conclusion of the game.

7. Play the game numerous times for one minute intervals. Remind students that each minute represents a growing season. Be sure that at the end of each minute, the trees total the apples produced. Remind the producer to record and graph the figures. Challenge students to describe how and why the trees are able to produce their fruit. The blossoms pollinated by bees will generally lead to fertilization and fruit production.

8. Play the game for at least three more seasons, but vary the pollination conditions (see below). You can choose one or more conditions from the list. The group adjusts its role playing to match the pollination condition. Growing seasons continue to be one-minute intervals.

Some Pollination Conditions
- The weather has been especially cold, so the bees are slow and sluggish - flying at only about half speed.
- The winter was harsh. A virus killed many of the bees in the hive. Only half the bees are left to do the job. Have half the bees sit on the floor or stay at the hive.

Evaluation:
Why do bees visit flowers? What do they get from a flower? (Nectar and pollen)
What does a bee get on its legs and body hair when it flies into a flower to get its nectar? (Pollen) How? (Pollen from the anther is transferred onto the bee because of its movement.)
What happens to the pollen collected on a bee’s body hair when it flies into another flower? (Some pollen falls into the new flower, causing pollination.)
What happens when a flower or apple blossom is pollinated? (Pollen is transferred from the stamen [male part] to the pistil [female part]. It sets things in motion for fertilization to take place so seeds or fruit can be produced.)
What would happen if the blossom or flower did not get pollinated? (No seeds or fruit would be produced.)

Extension:
1. Discuss what the bee does with the nectar that is collected from each flower. Where does honey come from, and how do animals and people use honey? Bring samples of honeycomb and honey for the students to observe and taste.
2. Students display their data using different kinds of graphs. Options include bar graphs, picture graphs and pie charts. Have students compare and select their favorite visual display of data.
3. Investigate what fruit producers do to bring insects into their fields and orchards for pollination. Take a field trip to an orchard or farm.
4. Invite a fruit producer or beekeeper to come to the classroom to discuss pollination and apiaries (places where bees are kept or collections of hives or colonies where bees are kept for their honey). Ask the beekeeper to bring his or her equipment and explain how different flowers make different tasting honey.
5. Research other insects, birds or mammals that are pollinators. List the factors, such as color, shape, fragrance and time of pollination (day or night) that attract pollinators. Examples include butterflies, moths, beetles, ants, hummingbirds, bats, cactus wren, mouse, and large animals that may brush against flowers.

Common Core Standards
- Science K.LS1.1 Use observations to describe patterns of what plants and animals need to survive
- Science K.ESS3.1 Use a model to represent the relationship between the needs of different plants and animals and the places they live
- Science 4.LS1.1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior and reproduction
Background Info

Many plants need to be pollinated to produce seeds or fruits. Pollination is the transfer of pollen grains in flowers from the stamens (male part) to the pistil (female part). Without pollination, fertilization does not occur, and plants will not produce seeds or fruit. When a pollen grain is deposited on the stigma, it forms a pollen tube that grows down the style to an ovule in the ovary. Sperm from the pollen grain travels down the tube. Fertilization occurs when sperm cells fuse with egg cells of the ovule. A seed then begins to develop. The ovary itself develops into fruit that encloses seeds. Some plants can pollinate their own flowers. This is called self-pollination. Pollen is transferred from the stamen of the flower to the pistil of the same flower or to a separate flower on the same plant. Examples of self-pollinators include tomatoes, cotton, peas, some types of string beans, wheat, and some violets.

Other plants need pollen from another plant or even another plant variety. This is called cross-pollination and pollen is transferred from the stamen of one flower to the pistil of a flower on another plant. Plants that are cross-pollinated rely on external agents, such as insects, birds, some mammals, wind, or water for pollen transport. Conifers, many deciduous trees, and almost all grasses, such as corn, rice, oats, barley, rye, and bluegrass, are wind pollinated. Many plants are pollinated by insects such as corn, ants, flies, butterflies, certain wasps, and other animals (e.g., bats and small birds) that find food in their flowers. The animals usually have wings and fly quickly from flower to flower. They usually have hairs, feathers or scales to which the pollen sticks. As the worker honeybee flits from flower to flower collecting nectar, pollen and water, a very important thing happens. The bee brushes against the pollen in the blossoms.

Pollen, a tiny, grainy material, is made by the anther, which is located at the tip of each stamen (male part of a flower). The stamen is usually located at the top or outside of the flower. Pollen is usually yellow, but some flowers have white, red, blue or black pollen. For seeds and fruit to form, pollen must reach the female part, or pistil, of a blossom. The pistil is generally located in the lower or inner part of the flower. When the pollen meets the stigma on the pistil, pollination occurs. Pollination stimulates fertilization of the flower. The pistil is made up of a stigma, a tube-like style, and an ovary that contains egg cells. Pollen from the bee goes down the style from the stigma to the ovary. When the pollen meets the egg cells in the ovary, fertilization occurs and seeds develop. If the blossom is a rose, rose seeds will be able to develop. If the blossom pollinated is an apple blossom, it is now possible for an apple to form.