Buzzy, Buzzy Bee is used with permission from Project Food, Land & People. For more information about the project or to obtain a complete copy of the *Resources for Learning* please visit www.foodlandpeople.org.

FLP™
Food, Land & People

Buzzy, Buzzy Bee

LEVEL: Grades 2-7
SUBJECTS: Science, Mathematics, Language Arts, Physical Education
SKILLS: Applying, comparing similarities and differences, computing, cooperating, creating and improvising, creating and interpreting graphs, describing, discussing, observing, recording, role-playing, understanding cause and effect

MATERIALS

Pictures of bees; 300 or more 2"x5-1/2" paper strips, popsicle sticks or big bag of popped popcorn (if you do the activity outside); paper, or plastic bags; paper clips or clothes pins; transparencies of the attached ***Parts of a Flower, Graphing Apples*** and ***Parts of an Insect*** sheets. **Optional:** headbands for each student - 10 in one color and the others in a different color - and a hat for the apple producer, envelopes, scotch tape, and photocopies of ***Graphing Apples*** sheet; and Internet access to *America's Heartland* Episodes.

VOCABULARY

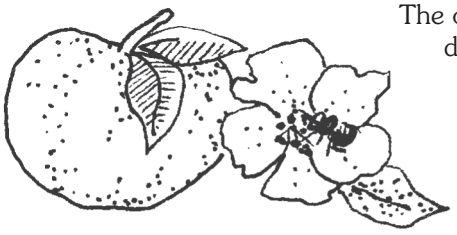
bee, beehive, drone, flower, fruit, insect, nectar, pollen, pollination, queen, stem, worker **Add for older students:** anther, filament, nectaries, ovary, petal, pistil, stamen, stigma, style.

RELATED LESSON

Investigating Insects

SUPPORTING INFORMATION

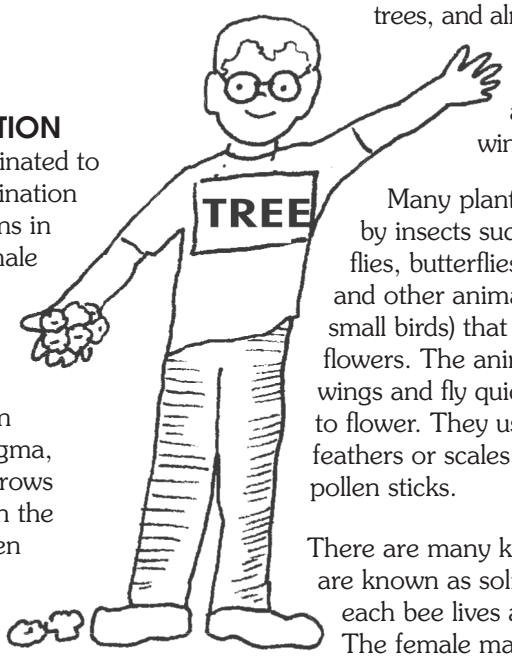
Many plants need to be pollinated to produce seeds or fruits. Pollination is the transfer of pollen grains in flowers from the stamens (male part) to the pistil (female part). Without pollination, fertilization does not occur, and plants will not produce seeds or fruit. When a pollen grain is deposited 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 selfpollination. 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 bees, 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.

There are many kinds of bees. Some are known as solitary bees because each bee lives and works alone. The female mates, makes her nest with about 10 cells where she

BRIEF DESCRIPTION

Students play a game in which they pretend to be honeybees and apple trees. In the process, they learn about plant pollination.

OBJECTIVES

The student will:
- review the process of plant pollination;
- demonstrate the sequence of plant pollination;
- describe the relationship between bees and flowers;
- graph the number of apples produced after pollination in the pollination game; and
- compare the effects of various conditions on pollination.

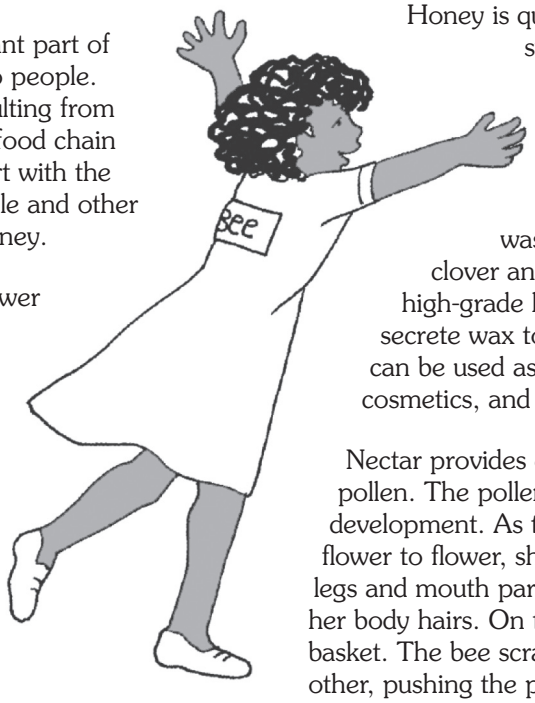
ESTIMATED TEACHING TIME

60 to 90 minutes.

lays her eggs (one egg per cell). The cells are stocked with pollen and nectar to feed the young. The female dies before the young hatch. The bumblebee and the honeybee, however, are called social insects because they live in groups (called colonies) and share the work.

A honeybee colony is like a huge family with 50,000 to 60,000 members. Three kinds of honeybees are in the family. The queen bee is the largest and most important bee. She can, however, be replaced. She lays thousands of eggs that will hatch into new bees. Male bees are called drones. Their job is to mate with the queen bee so she can lay eggs that hatch as larvae, transform into pupae, then emerge as adult bees. Worker bees are female bees that care for the queen and larvae, gather pollen and nectar, and make honey.

The work of honeybees is an important part of two different food chains beneficial to people. One food chain includes the fruit resulting from the pollination of flowers. The other food chain involves honey. Both food chains start with the flowers of plants. In both cases, people and other animals consume the fruit and the honey.



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 tubelike 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.

Flowers and other blossoming plants have nectaries that produce sugary nectar. The nectaries are situated at the base of the petals. With the movable, flexible tubes of its mouth parts, the worker honeybee sucks up nectar and water. The worker bee stores the nectar in a special honey stomach. When its honey stomach is full, the bee returns to the hive. Then the bee regurgitates the nectar to other bees or puts it in an empty honeycomb in the hive. Natural chemicals from the bee's head glands and the evaporation of water from the nectar change the nectar into honey. Honeybee workers must visit two million flowers to make one pound of honey. The average worker makes only 1/12 teaspoon of honey in her lifetime.

Honeybees make honey and wax. There are as many different kinds of honey as there are plants from which to gather it. The color and flavor is determined by the source of the nectar and the age of the honey. Honey is quality graded much like maple syrup, eggs or meat. Honey produced from specific flowers has a distinctive taste. Some consumers select honey based upon the quality grade and flowers from which honey was produced. Nectar from orange, clover and alfalfa blossoms produces high-grade honey. Worker honeybees also secrete wax to form the honeycomb. This wax can be used as an ingredient to make candles, cosmetics, and waterproofing compounds.

Nectar provides energy, but bees also need pollen. The pollen provides food for growth and development. As the worker bee moves from flower to flower, she scrapes off pollen with her legs and mouth parts. Some pollen also sticks to her body hairs. On the hind legs of a bee is a pollen basket. The bee scrapes one hind leg against the other, pushing the pollen into the pollen basket of the moving leg. This scraping is also done for the pollen basket on her other leg. She continues visiting flowers until both pollen baskets are full. She then flies back to the hive, leaves the pollen with the other workers, and returns for more pollen.

Collecting food is a big job. The workers must gather enough food to feed the colony in warm weather and to store food for cold weather when there are no flowers. A honeybee colony uses 50 to 75 pounds of pollen each year. Once a worker starts to collect food (pollen and nectar), she does not live long, only about 14 days.

Students may have heard about "killer bees" (Africanized honeybees - a slight variation of the honeybee that escaped from a research center in South America in the late 1950s and has now migrated to the southern United States). Because of the frightening image of their name, it may be important to compare

them with the European honeybees. European honeybees are very similar in appearance to Africanized honeybees. Only experts can tell them apart. Both make honey. Both sting only once, and the venom of their stings is equally toxic.

Africanized honeybees, however, react with greater ferociousness to disturbances, such as the vibrations of grass mowers and other threats to their nests. They have been known to pursue people and animals for distances of a quarter of a mile or more. Africanized honeybees swarm (divide into two parts) to form new colonies more frequently than European honeybees. They also will nest in places European honeybees would avoid.

Some people are very allergic to bee stings. They require immediate medical care. Because pulling or squeezing a stinger actually releases more venom, stingers should be scraped from the skin. You can use a credit card, knife edge, or even a fingernail. Once the stinger is removed, wash the area with soap and water. Apply an ice pack to help the pain and swelling. The sting site may be treated with an antiseptic to prevent possible infection.

Most of the time bees gather food for themselves and pollinate flowers at the same time. The bees need the flower for food - pollen and nectar. The flowers need the bees so they can produce seeds or fruit. Thanks to the bees and the flowers, we have a variety of foods.

GETTING STARTED

Gather preserved bees, if possible, and books or visual aids with pictures of bees and honeycombs. Make transparencies of the ***Parts of a Flower, Parts of an Insect***, and ***Graphing Apples*** sheets. Cut 30 2" x 5-1/2" paper strips with a paper cutter for each apple tree. (That may be a total of more than 300 strips.) For ease of handling, craft or popsicle sticks may be substituted for paper strips or popcorn, except for Step 10. Obtain paper or plastic bags and paper clips or clothespins for each tree (see Step 2). **Optional:** Make headbands for each student, 10 of one color for the trees and the rest another color for the bees. Obtain a hat for the apple producer. For older students, make individual photocopies of the ***Graphing Apples*** sheets, scotch tape, and three envelopes per bee for Step 10.

PROCEDURE

SESSION ONE

1. Ask students to tell you what they know about bees and why bees are important to people. Explain that honeybees are insects that live in colonies. In the colony live three kinds of honeybees: queen, drone and worker (see Supporting Information). Using the transparencies ***Parts of a Flower*** and ***Parts of an Insect***, briefly explain the process of plant pollination. Ask:

   - 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.)*

     What are the steps involved in bee pollination? *(Bee enters flower for nectar, pollen, and water. Bee lands on the anther and gets pollen on its body hairs and legs. Bee moves to stigma of same or another flower and leaves pollen behind. Pollination stimulates fertilization and the production of seeds and fruits.)*

   - After a flower is pollinated what occurs? *(Pollen tube develops, sperm from pollen grain travels down tube and unites with egg in ovule, and fertilization occurs.)*

2. Play a game with students to dramatize how flowers are pollinated. Each student plays the role of an apple tree, a Buzzy Bee or the apple producer. Students can wear headbands of different colors to differentiate the roles.

   Designate one student as the apple producer who owns the orchard. Give the apple producer the hat. There are 10 apple trees and they wear the 10 headbands of one color. Other students are bees and wear the other color headbands. Each apple tree holds about 30 paper strips or a handful of popcorn (more than enough to accommodate the total number of bees).

   Give each tree a paper or plastic bag. Use a paper clip or clothespin to attach a paper bag to the collar

or neckline of each tree. Or, tie a plastic bag to a belt or belt loop of each tree. The bags will be used to collect paper strips from the bees in Step 4.

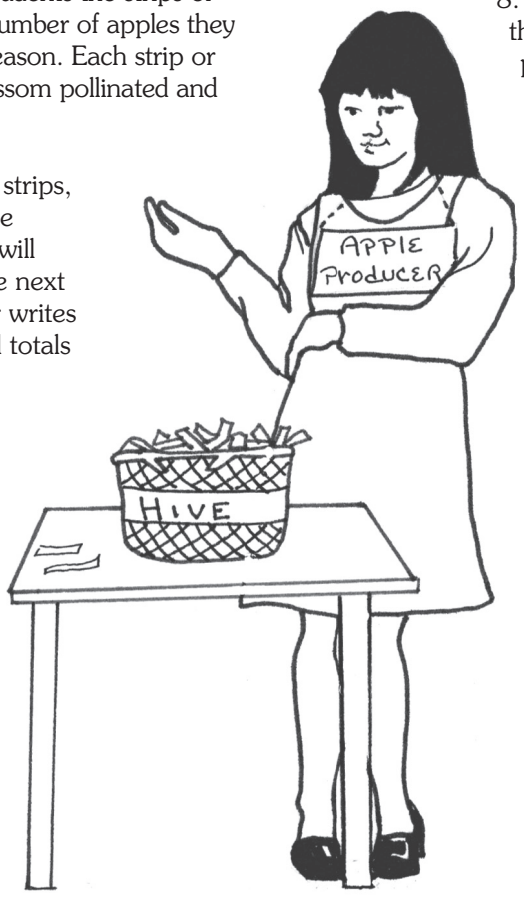
3. Designate a spot as the beehive. Younger students can practice how bees fly and get nectar out of a flower to dramatize the pollination process.

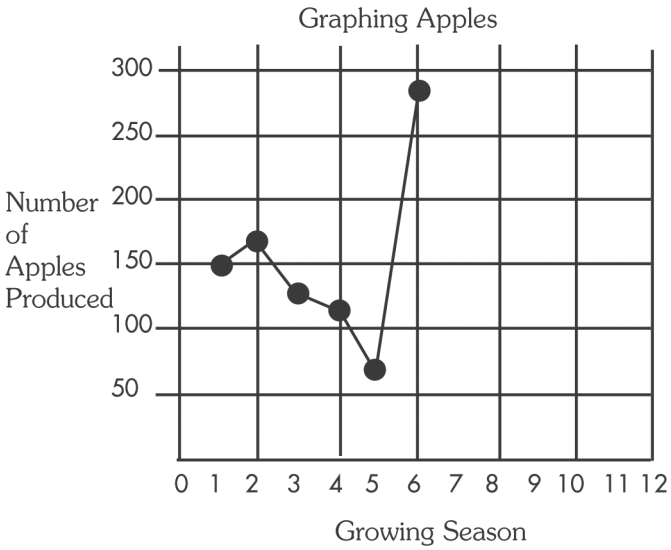
4. To play, each Buzzy Bee buzzes and flies from one tree to another. The bees take one paper strip or piece of popcorn from the tree they visit and place it in the bag of another tree. They receive another paper strip or piece of popcorn from that tree. (At the start of the game when visiting the first tree, the bees only receive a paper strip or piece of popcorn, since the bees do not have anything to leave yet.)

   One minute represents one growing season. Allow only one minute for the bees to fly from one tree to another, leaving and receiving a paper strip or piece of popcorn. On a designated signal, the Buzzy Bees return to their hive, leaving their paper strip or piece of popcorn in the bag of the last tree they visited.

5. The apple producer tells the trees to count the number of paper strips or pieces of popcorn in their bag. Include only the strips of paper or popcorn in the bag, not any of the strips or popcorn pieces the trees have in their hands! Tell students the strips or popcorn pieces represent the number of apples they can grow in their tree for this season. Each strip or popcorn piece represents a blossom pollinated and fertilized by the bees.

6. After each tree has counted its strips, have the tree individually tell the apple producer its total. (They will use the strips or popcorn 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. The apple producer graphs that number on the ***Graphing Apples*** transparency above the first growing season. **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

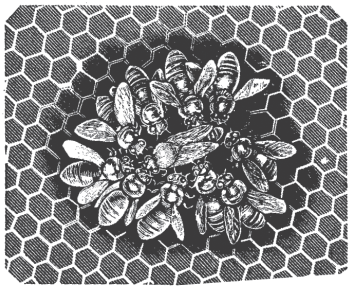
- The weather has been especially cold, so the bees are slow and sluggish - flying at only about half speed.

- 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.

- Since the hive was overcrowded, half the bees

swarmed (left the area entirely). There aren't as many bees left to do the pollination job.

- The apple trees were damaged in an ice storm. (Only half of the tree branches have pollen. Cut the pollen strips available in half.)



- A late frost hit the orchard. (They may have been pollinated, but then damaged. Go around and collect the paper strips from some of the trees.)

- A very brisk wind has been blowing. Bees either stayed in the hive or stopped working in the field. They will find shelter until the wind stops.

9. Graph the total number of apples produced on the Graphing Apples transparency. Indicate the weather conditions. Compare the data for all the growing seasons. The totals should vary from season to season. Ask students to explain possible causes for the differences by asking:

   - What do you notice about the number of apples produced during each season?

   - Did the total number of apples produced during each growing season stay the same? Why or why not?

   - Why do you think the totals are different? (Discuss any specific circumstances for individual growing seasons and the effects on the total number of apples produced.)

   - What does this tell you about the relationship between bees and flowers. (The bees need the flowers for food and the flowers need the bees to be able to produce seeds and fruit.)

   - Why are bees important to agriculture? (Many fruits and vegetables develop as a result of pollination and fertilization of flowers. Honeybees change nectar from flowers into honey.)

   - If you were an apple producer or orchard owner, what would you do to assure good pollination and fertilization for your apple trees? (Rent and release bees in the orchard at the first sign of bloom.)

   - What is the most interesting thing you learned about bees and pollination?

Optional for older students

10. Play the game this time with bees gathering nectar and pollen. At the end of the game students determine the amount of honey produced and pollen gathered. Using scotch tape or paper clips, have the bees attach an envelope to each leg (representing pollen baskets) and an envelope to their stomachs (representing the honey stomach). When bees take a paper strip from the tree, have them tear off two small pieces of paper - one to put in one of their pollen baskets and one to put in their honey stomach. The rest of the paper strip goes in the trees' bag. Play the game for several minutes. At the end, the bees return to the hive. Ask one bee at the hive to collect the pollen and nectar pieces as each bee empties their pollen baskets and honey stomach. (You may want to have two piles - one for pollen, the other for nectar - keeping the pollen and nectar separate.)

11. Have students determine how much nectar was gathered and made into honey. Tell students that 12 pieces of nectar paper represents one teaspoon of honey. Since six teaspoons equals one ounce, how many ounces of honey did the bees produce? How many pounds?

12. Have students determine how much pollen was gathered. Tell students that 72 pieces of pollen paper represents one ounce of pollen. Ask:

    - How many ounces of pollen did the bees gather? How many pounds?

    - A honeybee colony uses 50 to 75 pounds of pollen each year. Did the bees gather enough pollen for the colony to survive?

<u>SESSION TWO</u>

1. Play *America's Heartland* episode #208, segment ***Not So Sweet*** at http://www.americasheartland.org/episodes/episode_208/index.htm and episode #304, segment ***Migrant Bees*** at http://www.americasheartland.org/episodes/episode_304/index.htm and episode #403, segment ***Honey of a Harvest*** at http://www.americasheartland.org/episodes/episode 403/index.htm .

2. Discuss with students the importance of honeybees to the production of fruits and vegetables. Ask:

"How many fruit and vegetable crops depend on bees for pollination?" *(90)*

"If the honeybees were not able to pollinate those crops what would happen?" *(While other pollinators [butterflies, ants, hummingbirds, other bees, etc.] would pollinate, there would be a significant decline in the quantity of those fruits and vegetables.)*

"What problems face beekeepers and honeybees?" *(Varroa mites)*

"What is being done to help the honeybees?" *(Research and raising replacement bees and replacement queens.)*

3. Ask the students, "Where can bees be kept?"

4. To answer, play *America's Heartland* episode #212, segment ***Big Apple Buzz*** at http://www.americasheartland.org/episodes/episode_212/index.htm and discuss that honeybees are present almost everywhere, even where one least expects it.

5. Ask: "How and why is honey harvested?"

6. To answer, play *America's Heartland* episode #403, segment ***Honey of a Harvest*** at http://www.americasheartland.org/episodes/episode_403/index.htm and discuss that honey and honey flavorings are found in an array of products. Have the students identify their favorite. (Honey-flavored cereals, honey mustard, honey salad dressings, in barbeque sauce, in candies, etc)

EVALUATION OPTIONS

1. Have students draw a sequence story of the Buzzy Bee game, including how plants are pollinated.

2. Have students write a paragraph describing why bees are important in the pollination of apple tree blossoms and explaining conditions that affect pollination. Have them include one way the weather could hurt, slow or stop bees from pollinating and one way the weather could help bees pollinate apple trees.

3. Have students write or draw about their attitudes toward bees. They could do a "before" and "after" comparison.

4. Give students a graph showing 15 apples produced in the first season, seven in the second season, and 14 in the third season. Have students describe conditions that might have affected the pollination.

EXTENSIONS AND VARIATIONS

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. Ask local grocery stores or florists to save discarded flowers of various varieties. Have the students use hand lenses to study the parts of the flower. Ask them to look for pollen and then take apart the flowers. Have them draw and label the different parts of the flower.

4. Investigate what fruit producers do to bring insects into their fields and orchards for pollination. Take a field trip to an orchard or farm.

5. 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.

6. 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.

7. Have students investigate "killer bees" (Africanized honeybees), their origin, migration patterns, differences between them and European honeybees, potential for interbreeding between the two honeybees, concerns about them, safety procedures, and other topics of interest. Chart the migration patterns. Ask, "How might interbreeding between the two bees affect the manageability and effectiveness of bees as pollinators?"

8. Research other methods of plant propagation besides the formation of seeds (e.g., grafting, cutting, or breaking plant apart). Have students give examples of plants that are propagated in different ways. Have them create charts that illustrate the various methods of propagation.

CREDITS

America's Heartland episodes #208, segment ***Not So Sweet*** and episodes #212, segment ***Big Apple Buzz***, episode #304 segment ***Migrant Bees*** and episode 403 segment ***Honey of a Harvest***. KVIE 2006. www.americasheartland.org

ADDITIONAL RESOURCES

Bishop, Holly. *Robbing the Bees.* Simon and Schuster. 2006. ISBN13: 9780743250221

Cole, Joanna. *The Magic School Bus Inside a Beehive.* Scholastic. 1996. ISBN: 0-590-25721-8

Gibbons, Gail. *The Honey Makers.* William Morrow & Company. 1997. ISBN: 0-688-17531-7

Gibbons, Gail. *Apples.* Holiday House. 2000. ISBN: 0-8234-1497-3

High, Linda Oatman. *Beekeepers.* Boyds Mills Press. 1998. ISBN: 1-56397-486-X

Maestro, Betsy. *How Do Apples Grow?* HarperCollins. 1992. ISBN: 0-06-445117-8

Micucci, Charles. *The Life and Times of the Honeybee.* Orchard Books. 1997. ISBN 13: 9780395861394.

Polacco, Patricia. *The Bee Tree.* Philomel Books.1993. ISBN: 0-698-11696-8

Ransome, Hilda. *Sacred Bee in Ancient Time and Folklore.* Dover Publishing. 2004. ISBN13: 9780486434940.

WEB SITES

Basic Facts: Benefits of Insects, http://insectzoo.msstate.edu/Students/basic.benefits.html (accessed October 2008)

Bee Culture, The Magazine of American Beekeeping. http://www.beeculture.com (accessed October 2008)

Beekeeping, University of Florida. http://edis.ifas.ufl.edu/topic_beekeeping (accessed October 2008)

Best of the Bugs, University of Florida. http://pests.ifas.ufl.edu/bestbugs (accessed October 2008)

Bumblebarf, Science Article from Gallery Magazine. http://www.bumblebarf.com/index.html (accessed October 2008)

Communication and Recruitment to Food Sources by Apis mellifera, USDA ARS. http://gears.tucson.ars.ag.gov/ic/dance/dance.html (accessed October 2008)

The Honey bee Dance. http://ourworld.compuserve.com/homepages/beekeeping/beedance.htm (accessed October 2008)

Honeybee Dance Breaks Down Cultural Barriers, Science Daily, June 10, 2008. http://www.sciencedaily.com/releases/2008/06/080604074930.html (accessed October 2008)

Honey Industry, National Honey Board. http://www.honey.com/honeyindustry (accessed October 2008)

Honey Trivia, Take A Guess, Check Your Answers. National Honey Board. http://www.honey.com/consumers/kids/trivia/asp (accessed October 2008)

Insect Goods and Services, North Dakota State University. http://www.ndsu.nodak.edu/entomology/topics/goods.htm (accessed October 2008)

A Look at the U.S. Beekeeping Industry (includes Thumbnail Statistics link), National Agricultural Statistics Services, United States Department of Agriculture, http://gears.tuscon.ars.ag.gov/dept/abf.html (accessed October 2008)

Mystery Bee Disappearances Sweeping U.S. National Geographic News, February 23, 2007. http://www.news.nationalgeographic.com/news/2007/02/070223_bees.html (accessed October 2008)

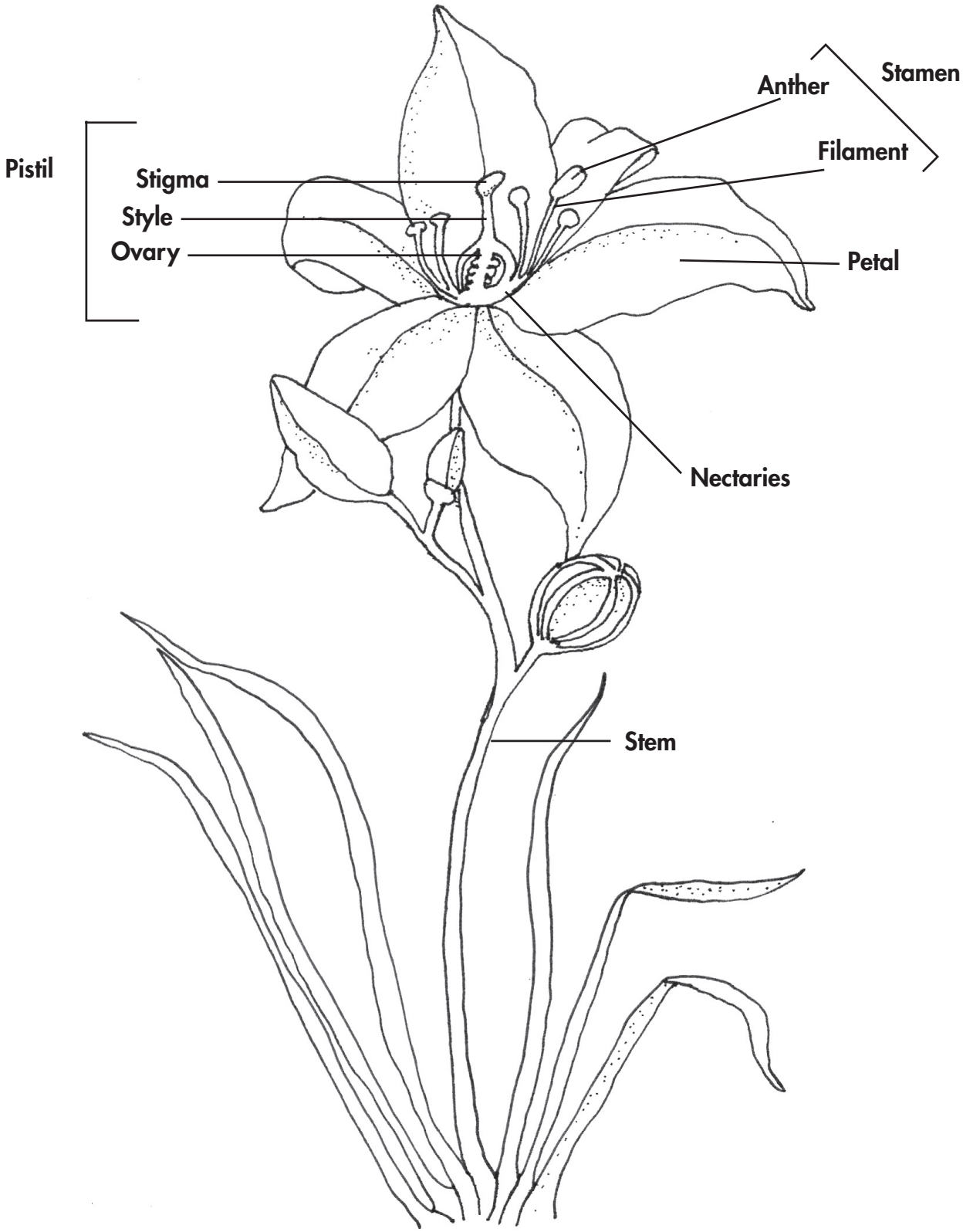
O. Orkin Insert Zoo, Student Resources Page, Hymenoptera – Ants, Bees and Wasps, http://insectzoo.msstate.edu/Students (accessed October 2008)

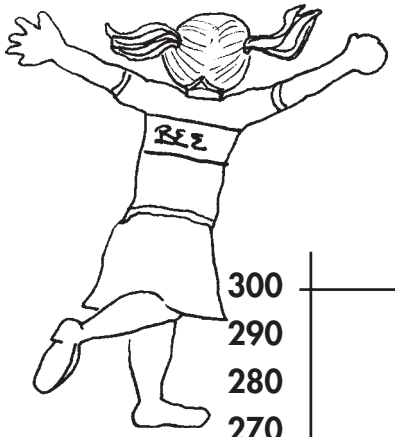
Tales From the Hive. Nova. Public Broadcasting System. http://www.pbs.org/wgbh/nova/bees (accessed October 2008)

The Topic: Bees (includes numerous links and activities). http://www.42explore.com/bees.htm (accessed October 2008)

The Value of Honey Bees as Pollinators of U.S. Crops in 2000, by Roger Morse and Nicholas W. Calderone, Cornell University. http://www.masterbeekeeper.org/pdf/pollination.pdf (accessed October 2008)

PARTS OF A FLOWER





GRAPHING APPLES

NUMBER OF APPLES PRODUCED

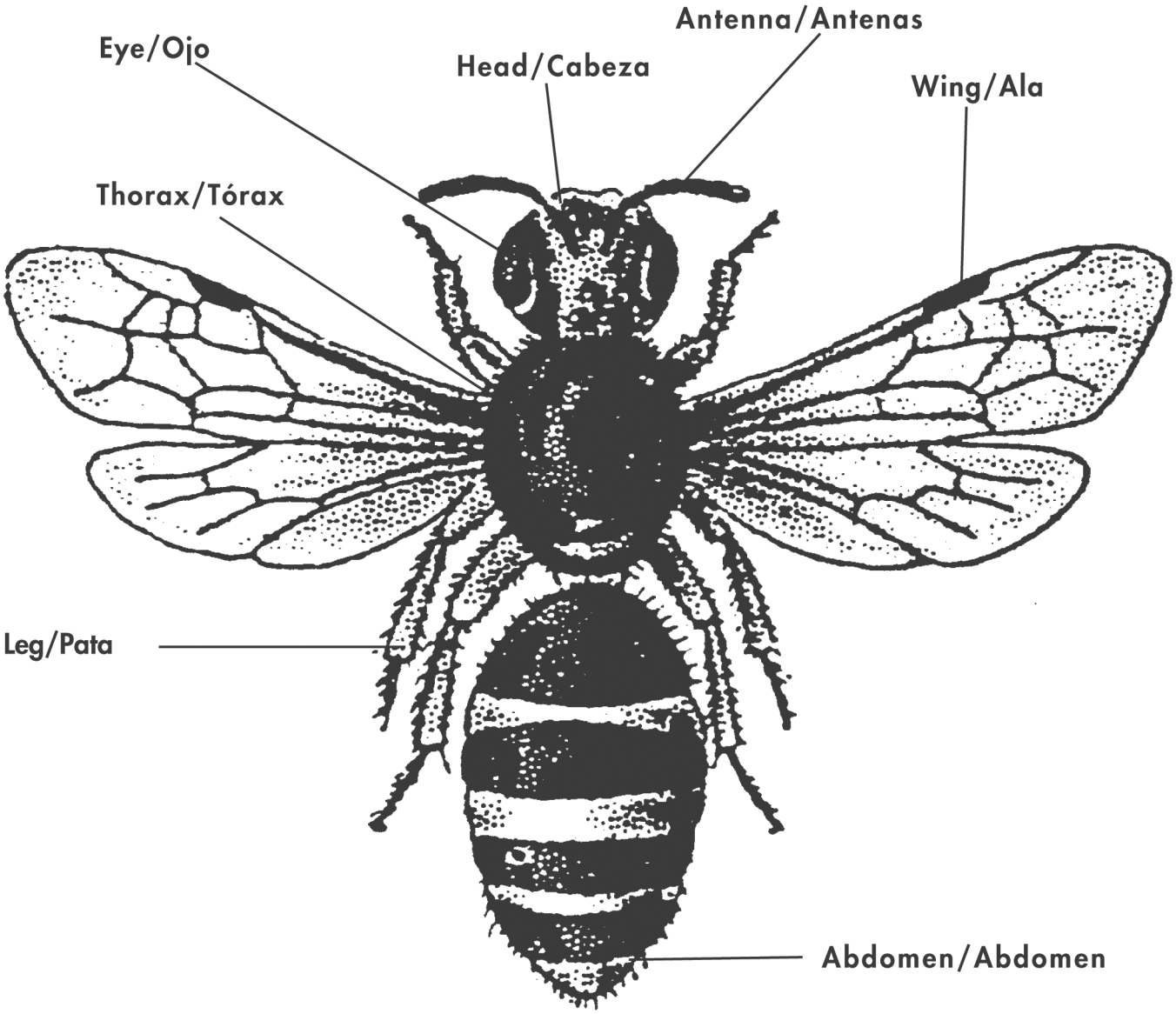
300
290
280
270
260
250
240
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

GROWING SEASON

PARTS OF AN INSECT
PARTES DE UN INSECTO

(English/Spanish words are provided.)



(Note: If this were a honeybee it would have a stinger under the abdomen and pollen baskets on the hind legs. Honeybees collect pollen on their body hairs and legs.)

(Nota: Si esta fuera una abeja recolectora de miel, tendría una ponzoña debajo del abdomen y sacos para recojer polen en las patas traseras. Las abejas recolectoras de miel recolectan el polen con pelos en su cuerpo y patas.)