



Module 6: Interdependence and Garden Life

Pollination and the Next Generation

Objectives

Students will be able to:

- list the parts to a flower;
- show how to pollinate flowers
- explain the best pollination technique for at least one type of plant

Oregon Content

Standards:

K.3 Scientific Inquiry

1.1L.1 Compare and contrast characteristics among individuals within one plant or animal group.

1.3 Scientific Inquiry
2.2L.1 Describe life cycles of living things.

2.3 Scientific Inquiry

3.3 Scientific Inquiry

4.3 Scientific Inquiry

5.1L.1 Explain that organisms are composed of parts that function together to form a living system.

5.3 Scientific Inquiry

6.3 Scientific Inquiry

7.1L.1 Compare and contrast sexual and asexual reproduction.

Explain why reproduction is essential to the continuation of every species.

7.3 Scientific Inquiry

8.3 Scientific Inquiry

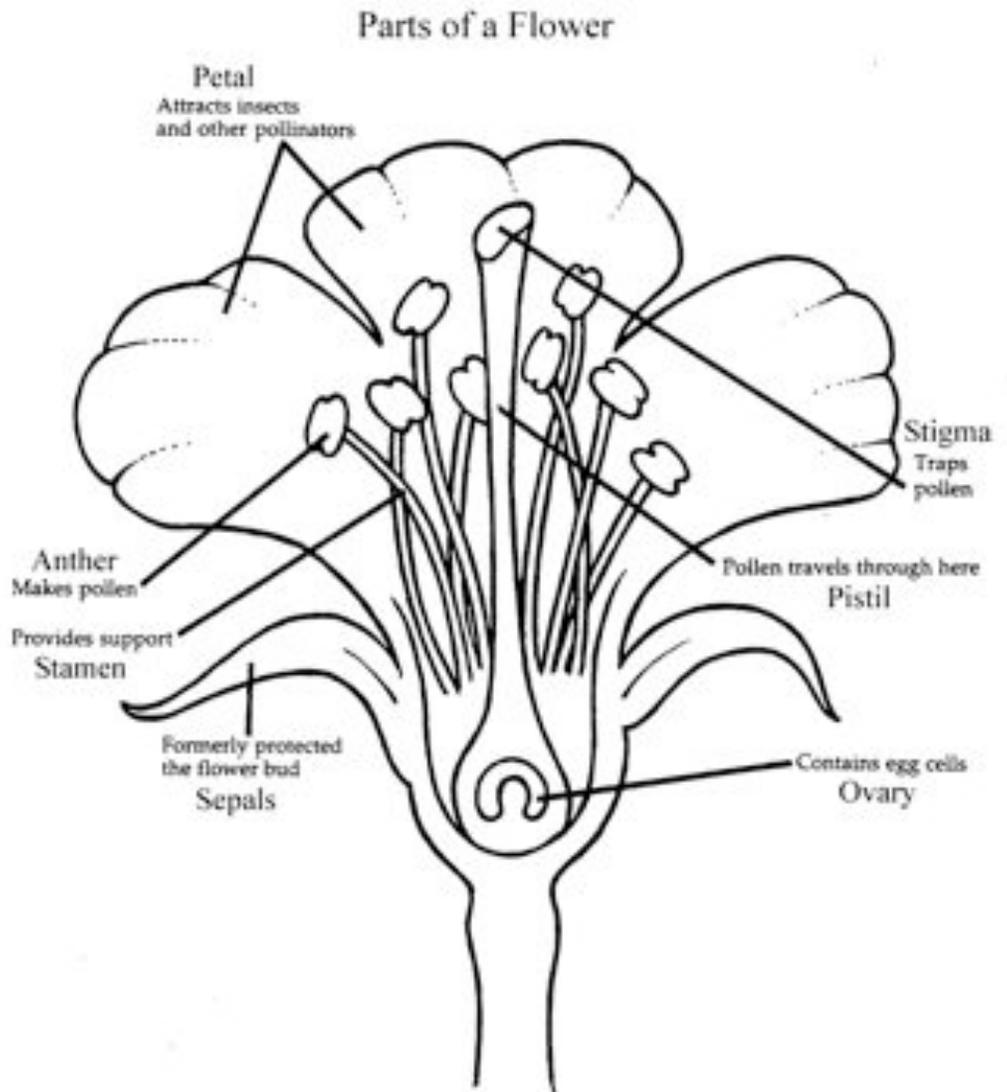
ET.1.B Create original works as a means of personal or group expression.

ET.2.B Effectively communicate and publish to multiple audiences using a variety of media and formats.

ET.2.D Contribute to project teams. Produce original works or solve problems in a team setting.

Background

Not just a pretty plant part, flowers are the way that plants are able to reproduce and create seeds for the next generation. (As well as many tasty fruits that we get to eat!)



<http://www.tiffin.k12.oh.us/olc/page.aspx?id=12927&s=911>

Oregon Content

Standards continued:

ET.3.B Locate, organize and use information ethically from a variety of sources and media.

ET.3.C Evaluate and select information sources and digital tools based on the appropriateness to specific tasks.

ET.3.D Analyze, evaluate, and summarize information or data and report results.

Vocabulary

Flower, sepal, petal, stamen, pistil, pollen, pollination

Garden Tasks

- Plant flowers to attract pollinators
- Hand pollinate plants
- Create a native bee house
- Plant warm weather crops
- Harvest early spring crops
- Make a flower salad to eat
- Harvest flowers for the students to take home

Bee Adaptations

Bees are specially adapted to collecting pollen. They have special baskets on their hind legs, called corbicula and the hair on their bodies is charged with static electricity, which attracts pollen grains.



<http://www.infiniteunknown.net>

- **The Outermost Whorl-** these are the SEPALS. They are the modified leaves that cover the bud. The sepals all together are called the calyx.
- **The Next Outer Whorl-** the PETALS. These are the showy parts of the flower that attract the pollinators. The petals altogether are called the corolla.
- **The Male Whorl-** is called the *stamen* (has the word “men” in it). The stalk of the stamen is the filament and the top is the ANTHER, which creates and holds the pollen.
- **The Inner Female Whorl-** is called the *pistil*, made up of the ovary (where the eggs are), the styles (the pollen tube that the pollen travels down to reach the eggs) and the STIGMA (where the pollen lands).

Pollination is the transfer of pollen grains from the stamen of one flower to the stigma of the same or another flower. Anything that transfers pollen from one flower to another is called a pollinator. There are more than 100,000 species, including bees (20,000 species), moths, butterflies, bats, birds, beetles and flies. Even wind can be a pollinator- the oldest method- but it is less efficient than living pollinators since the grain of pollen must hit the exact spot on the flower for reproduction.

Most plants are pollinated by organisms. Flowers and pollinators have co-evolved—where plants exhibit certain traits to attract a certain pollinator and pollinators have adapted certain physical characteristics that allow them to gather and transport pollen as they seek out food (nectar and pollen).

Examples: Daisies are not picky—many pollinators can distribute its pollen, however certain flowers are dependant on only one pollinator like the saguaro cactus in the southwest pollinated only by bats.

Plants may attract pollinators in a number of ways: color, unique designs (bull’s-eye, spiral), nectar, sweet smells, shapes, construction (a landing pad for bees or tubular shape for hummingbirds). While plants receive the benefit of transferred pollen, pollinators receive food for themselves and their offspring. Nectar is a sugar-based substance that contains vitamins, amino acids, and other nutrients. Pollen is a source of protein. Some plants also produce fatty oils, resin, or wax for their helpers.

Project

Making Fruit and Seeds

Length- three 30 min-1 hour sessions, then a couple weeks of checking to see if the pollination worked and fruit is forming

Materials- q-tips, wax/paper bags, tape, rubber bands, tweezers, paper, clipboards, pencils

Preparation- research hand pollination techniques for various plants so you can help students as they design their experiments and gather materials

1) In this activity, students will become pollinators. They will be trying to pollinate flowers in the garden to try and make their own fruit or seeds. Good plants to do this activity with are anything in the squash family, the grass family or the tomato family. Introduce the mechanics of pollination with some of the activities listed below, especially the flower dissection.

2) Next, have groups of students pick one plant that they want to pollinate in the garden. Turn this into an experiment. (For ideas on how to set-up an experiment, look at the Plant Needs lesson in Module 2.) They will decide as a group how they are going to pollinate a few of the flowers on their plant. Questions they should answer:

- How many flowers will you pollinate? (It will be good to do a few, around 5 to make sure that at least one will take.)
- Does your plant have perfect (both male and female) or imperfect (separate male and female) flowers? How will that change their pollination strategies? (They will need to use one male and one female flower if the flowers are imperfect since the male flower will have the pollen but the female flower will hold the seeds.)
- What pollen will you use to pollinate your flowers? Pollen from the same plant? Pollen from a different plant of the same type? Or pollen from a completely different species?
- How can you make sure that only you are pollinating the flowers you pick and not insects or the wind? (Tape up or cover pollinated flowers with paper bags, lightly closed so no insects can get into them.)

3) They should write up a procedure for their experiment that will answer the above questions and come up with their hypothesis. There are a lot of great resources on-line explaining how to hand pollinate various types of plants. Students can research these techniques as they plan their experiment. You could also have a horticulturalist or plant breeder come show them various pollination techniques.

4) They will implement their experiment and collect data, documenting the process over time with pictures. Success will occur if the flowers they pollinated make fruit or seeds. They will use their pictures and other collected data to create a how-to pollination manual to post on-line. Have each group present their findings/pollination manual to the other groups.

Extension: Depending on the time of year, you can later harvest the seeds from the fruit the students pollinated and then grow them to see what sort of plant they created. This can be especially striking with squash and corn because they interbreed so easily. It can also be fun to do with flowers to see what colors they end up with.

STEM Professional Connection: Have a horticulturalist come talk to the group about hand pollination and why people sometimes choose to hand pollinate instead of letting other pollinators do the job.

Activities

The activities below can be used to introduce or review the project concepts.

Flower Observations

Length- 10 minutes

Materials- examples of different types of flowers

Preparation- gather the flowers

Have the students sit in a circle around you. Hold up one of the flowers that you've brought. Ask the students what flowers are for (besides being pretty). Explain that flowers help plants make seeds. Hold up some of the different flowers that you brought. Ask the students to look for things that all or most of the flowers have in common. After listening a few answers tell them that even though they look different, most flowers have the same common parts because they need those parts to make seeds.

Ask students why they think the petals of flowers are so nicely colored? Why do flowers often smell so nice? Why do flowers have sweet nectar in the center? Explain that the flowers need to attract pollinators so that when the pollinator is moving around in the flower they will accidentally rub some of the pollen on the right place- the pistil. The pollen then goes down the pistil's tube to where the seeds will grow. Flowers attract pollinators to do this with their size, shape, smell, etc. Emphasize the amazement of a flower using insects to do work for them.

Flower Dissections

Length- 10-15 minutes

Materials- flowers to dissect, flower diagram sheet, other example flowers, hand lenses

Preparation- gather edible flowers

Give each student, or pair of students, a flower to carefully hold and examine. They will be trying to find all the parts of their flowers so they can figure out how flowers make seeds. You can hold up the flower diagram as you go through this, pointing to each part.

Hold up a flower that is still in bud form. Point out the special leaves that cover and protect the bud. Ask the students to see if they can find these special leaves (**sepals**), on their flower. Have them point to the sepals. Let the students know

that many flowers are different and they may not each have all the parts you name.

Explain that when the bud opens into a flower we can see the **petals**. Have the students point to the petals on their flower. Ask what they think the petals do for a flower- attract pollinators. You can show some different flower shapes and discuss the types of pollinators that would be interested in them.

Flowers have a special powder called **pollen**. Have the students look to find the pollen on their flower. The pollen on some flowers is hard to see, so show the more visible examples around. Name the part with the pollen as the **stamen**.

Next have the students look for the **pistil**. At the bottom is the **ovary**. This is where seeds are made. Allow the students to carefully pluck off their flower's petals to find these parts. Using the flower diagram, show how the pollen needs to move from where it is on the stamen onto the top of the pistil. Wonder aloud, "How can it get there?" Allow the students to make some guesses.

It's fun to do this activity with edible flowers like: brassica flowers, nasturtiums, peas, etc. That way they can eat the part of the flower as they go through the dissection. Use hand lenses so students can easily see the parts of the flowers.

Insect Pollination Game

Length- 10-15 minutes

Materials- jello mix and flour, four bowls, cotton balls

Preparation- gather materials

This activity demonstrates how pollinators collect pollen from plants. Divide the group into teams and arrange them in single-file lines at one end of the playing field. At the other end of the space two tubs are placed on the ground, one with red powder and one with white powder (any colors may be used). The first member of each team runs to the first tub carrying a cotton ball and collects some pollen. The team member returns to their team and deposits the pollen in a collecting dish. The child repeats this activity for the second tub of different colored pollen. The remaining team members take turns until they have all completed the activity.

Students will try to "win" by collecting the most pollen. You can discuss certain adaptive techniques animals have for collecting lots of pollen. You can also show the cross-pollination that takes place (the mixing of the red and white pollen).

Wind Pollination Game

Length- 10 minutes

Materials- flour, flour sieve, flowers (real or fake), tape

Preparation- pre-tape the flowers, gather materials

This activity demonstrates the difficulty of wind pollination and explains why many plants have adapted to be pollinated by animals instead. Give one student

a sifting sieve/flower shaker who stands a short distance away from the other students. The remaining members are given a flower with sticky taped centers (to collect “pollen”). The student with the sifting sieve shakes it vigorously. The others cannot move from their position by can wave their flower around to catch the “pollen.” Observe how difficult it is for pollen to transfer this way.

Become a Pollinator

Length- 5-10 minutes

Materials- Q-tips

Preparation- get q-tips

Have students become pollinators by giving them each a Q-tip. Allow them to move around the garden and transfer pollen from one flower to another, specifically from anther to stigma. This is a fun, short activity for younger students.

Pollinators and the Flowers

Length- 10 minutes

Materials- pollinator/flower cards, example flowers

Preparation- print game cards, review pollinator/flower relationships

This activity is a good way to introduce to older students the relationships between individual pollinators and plants. Talk about the relationship between pollinators and flowers, what they get from each other and how they’ve slowly, over time, formed to be able to use or attract each other. Certain pollinators are attracted to certain types of flowers. Some like certain smells, others like a particular color or shape to the flower. Show some example flowers if you have them so students can see the different shapes and smells of flowers.

Pass out the game cards. Some students will be flowers and some will be pollinators. Have the students read the back of their card to learn about their flower or pollinator. Then when you say go they will try to find their match. If any students are left out at the end, let them join with another pair until all the pollinators have found a flower and all the flowers have a pollinator.

After the game they can go around the garden in groups looking at flowers and deciding which pollinator the flowers growing there would attract based on the game.

Bee Dance

Length- 10-15 minutes

Materials- none

Preparation- none

Bees are amazing pollinators. They are also, contrary to popular belief, very gentle when they’re out searching for pollen to collect because they’re focused on their work. When a bee stings you it dies, something it doesn’t want to do.

Honeybees in particular are amazing creatures. When a worker bee finds a good bunch of flowers she will go back to the hive and do a dance to let the other bees know where the flowers are. There are two dances. One is the round dance. The

bee moves in circles, alternating left to right. This indicates that the food source is close. The faster she turns the better the food source. If the food source is farther away she will do the waggle dance, moving in a figure eight pattern. The direction she faces when going down the long middle section shows which direction the flowers are. The more the bee buzzes during the middle part, the farther away the flowers are.

In the game one person is the worker bee searching for flowers. Everyone else turns their back and closes their eyes as the worker bee goes out in the garden and picks a flower or group of flowers that it's going to tell the rest of the group about. (If there aren't many flowers in the garden or you're inside you can put out some fake flowers or drawings of flowers.) When they're ready the bee comes back to the "hive" and does their dance, showing where the flowers are. Everyone else tries to guess which flower they picked based on the dance they do. Make sure that you do a couple practice dances with the whole group before you send someone out to choose a flower.

You can add onto this game by giving all the students Q-tips and having them go pollinate the chosen flowers, showing the example pollen to the group.

Flower Scent Test

Length- 10 minutes

Materials- flowers with different smells

Preparation- gather different smelling flowers

Scent is a way that many flowers attract pollinators. Collect different flowers with different scents. Invite blindfolded students to smell the flowers and guess which one is which based on the smell. Try to get some flowers that smell sweet, some that are spicy and some that really don't smell good at all. Ask the students, "If you were a pollinator, which flower would you visit?"

Build a Flower/Pollinator

Length- 20 minutes

Materials- paper cups, pipe cleaners, tape, powder from jello mixes, etc.

Preparation- gather materials, make an example flower and insect for students

Have participants make an insect by bending pipe cleaners into an insect shape (should be small enough to fit into the bottom of a paper cup). The students will then make a flower-

- Poke a hole in the bottom of a cup.
- Wrap tape, sticky side out, around a pipe cleaner (to function as the pistil) and stick it through the cup. Tape pipe cleaner to the bottom of the cup.
- Sprinkle a teaspoon of powder (chalk, jello) into the bottom of the cup (to function as pollen from the anther). Have different colors for students to choose from.

Students stand near to each other, holding up their flower and "flying" their insects in and out of other flowers by tossing them into other people's cups. In

the end the “insects” should be coated with various colored powders and so should the pistils. This relates to real flowers. Inside the flower is a pistil that is sticky like the tape. The pollen sticks to the pistil and is used to fertilize the ovaries in the flower.

Flower Drawings

Length- 10-15 minutes

Materials- paper, crayons

Preparation- gather materials

This activity is a good way to wrap up a study of flowers. It give the students a chance to creatively imagine their own flower. Have the students draw their own personal flower and a pollinator that would be attracted to it. After drawing, students can name and share their flowers.

Flower Pressings

Length- 30 minutes

Materials- cardboard, scissors, popsicle sticks, glue, rope, wax paper

Preparation- gather materials

After observing various flowers, students can press those flowers to take home. You can make a simple home-made flower press with two pieces of cardboard reinforced with criss-crossed and glued on large popsicle sticks and a piece of thin rope tied around the whole thing. Put the flowers in between the cardboard covered in wax paper. If you want to do many flowers, add more pieces of cardboard (without the popsicle sticks) between the wax paper sheets.