



Lesson Plan

Plants & Insects

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Lesson: Plants & Insects

Module Code: 0202.1

Note: This lesson plan corresponds to the Foldscope Prepared Slide Box Set #2 - Plants & Insects.

Grade Level: Middle school and up

Duration: 1 hour (recommended)

Learning Objectives: Students will understand how flowering plants reproduce and be able to identify relevant anatomical features. Students will understand the role of pollinators in plant reproduction and be able to identify key anatomical adaptations of pollinating insects.

Section	Overview	Learning Goal
Activity 1	Plant reproduction	Students will understand how flowering plants reproduce and be able to identify relevant anatomical features.
Activity 2	Pollinators	Students will understand the role of pollinators in plant reproduction and be able to identify key anatomical adaptations of pollinating insects.
Activity 3	Extended	Students dissect and mount a flower and observe with Foldscope. Students apply their understanding of flowers & insects from prepared slides to a fresh sample.

Materials:

- Foldscoopes
- Foldscope Prepared Slide Box Set #2 - Plants & Insects. (This product is available for purchase at <https://www.foldscope.com/order>)

Activity 1 — Plant Reproduction

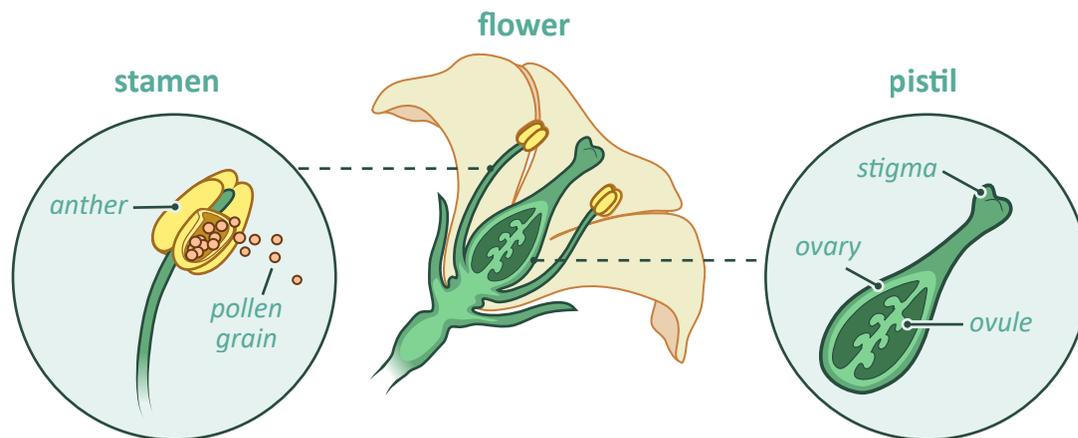
Section

Description

Intro Content

Angiosperms are plants that reproduce by growing flowers. This is the largest and most diverse group of plants; approximately 80 percent of all known green plants living now are angiosperms. Flowers are the home of angiosperms' reproductive organs. Flowering plant reproduction begins with **pollination**, the transfer of pollen from **anther** to **stigma**. The anther is the portion of the **stamen** that produces **pollen grains**, and the stigma is the sticky tip of the **pistil** that receives pollen grains. These pollen grains produce pollen tubes that grow down through the pistil until they reach the **ovary**, a hollow chamber that contains the plant's **ovules**, or eggs. The ovules are fertilized by the pollen grains and develop into seeds.

Flowering Plant Reproductive Parts



Once a fertilized seed reaches a place on the ground, it sprouts and begins growing. This growth originates from a special tissue called **meristem**, which is located in the tip of the plant and at its roots. This tissue is special because it contains cells that are **undifferentiated**, which means that they can develop into any type of cell within the plant. The meristem at the tip of the plant is called the **apical bud**.

Section	Description
Activity	<ol style="list-style-type: none"><li data-bbox="402 183 1455 302">1. Observe the components of plant reproduction in slides 2-2 and 2-3. Using these slides, can you tell the story of plant reproduction? What component is missing and why is that component important? <i>Slide 2-2 is a section of the anther of a maize plant. This organ produces pollen grains, which are shown in slide 2-3. The pollen grains fertilize the ovules in the stamen, which are not shown on these slides. Ovules are important because they contain the other half of the plant's genetic information. The fertilized ovules mature into seeds, also not shown; seeds grow into the next generation of plants.</i><li data-bbox="402 578 1463 651">2. Based on what you can see in slides 2-4 and 2-5, how do you think pine tree reproduction differs from flower reproduction? <i>In pine trees, the male and female reproductive organs are separated into two different types of pine cones, shown on slides 2-4 and 2-5. The male pine cone on slide 2-4 is the functional equivalent of the anther in a flower, and the female pine cone on slide 2-5 contain the ovules that would be found in the stigma of a flower. Unlike angiosperms, pine trees are gymnosperms and do not grow flowers. Their ovules are not enclosed in an ovary but are instead exposed bare in the cones.</i><li data-bbox="402 975 1463 1048">3. Observe the dandelion fuzz in slide 2-6. What is the function of dandelion fuzz in plant reproduction? Can you think of other ways that plants achieve a similar function? <i>Dandelion fuzz helps dandelion seeds catch the wind and sail far from their parent plant. This allows dandelions to spread their seeds over a greater area, increasing the reach of their species and decreasing competition among offspring. In addition to other methods of using wind for seed dispersal, such as the helicopter seed casings of maple trees, plants have also developed strategies that use animals to disperse their seeds. One animal dispersal strategy is burrs, which are spiky seeds with hooks that attach to animals' fur as they walk past the plants. Animals then carry these seeds for great distances until the burrs eventually fall or are rubbed off, greatly increasing the distance between the seed and its parent plant.</i> <p data-bbox="500 1506 805 1539"><i>(Continued on next page.)</i></p>

Section	Description
<p>Activity Guide (contd.)</p>	<p><i>Another strategy of seed dispersal by animals is fruit: by growing seeds within something sweet and nutritious that animals want to eat, plants allow their seeds to enter animals' digestive systems and be carried inside the animal until they are deposited intact within the animals' feces. This method has the added benefit of ensuring that seeds are surrounded by ample nutrients when they land.</i></p> <p>4. What is special about the apical bud shown in slide 2-1? Can you observe anything distinctive about the tissue that indicates its function?</p> <p><i>The apical bud contains meristem tissue and is the main site of upward growth for the plant. Distinctive features of meristem tissue include small, densely packed cells; thin cell walls; and large cell nuclei. There is also a high rate of mitosis, which may be observable in the configuration of nuclei.</i></p>

Activity 2 — Pollinators

Section	Description
<p>Intro Content</p>	<p>Some angiosperms self-pollinate by growing in such a way that pollen from a flower is likely to land on its own stigma or the stigma of another flower on the same plant. Because there can be genetic variation among the ovules within a plant, this results in some variation among the offspring. For more advantageous greater genetic variation, however, plants rely on pollinators to transfer pollen among different flowers of the same species. Pollinators are animals such as insects and birds that feed on the nectar of flowers and, in the process of feeding, bring pollen from one flower to another.</p> <p>The relationship between a flower and its pollinator is an example of mutualism, a mutually beneficial symbiotic relationship. Symbiosis describes any close relationship where at least one species benefits. The three types of symbiosis are mutualism, commensalism, and parasitism. In a mutualistic relationship, both organisms benefit. This is true of the relationship between pollinators and flowering plants: pollinators benefit from using the flowers' nectar as a food source... <i>(Continued on next page.)</i></p>

Section	Description
Intro Content (contd.)	<p>... and the plants benefit by being cross-pollinated to increase the genetic variation and success of their offspring. Commensalism describes a relationship in which only one species benefits and the other is not affected. For example, barnacles attach themselves to the skin of whales. The barnacles benefit by being transported to plankton-rich waters where the whales feed, and the whales do not seem to either benefit or be harmed by giving the barnacles a free ride. In a parasitic relationship, one species benefits and the other is harmed. Braconid wasps lay their eggs on the body of a tomato hornworm. As the wasp larvae grow, they kill the hornworm and feed off its body.</p>
Activity	<ol style="list-style-type: none"> 1. Consider what you already know about the insects in this slide kit (honeybee, butterfly, mosquito, fly, grasshopper). Which do you think are pollinators? <p><i>All of these insects are pollinators! The insects best-known for pollination in this group are probably the honeybee and butterfly. However, flies are actually the second-most important pollinating insect after bees. Flies are primarily drawn to flowers that have a brownish red color, including some that have evolved to smell like rotting meat to be more attractive to typically carnivorous flies. It may seem surprising, but mosquitoes are an important pollinator as well. Only female mosquitoes bite, and they only bite when they need protein from blood to develop their eggs, so nectar is the primary food of mosquitoes. Grasshoppers are perhaps the least likely pollinator— they are often thought of as pests that consume leaves and damage plants. Although this is generally true, a study conducted by scientists at the National University of Singapore from 2015 to 2018 found 13 species of grasshoppers, along with 28 other species from the same order, that were observed visiting flowers in Singapore, Malaysia, Thailand, Brunei, and Indonesia. After making these observations, they conducted an experiment in which they found that flowers that they exposed to katydids, a close relative of grasshoppers, were three times more likely to produce seeds— indicating that the katydids were truly aiding in pollination. This research is a good reminder that scientists are still discovering the roles different organisms play in ecosystems and there is always more to discover in your own backyard!</i></p>

Section	Description
Activity (contd.)	<p>2. What adaptations do you see that help these insects be effective pollinators? Can you identify any features on the slides?</p> <p><i>Look at slide 2-12. Honeybees' hind legs have a structure known as a "pollen basket" where they collect and store pollen after visiting flowers. This consists of a smooth cavity surrounded by stiff hairs that bees use to scrape pollen off their head and forelegs. On slide 2-18, you can see a butterfly's proboscis, a long, thin feeding tube that is specialized for uptaking nectar from flowers.</i></p>

Activity 3 — Extended

Section	Description
Intro Content	<p>Dissect a flower and mount it on slides to view in your Foldscope. What do the pollen grains look like? Can you identify its reproductive organs? Try dissecting another flower and comparing it to the first. What is different and similar between the two flowers? Do you see any differences that would make the flowers appealing to different pollinators? How might a pollinator adapt to feed from each flower?</p> <p>For Foldscope tutorials on sample preparation and viewing visit (https://www.youtube.com/playlist?list=PLnO8NcEb6LFy1p0rCVBfHY0JUGBswRC4m)</p>

Resources: <https://eol.org/docs/discover/flowering-plants>
<https://www.britannica.com/plant/angiosperm>
<https://kids.britannica.com/students/assembly/view/53831>
<https://www.britannica.com/plant/gymnosperm>
<https://sciencing.com/pollen-vs-seed-cones-12579032.html>
<https://www.thoughtco.com/will-pine-cone-grow-into-tree-3971255>
<https://courses.lumenlearning.com/boundless-biology/chapter/plant-development/>
<https://biologydictionary.net/apical-meristem/>

Resources <https://www.calacademy.org/educators/lesson-plans/flowers-seeking-pollinators>
(contd): <https://www.nationalgeographic.org/article/symbiosis-art-living-together/>
<https://sciencing.com/symbiotic-relationship-8794702.html>
<https://www.fs.fed.us/wildflowers/pollinators/animals/flies.shtml>
https://ucanr.edu/sites/PollenNation/Meet_The_Pollinators/Flies/
<https://mosquitoreviews.com/learn/mosquitoes-pollination>
<https://www.asianscientist.com/2018/09/in-the-lab/grasshopper-cricket-agriculture-pollinators/>
https://en.wikipedia.org/wiki/Pollen_basket
<https://micro.magnet.fsu.edu/primer/techniques/fluorescence/gallery/honeybeeleg.html>
<https://spie.org/news/6419-the-butterfly-proboscis-as-a-fiber-based-self-cleaning-microfluidic-system?SSO=1>



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