



Powerful Pollinators

Pollinators are essential to agriculture and the environment. About 80% of plants are pollinated by animals (**biotic pollination**) and 20% are pollinated by wind or water (**abiotic pollination**). There are about 200,000 species of animals that pollinate, most of which are **insects**. Of those, only about 1,000 are **vertebrates** such as birds, bats, and small mammals. For abiotic pollination, 98% is due to wind and 2% is from water.

What is Pollination? **Pollination** is the transfer of pollen grains from the male anthers of flowers to the female pistils of flowers. This allows for fertilization which allows the flowers to produce seeds.

Pollinator Conservation: There is a concern that we are losing pollinators due to habitat loss, disease, parasites, and environmental contaminants. Farmers help by planting cover crops, wildflowers, and native grasses in areas not in production. By building hedgerows, windbreaks, and providing a variety of flowering plants, farmers are attracting the native pollinators needed to grow their crops.

Activity: Below each photo on this page, write the pollinator's name and then list two facts about them.



Pollinator: _____

1. _____

2. _____

1 out of every **3** bites of **FOOD** requires a **POLLINATOR**



Pollinator: _____

1. _____

2. _____



Pollinator: _____

1. _____

2. _____



Pollinator: _____

1. _____

2. _____



Pollinator: _____

1. _____

2. _____



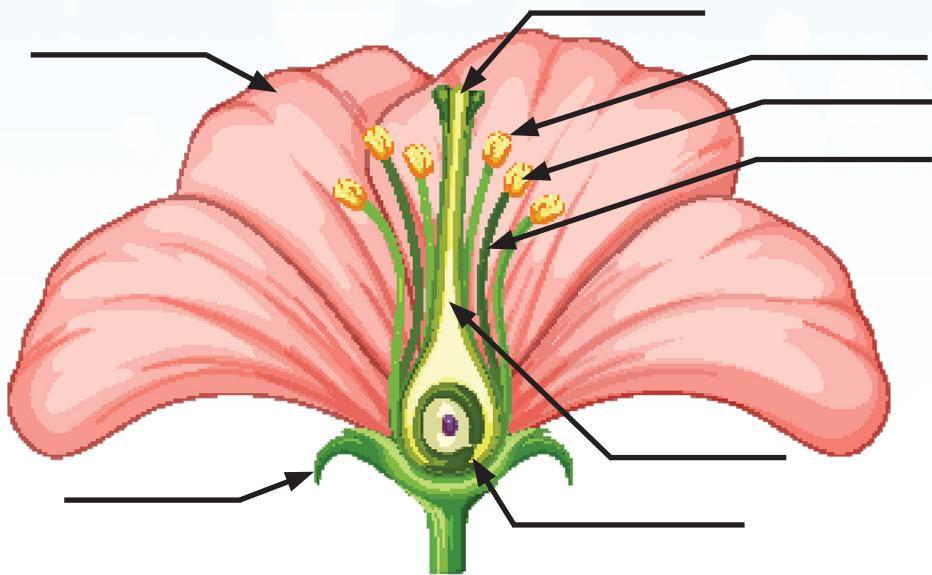
Pollinator: _____

1. _____

2. _____

The Basic Parts of a Flower

A flower is made up of many different parts. The sepal and petals are usually easy to see. The petals are the colorful, often bright, part of the flower. Colorful **petals** attract pollinators and are usually the reason why we buy and enjoy flowers. The **sepals** look like little green leaves growing at the base of the petals. The sepals enclose and protect the developing flower bud before it opens up into a fully developed flower. Flowers contain the reproductive system of the plant, and some of the most important parts of a flower are the male and female parts that carry the traits the parent plant will pass on to its offspring.



Activity: Using the glossary of flower parts below, label the parts of the flower on this page.

Petals -- the colorful, thin structures that surround the pollination parts of the flower

Sepal -- commonly green, leaflike structures that protect the bud prior to opening

Anther -- the bright sac that produces and contains the pollen grains

Stigma -- sticky surface where the pollen lands and eventually travels down toward the ovary

Filament -- the stalk that supports the anther

Pollen grains -- the powdery particles that contain the male portions of the flower; also a nutritious, protein-rich food for bees

Style -- the narrow region of the pistil between the stigma and the ovary

Ovary -- the base of the female portion of the flower containing the seeds

The male part of the flower is called the stamen. The **stamen** is the pollen producing part of the plant, and it is made up of two parts: the anther and filament. The **filament** is the stalk that holds the anther and attaches it to the flower. The **anther** produces and holds the pollen, which will hopefully be transported to the female part of the flower by wind, animals, or insects.

The female part of the flower is called the **pistil**, and it is made up of the stigma, style, and ovary. The **stigma** is the head of the pistil; it often looks like a sticky bulb on a long stalk in the center of a flower. The stigma receives the **pollen grains**. The **style** is the stalk that the stigma sits on top of, and the **ovary** is usually at the base of the style.

When a plant is pollinated, the pollen that has landed on the stigma grows a tube that reaches down through the style to the ovary. If pollen from an incompatible plant of a different species lands on the stigma, it won't grow a pollen tube. When the pollen tube reaches the ovary, the ovules inside the ovary can be fertilized by the pollen. Then the ovules become seeds, and the ovary swells. Seeds can be sown to grow new plants, and they can also be important food sources. We eat the seeds of wheat, corn, beans, and many other plants. We also eat many fruits, which are enlarged ovaries that contain the seeds of the plant.

Some flowers are **perfect**, meaning they have both male part and female parts in the same flower. Roses, lilies, and dandelions have perfect flowers. Other flowers are **imperfect**, meaning each flower has either all male parts or all female parts. Cucumbers, pumpkins, and melons have imperfect flowers.

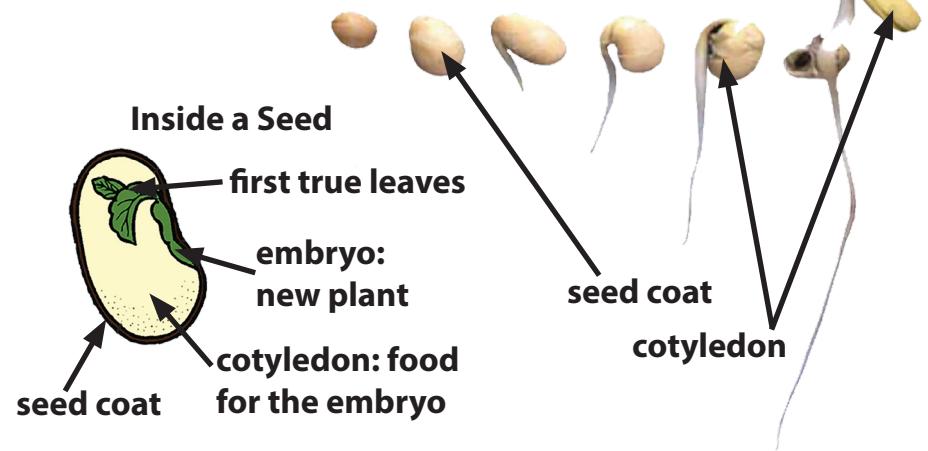


Seeds!

Seeds are vital to our survival. Without seeds, the plants that provide our food, fuel, fiber, oxygen, and many other essential products would not exist. Seeds are the method by which some plants reproduce. Each seed has a **seed coat**, an **embryo** (baby plant), and a food source in the form of either an **endosperm** or **cotyledons**.

In order for a seed to **germinate**, or sprout, it needs warmth, moisture, and air. Seeds remain **dormant** and will not germinate until the proper conditions are present. For example, in some climates the winter soil temperature may dip to below 32°F. Seeds will not sprout in these conditions. Once the ground thaws in the spring and the temperature rises to approximately 65°F, most seeds will sprout if moisture and air are also available. Most seeds germinate when the temperature is between 65-85°F.

Seed Germination and Anatomy



In the germination process, moisture softens the seed's outer protective covering, called the seed coat. The embryo pushes through the softened seed coat and the new plant begins to grow. The roots push further down into the soil and a shoot, which

contains the new plant's stems and leaves, pushes up towards the surface.

The germination process can be somewhat mysterious because it typically occurs underground where it cannot be observed.

Seeds of Opportunity

Did you know that there are a lot of exciting jobs in the seed industry? The seed industry is a vital, growing field whose employees not only make a good living, they also make a difference.

Management and Business

- Market Research & Planning
- Advertising
- Product Management
- Marketing Administration
- Customer Service Manager
- Financial Manager
- Food Broker
- Human Resources Manager
- Sales Representative
- Business Manager

Interests and Skills: sales, marketing, communication, organization, collaboration, creativity

Scientific and Engineering

- Plant Breeder
- Research Scientist
- Molecular Geneticist
- Field or Lab Technician
- Entomologist
- Pathologist
- Bioprocess Engineer
- Food Engineer
- Nanotechnologist
- Environmental Scientist
- Field, Plant, & Quality Manager
- Biomaterials Engineer
- Physiologist
- Business Manager

Interests and Skills: science, mathematics, genetics, computers, technology, research

Agriculture and Forestry Production

- Fruit and Vegetable Grower
- Greenhouse Manager
- Seed Producer
- Seed Technologist
- Aquaculturist
- Field Production Agronomist
- Plant Operator
- Maintenance Technician
- Tree Farmer
- Viticulturist

Interests and Skills: science, technology, computers, nature, problem-solving

The seed industry accounts for nearly 22 million jobs in the United States. To learn more visit www.FirstTheSeedFoundation.org.

Education, Communication, and Governmental Services

- Agricultural Science and Business Teacher
- Agricultural Science Reporter
- Environmental Impact Analyst
- Food Inspector
- Public Relations Specialist
- Naturalist
- Conservation Officer
- Plant and Animal Inspector

Interests and Skills: science, mathematics, education, communication, research, nature



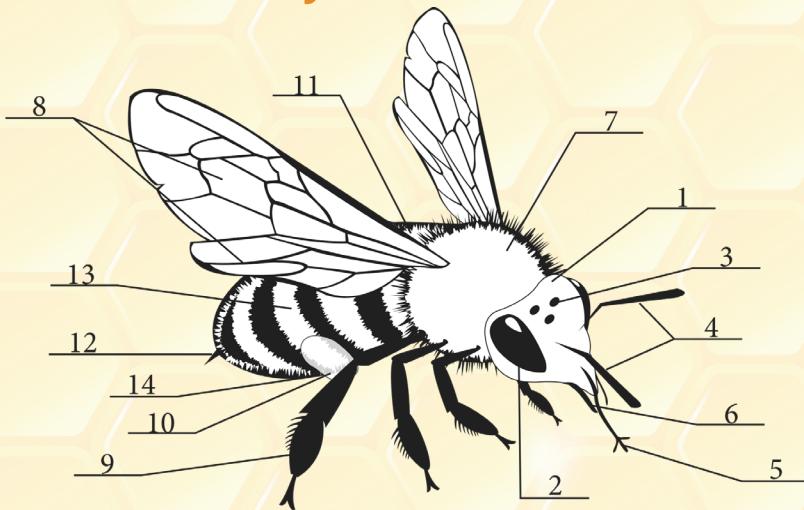
The Honey Bee



Honey bees are extremely important to humans. Bees are pollinators.

They collect pollen and nectar from flowering trees and plants and transfer pollen from flower to flower. Bees pollinate 95 different crops. Honey bees use the nectar they gather from flowers to make honey, which is the only commercial food produced by insects that is eaten by humans on a wide scale.

Anatomy of a Worker Bee



Honey bees are social insects and live in groups called colonies. Within each colony are three types or castes of honey bee: a queen, worker bees, and drones. Members of each caste have a slightly different body depending on the tasks performed.

The **queen bee** is the largest of the honey bees. She has a longer abdomen, a shiny thorax, and does not have pollen baskets on her legs. The queen has a stinger, which she uses to fight off other queens. She may sting multiple times without dying.

Worker bees are the smallest of honey bees. They have long proboscises used to suck up nectar from flowers. Worker bees' hind legs are fringed with stiff hairs that form pollen baskets. Workers have a stinger and a poison gland at the tip of their abdomen. Typically, worker bees can only sting once because their stingers and internal organs are pulled out when they sting and they die.

Drones, the male members of the colony, are somewhat larger than the workers. They have rounded abdomens, huge compound eyes, and powerful wings. Drones do not have a long proboscis and must be fed by worker bees. They also do not have stingers and therefore cannot defend themselves. Drones do not have wax secreting glands. The drones only purpose is to mate with the queen. Mating takes place in the air.

Activity: Match the description with the correct part of the bee by writing the corresponding letter on the appropriate line below.

1. head _____
2. compound eye _____
3. simple eyes _____
4. antennae _____
5. proboscis _____
6. mandibles _____
7. thorax _____
8. wings _____
9. legs _____
10. pollen basket _____
11. abdomen _____
12. stinger _____
13. honey sac _____
14. wax glands _____

- a. a stomach-like organ used to store nectar
- b. the middle region of the bee that contains the flight muscles, 4 wings, and 6 legs
- c. the front region of the bee that contains 2 compound eyes, 3 simple eyes, 2 antennae, mandibles, and the proboscis
- d. a collection of hairs where pollen is stored for transport
- e. movable feelers that detect smells and movement
- f. the rear region of the bee that contains organs for digestion, reproduction, and respiration as well as the stinger and wax glands
- g. glands that form and excrete wax

- h. used for walking, dusting antennae, brushing pollen off body hairs, and storing pollen
- i. beat 250 times per second allowing the bee to fly
- j. made up of tiny lenses that allow the bee to see ultraviolet light and visible light with the exception of red
- k. jaw-like structures used to knead wax and to chew honey and pollen
- l. have a thick lens that can sense changes in brightness
- m. a straw-like tongue used to suck nectar or honey
- n. barbed and has an attached venom pouch; used for defense



The Ant

Ants are from the Formicidae family. There are about 22,000 species of ants worldwide, many are found in the

tropical rain forests. There are 1.5 million ants for every person on earth! Ants have colonized every continent in the world except Antarctica (too cold) and a few frigid islands. They have been around since before the dinosaurs. This insect is successful due to their ability to adapt to their existing conditions and have diverse habitats.

Why Don't Ants Make Good Pollinators? Ants are more likely to take nectar without effectively pollinating flowers. Ants are among the most abundant, diverse, and ecologically important groups of insects on the earth; but they, unlike most pollinators, cannot fly from plant to plant. Most ants lack wings and typically forage only short distances. Ants form a group of social insects that are great lovers of nectar. These busy insects are often observed visiting low-hanging flowers to collect energy rich nectar by crawling into the flower. A few succulents and other plants are pollinated by ants. Plants in harsh, dry lands seem to rely on ants, as there might be few other pollinators available. Ants are not efficient at carrying pollen over long distances between plants and their nests.

What Comes in a Colony of Ants?

Ants live in social groups called colonies. Similar to honey bees, there are different types of ants living in the colony and performing designed roles.

Soldier ants (females) are the protectors.

Working forage ants (females) gather food. A foraging group is called a raid. They can travel over 300 feet in one night gathering food.

Nursery ants (females) care for the babies.

One sizable **queen ant** per colony produces eggs day and night and the male **drone ants** dote on the queen. Neither rarely leave the nest area.

Ant colonies wage wars and take over other colonies. The losing colony becomes slave ants looking after the winning colony.



The Ladybug & Beetles

Beetles are insects with three body parts, six legs, and most have two sets of wings. The front wings are thick and hard and lay over the thin back wings, which are used for flying. Beetles have two antennae on their head. Their antennae are feelers used to touch, smell, and taste things.

Colors and Markings: Ladybugs are colorful for a reason. Their markings help protect them by communicating to predators that they should eat something else because..."I taste terrible." When threatened, the bugs will secrete an oily, foul-tasting fluid from joints in their legs. They may also play dead for their protection. Birds are ladybugs' main predators, but they also fall victim to frogs, wasps, spiders, bats, fish, and dragonflies.

Most ladybugs have oval, dome-shaped bodies with six short legs. Depending on the species, they can have spots, or no markings at all and come in many colors. Seven-spotted ladybugs are red or orange with three spots on each side and one in the middle with its shiny red-and-black body. They have a black head with white patches on either side.

Are Ladybugs Boy or Girl? The ladybug is the common name given to beetles in the Coccinellidae family. This is misleading because not all ladybugs are ladies; they can be either female or male. It is difficult to determine the sex of a ladybug, but females tend to be larger than males.

How Useful are Ladybugs? Ladybugs are one of the most common of the beetle family of insects. Seven-spotted ladybugs are native to Europe but were brought to North America in the mid-1900s to help control aphid populations. Most people like ladybugs because they are pretty, graceful, and harmless to humans. Farmers appreciate them because they do eat aphids, mites, scales, thrips, white flies, and other plant-eating pests. One ladybug can eat up to 5,000 insects in its lifetime.



The Butterfly



Butterflies, just like honey bees, help pollinate flowers. Even though butterflies have longer legs and less pollen gets on their body, they are still effective pollinators. In fact, butterflies can travel farther distances than the honey bees, which means they can pollinate a greater area.

Butterflies pollinate during the day when flowers are open. Some pollen gets on the butterfly's legs and some on their bodies. As they go to another flower of the same species, that pollen gets transferred onto that flower.

Did You Know? Butterflies have better color perception than the honey bee and humans. They are able to see the color red, which the honey bee cannot. They also are able to see ultraviolet light which helps them see the nectar guides that are located on the flowers. Butterflies have good sight up to 10-12 feet and after that their vision becomes blurry.

At Home Activity - Chromatography Butterflies

Materials:

- Coffee filter
- Food dye or water colored markers
- Spray bottle
- Small clothes pin or pipe cleaner
- Drop cloth or newspaper to place under work station



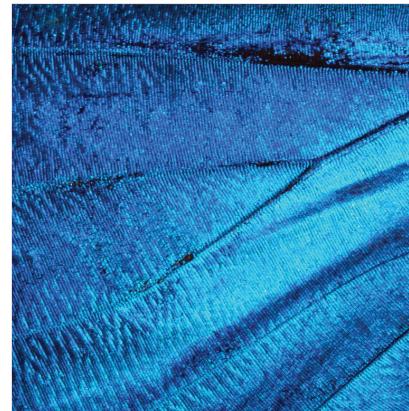
Step 1: Squeeze a few drops of food dye onto the coffee filter (or use markers to make circles of solid color). Keep them spaced out in order to let water bleed the colors.

Step 2: Spray the water using the water bottle evenly over the filter and colors. Let dry.

Step 3: Scrunch the coffee filter down the middle and secure with a clothes pin to form the two wings of the butterfly. A pipe cleaner may be used in place of clothes pin; the ends of the pipe cleaner can be used to form antenna.

Inside a Chrysalis

The pupa stage of a moth is called a cocoon, while for the butterfly it is called a chrysalis. This is when the caterpillar stops eating and begins its transformation into a butterfly.

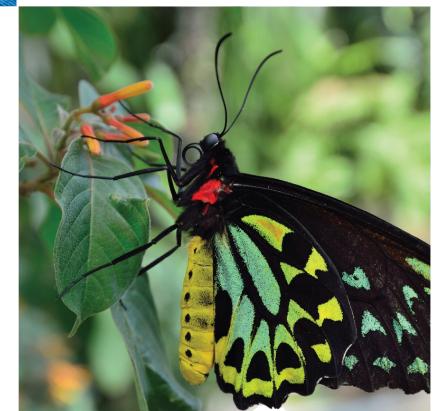


Transparent Wings

Butterflies have lots of colors. This is because their wings have tiny scales that reflect light. Underneath these scales the wings are made out of an exoskeleton called chitin, which is transparent.

Taste with Their Feet

Butterflies have taste receptors on their feet. They land on food such as fermenting fruit and these organs sense the dissolving fruit.



Drinking Nectar

The butterfly has a proboscis, which slurps up nectar from flowers. As the butterfly drinks, some pollen gets stuck on its hairs and transfers pollen from one flower to another.

The Hummingbird



Have you ever heard a hummingbird fly by you? They zoom by so fast that they make a "humming" sound. This is where the name hummingbird comes from. In fact they are also called hummers. They fly so fast that all you see is a blur. Hummingbirds flap their wings at incredible speeds. On average, a hummingbird will flap its wings 50 times a second

and can reach speeds as fast as 200 times a second. Now that is fast! This allows them to fly as fast as 34 miles per hour.

Hummingbirds are pollinators. They love to drink the sweet nectar from the flowers by sticking their beak into the flower and moving their tongue in and out 13 times per second to slurp up the liquid. When they do this, some of the pollen gets stuck to their beak. When they fly to a neighboring flower the pollen comes off on the pistil of the flower. About 8,000 flowers in North and South America depend on the hummingbird for pollinating.

Did You Know? There are over 340 species of hummingbirds and they are native only in North, Central, and South America. Hummingbirds are the only birds that can fly backwards, as well as hover, fly forwards, and even upside down. A flock of hummingbirds can be referred to as a bouquet, a glittering, a hover, a shimmer, or a tune.

Source: West Greeley Conservation District / 4-H Pollinator Habitat Program

Hummingbird Nectar Recipe

One way to attract hummingbirds is to set up a feeder with a sugary nectar to provide them with a food source.

1. Bring 1 cup of water to boil
2. Add 1/4 cup of white granulated sugar
3. Stir until dissolved
4. Boil this mixture for 2 minutes (this will help keep the nectar from spoiling too quickly)
5. Set aside to cool
6. Pour into a clean hummingbird feeder

5 Things Kids Can Do to Help Pollinators



- 1. Be kind to your pollinator friends.** Pollinators like bugs and birds are small and fragile. It's easy for people to hurt them. Be gentle and quiet when they are near!
- 2. Look, but don't touch!** When you see a butterfly, bee, beetle, or hummingbird outside, look, but don't touch! Pollinators won't hurt you if you leave them alone and are kind to them.
- 3. Don't use chemical sprays.** Bug your family to stop using chemical sprays in your house and garden. Chemicals kill bad bugs, but they hurt pollinators too.
- 4. Keep pollinators' homes safe.** And help make habitat for pollinators. Take care of a garden. Plant some flowers. When you find a bug in your house, gently take it outside to its natural habitat.
- 5. Bug someone!** Bugs and pollinators are fun and interesting. Teach your family and friends about these important creatures. Teach them to say "Thanks Bugs!" You can "bee" an expert!

Visit www.pollinator.org for more ideas and information.



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