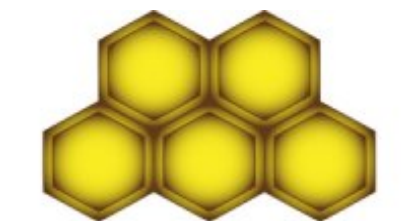


Bees and Pollination: An Educator's Guide

Sponsored by the West Seattle Bee Garden and Puget Sound Beekeepers Association



WEST SEATTLE
BEE GARDEN



PSBA
Puget Sound Beekeepers Association

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Introduction:

Thank you for your interest in providing bee and pollination education! The members of the Puget Sound Beekeepers Association and the West Seattle Bee Garden have a common passion for sharing bee and pollinator knowledge. While we wish we could send beekeepers into classrooms every day, and that every classroom was able to come visit the bees and plants at the West Seattle Bee Garden, we know this isn't always a possibility. We love the fascination that honey bees inspire and how this can motivate connections with our ecosystems. Honey bees are one of many significant examples of how our decisions impact our surrounding ecology. With these educational kits, our goal is to continue to fascinate and motivate beyond the reach of our own beekeepers and gardens. Thank you for your time and participation in achieving this goal.

“Education is the most powerful weapon we can use to change the world.”

- Nelson Mandela

Please visit our websites for more information and additional education materials;

Puget Sound Beekeepers Association (PSBA): pugetsoundbees.org

West Seattle Bee Garden (WSBG): westseattlebeegarden.com (click the 'For Educators' tab)

Have any comments, suggestions or questions? Please email us!

PSBA: president@pugetsoundbees.org

WSBG: westseattlebeegarden@gmail.com

Goals and Objectives:

Students will understand the structure of a honey bee hive and be able to describe the roles of different types of honey bees within the hive.

Students will understand the definition and significance of pollination and be able to describe the role and impact of pollinators.

Students will be able to identify a variety of different pollinators, and understand their role in pollinating different types of plants.

Students will be able to differentiate between social insects and solitary insects as well as bees and wasps.

Students will be able to describe the role of beekeepers.

Students will understand why some bees sting and best behavioral practices when encountering a bee.

Students will understand the challenges bees and pollinators are facing and the impact our decisions have on the health of bees, pollinators, and ecosystems.

Students will be able to identify steps they can take to help bees and pollinators.

Vocabulary Words:

Beehive – an enclosed structure in which honey bees live and raise their young. Natural beehives are naturally occurring structures occupied by honey bee colonies, such as hollowed-out trees. Beekeepers keep honey bees in man-made beehives, often in an apiary (a place where several beehives are kept).

Beekeeper – a person who keeps honey bees. Honey bees produce goods such as honey, beeswax, pollen, propolis, and royal jelly. Some beekeepers also raise queens and bees to sell to other farmers or for scientific research. Beekeepers also use honeybees to provide pollination services to fruit and vegetable growers. Many people keep bees as a hobby. Others do it for added income or as their main profession. Many factors affect the number of colonies a beekeeper will choose to maintain.

Brood – the young of an animal that is hatched and cared for. With regard to honey bees, brood consists of baby bees in the egg, larva, and pupa stages of development.

Cross Pollination – pollination of one flower or plant with pollen from another flower or plant.

Drone bee – a male honey bee and the product of an unfertilized egg. Unlike the female worker bees, drones do not have stingers and do not gather nectar or pollen. A drone's primary role is to mate with a queen.

Ecology – the scientific analysis and study of interactions among organisms and their environment. It is an interdisciplinary field that includes biology, geography, and Earth science.

Ecosystem – a biological community of interacting organisms and their physical environment. A complex network of interconnected system.

Honey – a sugary food substance produced and stored by certain types of bees, especially honey bees. Honey is made from the nectar of plants. Bees eat honey to give them energy. They also store honey in their hive to eat during colder weather when flowers aren't blooming and food sources are scarce. Bees use digestive enzymes in their body to partially digest the sugars in nectar. They place the honey inside the honeycomb and use their wings to fan the honey to decrease its moisture content so that it won't ferment. When the honey has reached the right moisture level, the bees place a wax capping over it, and save it for later. Microorganisms do not grow easily inside honey. When stored properly, honey is still edible after more than 1,000 years!

Honey bee – a type of bee that is primarily distinguished by the production and storage of honey and the construction of perennial homes containing nests made out of wax. Honey bees represent only a small fraction of the roughly 25,000 known species of bees.

Honeycomb – a group of repeating hexagon shapes made out of beeswax that provides the foundation of a honey bee hive. Bees construct many rows of honeycomb within their hive. The hexagon-shaped cells are used to store food (honey and pollen) and provide space for developing brood.

Interdependent – two or more people, animals, plants, or things that rely on each other for survival.

Leafcutter bee – a solitary bee and excellent pollinator. They have been especially helpful in pollinating alfalfa crops. Leafcutter bees build small tunnel-like nests with several cells composed of rolled up leaves. Each cell houses a single egg with some pollen and nectar for the developing larva. They do not aggressively defend their nests.

Mason bee – a solitary, stingless bee that is an excellent pollinator. Mason bee houses are commonly sold at garden shops. Mason bees nest in small tube-like spaces, sometimes nesting in the small gaps between shingle siding of houses. They are relatively harmless and cause no damage to structures.

Native bee – bees that originated from the land they inhabit. For example, native bees in Washington State are bees that have always lived here and come from here originally. Non-native bees originated on different continents and were later brought over to North America. As long as there is enough food and shelter, native bees are the most capable survivors within local habitats and can thrive without the assistance of beekeepers.

Pheromone – a chemical substance produced and released into the environment by a plant or animal, especially a mammal or an insect, affecting the behavior or physiology of others of its species.

Pollen – a fine powdery substance consisting of microscopic grains discharged from the male part of a flower or from a male cone. Each grain contains a male gamete that can fertilize the female ovule to which pollen is transported by the wind, insects, or other animals.

Pollination – the process of pollen transferring to the female reproductive organs of a plant, enabling fertilization to take place. Pollination is an essential step in the production of seeds. For the process of pollination to be successful, a pollen grain produced by an anther (male part) of a flower must be transferred to the stigma (female part) of a flower.

Propolis – a resinous mixture that honey bees produce by mixing saliva and beeswax with substances gathered from tree buds, sap flows, or other botanical sources. It is used as a sealant for unwanted open spaces in the hive. Propolis is used for small gaps, while larger spaces are usually filled with beeswax. Its color varies, but it's most commonly dark brown. Propolis is sticky at room temperature and above. At lower temperatures, it becomes hard and very brittle. Propolis is often referred to as "bee glue."

Queen bee – a female honey bee that is the mother of most, if not all, the bees in a beehive. A queen bee's only job is to lay eggs. Queen bees are developed from larvae selected by worker bees and specially fed in order to become sexually mature. There is normally only one adult, mated queen in a hive, and the bees will usually fiercely protect her.

Royal jelly – a honey bee secretion that is used in the nutrition of larvae and adult queens. It is secreted from the glands in the hypopharynx of worker bees and fed to all larvae in the colony whether they are destined to become drones (males), workers (sterile females), or queens (fertile females). After three days, the drone and worker larvae are no longer fed with royal jelly, but queen larvae continue to be fed this special substance throughout their development.

When a queen bee weakens or dies, worker bees will decide to make a new queen. They choose several small larvae and feed them copious amounts of royal jelly in specially constructed queen cells. This type of feeding triggers the development of queen morphology, including the fully developed ovaries needed to lay eggs.

Self-pollination – the pollination of a flower by pollen from the same flower or from another flower on the same plant.

Wasp – a social winged insect that has a narrow waist and a stinger. It constructs a paper nest from wood pulp and raises the larvae on a diet of insects.

Wind pollination – pollination of plants by means of pollen carried by the wind.

Worker bee – a female honey bee that performs important tasks within a honey bee hive. Nurse bees, guard bees, forager bees, and scout bees are all different types of worker bees.

Questions/Discussion:

What do you think a beehive is?

A: It's where bees live! It's where they sleep, store their food, and have their babies. In nature, honey bees choose to build their homes in hollow spaces, especially inside hollow tree trunks.

Beekeepers make hives out of wooden boxes, trying to simulate the same space bees would build for themselves inside a tree trunk. Inside the boxes are frames that honeybees use to build their honeycomb. These hives make it possible for beekeepers to manage the bees and give bees a place to live in areas where there aren't many trees, like in the city. Beekeepers can add boxes to make the hive taller as the population of the hive grows, and they need more space. Each stack of boxes is one hive.

How many bees do you think live in a honey bee hive?

A: Depending on the time of year, the number of honey bees can vary from 30,000 to 80,000. There are more bees in the summer when the flowers are blooming and there is a lot of work to do- like making honey! Honey is made from the nectar of flowers. During the summer, the hive needs a big team of bees to gather nectar and pollen from flowers, so they can feed their baby bees and store honey for the winter. In the winter, flowers aren't blooming and food sources are scarce, so the honey bees depend on the honey they have stored inside their hive for food. During this time, fewer bees are needed because there isn't as much work to do, and the honey bees primarily stay inside their hive.

All of the bees in the hive work together toward a common goal – the health of the hive. Each bee has a specific job to do to help make sure the hive is successful. They are an excellent example of teamwork!

**See photo of Langstroth hive, and honeycomb

There are three different types of honey bees. Does anyone know what the different types might be?

A: Worker, Drone and Queen. Some people refer to these three different types of honey bees as three different castes.

*See picture of worker, drone and queen honey bees

What do you think the different types of honey bees might do?

A:

Worker: Worker bees are all female, and they do almost all of the work! About 90%, or 9 out of every 10 bees in the hive, are worker bees. There are different types of worker honey bees, depending on the type of work they do.

- **Nurse Worker Bees** take care of the baby bees. Beekeepers often refer to baby bees in the

egg, larva and pupae stages of development as “brood”. Nurse bees also take care of the queen bee. They make sure the brood and queen have plenty to eat and ensure the queen is kept clean and healthy.

- **Guard Worker Bees** protect the hive from invaders like bears, skunks, humans, wasps and even honey bees from other hives that try to enter and steal precious honey from the hive.
- **Forager Worker Bees** are the honey bees we see in our gardens flying from flower to flower. Their job is to collect pollen and nectar from flowers, and bring it back to the hive to store as food.

Pollen is what bees eat for protein. Nectar is stored in the honeycomb and will eventually become honey! First some of the moisture in the nectar needs to evaporate, so that it becomes thick, like honey. This is an important step that will prevent the honey from going bad - with too much moisture, the honey will ferment. Honey is the bee’s source of carbohydrates. Forager worker bees will need to collect enough nectar to provide honey for the entire hive plus enough for the entire winter. Each hive needs at least 60 pounds of honey to survive the winter.

- **Scout Worker Bees** spend most of their time looking for new sources of food. They will travel up to 3-5 miles away from the hive searching for flowers. After finding a good spot, they come back to the hive and tell the forager bees where to go, by doing a waggle dance. The direction they are facing and duration of the waggle tells the forager worker bees which direction, and how far, to fly. They also give the forager bees clues via smell, by returning to the hive with pollen and nectar from the food source they are recommending on their bodies. Scout worker bees will also search for a new home for the hive to move to if needed.
- Other tasks worker bees perform include cleaning the hive, making honeycomb, ventilating the hive (using their wings to circulate fresh air), and packing pollen into the cells of the honeycomb. Worker bees are born ready to perform all of the different worker bee tasks when needed. They rotate tasks depending on their age. Younger worker bees clean the hive and take care of the queen, while older worker bees forage for food.

Drone: Drone bees are all boys, and they make up about 10% of the hive. Drone honey bees do not have a stinger, so they can’t sting! Drones have only one job, but it is very important – they mate with queens from other hives. Without drones, queen bees wouldn’t be able to lay fertilized eggs, and none of the hives would be successful. Drones from different hives will gather in the same area, called a drone congregation zone, which is located 10-40 meters above the ground. One of the first things a queen bee does in her life is leave the hive to go on her mating flight. The queen emits a certain chemical called a pheromone, and the drones can smell her pheromone as she flies by. Once the drones detect that the queen is near, they race to meet her and mate with her in flight. The queen will mate with about 10-15 drones during her one mating flight! Afterward, she will usually have enough sperm stored in her body to lay fertilized eggs for the rest of her life. Drones are big and strong, and have very large eyes. The need to have excellent vision to spot the queen when she is on her mating flight, and they must be very strong so they can fly fast to catch up with her.

Drones don’t do any work back inside the hive. They are fed and cared for by worker bees. The queen

will lay more drone eggs in the spring when drones are needed most. In the fall, drones are kicked out of the hive by worker bees. The drones don't have a productive role to play during the winter, and if they stayed, they would consume precious honey the rest of the bees rely on.

Queen – There is only one queen in a honey bee hive, and she has only one very important job – to lay eggs. The queen can lay more than 1,000 eggs per day – centering each egg in the middle of a honeycomb cell. She is the mother to all of the bees in the hive. A beekeeper is able to spot the queen because of her long abdomen, which is needed to store all of those eggs!

The queen can control whether she lays a female egg or a male egg. If she adds a sperm to an egg, it will become fertilized and grow into a female worker bee. All unfertilized eggs become male drone bees. It is believed that worker bees help the queen with this decision by determining the size of the honeycomb cells they build. The queen will lay male eggs in larger cells and female eggs in smaller cells.

Like drones, worker bees also pay close attention to the queen's pheromones. Inside the hive, the queen's smell lets the other bees know that she is around and how she is doing. If the queen bee gets sick, isn't able to lay eggs anymore, or dies, the worker bees need to act quickly to replace her (see FAQs for how this works).

The queen will only leave the hive for two reasons. The first instance is her mating flight. The second reason is if the hive decides to swarm. In this case, the original queen leaves the hive with half of the bees, and the other half of the bees stay behind and make a new queen (see FAQs for more information about swarms).

Why do you think we might like honey bees, and want to have them around?

A: Honey – yes, honey is delicious and may even have some health benefits. We love honey!

A: They help pollinate! Bees and flowers are interdependent. The bees depend on the flowers for food, and the flowers need the bees to pollinate them. Plants and bees help each other survive and reproduce.

Pollination (fertilization) happens when a pollen grain from the anther (male part of a flower) travels to the stigma (female part of a flower). Anything that helps spread pollen, and make pollination happen is a pollinator. Bees spread pollen while foraging for food – pollen sticks to their hairy bodies when they visit a flower and then some falls off while they visit other flowers. One forager worker bee can visit as many as 2,000 flowers in a day, making them very effective pollinators!

Plants need to be pollinated in order for them to be healthy and make seeds.

- A few plants are able to self-pollinate when pollen from the anther falls into the stigma of the same flower or plant. This happens most often in legumes such as peanuts, and soybeans. Self-pollinating plants usually need to be vibrated by a pollinator or the wind for pollination to happen.

- Other plants need to be cross pollinated, which is the transfer of pollen grains from a separate plant of the same species. These plants depend primarily on insects and wind for pollination.
 - o Plants that depend on insects like bees for pollination work hard to attract their attention. They often have bright colored flowers, smell sweet, and provide nectar. Nectar is food for pollinators.
 - o Plants that depend on wind for pollination usually do not have bright colors, special scent or nectar. Their pollen is smooth, light, and easily airborne. Their stigma and stamens are usually exposed to the air instead of inside pretty flowers.
- Some plants like orchids, peas, and sunflowers are healthiest when cross-pollinated but are able to self-pollinate, if needed. This is a good option for plants to have, in case they grow in an area where pollinators are scarce.

Why do we want plants to be healthy?

A: There are many answers including clean air, healthy ecosystems, and natural beauty

A: Plants produce food! Most plants that produce fruits and vegetables need to be pollinated by a pollinator. Only some plants can be pollinated by the wind.

There are more than 135 commonly consumed fruits and vegetables that are pollinated by bees. A few examples include apples, grapes, plums, pears, raspberries, blackberries, strawberries, oranges, watermelon, squash, pumpkins, zucchini, tulips, and lavender.

Plants that depend on the wind for pollination include grasses and grains. Examples include wheat, rice, corn, barley, oats, and rye.

**Wikipedia has a great list of crops pollinated by bees, including the type of bee that pollinates the specific crop, and the pollinator impact for each crop:

https://en.wikipedia.org/wiki/List_of_crop_plants_pollinated_by_bees

Plants are a very important part of keeping ecosystems healthy. Many different insects and animals are dependent on plants for food and shelter. People like us enjoy eating fruits and vegetables, but plants are important for animals to eat too. Our land is dependent on plants to keep it stable - without root systems to keep it in place, dirt will move more easily. Plants also help keep our water and air clean.

The health of every member of an ecosystem is important. One way to think of an ecosystem is as a big puzzle. All of its pieces are important. If one piece goes missing, the strength of the entire group is affected. Different pieces of an ecosystem include insects, animals, plants, land, air, and water. They are all interdependent.

Honey bees are not the only species of bee. Can you think of other different types of bees?

A: Bumblebees (46 different species in North America alone), carpenter bees, sweat bees, mason bees, and leafcutter bees

There are more than 25,000 species of bees in the world, and they are all important. Some bees are only able to pollinate certain flowers. For instance, honeybees are not able to get inside tomato flowers, but bumblebees and a few other native bees can. Some bees are especially good at pollinating certain types of flowers. For example, 250 orchard mason bees can pollinate apple tree blossoms as effectively as 50,000 honey bees! All bees have an important role to play in making sure that all of the different types of plants are pollinated and healthy.

Native bees are bees that originated in the area they live – they are native to the land. Honey bees are not native to North America. They were brought over by European settlers.

Although there are thousands of different species of bees, we often think of honey bees when we hear the word “bee.” Honey bees can serve as a medium for curious minds interested in the world of bees, social insects, and the important role of all pollinators. Not only do they produce a delicious food product, but they live together in hives, introducing us to a fascinating world of teamwork – as well as the wonder, importance and beauty of the nature that surrounds us every day.

Bees are not the only type of pollinator. Can you think of anything else that might be a pollinator?

A: Butterflies, ladybugs, hummingbirds, bats, flower beetles, wasps, flies, moths. Anything or anyone who helps move pollen from flower to flower is a pollinator. Even humans can even be pollinators!

Honey bees are known as a social insect. What do you think that means?

A: Social insects live together as a group. There are several distinct characteristics that define a social insect colony. They have a queen that lays all the eggs. She is the only insect in the colony responsible for reproduction. All the other members of the colony specialize in different tasks. They divide their work, assigning different tasks to different groups of the colony (for example, all the different types of worker honey bees, and the tasks they perform). They work together as a group to take care of the brood (babies) in their larva stage of development. The colony includes overlapping generations (grandparents and great grandparents all living together). Honey bees, bumblebees, wasps, ants and termites are examples of social insects.

The more we learn about social insects, the more fascinating they become. There are many intricate functions colonies perform to increase their odds of survival. It can be hard to understand how each individual insect in a colony knows what to do- or how they are able to complete such complex tasks. Sometimes a social insect colony is compared to a single organism – each insect inside the colony representing a single cell within the organism.

Most types of bees are solitary bees. What do you think a solitary bee is?

A: Unlike social insects, solitary insects live by themselves. Most solitary bees live in the ground, while some live inside hollow twigs, or inside holes in wood. All female solitary bees are fertile and make their nests by themselves. They do not make honey or beeswax. Solitary bees are important pollinators - they gather pollen and nectar from flowers to feed their brood. Solitary bee nests may contain several compartments. The female bee will lay an egg inside each compartment, provide food for the egg, then seal the compartment off. She will not return to care for her brood and will usually die after making one or more nests.

Wasps vs. Bees

Bees evolved from wasps, and they share some similar features. It is common for wasps to be confused for bees. Wasps serve some important functions. They help keep insect populations under control by consuming other insects, and they contribute to the food chain since they are consumed by other animal species, like birds. Wasps are omnivores, meaning they eat both meat and plants. Wasps survive primarily off of eating other insects, but they also consume sweet substances like nectar, fruits, and tree sap. Wasps are the insects we see most commonly at our picnic tables. Honey bees only consume plant products like nectar and pollen. Bees have developed features on their bodies to help them transport their food, like pollen baskets on their hind legs and/or extra hair on their bodies.

Wasps live together in nests. You may see their nests in areas like the eaves of homes, covered areas of decks and patios, or in the ground. The wasps we typically see in Washington State are yellow jackets and paper wasps. Yellow jackets usually nest in or close to the ground, while paper wasps tend to make their nests higher off the ground. Wasp nests are made out of a substance similar to paper. In nature, honey bee hives are found in hollow spaces like tree trunks, or other enclosed spaces. Their comb is made out of beeswax. Bumblebees usually make their nests either inside the ground or just above the ground in undisturbed places, like tall grasses. Bumblebees do make some beeswax, but significantly less than honey bees. Solitary bees (like mason bees) live alone in small confined places, like hollow twigs.

Unlike honey bees, wasps do not store food to last the winter. You may notice that wasps are more docile in the spring when food sources are plentiful, but they become more aggressive in the late summer and fall when their food supplies dwindle. In the fall, honey bee hives are at risk of wasp attacks. If the wasps make it inside the hive, they will eat anything they can find including honey, eggs, larvae, and pupae. A healthy honey bee hive can defend themselves against wasps. However, if the population of a hive is low, and/or the bees are weakened by disease or parasites (like mites), a hive may not be able to defend itself and can be completely taken over by wasps.

Wasps are also pollinators, but they aren't as effective as bees. Since nectar and pollen are not their primary food source, they do not travel to as many flowers as bees. Also, their bodies are not as hairy as most bees, so pollen doesn't stick to them as easily.

**See picture of yellow jacket wasp, paper wasp, honey bee, bumble bee, wasp nest mature wasp nest, honey bee hive and bumble bee nest.

Fear and Stings

It's common for people to be afraid of bees. Many of us have unpleasant stories to share from when we were stung by a bee or wasp. The good news is that bees don't *want* to sting us. Bees primarily sting if they feel threatened, or when they are defending their hive. In general, if we leave bees alone, they'll leave us alone. When we see bees flying from flower to flower, they are focused on gathering food to bring back to their hive. If you see a bee, take a few steps back. Do not try to shoo them away because this could scare them. Remember, bees have an important role to play in keeping the plants that grow our fruits and vegetables healthy!

It's common for beekeepers to wear protective clothing (suit, veil, gloves, etc.) when opening a honey bee hive. Bees may feel defensive when the top of their home is removed and the inside of their home is moved around. Since bees sting to defend their hive, beekeepers who open hives are at an increased risk of being stung. Still, some beekeepers choose to wear minimal gear, are gentle and calm when inside the hive, and are able to walk away without any stings.

Even with our best efforts and intentions, sometimes people do get stung. The best thing to do after a sting is remain calm and remove the stinger if you can. The stinger of a worker bee is barbed, so that stinger is harder to remove from the skin after a sting. A venom sack is attached to the stinger, and this emits the chemicals that cause stings to hurt. Therefore, if the venom sack is removed, the severity of the sting may be decreased. To remove a stinger, use a flat surface such as a credit card to gently scrape the stinger away. Never squeeze a sting- that could burst the venom sac. Ice can be used to decrease the swelling, and antihistamines such as Benadryl/diphenhydramine are helpful in reducing the itching. If there is concern for an anaphylactic reaction after a sting (especially swelling in the face or throat or difficulty breathing) the situation should be treated as an emergency. Call 911, offer Benadryl/diphenhydramine if it is available, and offer an EpiPen if one is available and symptoms are severe. Anyone with a known allergy to bees should carry an EpiPen, especially if they are near a beehive.

Beekeepers and What They Do

There are a variety of reasons people decide to become beekeepers. Many beekeepers choose to keep a couple of hives as a hobby, enjoying the connection to nature, working with the bees, and observing how the hive operates. Beekeepers often harvest modest amounts of honey to enjoy and share with family and friends. Some also like providing a home for bees and increased pollination of their gardens and local plants. Other people keep bees to collect data and do research or for other educational purposes.

Commercial beekeepers can have anywhere from a few dozen to *thousands* of hives. Keeping bees is their way of earning an income. These beekeepers harvest and sell large amounts of honey and can sell other products like beeswax candles and lip balm. Commercial beekeepers sometimes move their hives around to different farms so their bees can pollinate large areas of crops. For example, if a farmer has 100 acres of cherry trees in one location, all of those trees will bloom at the same time. In order for these trees to produce healthy fruit, they will need to be pollinated. Naturally, there often aren't enough pollinators around to pollinate that many trees at once, so hives of honey bees are brought in to ensure the job is completed thoroughly. After the bees finish pollinating the cherry trees, they may be moved to another crop that is ready to bloom.

Problems Facing Pollinators:

Bees and all pollinators are facing a variety of problems that affect their health and ability to survive. We all need healthy food and a home in order to live a healthy life. With changes to our ecosystems, sometimes housing options (trees) and food sources (flowers) for pollinators are removed. Some changes to pollinator habitat include clearing land for buildings and roads. When pollinators' habitat shrinks, their populations also decline.

Some chemicals sprayed on plants can also affect the health of pollinators. In order to prevent insects from damaging plants, sometimes chemicals called pesticides are sprayed on them. These chemicals can adversely affect the health of bees. Even if they don't kill the bee, they can sometimes make them feel sick or confused, which impacts their ability to perform their jobs well. Other chemicals called herbicides are sometimes used to kill certain types of weeds or other unwanted plants. Flowering weeds are often important food sources for pollinators. Too much use of these chemical herbicides can have other adverse effects on our pollinators and ecosystems. Weed control is sometimes necessary, but it is important to take a balanced approach that takes into account the health of the local pollinators.

Bees are also facing an increase in some diseases- especially parasites. The *varroa mite* is a parasite that attaches itself to honey bees. These mites make bees weaker by consuming their nutrients, and increase their susceptibility to disease. For beekeepers, the varroa mite is a primary reason hives do not survive the winter. All beekeepers will face varroa mite infestations and will have to confront the complex dilemma of how to manage them.

What Can We Do To Help Bees and Pollinators?

1. One of the easiest and most effective ways to help bees is to help restore their habitat, and provide them with a food source. This means planting pollinator-friendly plants and flowers! Even small gardens provide a great service to pollinators. Some pollinators, such as certain species of butterflies are not able to travel long distances between food sources. This makes it especially important to have small gardens dispersed around places like cities, so that they can travel from one food source to another. Landscaped yards are beautiful, but it's important to allow portions of the land to remain more natural, with twigs, leaves and native plants that provide food and shelter for pollinators.

Aster, bee balm (monarda), borage, oregano, lavender, echinacea, yarrow, and blackeyed susans (rudbeckia) are all examples of pollinator friendly plants that grow well in the Pacific Northwest.

More information about bee friendly gardening is available at this website:
<https://www.pugetsoundbees.org/bee-friendly-gardening/>

2. Bees need water as well. Setting out a shallow source of water provides an important spot for bees to stop and take a drink.

3. Avoid using pesticides (chemicals that kill insects) and try to purchase fruits and vegetables from small local farmers who grow their crops organically (without use of chemicals).

4. Avoid using herbicides (chemicals that kill weeds). Not only can these chemicals harm pollinators, but they also kill plants that are an important food source for bees and pollinators. Spraying large areas with herbicides can be harmful to bees and pollinators, as well as the local ecosystem.

5. Provide a home for bees. In areas where there aren't enough bees, it is helpful to provide a space for them to live. This could entail creating a hive and becoming a beekeeper. Providing homes for native pollinators is helpful too, and this requires less time and work. For example, mason bee homes are

easy to build or purchase and require almost no work at all!

Frequently Asked Questions:

Is there a king bee?

A: No, there isn't a king. The drones are the only male bees in the hive.

A: 'Queen' is a name we've given the queen bee, but she doesn't rule the hive like humans who are queens of countries. The queen bee is very special, and vital to the health of the hive, but the worker bees primarily make decisions for the hive.

What happens if the queen dies?

A: As long as a hive has eggs, they are able to make a new queen. If a hive does not have eggs, and is not given a new queen by a beekeeper, its population will decrease until there aren't any bees left in the hive.

It takes about 16 days for the queen to develop from an egg to adulthood and another one to three weeks for her to go on her mating flight and start laying eggs. Since queen bees lay around 1,000 eggs per day, the loss of a laying queen for about one month can be very disruptive to the population of a hive. Depending on the time of year and status of the hive, some beekeepers may choose to purchase a mated queen, instead of waiting on the hive to make their own. This introduces a new line of genetics to the hive.

How does the hive make a new queen?

A: Any female (fertilized) egg could potentially become a queen. Most of the time these female eggs will become worker bees. After the egg hatches and becomes a larva, the nurse bees will feed the larva a special substance called royal jelly during the first three days of her development. After this time, they feed the larva a combination of pollen and honey, sometimes referred to as 'bee bread'. If the hive decides they would like a female egg to become a queen, they will only feed her royal jelly throughout her entire development. This change in nutrition alters how the baby bee grows, and prompts her reproductive organs to develop fully - and she becomes a queen!

The worker bees also create a special cell in the honeycomb for developing queens. A cell is the space within the honeycomb where honeybees develop from an egg into an adult bee. Queen cells are usually about an inch long - much larger than the cells of worker bees or drones. The queen bee's body is longer than the bodies of drone and worker bees, so queen cells need to be longer in order for them to fit inside. Queen cells hang vertically on the frame of the hive (honeycomb) and look a bit like a peanut shell. Beekeepers look for queen cells when they inspect hives because they provide big clues about how the bees are doing and what they are up to. Depending on the location of the cell, beekeepers can tell if the hive is making a new queen because the original queen is sick or missing (a supercedure cell), or if the hive is planning to swarm (swarm cell). Supercedure cells are located in the middle of the frame, while swarm cells are located at the bottom of the frame. After spotting a supercedure or swarm cell, the beekeeper can prepare accordingly.

If a new queen is needed, a hive will usually create several queen cells to ensure that at least one of them successfully develops and hatches into a queen.

****include picture of queen cell****

What happens if there are multiple queens in the hive?

A: There can only be one queen in each hive. If several queens hatch, they will 'duke it out' until only one remains. If a queen hatches and notices there are other queen cells in the hive, she will sting the queen cells to kill the developing queen inside.

Can a queen bee sting?

A: Yes, queen bees have stingers. Unlike worker bees, a queen bee's stinger is not barbed. This means that she is not injured by stinging, and can sting multiple times. Queen bees will only sting other queen bees (see above).

Is it true that bees die after they sting?

A: This is true for worker bees. The stinger of a worker bee is barbed, and will remain in the skin of the person/animal they sting. Attached to the stinger is a venom sack that will cause discomfort for the person/animal that was stung. This is a form of protection for the hive and is meant to dissuade people or animals from trying to invade. A worker bee that loses its stinger this way is wounded too severely to survive – it has sacrificed itself for the safety of the hive.

What is a swarm?

A: A swarm is a sign that a hive is doing well, and has grown! As the population grows, the bees begin to run out of space in their hive. So, half of the bees leave the hive to live in a new home, and the other half of the bees stays behind. In nature, swarms are a good thing. It is how the bees reproduce - one hive becomes two!

Once the worker bees decide the hive should swarm, they need to prepare! They will need to find a new place to live. The scout worker bees work as a team to find the perfect new home. They start by identifying several options, then narrow their options down to the one spot they think would work best - it is a democratic decision! They will also need to make a new queen (see above). The original queen will leave with the swarm, and the hive makes a new queen for the bees that stay behind. The swarming bees will leave before the new queen hatches to avoid the conflict that comes with having two queens in the hive. The worker bees will even make the original queen run around the hive to get her in shape, and help her prepare for flying away with the swarm - teamwork!

Swarms can become problematic for beekeepers, especially in the city. If bees don't have trees to swarm to, they may try decide to live in a place where they aren't necessarily welcome, like inside the walls of people's homes. There are ways beekeepers can manage a hive that is preparing to swarm. Sometimes the beekeeper may choose to try and prevent the hive from swarming, or they might split the hive into two - simulating a swarm.

How long does it take for an egg to become a bee?

A: Honey bees develop in four distinct phases: egg, larva, pupa and adult. The amount of time it takes for an egg to develop into an adult bee depends on the type of bee. Drone bees take 24 days, worker bees take 21 days, and queens take 16 days.

**see the picture 'life cycle of a honey bee'

How long do honey bees live?

A: Again, this answer varies depending on the type of bee, and also on the time of year.

Drones: 20 days

Worker: Depends on the time of year and the amount of work they're doing. Bees are busiest in the summer and can literally work themselves to death.

Summer: 15-40 days

Spring/Fall: 30-60 days

Winter: 100-140 days

Queen: 1-5 years

What is the smoker for?

A: When a beekeeper is working with a well-populated hive, there are often bees spilling out of the boxes and covering all of the frames. This can make it difficult for the beekeeper to move the frames and boxes without hurting bees. It can also make it difficult for the beekeeper to see the signs they look for in order to assess and help the hive. A defensive hive may have bees that are aggressive toward the beekeeper, making it difficult to work. A smoker is used to help with these problems. Bees do not like smoke. When it is sprayed on the hive, they will go down into the hive to get away from it. With fewer bees on the surfaces, it is easier for the beekeeper to work with the hive and reduces the chance of accidentally harming the bees when moving components of the hive. Some people assume the smoke calms the bees, but this is not true. Smoke sends a message to the bees that their home is on fire which stops the bees from what they were doing and prompts them to go down into the hive to prepare to leave their home. Lastly, smoke effects the honey bee's ability to communicate. One way bees communicate is by smell, or pheromone. If there is an invader in the hive, some bees will send out alert pheromones, prompting other bees to become more aggressive and defend the hive. The strong smell of the smoke masks the smell of these alert pheromones, preventing the 'alert' message from spreading throughout the hive.

Beekeepers should try to use the least amount of smoke possible to comfortably work with the hive. Small amounts are ok, but too much smoke can be overly disruptive to the hive.

Do bees sleep?

A: Yes- all bees (probably) sleep. Most of the research on sleep focused on honey bees, but it is assumed that all bees sleep. Although honey bees do work very hard, even they need their rest. Research has shown that without sleep, honey bees are not able to perform their tasks as effectively.

Forager worker bees work hard collecting food while the sun is out during the day, and sleep inside the hive at night. The younger bees who work primarily inside the hive will take small naps throughout the day and night. When a bee is sleeping, its antennae droop downward, and it folds its legs underneath

the body. While honey bees almost always sleep inside their hive, some photographers have spotted bees sleeping inside flowers!

How fast do bees fly?

A: Honey bees fly at an average speed of 15 miles per hour but are capable of flying up to 20 miles per hour. This is about the same speed the average adult human is able to ride a bike and much faster than humans are able to run over long distances. When flying, honey bees flap their wings around 230 times per second!

I saw bees coming from the ground, were those honey bees?

A: Honey bee hives are almost always above ground. In nature, they are most commonly inside the trunks of trees. If you see bees coming from the ground, it is most likely a bumblebee nest or a wasp nest.

What is honeycomb?

A: Honeycomb is a group of repeating hexagon shapes made out of beeswax that provide the foundation of a honey bee hive. Bees construct many rows of honeycomb within their hive. The hexagon shaped cells are used to store food (honey and pollen) and provide space for developing young.

Beeswax is produced within the glands of honeybees. It is secreted from openings in their lower abdomen. Honey bees must consume honey to be able to make wax. A bee must consume about eight ounces of honey to make one ounce of beeswax- making beeswax a very valuable product.

Many people wonder why honeycomb is made out of such perfect repeating hexagon shapes. People have speculated about the shape of honeycomb for thousands of years. In 36 B.C.E., a Roman scholar speculated that bees construct their honeycombs using hexagons because it is the most efficient use of wax. He guessed that hexagons are the most compact shape, and that a group of hexagons has the shortest total perimeter compared to other shapes. More than 2000 years later, in 1999, a mathematician proved that the Roman scholar was right! Honey bees, on the other hand, apparently knew this all along.

The bees want to use their valuable beeswax as efficiently as possible. It takes a lot of time and effort to make honey- and a lot of time and honey to make beeswax! To accomplish this goal, honey bees would want to make all sides of the repeated shape the same size – so that the sides of one cell can be used for the cell next door. Also, they need a shape that won't waste wax by leaving any gaps in between cells (like circles). Hexagons are the ideal shape because they use less beeswax and save precious time and materials. Pretty smart, don't you think?

What does the hive do with dead bees?

A: Worker bees will remove dead bees, and dispose of them outside of the hive.

How far from the hive do honey bees travel?

A: Honey bees will routinely travel within a three mile radius of the hive to collect pollen and nectar from flowers. If food sources are scarce, they are able to travel up to a five miles to forage for food.

What happens to the drone after it mates with the queen?

A: Drones that are successful in mating with the queen are injured in the process, and they don't survive. Only about 1 in 1,000 drones will be successful in mating with a queen.

What is the “waggle dance”?

The waggle dance is a form of communication used by honey bees. It is how scout and forager worker bees communicate the location of food sources. For example, if a scout worker bee locates a bunch of blueberry bushes in bloom, they can return to the hive and tell the forager worker bees where the bushes are located. The direction the bee faces while dancing tells the other bees which way to fly, and the duration of the ‘waggle’ indicates how far to fly. Research has shown that this form of communication is remarkably accurate.

Is it true that honey can help with allergies? Does honey have health benefits? Or health risks?

A: It is possible. Honey contains small amounts of pollen from the flowers visited by honey bees. Some people are allergic to the pollen in these flowers, and it is thought that consuming small amounts of pollen (like the amount found in raw honey) can help people's bodies get used to pollen and decrease their allergic reaction to it - similar to immunotherapy. The jury is still out on just *how* effective consuming honey is for treating allergies, and this could vary from person to person. Many people with allergies are allergic to pollen from grasses, and bees do not visit grass to collect pollen and nectar. Although, some studies have shown there is still very small amounts of grass pollen in honey - although the amount is very small, and variable. Keep in mind that pasteurized honey no longer contains pollen, so be sure to look for local raw honey if you are interested in any benefit to allergies. Honey has also shown to have some antimicrobial effects, and may be able to decrease the pain, swelling, redness, and healing time associated with infected wounds. Some doctors recommend honey as a cough suppressant, due to it's coating effect on the throat, and note that the minerals and antioxidants present in honey could be beneficial as well. Due to the risk of botulism, it is not recommended to feed raw honey to infants under 12 months of age.

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