Pollinator Taxonomy

Learning Outcomes

Learn about the various pollinators in your area and how different some pollinators can be.
Identify pollinators in a garden or meadow and be able to describe the differences to others.

Challenges

Pollinator Field Trip

- Insect pollinators include: butterflies, moths, flies, bees, wasps, beetles, and more (others). Determine what pollinators are thriving in your area by visiting a local meadow or garden on a sunny day. Use a tally method to keep track of how many of each of the above 7 groups that you see and how long you were looking. Teach a family member or friend what you find and submit your list of pollinators.
- ***Learning Outcomes:*** *Learn what types of pollinators are in your local area. Learn how to differentiate between certain types of pollinators.*

Fly or Bee?

- Common insect pollinators fall under the scientific Orders of Hymenoptera (wasps and bees), Coleoptera (beetles), Lepidoptera (butterflies and moths), and Diptera (flies). Each has a distinctive anatomy such as specialized mouthparts, sense of smell, sight of specialized appendages that aid them in finding and pollinating flowers. Submit a paragraph describing pollinators from each of the above orders noting any special anatomical parts that aid them in finding or pollinating the flowers that they are attracted to. A good resource for this is http://www.fs.fed.us/wildflowers/pollinators/index.shtml
- ***Learning Outcomes:*** *Learn how different types of insects can be pollinators. Learn what makes each insect unique and how they may be attracted to certain types of flowers rather than others.*

Bumble Bee Biologist

Learning Outcomes

Learn about various types of bumble bees. Learn how to collect and preserve an insect specimen. Learn how to be a citizen scientist and add data to an online database.
Pretend you are an entomologist. Capture and preserve a bumble bee specimen. Take pictures of wild bumble bees and post them on an online database.

Challenges

Specimen Collector

- Collect a common bumble bee from your home environment and preserve it for study according to the guidelines found in *How to Collect, Preserve and Identify Insects*. Pin the specimen and post a picture of it on a social media platform of your choice. Submit a screenshot of your post.
- ***Learning Outcomes:*** *Learn how entomologists collect and preserve insect specimens.*

Bumble Bee Watch

- Visit the bumblebeewatch.org website. Learn why the website was created and why their work is important. On the website research the rusty patched bumble bee and discover what is being done to help save this species. Submit a brief explanation of their mission and 5 things that you learned about the rusty patched bumble bee.
- ***Learning Outcomes:*** *Learn about bumble bee watch and their mission to protect endangered invertebrates.*

Bumble Bee Photographer

- Take 5 pictures of bumble bees in the wild. Submit these photos on the bumble bee watch either on the website or through the downloadable app. Attempt to identify what species of bumble bees you took pictures of using their preliminary identification tools. Submit your photos and species list.
- ***Learning Outcomes:*** *Learn how to take pictures of bumble bees, how to post them on bumblebeewatch.org and how to identify them.*

Conserve the Monarchs

Learning Outcomes

Learn about the life cycle of a monarch and the incredible migration that this species undergoes every year.
Take pictures of a monarch, raise a monarch from a caterpillar to adult, and discover the migration route of monarchs.

Challenges

Raise a Monarch

- Find a monarch caterpillar and raise it in a terrarium or a container. Watch it progress through metamorphosis until it is a butterfly, making note of how long each phase lasts. Then release the butterfly. Submit your photos. If you are unable to find or raise a monarch, ask someone who does raise them how it is done or research on the internet how others have raised them. Submit a brief explanation of what you have learned.
- ***Learning Outcomes:*** *Learn about metamorphosis and how to raise a monarch caterpillar.*

Monarch Photography

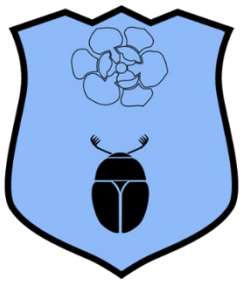
- Take a picture of a monarch butterfly visiting a flower. Research factors that have led to recent declines in monarch populations. Post the picture on a social media of your choice with a description of where you found it and inform others on what you have learned about the decline of the species. Submit the photo as well with the description you shared on social media.
- ***Learning Outcomes:*** *Learn where monarchs are found in your community.*

Monarch Life Cycle

- Research the life cycle of a monarch butterfly and why milkweed is important to the species. Submit a brief description of each stage of its life starting as an egg and ending as an adult, as well as how the species uses milkweed plants. Describe the differences in milkweed varieties and how climate change has possibly affected the growth habits of this plant.
- ***Learning Outcomes:*** *Learn the life cycle of a monarch butterfly, and why milkweed is important to the species.*

Monarch Migration

- Monarchs are known for their impressive migration distances. Research about the monarch migrations. Learn about the migration routes and why they undergo such a long migration. Teach one other person about your findings. Research what efforts are being done to help monarch conservation along their migration routes. Submit a brief explanation of what you discovered as well as 2 things that the other person learned.
- ***Learning Outcomes:*** *Learn the migration routes of monarchs.*



Pollinator Matchmaker

Learning Outcomes

Learn the parts of a flower. Learn how pollination occurs with the help of insects. Learn how species of flowers have evolved to attract certain species of pollinators.
Virtually dissect a flower and an insect while identifying how each plays a role in pollination. Play a match-making game to pick which pollinator is best for each type of flower. Then use these skills to dissect a real flower while teaching someone else about pollination.

Challenges

Virtual Dissection

- Insects have evolved to interact with flowers in unique ways. Complete the virtual plant dissection and the insect co-evolution learning activity to learn how flowers and pollinating insects differ one from another. You will soon notice that some flowers seem to be perfectly designed for certain pollinator insects and vice versa. Pick one flower and one insect that you think are a good match. Submit a description of the reproductive parts of the flower and explain why the insect is best suited as its pollinator.
- ***Learning Outcomes:*** *Learn the parts of a flower and how flowers attract insects and how insects interact in their own unique ways with flowers for pollination to occur.*

Matchmaker

- Once you have completed the Virtual Dissection, you should know that some pollinators are mostly attracted to specific flowers. Complete the Flower and Insect matching game at the end of the discussion lesson. Submit a screenshot of the completed activity.
- ***Learning Outcomes:*** *Learn how some flowers attract specific types of pollinators, and how different types of insects pollinate different types of flowers more efficiently.*

Dissect a Real Flower

- Understanding the anatomical parts of a flower will help you understand how pollination works. After studying the anatomy of a flower, dissect a flower from a nearby garden (with permission) and teach a family member about the anatomical parts of a flower and how pollination occurs. Submit a photo of the dissected flower with a brief explanation of what you taught.
- ***Learning Outcomes:*** *Learn about the anatomy of a flower and teach others how pollination works.*

Pollinator Photographer

Learning Outcomes

Learn how to take pictures of challenging subjects such as insects. Learn how to share your pictures on an online database such as iNaturalist. Learn the range of the insects you have found.
Practice your photography skills on insects while they visit flowers. Share your pictures on iNaturalist. Discover where else your insect has been found.

Challenges

Picture Perfect Pollinators

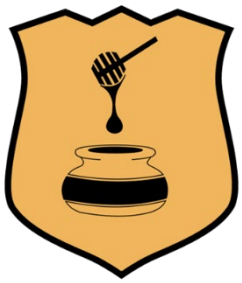
- Photograph 6 different insects from at least 4 different scientific orders (Diptera, Coleoptera, Hymenoptera, and Lepidoptera) while they are interacting with a flower. Submit these pictures on iNaturalist. Submit a list of the 6 insects you posted on iNaturalist.
- ***Learning Outcomes:*** *Learn how to take photos of insects and how to post them on iNaturalist.*

iNaturalist Pollinator Range

- Once you have uploaded your pollinator pictures to iNaturalist, look to see if others have also posted pictures of your 6 insects. See where else your insects can be found. Research online about the range of the given insect. Compare that with what you see on iNaturalist. Submit a brief explanation comparing the two ranges and where you can find your 6 insects that you submitted pictures of.
- ***Learning Outcomes:*** *Learn about insect ranges, and where to find certain species.*

Pollinator Locations

- Some pollinators are being found less and less commonly in recent years, such as the rusty-patched bumble bee. Researchers rely on citizen science data to help track population change on insects as they become endangered. Describe how the range of rusty-patched bumble bees have changed over recent years. Submit your findings.
- ***Learning Outcomes:*** *Learn why insect ranges, including pollinators, are important for studying how they interact with the environment and how populations are changing over time.*



Honey Bees As Friends

Learning Outcomes

Learn the importance of honey bees in producing goods. Learn what items around the house have ingredients and materials in it that were made by a honey bee.
Honey bees produce materials that humans use to make a variety of things. What around your house is made from the help of honey bees?

Challenges

Honey Production

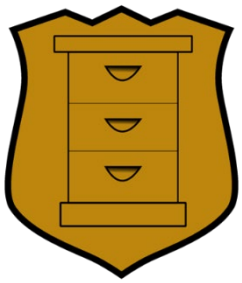
- Honey has been used as food for thousands of years by people around the world. It can be used a variety of recipes. Make a list of 20 foods, each from a different country, that include honey in the recipe. Upload or submit your responses.
- ***Learning Outcomes:*** *Learn how important honey has been in cultures around the world. Learn recipes from different cultures.*

Honey Bee Product Show and Tell

- In addition to honey, beekeepers collect other materials from honey bees including pollen, beeswax, bee bread, propolis, royal jelly and even bee venom. These materials are used in a variety of ways. Collect 5 items made from these honey bee products and bring to class or post on social media. Post a picture of the 5 items on social media and submit a screen shot.
- ***Learning Outcomes:*** *Learn what items people use every day that are made from honey bee products other than honey.*

Mind Your Own Beeswax

- Next to honey, beeswax may be the second most important material produced by honey bees. We use this material in our everyday lives. Research how a honey bee produces wax and what it is used for. Describe how beeswax is used by humans and include a list of 5 items that are made of beeswax. Submit your responses.
- ***Learning Outcomes:*** *Learn how honey bees make wax and how humans use this in everyday life.*



Commercial Bee Keeping

Learning Outcomes

Learn how a honey bee farm works to produce honey. Learn the parts of a honey bee box. Learn different types of honey and products made by honey bees.
Visit an apiary and taste different types of honey. Discover how a commercial honey bee hive works.

Challenges

Honey Tasting

- Honey can taste slightly different depending on what flowers the honey bees visited while foraging. Talk with your teacher about setting up a honey tasting demonstration in your class. Bring in 3-6 different types of honey for everyone to try. Test whether students have a honey preference. Submit the results of your study.
- ***Learning Outcomes:*** *Learn how different honeys can taste depending on where they come from.*

Apiary Visit

- Visit an apiary (honey bee farm). Submit a photo of you standing by a honey bee hive with a brief description of 5 things you learned while visiting the farm.
- ***Learning Outcomes:*** *Learn how a honey bee farm works.*

Honey Bee Box

- After either visiting an apiary, or researching on the internet, submit a brief description of a commercial honey bee box. Within your description, include the different components of the honey bee box. Tell how the various parts of a honey bee box are used by the bees as well as how they used by beekeepers to raise bees and collect honey and other goods. Finally, describe what "bee space" means and how modern hives use Langstroth's discovery to improve honey production.
- ***Learning Outcomes:*** *Learn the components of a commercial honey bee box.*

Bee Social System

Learning Outcomes

Learn what makes a social insect, and the different duties of a honey bee. Learn how bees communicate using a waggle dance.
Discover what it means to be a "social insect." Take a tour of a honey bee hive. Interpret a waggle dance.

Challenges

Insect Sociality

- Some insects. such as honey bees, are referred to as "social insects." Research what it means to be a "social insect." Submit a brief explanation of what 'sociality' means and include any disadvantages for insects living in a social system. Compare and contrast this with human social systems.
- ***Learning Outcomes:*** *Learn how insects are social and what positives and negatives being social can have.*

Visit to the Royal Palace

- Complete the virtual simulated tour of a honey bee hive. Pretend you are a news reporter and interview each of the bees within the hive to learn what their role is. Submit the required final news report of your experience, including a brief description of each bee's role within the hive.
- ***Learning Outcomes:*** *Learn how a honey bee hive works. Learn the roles of honey bee workers and how they must all work together for the good of the hive.*

Waggle Dance

- Honey bees mostly communicate with each other using pheromones but a unique form of communication called a waggle dance has been discovered. Research how honey bee foragers use the waggle dance to show others where outside resources are located. Submit a brief explanation of what you find including the important components of a waggle dance and how other bees interpret it.
- ***Learning Outcomes:*** *Learn how honey bees communicate. Learn how bees use the waggle dance.*

Responsible Homeowner

Learning Outcomes

Families learn how to provide pollinators with valuable resources, and how to maintain a yard in a pollinator friendly manner.
Create a pollinator friendly habitat in your backyard. Manage your yard in a way that has less of a negative impact on pollinators.

Challenges

Mowing for Pollinators

- Mowing lawns often removes floral resources for pollinators such as clovers or dandelions. Through internet research and discussion with lawn care professionals, determine optimal lawn mowing heights in your area and why higher cuts can help pollinators. Submit a brief explanation of what you learned.
- ***Learning Outcomes:*** *Learn how to mow a yard without taking resources away from pollinators such as clovers that provide pollen and nectar.*

Pollinator Sanctuary

- When choosing flowers that provide resources for pollinators, it is important to consider native species that can survive in the region's climate. Research native flowering plants in your area and find where you can buy seeds. Plant them to create a pollinator garden/sanctuary in your backyard or in an area nearby. Remember that even a very small plot of flowers can be a valuable resource for pollinators. Submit a photo of your newly plants pollinator sanctuary as well as a list of the flower seeds that you planted. http://indiana.clearchoicescleanwater.org/plants is an excellent source for this project.
- ***Learning Outcomes:*** *Homeowners learn how to provide resources for local pollinators and the importance of native flowers.*

Water the Pollinators

- Pollinators also need a source of clean water. Put a birdbath, or a container that can hold a shallow pool of fresh water near your new pollinator garden. On a sunny day, record the different types of insects that visit the water source. Submit a photo of the birdbath and a brief list of the insects you have observed using it. You can use a tally list with the categories Butterflies/Moths, Bees/Wasps/ Ants, Beetles, Flies, and Others.
- ***Learning Outcomes:*** *Learn how to provide pollinators with valuable resources such as water.*

Landscape Management

- It is important to understand how to construct and manage a residential landscape that is sustainable eco-friendly, and aesthetically pleasing. Complete the Landscape Management virtual learning activity and learn how to incorporate these landscaping principles in a way that will help conserve pollinators. Submit a screenshot of your best score and list 3 landscaping tips that you learned from the activity that will benefit pollinators.
- ***Learning Outcomes:*** *Learn how to manage a yard in a sustainable, eco-friendly, and aesthetically pleasing way.*

Pollinator Conservation Educator

Learning Outcomes

Friends and/or relatives learn the importance of pollination and species that aid in the process, as well as how to improve their own yard to benefit pollinators.
Educating others about the importance of pollinators is important in the conservation of these species. Knowing how pollination occurs and how to make a yard more pollinator friendly are both important lessons to teach others.

Challenges

Help Other Learn

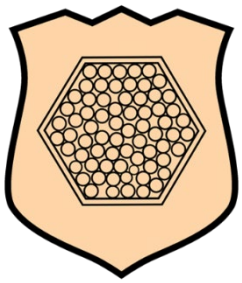
- Teaching others about the importance of pollinators is key to their conservation. Teach a sibling, relative or friend about why pollination is critical to human food production, the importance of pollinators, how pollinators are currently in decline and why it makes a difference to people. Describe their reaction to your lesson and list 2 things they learned.
- ***Learning Outcomes:*** *Families learn about the importance of pollinators.*

You Can Help

- Based on what you know about the life essential requirements of pollinators, list 10 potential ways to improve a neighbor or relative's yard to benefit pollinators. This may include conserving or planting native flowers, changing the lawn mowing height, or creating access to water or shelter for pollinators. Discuss with the homeowner the improvements you have noted. Upload or submit your list of improvements.
- ***Learning Outcomes:*** *Family members learn how to improve their yard to benefit pollinators.*

Walk the Walk

- With permission, pick an improvement from your list and actually implement it in your neighbor's or relative's yard. Upload a picture with a description of what you did to a social media site of your choice.
- ***Learning Outcomes:*** *Learn how easy it is to improve the yard to make it more pollinator friendly.*



Pollinator Friendly Landscaping

Learning Outcomes

Learn the basic needs of pollinators and discover areas nearby that already provide these needs. Learn how to build a native bee box to provide certain species of non-social bees shelter. Provide Pollinators with resources to help them thrive. Discover areas nearby that already are great for pollinators.

Challenges

Pollinator Basic Needs

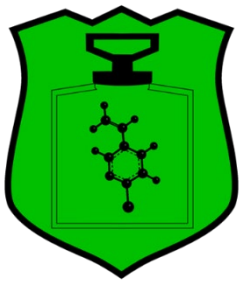
- Pollinators, like all organisms, have basic survival needs. These include water, food and shelter at a minimum. Research what food and shelter each group of pollinators require. If water is a necessary, describe how and where can they obtain it? Relate what you discover to a family member or friend. Submit a brief answer to these questions as well as 3 things your family member or friend learned.
- ***Learning Outcomes:*** *Learn the basic environmental requirements of pollinators and teach that to others.*

Community Habitats

- Find 5 places in your community or nearby that you believe are good habitats for pollinators. Submit a brief description of each location and include the characteristics that each place offers pollinators.
- ***Learning Outcomes:*** *Learn which areas near you provide pollinators with all the resources they need.*

Native Bee Box

- Following the link provided, or by doing your own research, construct a native bee box that will provide shelter for species of bees other than honey bees, such as mining bees. Submit a photo of your finished project hanging where bees will have access to it. https://modernfarmer.com/2017/02/build-native-bee-hotel/
- ***Learning Outcomes:*** *Learn how to provide shelter to native bees.*



Pesticide Application Awareness

Learning Outcomes

Learn how to safely use pesticides, and why pesticides move "off-target" and pose threats to pollinators.
Research safety protocols in using pesticides and how pesticides can pose threats to non-target species.

Challenges

Proper Use of Pesticides

- Pesticides must be used cautiously and according to their published safety instructions. Select a common household insect pest and research one insecticide used to treat this pest. Submit an explanation of how to use this pesticide safely.
- ***Learning Outcomes:*** *Learn how to properly use pesticides to manage common pests.*

Pesticide Label

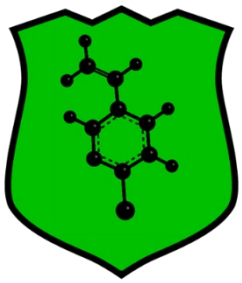
- Find a pesticide label that discusses regulation for human health, the environment, and pollinators. Upload a picture of the safety information and highlight the important information on this label.
- ***Learning Outcomes:*** *Learn the dangers a pesticide poses to humans, pollinators, and the environment and how to properly use it to minimize the negative impacts.*

Pesticide Movement

- Research ways that pesticides can move "off-target." In your submission, define and give an example of 4 of drift, leeching, run-off, and volatilization as they pertain to the movement of pesticides.
- ***Learning Outcomes:*** *Learn how pesticides can reach non-target species and move throughout the environment.*

Interview

- Knowing how pesticides can move through the environment, discuss with either a local Professional Pesticide Applicator or a Commercial Producer how they avoid or prevent possible pesticide movement. If you cannot contact a professional, research on the internet how professionals can avoid each type of pesticide off-target movements. Submit a brief explanation of what was discussed.
- ***Learning Outcomes:*** *Learn how local farmers and pesticide applicators try to prevent pesticide movement through the environment.*



Forager Hazards

Learning Outcomes

Learn the hazards that humans impose on bees when a honey bee forages.
Use the simulator and follow a honey bee on its flight to forage and see what hazards that it runs into.

Challenges

Flight Simulator

- Complete 6 different foraging flights on the Honey Bee Plight simulator to determine some of the hazards honey bees routinely encounter. Submit a screenshot of each of the 6 resulting incident reports.
- ***Learning Outcomes:*** *Learn what hazards honey bees face when foraging for resources.*

Honey Bee Hazards

- After completing the flight simulator of the honey bee, or by doing your own research, submit a brief explanation of 4 different ways pollinators may encounter pesticides while foraging.
- ***Learning Outcomes:*** *Learn how honey bees encounter pesticides in the environment.*

Introduce a Friend

- Help one other person complete at least one mission on the honey bee plight simulator. Submit a photo or writeup of their experience and describe one thing they learned.
- ***Learning Outcomes:*** *A family member or friend learns about the hazards that honey bees face while foraging.*

Pollinators and Integrated Pest Management

Learning Outcomes

Learn how to manage pests through the use of pesticides in a way that minimizes harful impacts on beneficial insects. Learn alternatives to chemical pesticides.
Learn what IPM means. Discuss with a local farmer about the importance of pesticides. Discover what is needed in your area to apply pesticides and alternatives to routine pesticide use.

Challenges

Define IPM

- Research what "IPM" means to insect pest managers and submit a brief explanation.
- ***Learning Outcomes:*** *Learn what IPM stands for and why it is important.*

Pesticide Uses

- Discuss with a commercial grower how and why pesticides and transgenic crops are important/useful for crop production. Submit a brief explanation on what you learned.
- ***Learning Outcomes:*** *Learn why farmers use pesticides for crop production.*

Pesticide Applicator

- Research how to obtain a certificate orlicense to apply pesticides in your state. Submit a brief explanation of what you found.
- ***Learning Outcomes:*** *Learn what it takes to be certified to apply pesticide chemicals.*

Pesticide Alternatives

- Pesticides are not the only method of pest management. Other methods of pest control may include crop rotation, biological control, augmented biological control, importation biological control, tillage, and use of cover crops. Choose one commercially produced crop and submit a list of 2 insecticides and 2 alternative methods of controlling one of its primary pests. Submit this report.
- ***Learning Outcomes:*** *Learn alternatives to chemical pesticides*