FROST SCIENCE

NEEF

Greening STEM Biodiversity Series

PROMOTING POLLINATORS

Image: Bob Peterson

Grades 6-8

SUPPORTED BY
Royal Caribbean Group

Overview

Students will explore the world of pollinators by researching either honeybees or butterflies, focusing on what their needs are for a successful habitat and the threats they face in South Florida. After their research, students will participate in a service-learning project in which they will apply the engineering design process to plan (and build) a pollinator habitat that will attract honeybees, butterflies, or both.

Lesson Objectives

- Students will recognize the importance of pollinators, the threats they face in South Florida, and how to mitigate these threats.
- Students will successfully research pollinator habitats and become familiar with how to help them thrive in a South Florida environment.
- Students will apply the engineering design process to plan a pollinator habitat that will attract honeybees, butterflies, or both and evaluate how it impacts the biodiversity within an ecosystem.

Key Ideas and NGSS (Grades 6-8)

- Pollinators play a key role in ecosystems as they support the growth of trees, flowers, and other plants which provide food and shelter for other organisms within an ecosystem. (MS-LS2-1, MS-LS2-2, MS-LS1-4)
- Habitat loss to human development, climate change, pesticide use, and invasive species are all partly responsible for the decline of bees and other pollinator species. (MS-ESS3-4, MS-LS2-1, MS-LS2-4)
- The engineering design process is a series of steps engineers use to identify and solve problems. (MS-ETS1-2, MS-ETS1-2, MS-ETS1-4)

Additional Standards: *ELA/Literacy – CCRA.L.6, RST.6-8.1, RST.6-8.4, WHST.6-8.7 Arts – NCAS Anchor Standard #1*

Giant Swallowtail *(Papilio cresphontes)*

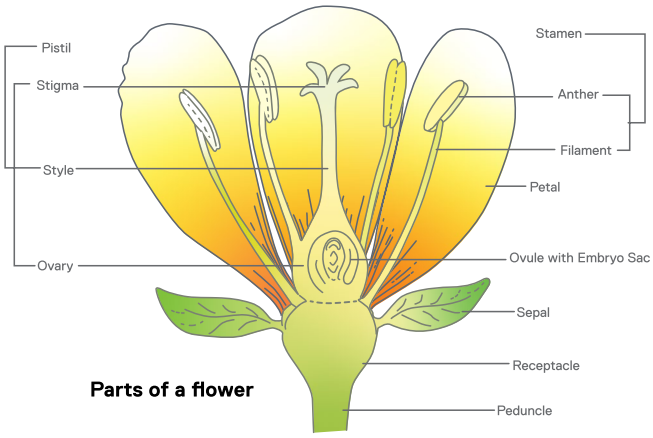
Background Information

Introduction to Biodiversity

Biodiversity is the natural variations of living organisms, including plants and animals, at all levels, from genes and microorganisms, to habitats and ecosystems. It tends to be richest in the tropics, including rainforests on land and coral reefs in oceans, in part due to a warmer climate. It may be hard to see how an animal that is only found in one remote part of the world can impact you personally, but having biodiversity on earth is essential for human survival. Biodiversity on earth is the reason we have food, drinking water, oxygen to breathe, medicines, and shelter. Having diverse life means that different factors, such as increased solar radiation from the sun, or a disease, doesn't wipe out all life on earth, but rather that some life can continue to thrive.

The Importance of Pollinators

Pollination happens when a pollen grain from the anther of a flower is transferred to the stigma of either the same flower or another flower of the same species. This crucial step is required for reproduction and allows for the ongoing survival of pollinating plants. Though pollen grains can be transported by wind or water, more often than not pollinators, including bees and butterflies, are responsible for moving pollen grains from flower to flower. This process is very important to people as pollinating plants make up more than half of the world's diet of fats and oils. In the United States, more than 150 food crops rely on pollinators. Those same crops are worth more than $10 billion a year. Without pollinators our food production would screech to a halt, causing a food shortage that would be harmful to people worldwide. Some of the most prevalent pollinators in Florida are honeybees and butterflies, both of which are threatened by habitat loss, climate change, and invasive species.



Parts of a flower


Western honeybee *(Apis mellifera)*

Threats to Honeybees and Butterflies

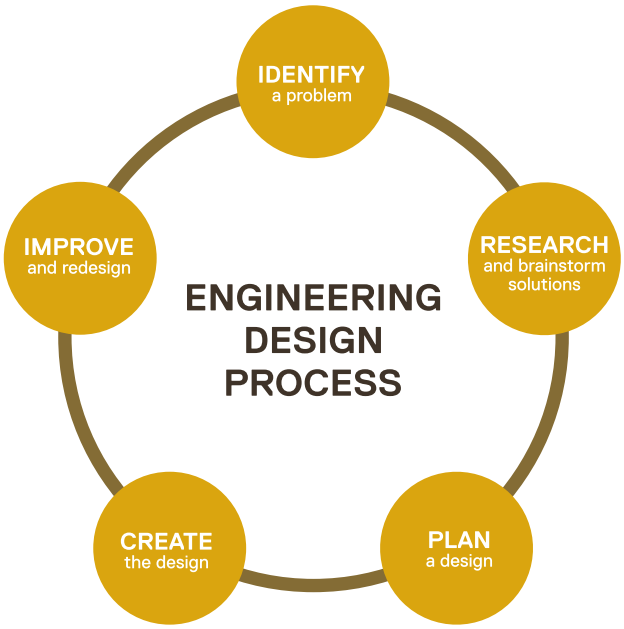
Western honeybees *(Apis mellifera)* are native to Africa, Asia, and Europe and thus are non-native species to South Florida. Not all non-native species get classified as invasive as some get integrated into local communities effectively, and in the case of the honeybee, become a treasured species. Three out of four crops in Florida rely on honeybees as pollinators making them incredibly important to Florida's economy. Unfortunately, honeybee populations have declined significantly over the years. There is no one specific cause linked to honeybee decline; however, a few causes include the use of pesticides and fertilizers, parasites, invasive species, and habitat destruction. For example, the varroa mite *(Varroa destructor)*, a parasite known to attack eastern honeybees *(Apis cerana)*, has made its way to the United States and began attacking the western honeybees. Since western honeybees have not yet adapted to living with the parasite, further reductions in the populations of western honeybees


Varroa mite *(Varroa desctructor)* on a honeybee host.

throughout the US has been seen. Florida's high number of invasive species also affects the biodiversity of its natural environment which can further lead to honeybee decline as their sources of food are either being replaced by invasive species or sometimes even being destroyed by other invasive species such as invasive reptiles who feed on native plants.

Monach butterfly *(Danaus plexippus)* on a milkweed plant *(Ascelepias syriaca)*.

Butterflies *(Papilionoidea)*, another group of important pollinators in Florida, are also becoming increasingly endangered. Florida is home to around 160 species of butterflies and of those, 25 (or 15%) are considered in peril. Butterflies are susceptible to habitat loss, chemical pesticides, such as those used to control mosquito populations, as well as pests that can affect important plants in the butterfly's nutrient and lifecycle. Butterflies as pollinators, feed on plant's nectar as a source of nutrition when they are adults. Like all living creatures, they have their preferred diets. However, butterflies also need specific plants to lay their eggs, known as the host plant, with some butterfly species only having one host plant species. For example, the Monarch butterfly *(Danaus plexippus)* will only lay its eggs on milkweed *(Asclepias syriaca)*. The selection of a host plant is critical for the survival of the caterpillar once it hatches from the egg. However, these important plants are often removed by humans for construction and development purposes resulting in butterflies losing not only their source of food but also an essential habitat for their offspring.



The Engineering Design Process

The engineering design process is as series of steps that engineers use as guide to solve problems and challenges. Though similar to the scientific method, the engineering design process is meant to be iterative, meaning that it is highly encouraged that implementors repeat any steps as needed, especially as it may result in improvements and ultimately a better product or solution. The steps to the engineering design process may vary according to user and sometimes specific engineering field; however, it is always a cycle and has key steps including: identifying a problem or challenge, researching and/or brainstorming solutions, plan a design, create, and then improve (or redesign) based on testing and evaluating the design.

Story Highlight

The Atala butterfly *(Eumaeus atala)* lays its eggs on the coontie plant *(Zamia pumila)* and only the coontie plant, making it vital for the survival of this species of butterfly. The coontie is known for its roots being an excellent source of starch which also made it invaluable to Native Americans and European settlers as it could withstand the high humidity and temperatures in Florida. The plant was sold almost exclusively to the military during World War 1, one mill in Miami processing as much as 18 tons daily for military purchase. With the coontie plant quickly disappearing, the Atala butterfly disappeared alongside it. The butterfly was thought to be extinct until a naturalist in the 1970s found a surviving colony on a barrier island off the coast of Miami. Once the species was found, recovery efforts were undertaken to bring the species back from the brink of extinction. The recovery efforts worked so well that the Atala butterfly is now thriving in South Florida, once again working to pollinate native plants like lantana, wild coffee, and cabbage palms.

Atala butterfly *(Eumaeus atala)*

Key Vocabulary

Anther – the pollen containing part of the flower

Invasive Species – an organism that is not native to a particular area, but has taken over the area and its resources

Biodiversity – the variety of life that exists within an ecosystem

Ecosystem – a community of living creatures and nonliving things interacting and forming relationships within a given space

Native species – an organism that is naturally occurring in a particular area

Non-native species – an organism that lives outside of its native area as a result of deliberate or accidental introduction

Parasite – an organism that lives on or inside of its host, getting its food from the host or at the expense of them

Pests – an organism that is destructive by feeding on crops, food, livestock, etc.

Pesticides – chemical applicant used to keep pests from feeding on particular crops or plants

Pollination – the means by which a plant reproduces as an insect or animal brings pollen from one plant to another of the same species

Predation – the act of one animal preying on another for food

Stigma – the part of the flower that receives the pollen during pollination

Materials (per student)

- Pollinator Profile and Habitat Worksheet (attached page 9)
- Writing Utensil
- *Optional: Gardening Gloves*
- *Optional: Native Plant Seeds*
- *Optional: Trowel*
- *Optional: Soil and Small Rocks*

Project Procedure

Please note that this project can be done in small groups or individually.

1. **Introduction:** Begin lesson with a discussion about the process of pollination by asking the following:
   a. What is pollination?
   b. How does it happen?
   c. How do insects facilitate pollination?
   d. Teachers are encouraged to show the video *'An Orchid's Trap' (available under the Additional Resources section).*

2. **The Importance of Pollinators and Threats:** Continue the discussion by asking:
   a. Why are pollinators important?
   b. How are food crops reliant on pollinators?
   c. How do food crops affect the economy?
   d. Why are pollinators at risk?
   e. How might agricultural inspection stations help reduce some of these risks?
   f. What might happen if we lost our pollinators? Cultural effects? Environmental effects?

3. **Research Component:** Students will choose a specific species of pollinator, from either honeybees or butterflies, and complete the following information on the Pollinator Profile and Habitat Worksheet:
   a. Pollinator diet: What specific plant(s) do they prefer to eat?
   b. Preferred habitat: Where do they live and thrive?
   c. Reproduction: Are there plants or habitats that are key to the species' lifecycle, including for laying eggs?
   d. Risks: Do they have any predators? Is habitat loss impacting their preferred habitat? Any other risk factors?
   e. Did you know?: Share an interesting fact that you found during your research about the species.

4. **Understanding the Engineering Design Process:** Students will learn about the engineering design process and use it to plan a garden that is suitable for their chosen pollinator (and maybe some other pollinators too!). Introduce the engineering design process by going over the following steps:
   a. Step One: Identify the problem or challenge *(designing a pollinator habitat)*
   b. Step Two: Brainstorm solutions to the challenge *(apply research to determine what the pollinator habitat will need to have, how big it should be, and how it will look)*
   c. Step Three: Plan a design *(list needs and required materials to build the habitat)*
   d. Step Four: Create a design *(sketch the design for the pollinator habitat)*
   e. Step Five: Evaluate the design *(present the design to teacher and classmates for feedback)*

5. **Applying the Engineering Design Process to their Habitat:** Students will be presented with the challenge of creating a habitat for a pollinator of their choice to help combat habitat loss. Discuss the following questions and have students complete their Pollinator Profile and Habitat Worksheet:
   a. What is the problem? How will a pollinator habitat help mitigate this issue?
   b. What solution will they present to help address this problem?
   c. What materials/area will they need for a pollinator habitat?
   d. What are some key features that their pollinator needs to thrive?
   e. What are some risks and predators their pollinator may face?
   f. Tips and items to consider for creating a pollinator habitat:
      i. Consider how much sunlight your chosen location gets.
      ii. Consider the type of soil that your pollinator habitat will require, is it rocky, acid, clay-like or nutrient rich?
      iii. Consider the type of plants needed. Are they native plants?
      iv. If designing for a butterfly habitat, do they need different types of plants?
      v. Consider flower color choices, does your pollinator have a preference?
      vi. Consider water sources for plants and pollinators.
      vii. What kind of maintenance will your habitat need?

6. **Project Presentation and Reflection:**
   a. Students will evaluate information completed on their Pollinator Profile and Habitat Worksheet and put together a short PowerPoint presentation about their design and submit it for review. Their presentation should include:
      i. Pollinator profile so that they can specify how their garden is tailored to their specific pollinator
      ii. Design sketch so that other students can visualize their design
      iii. Key factors in their design and how it is a good habitat for their pollinator
      iv. Maintenance plan for its ongoing sustainability
   b. As a class, encourage students to share their presentations with their classmates and evaluate the design(s) by discussing the following:
      i. How would you measure success of the design?
      ii. What modifications or suggested improvements/expansions would you suggest for their habitat?
      iii. What other pollinators may benefit from their habitat?
      c. Finish with a class discussion to reflect on their presentations:
      i. What kind of similarities or differences are present in the various pollinator habitats presented?
      ii. What are more ways you, or a community as a whole, can help increase biodiversity and pollinator habitats?

Zebra Longwing Butterfly *(Heliconius charithonia)*

Optional Extension

As an optional extension activity, students may put their design into action by building their pollinator habitat at home or as a class at school. Please encourage them to consider the following information and all safety precautions if they choose to complete the optional extension:

1. Consult with an adult regarding safe use of any materials. Students are highly recommended to use proper PPE such as gardening gloves.
2. Consider the use of native seeds/plants over foreign/invasive plants.
3. Take photos of each step so that they may monitor progress.
4. Continue reevaluating their plan to consider additional modifications.

Notes/Considerations

For English Language Learners, we recommend reviewing this article for helpful tips: https://www.cambridge.org/us/education/blog/2019/08/29/unlocking-science-english-language-learners-part-three/

For students putting their plans into action, they should consider any possible allergies and may want to protect themselves when planting by wearing gloves and long sleeves.

Additional Resources

- ENY2042: Attracting Native Bees to Your Florida Landscape https://edis.ifas.ufl.edu/LyraEDISServlet?command=getImageDetail&image_soid=FIGURE%203&document_soid=IN1255&document_version=1
- Florida Coonties and Atala Butterflies - https://edis.ifas.ufl.edu/mg347
- Why is Pollination Important? - https://www.fs.fed.us/wildflowers/pollinators/importance.shtml
- Honeybee - http://bugs.ufl.edu/bug-pix/honey-bee/

Butterflies pollinating at Harris Neck National Wildlife Refuge in Georgia

Pollinator Profile and Habitat Worksheet

Student Name: _____

Chosen Pollinator: _____
Species Name

Pollinator Diet: _____
What specific plant(s) do they prefer to eat?

Preferred Habitat: _____
Where do they live and thrive?

Reproduction: _____
Are there plants or habitats that are key to the species' lifecycle, including for laying eggs?

Risks and Predators: _____
Do they have any predators? Is habitat loss impacting their preferred habitat? Any other risk factors?

Draw your pollinator

Did You Know?:
Share an interesting fact that you found during your research about the species.

Designing a Pollinator Habitat

Apply the engineering design process to your pollinator habitat design by answering the following questions:

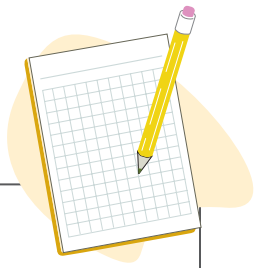
Step One: What is the problem or challenge?

Step Two: What are some proposed solutions?

Step Three:

a. Pollinator Needs (e.g. space, amount of sunlight, food, reproduction, shelter):

b. Materials Needed for Habitat?



Step Four: Sketch Design

Step Five: What modifications and improvements/extensions would you make to your habitat?