Lesson 5: Pollinator Super Powers

budburst
A project of the Chicago Botanic Garden

Unit: Plants, Pollinators & People - Ecosystems

Unit Driving Question: Should we include cultivars in our native pollinator garden?

Unit Anchor Phenomenon/Storyline: Local fire fighters let the milkweed plants grow and the monarchs soon came! (See full story in Lesson One.)

Overview

Pollinators have special abilities to see guides that flowers provide to attract them; however, bees can't distinguish red and butterflies are legally blind! This lesson focuses on one super power that many insects have – especially the bees and butterflies. They see using not only the visible light spectrum, but also the ultra-violet light spectrum. We protect our eyes and skin from UV light waves with sun glasses and lotion, yet the insects have the ability to use these light waves to 'see' flowers differently than you or I do. Students should use this information when they decide which flowers to put in any gardens they want to create that will attract specific pollinators.

Grade(s): Five-Eight	Time Recommendations: 1 – 2 class periods
Central Focus: By understanding that insect pollinators have abilities to see certain colors and color patterns in flower petals, students will have a better understanding of why cultivating flowers from native plants that produce a different color variation, might impact the preferred pollinator's ability to 'notice' the nativar or seek it out for its nectar.	**Student Objectives**: 1. Make a claim and provide evidence and reasoning as to why bees prefer the blue colors over reds or orange colors. 2. Explain why people see flowers differently from insects. 3. Determine what colors of flowers are best to attract specific pollinators.
Essential Question: How do flowers use their colorations to attract specific pollinators? Do insects like bees and butterflies see differently than humans?	

NGSS Alignment: See Unit Overview for list of NGSS standards being addressed.

Vocabulary: visible light, ultra violet light (UV), vision, light wave, electromagnetic spectrum (EMS), frequency, ROY G BIV

Materials:

- Spiral notebook and pencil
- Electromagnetic Spectrum Poster (see lesson resources or a find picture of one from the internet)
- Butterflies and Flowers PowerPoint
- The ability to download pictures and show them on a projection system and view video clips from the internet sources provided.
- Optional: A crystal prism to capture sunlight and create a rainbow

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Advance Preparation and Teaching Tips

Teaching Tips: Be sure to download the free book chapter from the NSTA Learning Center and read it ahead of time for some good background information about how insects see. Register for a free account by going to: https://common.nsta.org/resource/?id=10.2505/9781933531298.3

Pre-teaching/Background Knowledge/Misconceptions

Students may not have learned about the visible light spectrum yet. Give them some background information about ROY G BIV and how that stands for the rainbow of colors humans can detect with their eyes. Tell them that the letters of the imaginary name spell out the colors in the order they are found in a rainbow: red, orange, yellow, green, blue, indigo blue, and violet.

Activities

Engage (Inquiry/Anticipatory Hook/Opening/Activate Prior Knowledge/Create Interest/Orient to Content)

1. Using the Butterflies and Flowers PowerPoint provided, show the photographs above or any butterfly photos where the eyes stand out) of two butterflies and their eyes. Ask your students if when they look at a flower do they see the flower the same way insects like bees and butterflies see it? If they say no, then ask them why they think they see things differently. Write all explanations on a board or poster paper.
2. Now show students the photo of the flower (below) and have them describe the color(s).

3. Tell students it is two pictures of the same flower. Can they explain why it looks two different colors? Ask them if things look the same when they put on sunglasses. Depending on the type of sunglasses, some are tinted and make everything look rosier or more yellow, etc.
4. Tell students that our eyes have the ability to detect certain frequencies of light waves called the visible light spectrum. Some students may already be familiar with ROY G. BIV. If they have ever

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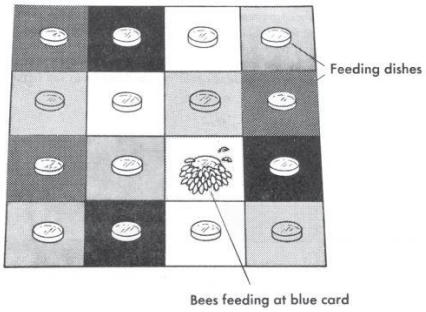
learned about rainbows, some students will know that the colors that we see are usually in this order: red (R), orange (O), yellow (Y), blue (B), a darker indigo blue (I), and violet (V) or purple. If the teacher has a glass prism, use it here to show a rainbow on the wall. A light from a cell phone shining through the prism will usually be strong enough to show a rainbow when the light is pointed at the prism. Sometimes teachers have crystal prisms hanging in their windows to create rainbows when the sun shines.

5. Show students a chart/poster of the electromagnetic light spectrum and point out (or have a student point out) where the visible light waves are. Now ask students where infrared light waves are on the chart (the kind of waves picked up by police officers who use night vision goggles. If you prefer, NASA has a short video clip- 3 minutes (also available in Spanish) at: https://illinois.pbslearningmedia.org/resource/phy03.sci.phys.energy.nasaspectrum/the-electromagnetic-spectrum-nasa/
6. Tell students that butterflies have special eyes that mainly pick up Ultra violet light waves – clear on the opposite side of the visible light spectrum from infrared. That's why bees can't see red. They are able to detect some visible light waves and the UV light waves starting with visible light waves that show up as yellows, greens, and blues. And butterflies are legally blind using mainly UV light to navigate toward a flower's nectar.

Explore (Conceptualizing Concepts/Student Activities/Instructional Strategies and Learning Tasks/Development of the Concept)



7. Explain the experiment conducted by an Australian zoologist, Karl von Frisch.
   NOTE: for background reading, the book chapter is available to all educators for free at the NSTA Learning Center. All you need to do is register for a free account and go to: https://common.nsta.org/resource/?id=10.2505/9781933531298.3 to download it into your NSTA personal library. Von Frisch wanted to find out what bees could see. Here is a sketch of his experiment:
8. One square of the checkerboard was colored blue, and the remainder were shades of greys from white to black. Every card had a shallow glass dish of water. The water on the blue square was sweetened with sugar. Von Frisch discovered that bees learned where the food was by color location using the color blue; however when he placed the food on a red card, bees would search red, grey, white, black, etc. They couldn't discriminate the red color from the greys. He found that they also confused yellow with green or orange, and blue colors with violet.

Explain (Checking for Understanding/What the students are doing to construct meaning and what the teacher is doing to facilitate the process)

9. Using what students learned about the EMS (electromagnetic spectrum) and how bees can see blues and UV light waves, have students make a claim about what bees can see, and have them back it up with the evidence from this experiment and the information on an EMS chart. Have them write their claims and evidence and reasoning in their science journals.

Extend (Applying New Knowledge/Guided Practice/Independent Practice)

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10. Show students the video clip, Insecta Spectra (2.46 minutes) Here they will see flowers using their visible light abilities and then see how the bees and butterflies might see the same flowers with UV light.
11. Ask students why bees still go to red flowers if they can't see the color red. Let them discuss their ideas in pairs, and then share out with the class. Here is one explanation they may have come up with: Many red flowers may reflect UV light too, and that would make them appear colorful to bees. They may be interested in knowing that hummingbirds have eyes that are more sensitive to red wavelengths than those of bees, and that is why hummingbirds are most attracted to flowers with bright red flowers.

Evaluate (Closing/Exit Slip/Wrap Up/Tie Up the Lesson/Provide Cognitive Closure)

12. Ask students to answer this question: Would you want a pollinator garden to have flowers of all one color? Why or why not? They should support their responses with evidence they gathered from this lesson.

Assessments/Evidence of Student Learning

Informal Assessments: Use probing questions throughout the lesson to check for understanding.

Formal Assessments: The CER (Claims, Evidence, Reasoning) activity in the lesson can serve as a more formal assessment of students' learning for this lesson.

Student and Teacher Resources

For more information about the Electromagnetic Spectrum (3.55 min) go to:
https://illinois.pbslearningmedia.org/resource/lsps07.sci.phys.energy.lightcolor/light-and-color/

If you have a prism, show students how to create the spectrum of visible light to create a rainbow (demonstrated in the above video clip)

3D Game Lets You See Through an Animal's Eyes (1:42 min):
https://www.youtube.com/watch?v=rT3Iz5VA2eQ

Reference List:

Stebbins, R. et.al. (2008). Animal coloration: Activities on the evolution of concealment. *Animal coloration (book chapter)*. NSTA Press. Accessed at https://common.nsta.org/resource/?id=10.2505/9781933531298.3

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