Lesson: Pollinator Symmetry

Grade Level: Fourth Grade, Life Sciences

Overview: In this lesson, students will learn about the key role of **bilateral symmetry** in pollinators and flowers. Research scientists have observed the phenomenon of pollinator attraction to the color and to symmetrical appearance of plants. In fact, many animals and insects are symmetrical. This symmetry is important to the reproduction and survival of plants. Students will take this given knowledge and create bilateral symmetrical pollinators. Students will have to draw the mirror image by using mathematical shapes and lines. Students will then use a method of painting and folding to create a symmetrical insect and/or flower.

Science content and standards:
Pennsylvania New Academic Standards for Science-
https://www.pdesas.org/Page/Viewer/ViewPage/11

Fourth Grade: Life Sciences, From Molecules to Organisms: Structures and Processes

Standard 4-LS1-1: Construct an argument that plants, and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

Science Practices:
APPENDIX F – Science and Engineering Practices in the NGSS
https://www.nextgenscience.org/sites/default/files/Appendix%20F%20%20Science%20and%20Engineering%20Practices%20in%20the%20NGSS%20-%20FINAL%20060513.pdf
Practice 6 Constructing Explanations and Designing Solutions

- Construct an explanation of observed relationships (e.g., the distribution of plants in the backyard).
- Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.

Math content and standards:
Pennsylvania Academic Standards for Mathematics-
https://www.stateboard.education.pa.gov/Documents/Regulations%20and%20Statements/State%20Academic%20Standards/PA%20Core%20Math%20Standards.pdf

Mathematics- 2.3 Geometry

Standard- CC.2.3.4.A.3: Recognize symmetric shapes and draw lines of symmetry.

Math Practices:
Pennsylvania Common Core State Standards for Mathematical Practices.
https://static.pdesas.org/content/documents/Math_Practices_and_Grade_Progressions_rev%201-24-13.pdf

1. **Make sense of problems and persevere in solving them.**
    - Use concrete objects or pictures to help them conceptualize and solve problems.
2. **Look for and make use of structure.**
    - Generate number or shape patterns that follow a given rule.

Science & Math Connection:
Relationships and Convergences Found in the Common Core State Standards in Mathematics (practices), Common Core State Standards in ELA/Literacy*(student portraits), and A Framework for K-12 Science Education (science & engineering practices) *Venn Diagram NSTA Science, Math, & ELA-*
https://static.nsta.org/ngss/PracticesVennDiagram.pdf

- S2. Develop and use models
- M4.Model with mathematics
- S5. Use mathematics & computational thinking

Materials:

- Pollinator Symmetry Student Guide
- Pencils
- Color pencils
- Paint & paint brushes
- Ruler

Resources:

- Student reading PDF version, *"The Mystery of Symmetry"*
- Pollinator Symmetry Student Guided worksheet
- List of symmetrical insects & video resource for students, https://esplora.org.mt/insects-symmetry-and-fluttering-wings/
- *"How to Build an Insect"* By: Roberta Gibson https://www.amazon.com/How-Build-Insect-Roberta-Gibson/dp/1541578112/ref=sr_1_1?crid=3EW5QVPJZRJMK&keywords=how+to+build+an+insect&qid=1670956838&sprefix=how+to+build+an+insect%2Caps%2C66&sr=8-1

Learning Objectives:

- Students will learn about Bilateral Symmetry and reference to mathematical symmetry in shapes.
- Students will use an insect template, (Beetle & Bee) to make a symmetrical pollinator.

- Students will choose their own bilateral symmetrical insect with reference to the insect library of photos.

Lesson Procedure:

1. The teacher will introduce the lesson by having students read the passage and complete the guided questions in, *"The Mystery of Symmetry"*.
2. Students will then use paint and brushes to complete the guided examples from the Pollinator Symmetry student guide.
3. The teacher will then show students the short video reference, https://esplora.org.mt/insects-symmetry-and-fluttering-wings/ .
4. The teacher will have students choose their own example of a symmetry insect or plant by using the insect examples as a reference, https://esplora.org.mt/insects-symmetry-and-fluttering-wings/ .

   Helpful tip: There are lots of symmetrical animals and plants out there! Have students use their technology devices to search for other examples of symmetrical pollinators!
5. Students will use the following materials; ruler, pencil, and coloring materials to draw their own symmetrical insect and/or plant on the student guided worksheet.
6. The class will complete this unit by reading the following book, *"How to Build an Insect"* By: Roberta Gibson.

The Mystery of Symmetry

investigating the role symmetry plays in plant-pollinator relationships

Pollinators and flowers have a complex relationship that has lasted for millions of years. **Pollinators** are animals that eat **nectar** and **pollen** from flowers. In doing so, they unintentionally move pollen on their bodies from flower to flower. This **pollinates** flowers, which is necessary for many plants to reproduce.

Scientists are very interested in plant-pollinator relationships. By understanding why pollinators have **preferences** for certain flowers over others, we can plant better gardens for them. Pollinators are extremely important animals to protect, as 90% of flowering plants require animal pollination.

There are many possible features that pollinators consider when deciding whether or not they want to feed from a flower.
Why do you think pollinators choose to feed from certain plants? Brainstorm four ideas below:

Notes

1.

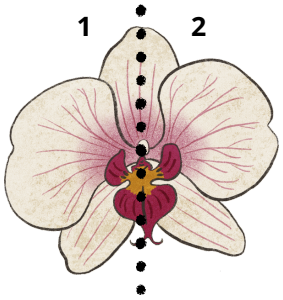
2.

3.

4.

Some scientists are very interested if **symmetry** plays a role in plant-pollinator relationships. Symmetry is when an object is equal on both sides. **Are pollinators choosing symmetrical flowers over asymmetrical flowers?** Or, are there other factors at play, such as nutrition or color?

Radial Symmetry



Bilaterial Symmetry

The prefix 'bi' means 'two'. Bisymmetrical flowers have two equal sides!

The two main types of symmetry in flowers are **radial** and **bilateral symmetry**. When looking at a flower ask yourself: can you fold the flower in half more than one way and have two sides match? If so, the flower is radially symmetrical. If you can only fold it in half once with matching halves, the flower is bilaterally symmetrical.

Let's learn how a scientist tested flower symmetry and pollinator flower preferences!

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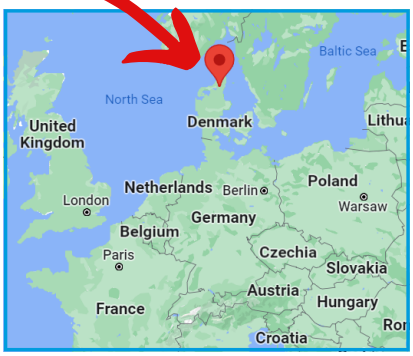
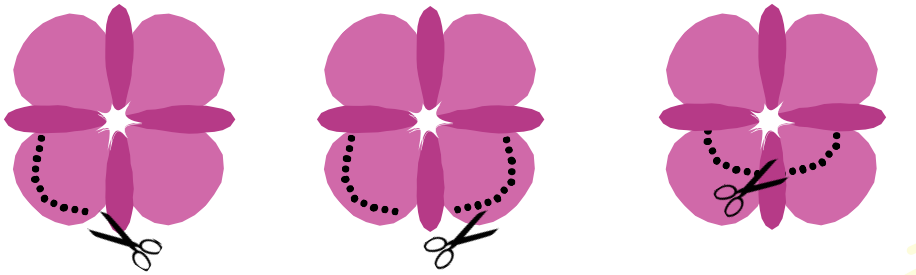
Dr. A P Møller set up an experiment in Kraghede, Denmark to determine if bumble bees were more likely to feed from symmetrical flowers. Møller also wondered if the size of the flower was important to bees.



A bilaterally symmetrical flower called Fireweed (*Epilobium angustifolium*) was used in this study. To create **asymmetrical** and different sized versions, Møller simply cut the petals with scissors.

Asymmetric **Symmetric (large)** **Symmetric (small)** **Control**



A **control** is an element that remains unchanged. The control is used as a benchmark to compare other test results in an experiment.

Which flowers do you think bumble bees preferred? Or, do you think they have no preference? Create a **hypothesis** and provide a **reason** for your hypothesis.

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Dr. Møller noted each time a bumble bee ate from a flower, and recorded the flower type. **Create a bar graph using the data in table one**. Flower types are on the **x-axis** and the 'number of visits' is on the **y-axis**.

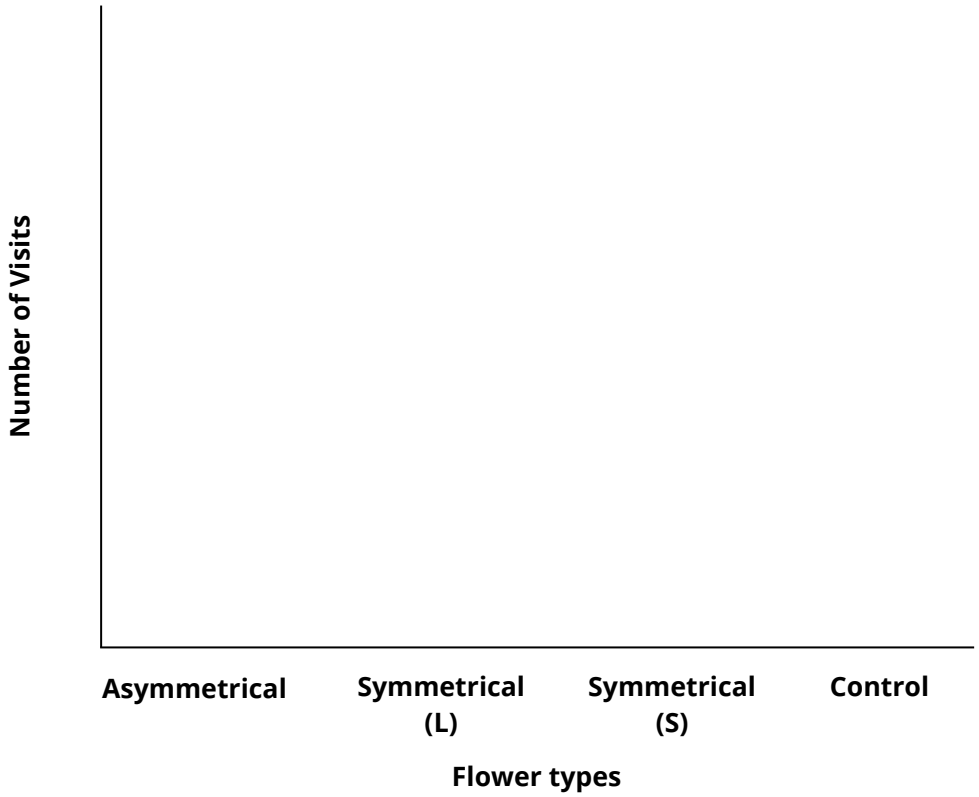

Table 1

Time of Visit (AM)	Flower Type
10:00	Control
10:03	Control
10:04	Asymmetric
10:07	Symmetric (L)
10:08	Symmetric (S)
10:12	Control
10:15	Symmetric (L)
10:17	Symmetric (S)
10:18	Control
10:21	Symmetric (L)
10:24	Symmetric (L)
10:26	Control
10:27	Symmetric (S)
10:29	Asymmetric
10:30	Symmetric (S)

1. Study your bar graph. Which type of flower did the bumble bees prefer in this study? Why do you think this flower type was preferred?

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2. Look at the photo of the flower, Fireweed (Epilobium angustifolium). Consider what other characteristics of Fireweed could be tested to further our understanding of why pollinators choose to eat from certain flowers over others. **Hint: you can answer this in a form of a question by starting with 'I wonder...'**

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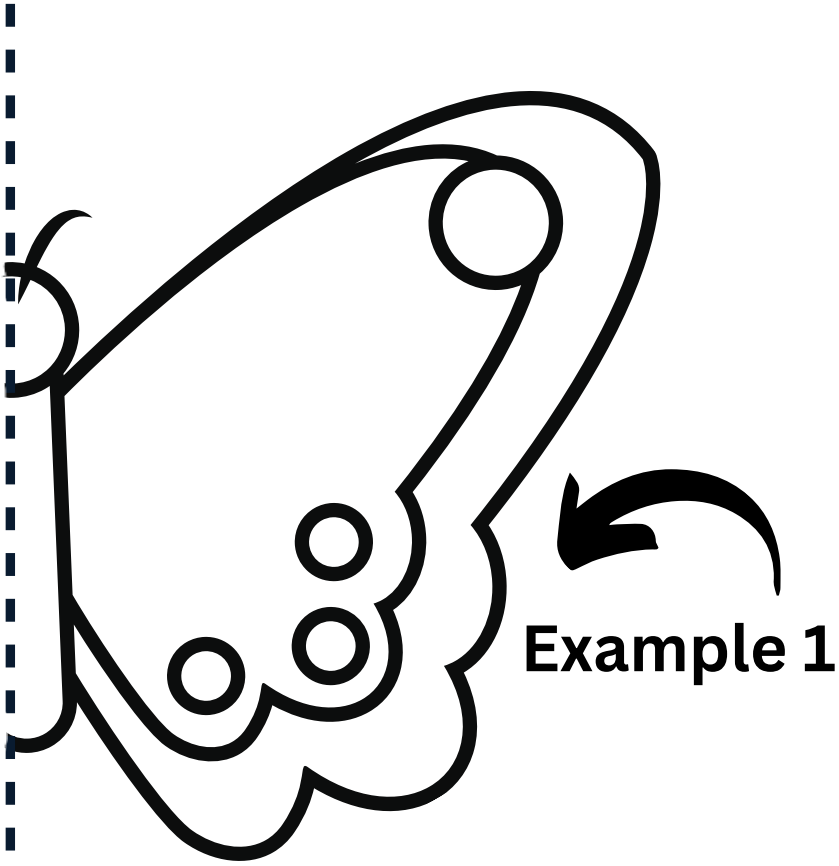
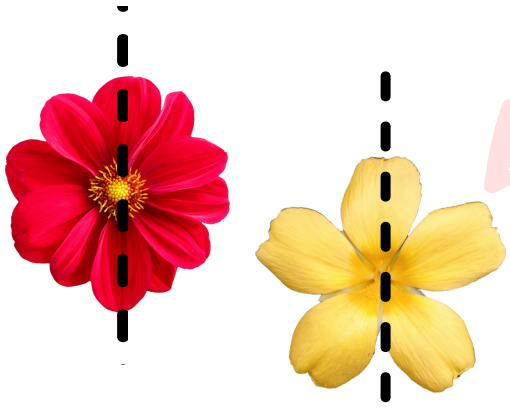
Pollinator Symmetry

Directions: Look at the following pollinators, what shapes, angles, and lines do you think would match on the right side? For example 1 and 2, using a paint brush to **paint** the right side of the object. While wet, **fold** the paper on the dotted line. **Press down and open** the folded paper. Does your object look symmetrical?

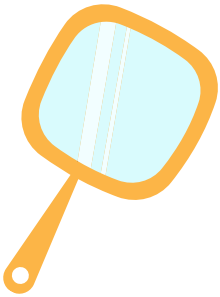


Left

Right



Many plants and pollinators are symmetrical. **Symmetry** exists when an object could be **divided into two** identical mirror halves.



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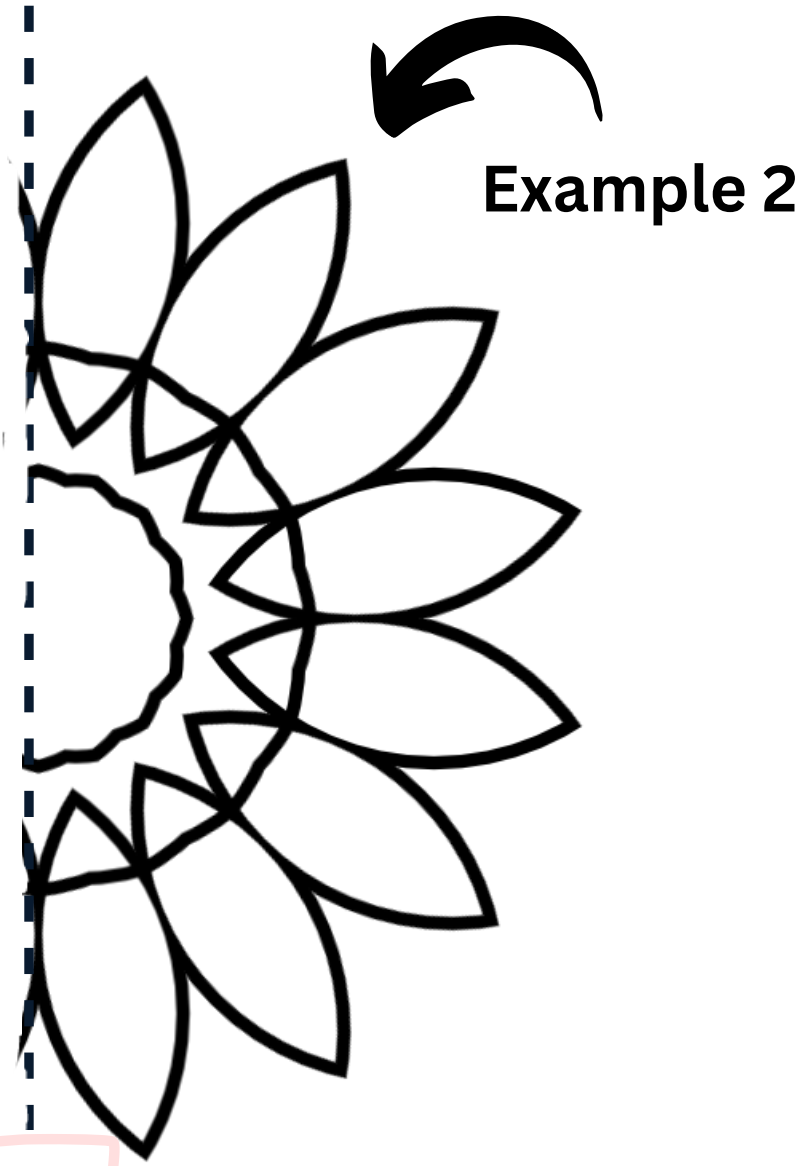
Left

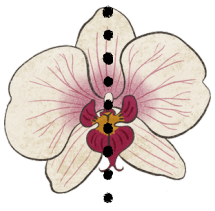
Right



Example 2

Radial Symmetry

Bilaterial Symmetry



The two main types of symmetry in flowers are **radial** and **bilateral symmetry**. When looking at this flower ask yourself: can you fold the flower in half more than one way and have two sides match? If so, the flower is radially symmetrical. If you can only fold it in half once with matching halves, the flower is bilaterally symmetrical.

What type of **symmetry** is this flower?

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What type of **shapes, angles, and lines** do you see in this flower?

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Directions: Select a insect or plant that is symmetrical. Then use a ruler to help you draw and color the pollinator in the blank area below.

Describe your **symmetrical** plant or pollinator:

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