Lesson: Bee-Healthy Farm

Grade Level: 3rd-5th Grade, Environmental Literacy

Overview: In this lesson, students will learn the importance of a healthy diet for living organisms. Students will learn about the importance of agriculture and how humans can affect food crops. Students will learn that the key role to a healthy agriculture is having a thriving population of pollinators. The class will hear stories from STEM-related careers in the agricultural industry and the importance of pollinators for our food.Students will gain knowledge and design their own pollinator garden. Students will choose different types of plants based on; native and non-native species, color, and growing season. Students will use math to measure their garden bed and will use formulas to find the area/perimeter of their garden bed. Students will be able to share the similarities and differences of their pollinator garden beds.

Science Content & Standards:
Pennsylvania New Academic Standards for Science-
https://www.pdesas.org/Page/Viewer/ViewPage/11

Environmental Literacy and Sustainability- Agriculture and Environmental Systems and Resources

Standard- 3-5ELS1-3: Analyze how living organisms, including humans, affect the environment in which they live, and how their environment affects them.

Standard- 3-5ELS1-4: Make a claim about the environmental and social impacts of design solutions and civic actions, including their own actions.

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

Practice 1 Asking Questions and Defining Problems

- Ask questions about what would happen if a variable is changed.
- Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.
- Use prior knowledge to describe problems that can be solved.
- Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.

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.

- Apply scientific ideas to solve design problems.

Math Content & Standards:
PA CORE STANDARDS Mathematics
https://www.pdesas.org/Page/Viewer/ViewPage/14?SectionPageItemId=659

2.1 Numbers and Operations-C) Numbers & Operations — Fractions
2.4 Measurement, Data, and Probability- (A)Measurement and Data

Standard- CC.2.1.3.C.1: Explore and develop an understanding of fractions as numbers.

Standard- CC.2.1.4.C.1: Extend the understanding of fractions to show equivalence and ordering.

Standard- CC.2.1.5.C.1: Use the understanding of equivalency to add and subtract fractions.

Standard- CC.2.4.3.A.5: Determine the area of a rectangle and apply the concept to multiplication and to addition.

Standard- CC.2.4.3.A.6: Solve problems involving perimeters of polygons and distinguish between linear and area measures.

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

- Look for and make use of structure.
- Model with mathematics.
- Use appropriate tools strategically.

Math & Science 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:
- Printed student resources pdfs, listed in resources tab.
- Pencil

- Ruler
- Colored pencils

Resources:

- Student reading passage:
  - *Bee-Healthy Farms* Student Reading passage
- My Bee-Healthy Garden Graphing Worksheet
- Pollinator plants arranged by bloom time pdf
- Student resource videos:
  - "Plant a Pollinator Garden" by National Geographic, https://youtu.be/M76sB_YPoU0
  - "The Arboretum at Penn State: Pollinator and Bird Garden" by PSU https://youtu.be/TeHd4AAq_Uc
- Read aloud, 'The Farm That Feed Us" by Nancy Castaldo

Learning Objectives:

- Students will learn about the importance of a healthy nutritional diet for humans and pollinators.
- Students will learn about the negative and positive environmental impacts humans have made.
- Students will learn about ways to create a pollinator friendly garden.
- Students will create and design a pollinator nutritional garden.
- Students will measure and use formulas such as area/perimeter to find the dimensions of their garden.

Procedure:

1. The teacher will introduce the lesson by having students read and discuss, "*Bee-Healthy Farms"* reading passage, located in the google folder. The teacher can use the following questions to guide students into a introduction discussion for this lesson;
   a. "What is the difference between **Pollen** and **Nectar**?"
   b. "Do you think bees are similar to us in regards to choosing what we eat?"
2. The class will then watch the short video, "*Plant a Pollinator Garden"* from National Geographic. The teacher can guide students through a classroom discussion about the video;
   a. "Why do you think it is important to plant native pollinator plants?"
   b. "Why should we promote the growth of pollinators?"
3. The teacher will then hand out to students the "Pollinator Plants Arranged by Bloom" list, located in the google folder. The teacher will also demonstrate to students how to read and interpret the list. The teacher can use the following guided questions when explaining how to interpret the data.
   a. "What do you think **Native** means?"
   b. "How do you know if some plants have multiple visiting **pollinators**?"
   c. "Do you think a pollinator garden should bloom all year round? Why?"

4. Using the bloom sheet, model to students how to use the list to design a graphed garden on the *My Bee-Healthy Garden Graphing Worksheet*.
5. Students should use colored pencils to create a colorful garden bed that correlates with the plant's bloom colors.
6. Once the class has completed their pollinator garden. Students can share and explain their garden designs.
7. The teacher can complete the lesson by reading out loud to class, "*The Farm That Feeds Us*" by Nancy Castaldo.

Bee Healthy Farms

creating gardens that are nutritious for bees

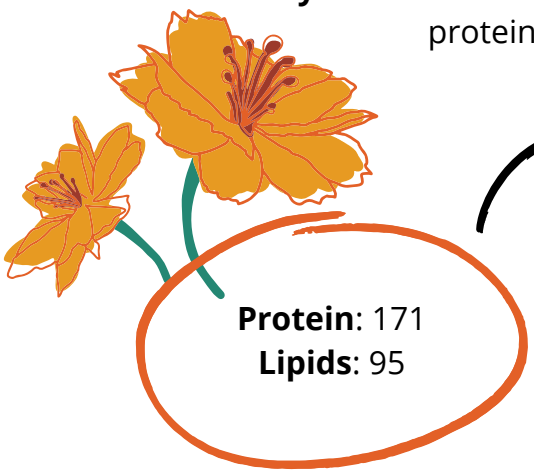
When bees are feeding from flowers, they are eating either nectar or pollen. **Nectar** provides bees with **carbohydrates**, or sugar. **Pollen** provides bees with **protein** and **lipids (**also known as fats). Similar to us, the right ratios of carbohydrates, protein, and lipids, collectively known as **macronutrients.** is part of a healthy diet. From these macronutrients, bees have the energy to fly, grow, and reproduce.

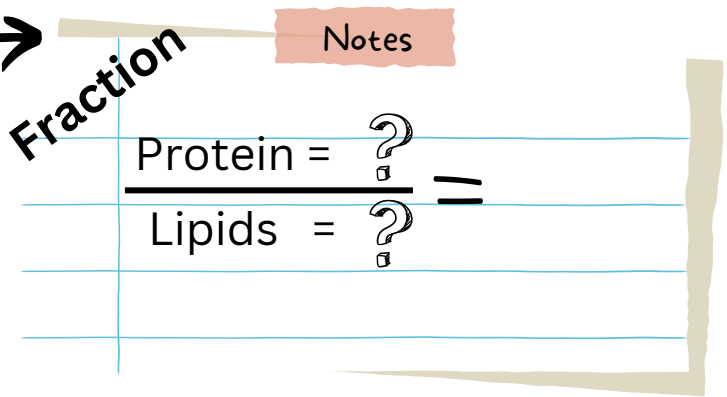
Like bees, humans need to have a healthy and nutritional diet to thrive. Eating a variety of foods can help you receive a full range of macronutrients and micronutrients (things like vitamins). For a well balanced diet, it is important to eat different types of veggies, fruits, dairy, meats, and carbohydrates. Just like bees, these macronutrients will help you maintain a healthy lifestyle.

How can you make healthy choices when picking out foods to eat?

Not all flowers have the same macronutrients. For example, some pollen has more protein than lipids while others have more lipids than protein. We call this the **protein-lipid ratio**, written as P:L. To calculate it, it becomes a fraction, written as P/L. All species of flowers have different protein-lipid ratios.

Try it! Determine this flower's protein-lipid ratio. Then, write the protein-lipid ratio as a **fraction**, and solve.





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There is evidence that bees may select the flowers they feed from based on the amount of protein in the pollen. However, it is also possible that bees select flowers in other ways such as visual cues, including flower size, color, and shape. Researchers at Penn State University wanted to explore this theory.

If we can understand the flower preferences of wild bees, then we can plant gardens that are the best for bees. As bees face numerous threats including pesticides, habitat loss, and climate change, pollinator-friendly gardens are more important than ever.

Researchers at Penn State University used Eastern Common Bumble Bees (*Bombus impatiens*) in a recent study. Only worker bees were used, as they are the bees that collect pollen for the hive. The following table is data collected from observations of the worker bees visiting flower species in the wild.

What observations can you make from looking at this table?

Flower Name	Carbohydrate	Protein	Lipids
American senna	118.47	237.28	51.72
Spiderwort	70.43	358.25	103.74
Culver's root	55.32	186.72	83.71
Purple coneflower	101.76	171.43	95.03
New England aster	91.35	91.04	84.03
Joe-Pye weed	112.66	146.48	158.76
Boneset	87.20	78.00	108.01

The flower with the lowest amount of protein: _____.

The flower with the highest amount of lipids:_____.

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Math Time!

Direction: Read the following scenario and answer the questions below.

You own a shop in town and have a garden bed in the front of your business. Knowing how important bees are, you want to plant flowers that are good for them. You only have room for three different flower species.

Flower Name	Carbohydrate	Protein	Lipid
American senna	118.47	237.28	51.72
Spiderwort	70.43	358.25	103.74
Culver's root	55.32	186.72	83.71
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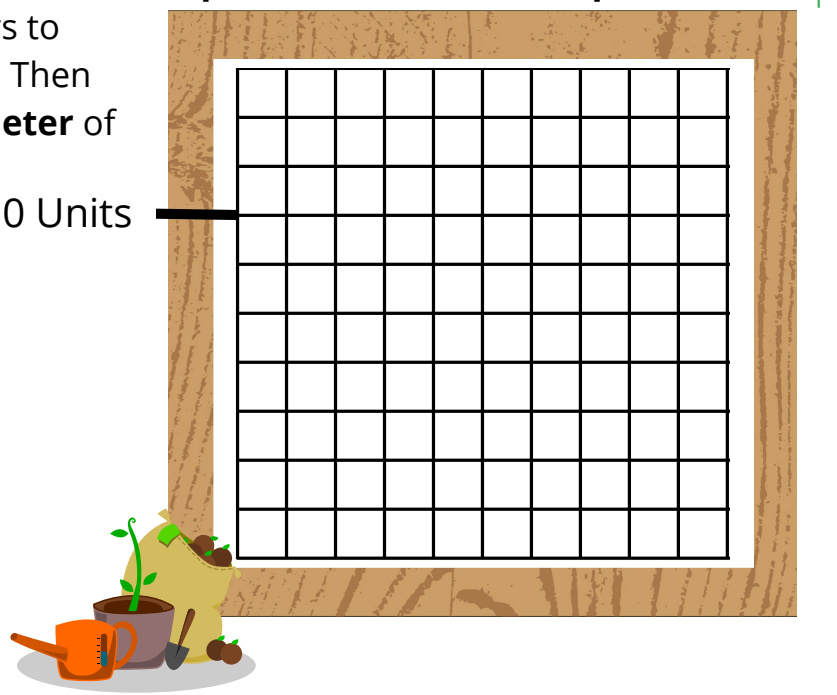
Using the same table from page 2, select three plant species.

1. _____
2. _____
3. _____

Below is a small garden bed. Use your **three chosen flower species** and plant them in the empty garden bed. Use different colors to represent different species in the bed. Then calculate and find the **area** and **perimeter** of the whole garden bed.

1 planted flower = 1 square unit.

10 Units



Area = Length X Width

A= L X W

A= _____

Perimeter = Sum of all sides

P = L + L + L + L

P= _____

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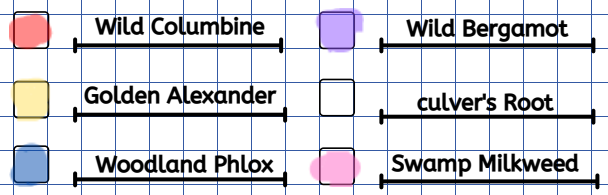
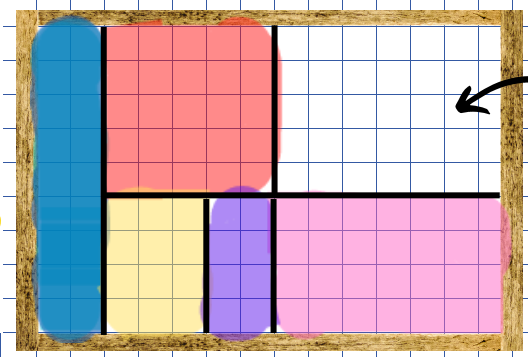
My Bee-Healthy Garden

Name: _____

Directions: Using the Pollinator Plants Arranged by Bloom Time list, choose **6 plant species** to create a nutritional garden for visiting pollinators. Remember to design a **colorful** garden that also **blooms all year round.** Fill in the key below for your garden. Label with the common name and bloom color for each plant.

GARDEN KEY Example:

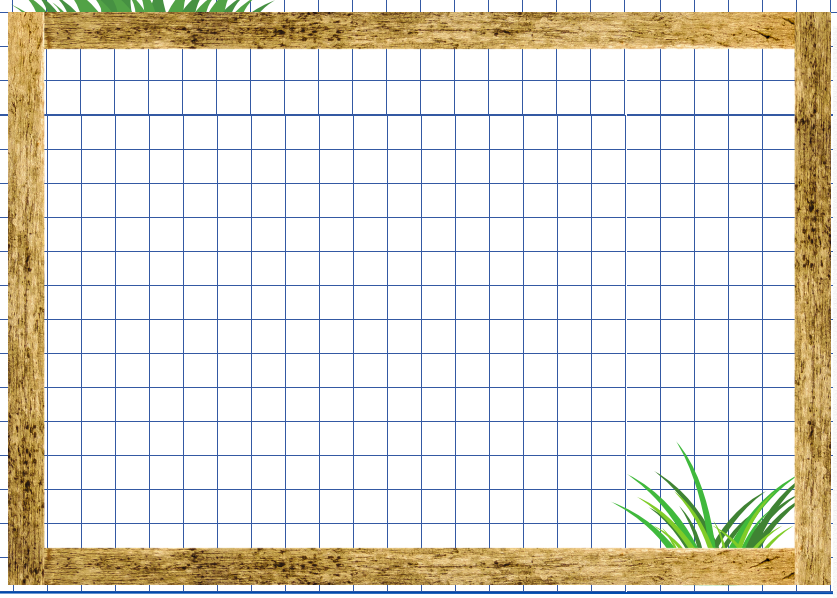




Example

MY GARDEN KEY:

Bloom Color	Common Name	Visiting Pollinator



Garden Math!

Find the Perimeter of your garden?

Find the Area of your garden?