



Alkali Bee, alfalfa pollinator,
Nathaniel Gross, Buguide

Lesson Title: Price of Pollination

Grade: 6-8

*Duration of Lesson: 1- 45 minute class
Plus student research time*

Brief: Students will understand that part of our food cost is for the rental or purchase of pollinators.

Materials:

Montana Pollinator Education Project Bee Identification cards

Montana Pollinator Education Project Poster

Additional pollinator posters from Montana Department of Agriculture if available, can also be seen at:
[Pollinator Posters](#)

Key Terms

Agriculture, pollinator, cost of goods sold, alkali bee, leafcutter bee, chalkbrood, legume, and diversity.

MONTANA COMMON CORE STANDARDS:

ELA: 6-7. Writing

7. Research to Build and Present Knowledge: Conduct short research projects to answer a question, drawing on several sources and generating additional related, focused questions for further research and investigation.

ELA 8. Writing

4. Production and Distribution of Writing: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

NGSS MS. Structure, Function, and Information Processing

Science and Engineering Practices, Planning and Carrying out Investigations

Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. (MS-LS1-1)

NGSS MS. Matter and Energy in Organisms and Ecosystems

Disciplinary Core Ideas, LS2.A: Interdependent Relationships in Ecosystems

Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and nonliving factors. (MS-LS2-1)

Understanding(s) /Big Ideas:

Students will understand that the price of many foods includes the price of farmers buying, raising, or renting pollinators.

Essential Question(s):

Do farmers need to pay for pollination of crops?

Students will know:

Many different crops require additional pollination sources.

Students will be able to: Understand the role of pollinators in food production, and estimate the dollar value for certain agriculture crops.

Performance / Observations

Performance Task(s):

Research paper on pollinator dependent crops.

Other Evidence:

Learning / Inquiry Activities

Introduction

“A recent study by Cornell Univeristy looked at the economic value of pollinators for 58 crops that depend directly on insect pollination to produce a crop, including apples, blueberries, almonds, cherries, oranges, and squash, crops worth \$16.35 billion. But that is only part of the picture. There are many other important crops, such as alfalfa, sugar beets, asparagus, broccoli, carrots, and onions that depend on pollinating insects in order to produce the seeds we need to continue to grow these crops. These crops added another \$12.65 billion in value.” For more information visit:

<http://www.news.cornell.edu/stories/May12/Pollinators.html>



<http://www.public-domain-image.com/>

Almond blossom



Almonds

Many of the foods that we eat, approximately one in every three bites, depend upon pollinators. Almonds are one of the crops that rely heavily upon pollinators for seed production, and humans consumed 1.4 pounds of almond seeds per person in 2009. Almonds add over 3.4 billion dollars to the US economy in jobs, sales, and services and are found in cereals, oils, and eaten as whole almonds.
http://www.agmrc.org/commodities_products/nuts/almond-profile/

The pollinator cost for farmers in growing almonds can be up to 20% of the cost to culture almonds, and the price consumers pay and the availability of almonds is largely tied to pollinators.
<http://www.almondboard.com/Growers/Documents/Economics%20of%20Growing%20Almonds,%20revised.pdf>

Many of our domesticated crops are reliant upon pollinators; one Montana crop that is pollinator dependent is the alfalfa seed crop. “Alfalfa, queen of forage crops, is the nation’s most important forage, and Montana’s leading hay crop. Most authorities believe that alfalfa, which means “Best Fodder” in Arabic, originated in southwestern Asia. Alfalfa was brought to the New World by 16th Century Spaniards and introduced to the United States by missionaries from Mexico. Alfalfa was reportedly grown in the Yellowstone Valley as early as 1884. Alfalfa is adapted to a wide range of environments and is grown on more than 1.3 million acres throughout Montana. Alfalfa can produce abundant forage and is ideal for improving the soil nitrogen levels while providing erosion control. Its extensive root system often penetrates to depths of 20 feet or more, extracting water from great depths. This characteristic makes it well adapted for recharge areas that contribute to saline seep.” Growing Alfalfa for Hay, MSU Extension Publication (MT8505). In Montana alone market values of alfalfa reach above \$430,000,000.00.

As mentioned, alfalfa is one of the crops that needs special pollinators in order to produce seeds. Alfalfa is effectively pollinated for alfalfa seed production by the Alkali bee and the Leafcutter bee. Other bees have a very hard time pollinating alfalfa, which is part of the legume family, because of a snapping mechanism in the flower called a keel. (See the MPEP Alkali Bee card, #3). Alkali bees and Leafcutter bees have found ways to divert the snap and effectively pollinate the flowers. Honey bees have found ways to take the nectar from the alfalfa flower, but shy away from gathering pollen as they do not like the flower’s snap.

Montana farmers work very hard to insure that their alfalfa seed fields are stocked with enough bees to pollinate the alfalfa flowers. “Alfalfa leafcutting bees are the major commercial pollinator of seed

alfalfa in western North America, although they were introduced to the United States (accidentally) just over 60 years ago. Some estimates indicate that each female bee can pollinate enough flowers to produce a quarter pound of seed.” Sue Blodgett, MSU Entomology.

Many diseases plague leafcutter bees, one of them is a disease called chalkbrood. This fungal disease enters through the stomach of the larvae, eventually killing it and leaving the corpse white and chalky looking. In the US researchers are trying to find ways to combat chalkbrood disease, which is very costly to alfalfa seed producers.

Many other crops rely heavily on pollinators as well. The chart below shows some of the foods that we eat which depend on pollinators.

Which Foods Depend on Bees?

Many of the foods and crops we rely on need or, at the very least, benefit from bee pollination. Here's a list of some of those crops.

• Alfalfa	• Flax
• Almonds	• Garlic
• Apples	• Gooseberries
• Asparagus	• Grapes
• Beans	• Horseradish
• Beets	• Kale
• Blackberries	• Lettuce
• Blueberries	• Mustard
• Brussels sprouts	• Onions
• Buckwheat	• Parsley
• Cabbage	• Peaches
• Cantaloupe	• Pears
• Cauliflower	• Plums
• Celery	• Pumpkins
• Cherries	• Radishes
• Chestnuts	• Raspberries
• Chives	• Rhubarb
• Clover	• Squash
• Cranberries	• Strawberries
• Cucumber	• Sunflowers
• Currants	• Sweet potatoes
• Eggplant	• Turnip
	• Watermelon

A booklet explaining more about pollinators and these crops can be found at:

<http://www.agriculture.technomuses.ca/english/bees/pollination/food-depends-on-bees.php>

Besides just a shortage of food, without pollinators fruits and vegetables are not completely filled out.



Raspberries, *Rubus idaeus* L., after passive self-pollination (left and middle) and open insect pollination (right). (Photo by Jim Cane, Bee Research Institute, Longan, USA)

Photo shows effects of lack of complete pollination vs. complete.

Learning / Inquiry Activities:

This lesson teaches about some of the unique pollination systems on our earth and the impact pollinators have on volume and quality of food produced. After teaching the information above ask students to each pick one of the crops on the list above. Assign students a research writing exercise in which they will research the following for each crop:

1. State in which the crops is produced on a large commercial basis (over \$100,000 per year).
2. Amount of yield of the crop in the state.
3. Pollinator information about each crop, such as specific pollinators and information about the pollinator.
4. Information on the price to farmers for providing pollinators for their crops.

Some sources for research data:

National Ag Statistics Service <http://www.nass.usda.gov/>

Pollination Specifics: http://en.wikipedia.org/wiki/List_of_crop_plants_pollinated_by_bees