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Lesson Title: The Buzz on Bumble bees.

Grade: 5-8

Duration of Lesson: 2- 45 minute classes

Brief: Students will understand the individuality and vital importance of Bumble bees.

Materials:

Montana Pollinator Education Project Bee Identification cards

Montana Pollinator Education Project Poster

Montana Pollinator Education Project seed packet (optional for plantings)

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

Key Terms

Agriculture, bumble bee, *Bombus*, buzz pollination, forage, ecosystems, fauna, eusocial, solitary, social, native plants, commercial greenhouse.

MONTANA COMMON CORE STANDARDS:

ELA 5. Reading Informational Texts

4. Craft and Structure: Determine the meaning of general academic and domain-specific words or phrases in a text relevant to grade topic or subject area.

ELA 6. Reading Informational Texts

4. Craft and Structure: Determine the meaning of words and phrases as they are used in text, including figurative, connotative, and technical meaning.

ELA 7. Reading Informational Texts

4. Craft and Structure: Determine the meaning of words and phrases as they are used in text, including figurative, connotative, and technical meaning; analyze the impact of a specific word choice on meaning and tone.

ELA 8. Reading Informational Texts

4. Craft and Structure: Determine the meaning of words and phrases as they are used in text, including figurative, connotative, and technical meaning; analyze the impact of a specific word choice on meaning and tone, including analogies or allusions to other texts.

NGSS MS. Interdependent Relationships in Ecosystems

Disciplinary Core Ideas, LS2.C: Ecosystem Dynamics, Functioning, and Resilience

Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (MS-LS2-5)

<u>Understanding(s) /Big Ideas:</u> Students will understand unique qualities of bumble bees in food production.	<u>Essential Question(s):</u> Why are bumble bees necessary in cool climates?
<u>Students will know:</u> Bumble bees are a vital link in the food chain. Commercial applications of bumble bee rearing.	<u>Students will be able to:</u> Articulate the importance of bumble bees to their diet.
Performance / Observations	
<u>Performance Task(s):</u> Reading for content.	<u>Other Evidence:</u> Overarching economic and nutrition impacts of bumble bees.
Learning / Inquiry Activities	

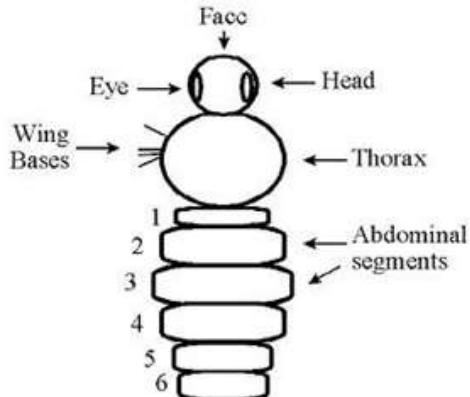
Instructor Introduction (Optional student reading):

Bumblebees are common bees; most of them are black and yellow, some with more black than yellow, while others have more yellow than black, and still others have white or red markings. Bumble bees possess some characteristics that will help you to distinguish them from other bees in the region: they

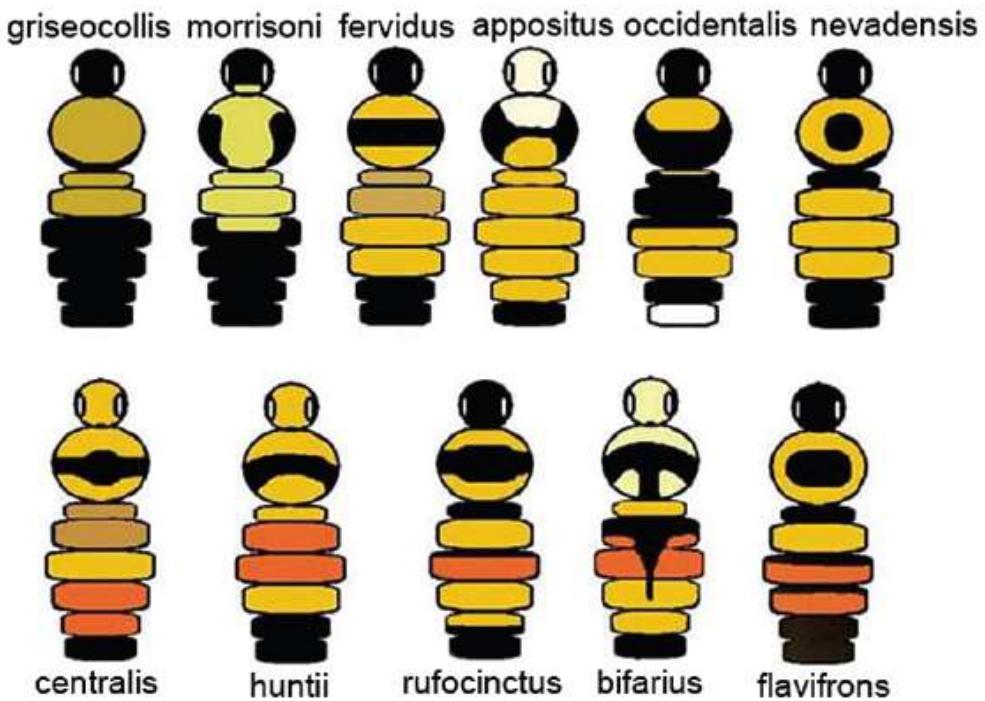
are big and seen in early spring, they are harrier than most other bees, and females transport pollen as a wet mass held in a “pollen basket” on the hind leg. The pollen basket of the hind pair of legs is broadened and concave like a shallow, elongate spoon. If empty, its polished surface can be seen reflecting light. Only the honey bee in our fauna has a similar pollen basket; other bees that collect pollen carry it in a dense brush of hairs either on the hind leg or under the abdomen. Bumble bees are much harrier than the honey bee when you see them with the naked eye.

Bumble bees large size lets them carry huge pollen loads, allowing longer foraging trips, and achieving better contact with flowers. Bumble bees will also work under conditions that other pollinators find intolerable. They can pollinate in a greenhouse or work in temperatures below 50° F. Their ability to pollinate in cooler temperatures makes them the perfect solution for pollinating early spring blooms of fruit crops in Montana. Bumble bees generate their own heat by rapidly vibrating their wings. They are also important pollinators of food crops in the Solinaceae family, like tomatoes, whose blossoms must be rapidly vibrated to release their pollen. To watch a video of buzz pollination click [here](#).

Bumble bee guide: Courtesy of USDA ARS Logan, Utah



- 1) **Head.** What is the hair color atop the head yellow or black?
- 2) **Thorax.** Is there a patch of black hair on the top of the thorax, between or behind the wings? If so, is it a disc of black, a band of black, or is the entire hind half of the thorax covered in black hair?
- 3) **Abdomen.** Is the tip white? Are there orange bands? Which segments are orange? Is an orange band split by a central black stripe along the upper surface? Are the yellow hairs greenish or golden?



Bumble bee identification guide available at: <http://www.ars.usda.gov/Services/docs.htm?docid=10749>

SOCIAL BEHAVIOR

All of the *Bombus* species are eusocial. Eusociality is characterized by a reproductive division of labor, consisting of queens, workers and males; overlap of generations; and cooperative care of offspring. *Bombus* workers are usually smaller than the queen, but otherwise they are similar morphologically. Bumble bees are solitary bees, meaning they don't congregate in a hive, which makes them less likely to

be aggressive as they are not guarding a hive. They also have some social behaviors, for example the queens may hibernate together.

COLONY LIFE CYCLE

The colony cycle of a bumble bee starts in the spring. Queens, which have over-wintered in protected locations, will initiate a new colony. Queens emerge very early in the spring in Montana. The queens will often locate a preexisting cavity in the soil, such as an abandoned rodent nest or a hole in a log. Locating a suitable location often takes considerable time. *Bombus* queens are visible in the spring flying close to the surface of the ground searching for a cavity. It is common for *Bombus* queens, even of different species, to fight for a nesting location ([Heinrich,1979](#)).

Female workers, which are smaller than queens, are produced during most of the summer. The queen will forage for pollen for her first group of workers. Following that, workers will do most of the foraging. In the nest, the pollen is placed in a ball, and several eggs are laid in it. The queen, or workers, can incubate the pollen mass to speed the development of the young. As the summer proceeds, the colony will start producing males and new queens. The new queens mate in the fall, and then overwinter in protected locations.

BODY TEMPERATURE AND WORK

At rest a bumble bee's body temperature will fall to that of its surroundings. To raise the temperature of the flight muscles high enough to enable flight the bumble bee shivers and vibrates, rather the same as we do when we are cold. This can easily be seen in a grounded bee as her abdomen will pump to ventilate the flight muscles. The rate of pumping can give an indication of the temperature of the bee. Ranging from around 1 pump per second when she is at 10°C, to 6 pumps per second when she reaches 35°C. The time taken to raise the thorax temperature has been studied and is laid out in the table below.

Bee/air temp. °C	Time taken to reach 30°C
24	a few seconds
13	5 minutes
6	15 minutes

ACTIVITY 1: STUDENT READING EXERCISE

BENEFITS OF BUMBLE BEES

Excerpt from: Befriending Bumble Bees

“Most people raise bumble bees to benefit from their impressive pollination services, a service that is vital to both food production and the health of our ecosystem. With a large variety of problems afflicting the honey bee industry such as pests, pesticides, diseases, and poor financial returns it is important to broaden the range of bee species used for commercial pollination.

Unlike honey bees, which were imported to the Americas by European colonists, there are many bumble bees that are native to North America. Having evolved along with our native plants, bumble bees are efficient and important pollinators of many native wildflowers and crops such as cranberries, blueberries, raspberries, squash, and melons.

Buzz Pollination

Bumble bees ensure the perfection of tomatoes by performing a special feat called "buzz pollination." The bumble bee grabs the anther cone (the flower part containing the pollen) and shakes it, releasing pollen that would otherwise stay trapped in the anther cone. The pollen is then available to fertilize flowers so that fruit can be produced. Good pollination produces large, evenly shaped, attractive fruits.

Greenhouse Heroes: Bumble bees are used to pollinate most tomatoes grown in commercial greenhouses. Bumble bees adapt well to use in greenhouses. Commercial bumble bee rearing companies produce bumble bee colonies year-round to serve greenhouse tomato production.

One of the qualities that sets bumble bees apart from many other pollinators is a special behavior called "buzz pollination" that some flowers, such as tomatoes, require for pollination. During buzz pollination, bees grab the flower and shake it, releasing pollen that would otherwise remain trapped within the flower. Most other bees, including honey bees, are incapable of performing buzz pollination, so bumble bee colonies are used to pollinate most tomatoes grown in commercial greenhouses.

There are also rare native wildflowers that depend on bumble bees for pollination. As natural habitats become more fragmented by housing and other land developments, wild bumble bee populations are likely to decline and some native wildflowers may lose their pollinators. Without pollination, plants cannot produce seeds.

Bumble Bees and Native Flowers: Although bumble bees are a common sight in most flower gardens, not all bumble bee species have adapted well to changes that have taken place in the landscape since the colonization of America. Planting pollinator gardens can be of great help to the diversity of flowers bees need.

Bumble bees are creatures of undeniable beauty and charm. You are sure to become fascinated while watching their interactions and marveling at the ever-changing sculptures of wax inside their nests. Observing the bumble bees you raised foraging in your fields or gardens will have a deeper meaning when you understand more about these avid pollinators.” Evans, Burns, and Spivak, 2008

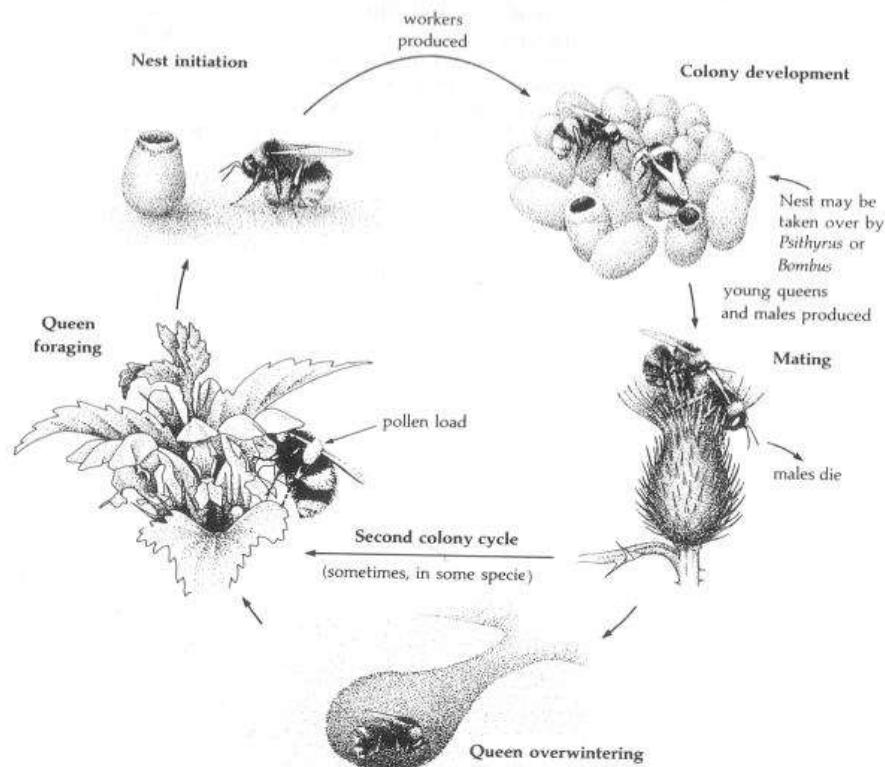
Bumble Bees, Social and Solitary:

Bumble bees are solitary bees, meaning they don't congregate in a hive, which makes them less likely to be aggressive as they are not guarding a hive. They also have some social behaviors, for example the queens may hibernate together.

Bumble Bee Life Cycle: The colony cycle of a bumble bee starts in the spring. Queens, which have over-wintered in protected locations, will initiate a new colony. Queens emerge very early in the spring in Montana. The queens will often locate a preexisting cavity in the soil, such as an abandoned rodent

nest or a hole in a log.

When food is plentiful and outside temperatures fall below 10°C bumble bees generally stay inside the nest and live off their stores of pollen and nectar. At times when food is scarce or stores are low they will forage when the outside temperature is as low as 6°C, and queens will forage at even lower temperatures. In severe conditions they have even been known to vary their flying height to and from the nest to take advantage of any temperature differences.



SOURCE: [HTTP://WWW.BUMBLEBEE.ORG/LIFECYCLE.HTM](http://WWW.BUMBLEBEE.ORG/LIFECYCLE.HTM)

ASSESSMENT: STUDENT WORKSHEET ON READING COMPREHENSION FOR ACTIVITY 1.

1. List two main reasons people raise bumble bees.

a. _____

b. _____

2. List two places that bumble bees are more effective than honeybees for pollination.

a. _____

b. _____

3. List two unique qualities of bumble bees.

a. _____

b. _____

4. After reading this article, why do you think it is important to try and protect bumble bees?

5. What is the main idea of the article?

6. How can each of us help create bumble bee habitat? List as many actions as you can.

Extended Information

<http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/plantsanimals/pollinate/help/>

http://www.plants.usda.gov/pollinators/Montana_Native_Plants_for_Pollinator-Friendly_Planting.pdf

http://www.plants.usda.gov/pollinators/Plants_for_Pollinators_in_the_Intermountain_Web_PM%202.pdf



BUILDING A BUMBLE BEE NEST BOX

THE FOLLOWING LINK PROVIDES DETAILED INSTRUCTIONS ON BUILDING A BUMBLE BEE NEST AND INFORMATION ON SUCCESSFUL TIPS FOR BUMBLE BEE REARING:

http://www.ars.usda.gov/SP2UserFiles/Place/54280500/Bumble_beeRearingGuide.pdf



PLANTING A POLLINATOR GARDEN/ PROTECTING POLLINATORS MOVIE

The Montana Pollinator Education Program provides pollinator friendly seeds for you students to plant: Contact lbrenneman@mt.gov for more information and seed packets.

Pollinator Friendly Plants

<http://pollinator.org/guides.htm>



BUMBLE BEE (BOMBUS sp) BIOLOGY

<http://academic.evergreen.edu/projects/ants/TESCBiota/kingdom/animalia/phylum/arthropoda/class/insecta/order/hymenoptera/family/apidae/bombus/biology.htm>



CONSERVING NATIVE BEES

http://www.msue.msu.edu/objects/content_revision/download.cfm/item_id.372953/workspace_id.-30/Enhancing%20Farm%20Landscapes%20for%20Native%20Bees.pdf/

Many of the materials used in this lesson are courtesy of: <http://bumble bee.org/>

<http://agr.mt.gov/agr/Programs/AgClassroom/>

Works Cited:

Elaine Evans, Ian Burns, and Marla Spivak 2008

Befriending Bumble Bees

Kweskin, Matthew 1996

The Bumble bees of Evergreen

Wilson, E. O. 1971.

The Insect Societies. Harvard University Press, Cambridge