

# Beyond the Bug

**Grade Level: 4-8**

## Lesson Overview

How often have you heard someone say, “Eww, a bug!” Maybe you’ve even said it yourself! But insects play an important role in our everyday lives—and not just as pollinators or producers of honey. In this lesson, students will discover several other ways humans use insects.

## Student Objectives

1. Students will learn about insects as a source of products that benefit people.
2. Students will identify products which come from insects--such as shellac, natural red food dye, and silk--and the insects that provide these products.

## Materials

- ✓ Entomology Fact Cards (set of 6 per group of 3 students)
- ✓ Useful Insects Matching Cards (set of 24 per group of 3, cut apart in advance)
- ✓ Useful Insects Information Grid (1 per group of 3)
- ✓ Useful Insects Answer Key
- ✓ paper
- ✓ pencils

Several items containing insect ingredients, such as:

- ✓ red lipstick (cochineal)
- ✓ jelly beans (confectioner’s glaze)
- ✓ silk fabric scarf or scrap
- ✓ honey
- ✓ small can of shellac (lac)
- ✓ beeswax lip balm
- ✓ basket or container to hold above items

## Vocabulary

- **beeswax** - the wax produced by honeybees to make honeycombs; used for products such as polishes and candles
- **bug** - informal term for a small insect; “true” bugs are insects with sucking mouth parts within the order Hemiptera

- **carmine** - another name for cochineal, a vivid red dye made from cochineal insects
- **cochineal** - scale insect cultivated on cacti and used to produce a red dye of the same name
- **house cricket** - a type of cricket raised for use as pet food, research, and human consumption
- **entomology** - the branch of science that focuses on the study of insects
- **entomophagy** - the practice of eating insects
- **honey** - a sweet, sticky, edible substance produced by honeybees from nectar which has been collected from flowers
- **honeybee** - a type of bee that collects nectar and pollen from flowers and produces wax and honey (while dictionaries spell it as one word, "honeybee," entomologists consider it more accurate to spell it as two words, "honey bee")
- **insect** - small invertebrate animal with six legs and one or two pairs of wings
- **insect farming** - raising insects as livestock for human consumption, animal feed, or other purposes
- **lac** - waxy resin secreted by the lac beetle and used to make shellac for woodworking and sealing wax for candies and other foods
- **lac insect** - a species of scale insect that produces lac, a resin used to make shellac
- **mealworm** - larval stage of the mealworm beetle; used in research, as pet food, and for human food
- **minilivestock** - term used to describe insects raised as an agricultural product; also known as micro stock
- **nopalry** - nopal or prickly pear cactus farm where cochineal insects are raised
- **sericulture** - raising silkworms for the production of silk
- **shellac** - purified lac that is used to make varnish
- **silk** - a soft, fine, and strong fiber obtained from the cocoons of silkworms and used to make fabric

- **silkworm** - larval form of the silk moth; silkworm cocoons are processed to make silk fabric

## Background Information

When it comes to insects and agriculture, most people probably think of pollinators like honeybees, or crop pests like boll weevils. However, insects also play other roles in agriculture: as food for humans, as feed for pets and livestock, and for other useful products. Insect farming is the practice of raising and breeding insects to fulfill these roles.

Humans have been eating insects—a practice known as entomophagy—for thousands of years. Although not currently common in Western countries, the United Nations Food and Agriculture Organization (FAO) estimates that about 20% of the world's population consumes insects as part of their diet. Insects are high in protein and other nutrients and require less space, feed, water, and time to produce compared to food animals like poultry or cattle. Crickets, locusts, termites, and mealworms are just some of the kinds of insects that are edible by people.

There is also growing use of insects as a feed ingredient for livestock. Because of their high protein content, insects can be a partial replacement for soy protein in diets for poultry, pigs, cattle, and fish. Efficient use of energy and space makes raising insects a sustainable way to meet the increasing demand for livestock feed as the world's population grows. In fact, in 2020, international food and feed company ADM announced a partnership with InnoVaFeed to build the world's largest facility to produce insect protein for livestock to be located in Decatur, Illinois.

Finally, insects have long provided us with products such as shellac, waxes, and natural dyes. Even if you don't think you would ever willingly consume an insect or use a product produced by one (with the possible exception of honey and beeswax), chances are good that you consume and use insects and their products often in your daily life.

## Procedure

### Part 1

1. As an interest approach, hold up the basket or container into which you have placed several of the items listed in the materials list. Tell students that all the items in the basket have something in common (but don't tell them what it is).
2. Divide students into teams of three. Instruct each team to appoint a leader, recorder, and presenter. The leader is in charge of keeping the team on task and watching the time, the recorder will take notes, and the presenter will share the team's results.

3. Hold up each of the items in the basket and say what it is. Team recorders should get out a pencil and a piece of paper to make a list of the items.
4. Give teams 5-7 minutes to discuss the items. Encourage students to think about what each is made from. Team recorders should write down their team's ideas. Pass around the basket so each team can see the items up close.
5. When time is up, invite the presenter from each team to share with the class the highlights of their group's discussion and their answer.
6. Hold up each of the items again and tell students they all contain a product from insects (but don't say how).

### Part 2

7. Explain that students will now work in their teams to learn about six different insects and the products they produce. Each team member will focus on two different insects and share their new knowledge with their teammates. Teams will then compete to see which can most accurately complete a matching activity.
8. Distribute to each team: one set of Entomology Fact Cards, one set of Useful Insects Matching Cards, and a Useful Insects Information Grid.
9. Each team member should read two Fact Cards, highlighting or taking notes as they go. (If cards are laminated in advance, students may use transparency markers.) Once they are finished reading, students will take turns summarizing what they learned. Going forward, each student's job is to be the team expert on their two insects.
10. The Useful Insects Matching Cards should be shuffled and piled upside down.
11. Students now take turns drawing a card to match with a correct square on the information grid. If unsure where to place a card, they should consult the team's expert on that insect. The expert may answer from memory, read aloud the relevant portion of their Fact Card, or check their notes to help choose a match.
12. When all teams have completed their information grids, display the answer key so teams can check their answers. The team with the most correct matches wins!
13. If time allows, have teams clear their grids and try again with a time limit.

### **Extension Activities**

1. Challenge students to conduct research on another insect used by humans and then create a fact card similar to those provided in this lesson. Possible insects include:

- agave worm
  - black soldier fly
  - Japanese wax scale
  - locust
  - long-horned beetle
  - rhinoceros beetle
2. From Hatch to Harvest: The New Food Frontier lesson correlates well with this lesson.

## **Additional Resources**

- The Bug Girl: Maria Merian's Scientific Vision by Sarah Glenn Marsh ISBN 978-0807592571
- BugGuide: Identification, Images, & Information For Insects, Spiders & Their Kin for the United States & Canada <https://bugguide.net/node/view/15740>
- Chirp by Kate Messner ISBN 978-1547602810 (This book is recommended for 7th-8th grade students. Due to sensitive content, teachers are advised to read the book in advance.)
- Insect Farming [https://en.wikipedia.org/wiki/Insect\\_farming](https://en.wikipedia.org/wiki/Insect_farming)
- Insect Identification for the Casual Observer <https://www.insectidentification.org/>
- Insects as a Source of Raw Materials <https://www.britannica.com/animal/insect/Insects-as-a-source-of-raw-materials>
- Insects for Food and Feed <http://www.fao.org/edible-insects/en/>

## Standards

### ***Illinois English Language Arts Standard***

RST 1 Cite specific textual evidence to support analysis of science and technical texts.

### ***Illinois Social Science Standard***

SS.EC. 2.4 Describe how goods and services are produced using human, natural, and capital resources (e.g. tools and machines).

The **M**ultidisciplinary **A**gricultural **I**ntegrated Curriculum (mAGic) was created in 2004 under the leadership of the Illinois State Board of Education (ISBE) and the Facilitating Coordination in Agricultural Education Project (FCAE). Funding was made available through the FCAE grant budget from the agricultural education line item of the ISBE budget. This revision, as printed, was developed in April 2021.



These mAGic lessons are designed to bring agriculture to life in your classroom. They address the Illinois Learning Standards in math, science, English language arts and social studies.

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# ENTOMOLOGY FACT CARD

Image by Frank Vincentz via Wikimedia Commons



**cochineal**

*Dactylopius  
coccus*

**COCHINEAL** insects are native to the Southwest United States and Mexico. They are scale insects, which are a type of sap-eating insect covered with a scale or waxy coating. Cochineal insects feed on the juices of prickly pear cacti.

## **Appearance**

Cochineal are soft, oval, and covered by secretions of a waxy substance that makes them appear grey or white. Under this protective coating, their bodies are a purplish-red. This coloring is a result of the carminic acid they produce as a deterrent to predators.

## **Farming**

Cochineal insects are raised on nopal (prickly pear) cactus farms. Such a cactus farm is known as a nopalry. The insects are harvested at about 90 days old by picking them off the cacti and placing them in bags. They are then dried and processed.

## **Uses**

The red dye known as cochineal extract is made from dried, pulverized bodies of cochineal insects. Carmine is another coloring which can be processed from cochineal. Cochineal dyes are used to color fabrics, as a natural food coloring, and in cosmetics like lipstick and blush.

Image by Andrew Cannizzaro via Wikimedia Commons



# ENTOMOLOGY FACT CARD

**honeybee**  
*Apis mellifera*

**HONEYBEES** (also known as “honey bees”) are native to Europe, western Asia, and Africa but introduced worldwide by humans beginning in the 1600s. Honeybees live in colonies consisting of a queen, workers, and drones. Honeybees feed on pollen, nectar, and honey (stored, concentrated nectar).

## **Appearance**

Honeybees are flying insects with distinctive black bands and yellow-orange rings on their abdomen. They have a hairy thorax, somewhat less hairy abdomen, and brown or black legs. They also have a structure called a corbicula or pollen basket on their hind legs.

## **Farming**

The practice of maintaining honeybee colonies is known as apiculture, or beekeeping. Apiarists, or beekeepers, raise honeybees to produce honey and other products and to pollinate crops. Commercial beekeepers have hundreds or even thousands of hives which are transported by truck to pollinate crops like almonds or apples when they are in bloom.

## **Uses**

Aside from their role as pollinators, honeybees produce honey, beeswax, and other products. Bee pollen is extracted from honeycomb cells. Royal jelly is secreted by worker bees to feed larvae and the queen. Propolis is a “bee glue” that bees produce to seal cells in the hive. Each of these products can be used for nutritional or medicinal purposes.



Image by Hans Schneider Geyersberg via Wikimedia Commons



# ENTOMOLOGY FACT CARD

house  
cricket

*Acheta  
domesticus*

**HOUSE CRICKETS** are a jumping insect that likely is native to Southwestern Asia. They are found worldwide due to introduction by humans. Like other crickets, they are known for their ability to “chirp” by rubbing their forewings together.

## Appearance

House crickets are brown or grayish in color, with prominent hind legs. They grow to about 3/4 inches (19 mm) long. Females have a dark brown or black ovipositor in the rear.

## Farming

House crickets are farmed as feed for pets and as food for humans. Modern commercial cricket farms raise the crickets in high-tech facilities that use automation and robotics to control temperature, airflow, humidity, feeding, watering, and harvesting.

## Uses

While house crickets are a common feeder insect for pets like reptiles and birds, they are also edible by humans. In Asia, dry-roasted or deep-fried crickets are eaten whole. In the U.S., raising food-grade crickets is a growing industry, especially to produce cricket flour as an ingredient in energy bars and baked goods. Because they are nutritious and more efficient to raise than traditional livestock, crickets are considered a sustainable way to help feed a growing population.

Image by Jeffrey W. Lotz, Florida Department of Agriculture and Consumer Services, Bugwood.org



# ENTOMOLOGY FACT CARD

lac insect  
*Kerria lacca*

**LAC INSECTS**, also known as lac bugs, are native to Asia. They are scale insects, a type of sap-eating insect covered with a scale or waxy coating. Lac insects feed on the sap of plants and secrete a resin called lac. Eventually, the entire bug is covered in a hardened lac tube in which it lays its eggs.

## Appearance

Lac insects are tiny and deep red or yellow in color. When they are feeding, they are hardly recognizable as insects, as all that is visible are the hardened secretions they produce. These secretions resemble dribbles of hardened sap.

## Farming

Lac bugs are raised by providing host plants on which the larvae feed. As they feed, the larvae secrete modified tree sap called lac until entire twigs are covered. The twigs are cut from the plants and the lac is scraped off to be processed into refined flakes called shellac.

## Uses

Lac resin is a natural polymer which can be used for products including wood varnish, pharmaceutical coatings, a spray coating for fruits, and to make the confectioner's glaze found on jelly beans and other candies. Waste water from lac production is also used to make a red dye.

Image by MarioM via Wikimedia Commons



# ENTOMOLOGY FACT CARD

**mealworm**

*Tenebrio  
molitor*

**MEALWORMS** are larva of the mealworm beetle, a species of darkling beetle. They may have come from the Mediterranean region originally, but are now widespread due to human introduction. Mealworms feed on vegetation, dead insects, and stored grain.

## **Appearance**

Mealworms are about 1 to 1.5 inches (2.5 to 4 cm) long, tan or brownish in color, and segmented.

## **Farming**

Mealworms are raised commercially in carefully controlled indoor facilities. Thousands of eggs are placed in trays of feed such as wheat bran with sliced carrots for moisture. Once the eggs hatch, the larvae feed and grow, molting 10-20 times before pupating. The mealworms are harvested at 2 to 4 months old and frozen until delivered.

## **Uses**

Mealworms are high in protein and fat, making them a popular feeder insect for pets, poultry, and to feed wild birds. Mealworms are also edible for humans and are processed into foods like mealworm burgers. In Southeast Asia they can be found in food markets or as street food. Mealworm waste, called frass, is sold as fertilizer. Mealworms can feed on polystyrene, so they may even be useful for breaking down plastic waste in the future.

Image by ID 41330 via Pixabay



# ENTOMOLOGY FACT CARD

**silkworm**  
*Bombyx mori*

**SILKWORMS** are the larval form, or caterpillar, of the silk moth. The domestic silk moth has been selectively bred for thousands of years, beginning in China and later spreading to India, Korea, Nepal, and beyond. Silkworms prefer to feed on white mulberry leaves but will also eat Osage orange and lettuce.

## Appearance

Silkworms are cream-colored, segmented, and about 1.5 inches (4 cm) long, with a horned tail. When they are ready to pupate, they produce a fluid in their silk glands that hardens into a half-mile long silk thread with which they wrap themselves to form a whitish cocoon. Adult domestic silk moths are grayish in color and cannot fly.

## Farming

The practice of breeding silkworms to produce raw silk is known as sericulture. Sericulture has existed for at least 5,000 years. About 70 million pounds of silk are produced annually.

## Uses

Silkworms are primarily raised for the production of silk. Silk moth pupae, which are boiled to obtain the cocoons without damaging the silk fibers, are eaten in some cultures. Silkworms are also important for use in scientific research. In fact, the first animals in which pheromones were discovered were domestic silkworms.

## Useful Insects Information Grid

Native to the southwest U.S. and Mexico; feed on juices of prickly pear cacti	Secrete a resin which is used for wood varnish	Produce a liquid that hardens into a thread which it wraps around itself to form a cocoon	Popular feeder insect for pets, poultry, and wild birds
Feed on pollen, nectar, and honey (stored, concentrated nectar)	Produce carminic acid as a deterrent to predators	Edible for humans; can be processed as burgers or found as street food in Southeast Asia	Hives are transported by truck to pollinate crops when they are in bloom.
Can be ground into flour for energy bars and baked goods	Prefers to feed on white mulberry leaves but will also eat Osage oranges and lettuce	Brown or grayish in color; known for their ability to “chirp” by rubbing their forewings together	Larvae will feed on vegetation, dead insects, and stored grain
Resin is refined to make confectioner’s glaze found on jelly beans and other candies.	This insect’s name is the same as a name for the dye which can be produced from it.	Live in colonies consisting of a queen, workers, and drones	Eventually, the entire bug becomes covered in a hardened tube formed by its secretions
Can feed on polystyrene and may be useful for breaking down plastic waste	Raised in high-tech facilities that use automation and robotics	The practice of breeding this insect to produce fabric is known as sericulture.	Red dye made from the dried, pulverized bodies of this insect is used in cosmetics like lipstick and blush.
Pupae are boiled to obtain their cocoons without damaging the fibers	Maintaining colonies of these insects is known as apiculture.	A natural polymer which can be used for pharmaceutical coatings and to spray on fruits	Considered a sustainable way to help feed a growing population

# Useful Insects Matching Cards

(To be cut apart and matched with descriptions on the Information Grid)



**cochineal**



**cochineal**



**cochineal**



**cochineal**



**honeybee**



**honeybee**



**honeybee**



**honeybee**



**house cricket**



**house cricket**



**house cricket**



**house cricket**



**lac insect**



**lac insect**



**lac insect**



**lac insect**



**mealworm**



**mealworm**



**mealworm**



**mealworm**



**silkworm**



**silkworm**



























**silkworm**



**silkworm**

# Useful Insects Answer Key

(Check your answers by comparing your finished grid to this key.)

 <p><b>cochineal</b></p>	 <p><b>lac insect</b></p>	 <p><b>silkworm</b></p>	 <p><b>mealworm</b></p>
 <p><b>honeybee</b></p>	 <p><b>cochineal</b></p>	 <p><b>mealworm</b></p>	 <p><b>honeybee</b></p>
 <p><b>house cricket</b></p>	 <p><b>silkworm</b></p>	 <p><b>house cricket</b></p>	 <p><b>mealworm</b></p>
 <p><b>lac insect</b></p>	 <p><b>cochineal</b></p>	 <p><b>honeybee</b></p>	 <p><b>lac insect</b></p>
 <p><b>mealworm</b></p>	 <p><b>house cricket</b></p>	 <p><b>silkworm</b></p>	 <p><b>cochineal</b></p>
 <p><b>silkworm</b></p>	 <p><b>honeybee</b></p>	 <p><b>lac insect</b></p>	 <p><b>house cricket</b></p>