

- If students are observing their own meal worms, have them record the number of times the meal worm molts, or sheds its exoskeleton, as it grows.
- Have students record the number of weeks until their meal worms pupate, and how long they remain in the pupas.

Suggested Extensions

Look for scarabs in books about ancient Egypt; discuss the use of symbols in their art and culture. Compare to animals in our culture: what do the American eagle, lion, pig and rat symbolize to the students?

Vocabulary

abdomen
antennae
Coleoptera
complete metamorphosis
exoskeleton
elytra
grub
larva, larvae
predators
pupa
nutrient recyclers
thorax

Resources on the Internet

www.nhm.ukans.edu/ksem/beetles — The Coleopterists Society provides beetle-related links to other sites.

www.entsoc.org — This site includes links to just about any bug-related site on the Web.

www.sasionline.org — The Sonoran Arthropod Studies Institute is a non-profit organization dedicated to arthropod research and education projects.

www.nhm.org — The Natural History Museum of Los Angeles County's web site includes pages devoted to the Insect Zoo.

Suggested Reading for Educators

Bellamy C., Evans, A.V., 1996. *An Inordinate Fondness for Beetles*. Henry Holt Publishing, New York, NY.

Echols, J.C., 1993. *Ladybugs*. Lawrence Hall of Science, Berkeley, CA.

White, R., 1983. *A Field Guide to the Beetles of North America*. Peterson Field Guide Series. Houghton Mifflin, Boston, MA.

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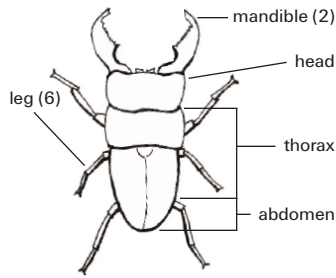
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One of the most spectacular groups of insects is beetles. Beetles have some of the most diverse survival strategies of all insects. Some of them can mix noxious, defensive chemicals in their bodies, while others can feign death to avoid being eaten. Some are shiny and smooth, some have stripes or dots. Can you imagine having over 350,000 cousins to get to know? That is how many types of beetles there are in the world, with more species being discovered every year.



All beetles are insects, complete with a hardened shell that protects their bodies called an exoskeleton. All insects have six legs as adults, one pair of antennae and three body sections. The head contains the mouth parts and the sensory organs; the thorax contains muscles needed to move the legs and wings, if any; and the abdomen is where the internal organs needed for respiration, digestion and circulation are located. Beetles are in the insect family *Coleoptera*, which means "sheath-winged." This refers to the elytra, hardened wing covers that protect the beetles' forewings (if any) and bodies. All beetles have mouth parts that are adapted for chewing, and all beetles undergo the four stages of complete metamorphosis: egg, larva, pupa and adult.

Roles in Nature

Beetles are so well armored and come in so many shapes and sizes that they have adapted to conditions in virtually every terrestrial or freshwater habitat. The predaceous diving beetle lives underwater and carries an oxygen bubble under its wings to breathe. The *Tenebrionids* are a family of beetles that can live in the hottest deserts on the planet, diving under the sand to escape desert heat and conserving moisture with a thickened exoskeleton.

Beetles utilize a wide variety of substances as food. Nutrient recyclers, such as the dermestid and darkling beetles, play a crucial role in the planet's recycling system, helping to break down decaying plant and animal matter to enrich the soil. Predators, such as the ladybug and tiger beetle, control pest insects.

Human Attitudes Towards Beetles

Because some species flock to things that we may find distasteful (such as the burying beetle's attraction to rotting carcasses) most people avoid beetles. There are beetles that are harmful to humans economically, such as the boll weevil, whose insatiable appetite nearly destroyed the cotton-based economy in the American south-east. Other beetles cause damage to houses by boring through wood, like the powder post beetle. However, most beetles are harmless to humans and are vital to the planetary food web. Because of their taste for aphids, predatory ladybugs are prized by gardeners. They are collected en masse from their winter resting sites and sold in nurseries.

Beetles in Culture

There was one civilization that embraced beetles. The ancient Egyptians revered dung beetles as symbols of the mysterious forces that moved the sun across the sky, and they included dung beetles in their paintings, carvings and jewelry. Adult dung beetles lay their eggs in a ball of dung and the developing larvae feed on the dung ball from the inside. In some parts of the world, protein-rich beetle larvae are an important food source.

Beetle Conservation

Multiple factors, such as the loss of habitat and overuse of pesticides, have threatened many beetles. As of 1994, nine species of beetles were listed under the Endangered Species Act, the most notorious being the American burying beetle. Once widespread, by 1975 American burying beetles were collected in just two areas in the United States: eastern Oklahoma and Rhode Island. This industrious carrion beetle locates a decaying bird or mammal carcass, and digging under and around it, covers it with soil. The female lays her eggs directly on this food source, thus exhibiting a high degree of parental care. Because they bury animal remains, these beetles may help control the populations of other pest insects, such as flies and ants, that depend on fresh carcasses for food and egg laying sites (Bellamy & Evans, 1996).

Since being listed in the Endangered Species Act, various plans have been developed by the U.S. Fish and Wildlife Service to increase the populations of the American burying beetle. Habitats have been set aside and protocols have been established to rear the beetle in universities and zoos and reintroduce it into the wild. The American burying beetle has shown signs of recovery, and

small populations are now found in Arkansas and Nebraska. This is but one example of a successful conservation effort that may save an oft-overlooked but significant beetle species.

Set Up a Classroom Beetle Habitat

It is easy to observe the fascinating transformation of complete metamorphosis when you set up a meal worm colony in your classroom. Meal worms, the larval form of darkling beetles, are commonly sold in pet stores as food for reptiles and amphibians. If you have small plastic pill bottles or clear plastic film canisters, you can assign each student or a small group of students a meal worm of their own. These beetles are completely harmless and cannot bite or run very fast. As long as they are well fed, adult beetles will not attempt to escape their habitat.

Materials

- A large plastic bin 2"-3" deep
- A bag of oat or wheat bran
- Two layers of burlap or cheesecloth cut to fit inside the bin
- Light all-purpose household oil to coat the outside edges of the bin when the beetles mature
- Approximately 50 meal worms, available at pet stores and bait shops

What to Do:

1. Lay the square of burlap in the tray.
2. Pour 1"-2" of bran into the tray.
3. Add the meal worms.
4. Lay the square of burlap or cheesecloth on top of the bran, which gives the adult beetles a place to pupate.
5. Add a fresh slice of apple, potato or lettuce on top of the bran every week; this will provide all the moisture your meal worms need. Add fresh bran as the level goes down.

Simple Experiments

Develop some simple experiments to observe behaviors and record major events in the life cycle:

- Measure individual meal worms weekly and record growth rates on a graph.
- Place a few "control" meal worms in the refrigerator to see if they develop at the same rate.
- Place meal worms in the center of some styrofoam meat trays; cover half the tray with black construction paper and hypothesize whether the meal worms will move to the dark or light side of the tray.

(Continued)