

# Mealworms

- 2nd - Insects and Plants
- 4th Grade - Environments



**What to do when they arrive.** Mealworm beetles are shipped in a container with a “breathing” cap to provide air. They need no special care but should be used as soon as possible, as they have a rather short life span. Keep beetles at normal room temperatures in low light. **Store in a cool place at 45 to 65°F out of direct sunlight.** At warmer room temperatures, larvae will soon pupate. Cover loosely with a paper towel to provide crawling space. Add slices of potato or carrot for moisture and add a substrate of bran for food. Replace as necessary or if it becomes moldy.

The mealworm is not a worm; it is a larva. Any similarity to a true worm is incidental. mealworm larvae are golden yellow and have 13 segments—a head, three thoracic segments, and nine abdominal segments. Mealworm larvae are the counterpart of the familiar caterpillar in the butterfly story. They pull themselves around on six stubby legs, one pair on each thoracic segment.

Mealworms are the larval stage of darkling (aka Tenebrio) beetles. Beetles, along with all their other insect kin (true bugs, flies, bees, wasps, ants, on and on), are members of the phylum Arthropoda, a word meaning jointed legs. Like all members of their phylum, insects wear their skeleton on the outside like a suit of armor. This is practical when they are under attack, but very inconvenient when they are trying to grow. Arthropods solved this problem by molting (shedding) this outer shell-like cuticle periodically. Immediately following the molt, the soft white larva expands before the new larger cuticle hardens. For mealworms this process repeats five times over a 2-month period, after which the larva is about 3 cm long. The final larval molt reveals the next stage, the pupa.

**Life cycle.** Darkling beetles follow a life history known as complete metamorphosis. Like butterflies and moths, they go through four distinct stages during their life cycle. A female beetle lays eggs, as many as 500 in her brief lifetime of a month or two. The eggs are about the size of the period at the end of this sentence. After a couple of weeks the equally tiny larvae emerge from the eggs. The larvae are known as mealworms, but of course they are not true worms. The larvae are golden yellow and have 12 body segments. They are the counterpart of the familiar caterpillar in the butterfly story. Mealworms pull themselves around on six stubby legs that are all crowded at the front.

The larvae seem to have two purposes in life: eat and grow. Beetles are arthropods, and like all members of their phylum they wear their skeleton on the outside like a suit of armor. This is very practical when they are being attacked, but very inconvenient when they are trying to grow. The arthropods have solved this problem by shedding (molting) their shell periodically. Immediately following the molt the soft, white larvae expand before the new larger shell hardens. This process may repeat half a dozen or more

times over a 3-month period, after which time the larvae are about 2 cm (3/4") long. The final larval molt reveals the next stage, the pupa.

The pupae don't eat and they don't move except for a twitch or two when disturbed. Inside, however, the mealworm is turning into a beetle, much the same as a caterpillar turns into a butterfly while sequestered inside the chrysalis. In 2 or 3 weeks the pupa splits open and out walks a beetle, white at first, but soon turning to brown and finally black after a day. The beetles mate and lay eggs, and the cycle repeats.

**Habitat and food.** Mealworms and darkling beetles are rarely seen in the wild, but when they are, it is likely to be in a field where wild grasses flourish and seeds are plentiful. They are most often found in barns, grain storage facilities, and food preparation areas. This organism has benefited by living close to human enterprises, because we unwittingly provide a much better environment for the success of mealworms than could be found in the natural world. For this reason mealworms have become a minor pest in grain storage areas.

Mealworms and darkling beetles are excellent classroom animals—they exhibit interesting behaviors, they are small but not tiny, they don't bite, smell, fly, or jump, and they are extremely easy to care for. Mealworms live right in a container of their food source: bran, cornmeal, rolled oats, breakfast flakes, or chick starter mash. All are excellent foods, but bran and chick starter are recommended. The food must be kept dry. Mealworms can go through their complete life cycle without any added water (they are very efficient at extracting water from the food), but it is recommended that small bits of apple, potato, or carrot be added from time to time.

Mealworms should be kept in large, relatively flat containers. They seem to thrive best when the colony has a large surface area. Keep the bran about 2 or 3 cm ( $\pm 1$ " ) deep in a basin, bus tray, aquarium, or plastic shoe box. If the container sides are steep and smooth, it is not necessary to keep the container covered. Adults and larvae seem to prefer hiding under bits of paper or light cardboard; the pupae give no indication that they care.

The mealworm's preferred environment is very dry, moderately warm, and dark. A bit of apple provides extra moisture for the mealworms and seems to stimulate rapid growth. As the temperature increases, so does the rate at which mealworms advance through their life cycle. Under ideal conditions, in a classroom, the complete life cycle can take place in as little as 3 months, but more likely it will take 4 months. Cold slows the process almost to the point of suspended animation. Mealworms can be put into the refrigerator (not the freezer) for periods of time to stop metamorphosis.

In addition to providing reliable opportunities for observing a complete life cycle in the classroom as in the **Insects and Plants Module**, mealworms can also be used for other activities. Mealworms can be used for structure/function observations and behavior investigations. And they are just nice to have around to remind us that life on earth takes a seemingly endless variety of forms, and that part of being human is to have compassion and respect for all life.

**Food and Water.** **The mealworm culture must be kept dry.** Mealworms can go through their complete life cycle without any added water (they are very efficient at extracting water from their food), but it is recommended that moisture continually be provided in the form of small bits of apple, sweet potato, or carrot. Otherwise the larvae and adults may attack each other in search of additional moisture. If carrot or sweet

potato is used as the moisture source, the frass will be orange, adding evidence that the granules are waste rather than eggs.

**Mealworm Homes.** Large cultures of mealworms (200 or more) should be kept in large, relatively flat containers. They seem to thrive best when the colony has a large surface area. Keep the bran 5–10 cm (2–4") deep in the clear plastic basin provided in the kit. If you want to expand your mealworm activities, any basin, bus tray, or old aquarium will do. If the container sides are steep and smooth, it is not necessary to cover the container.

The mealworms's preferred environment is very dry, moderately warm, and dark. As the temperature increases, so does the rate at which mealworms advance through their life cycle. Under ideal conditions the complete life cycle can take place in as little as 3 months, but more likely it will take 4. However, students should be able to see their mealworms advance through the three important stages of larva, pupa, and adult in 4 to 6 weeks if the larvae are large and well advanced at the time they are introduced.

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### Mealworm Life Cycle

Stage	How long?	Food	Moisture	Other Information
Egg	7-14 days			
Larva	30-90 days	Bran	Apple	5 molts occur
Pupa	10-20 days			
Adult	5-10 days	Bran	Apple	Death: 30 days
Egg	The cycle continues.			

**End the life cycle.** As long as the four needs are attended to, new generations of darkling beetles can continue to flourish. Many teachers decide to cultivate a culture of mealworms in their classroom and maintain them year-round. Set up your culture in a rectangular plastic container with a lid. Poke some air holes in the lid and cover the bottom of the container with bran (about 1–2 inches deep depending on the depth of the container). Add mealworms and darkling beetles to the habitat. Add a piece of carrot or potato about once a week for moisture.

**What to do with them when the investigations are completed.** Keep and care for the mealworms in your class or *return to the district science coordinator for distribution to other schools.*

**Care for the environment.** At some point you may want to end the cycle. It is very important to never release organisms into an environment they were not collected from. In addition, the insects and mealworms would most likely perish quickly if released. To humanely end these organism's life cycle, place the organisms in a bag in the freezer overnight; discard the bag in the trash the next day.