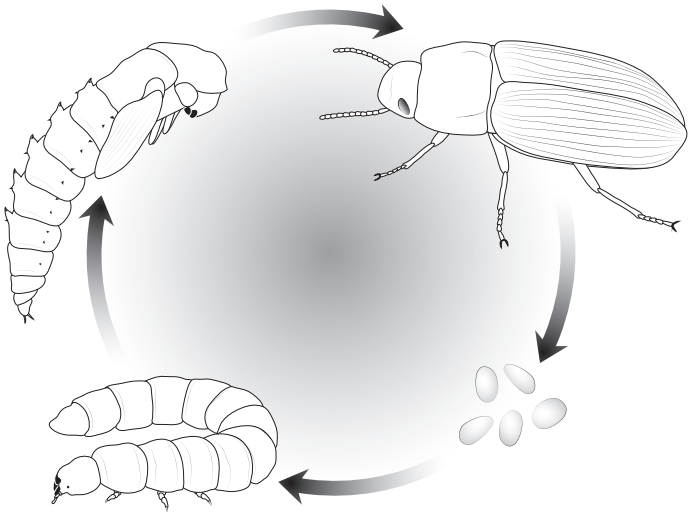
6.1: Other Animals Reading
Mealworms: Eat and Be Eaten

Mealworms are the larval (immature) stage of a small black insect called the mealworm beetle. Mealworms are exceptionally good at eating. The larval mealworms hatch from small eggs and eat grains and vegetables. As they eat, they shed their skin (called an exoskeleton) 9-20 times so that their bodies can grow. Imagine having to shed your skin to get bigger! Once the mealworms reach a certain size, they stop eating and put on a hard shell in which they grow the body of an adult beetle. This process is called pupating. Once their adult body is ready, they emerge from their pupal shell. Adult mealworm beetles cannot fly; they also eat grains and vegetables as they search for mates to make new mealworm eggs. In general, mealworms live about 3 months, but they can live longer in cool environments. Below is an illustration of the mealworm lifecycle.

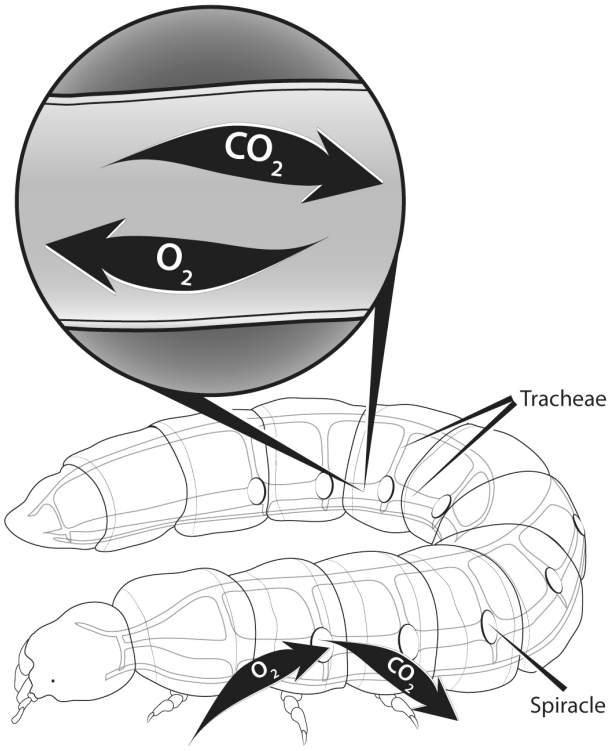


Mealworms have a complicated relationship with humans. On one hand, they are often considered pests because they get into and eat stored vegetable and grains. These insects are originally from southern Europe, but now can be found almost anywhere humans live. Their ability to eat many human foods has given them a free ride around the world. However, many animals like to eat mealworms, so they are grown commercially as food for pets (including chickens, reptiles, and small mammals), fishing bait, wild bird food, and even as a healthy snack for people![1]

How Do Mealworms Breathe?

Mealworm cells need oxygen, but mealworms don't have hearts or lungs. How can they get oxygen to their cells?

Although mealworms have mouths (to eat with), they do not breathe through lungs like mammals, reptiles, or birds. Mealworms, like other insects, exchange air through a network of holes (spiracles) and tubes (tracheae) in their abdomen. They have a *passive* respiration system where air constantly flows both in and out of their bodies instead of with single *in* and then *out* breaths. Just as with other animals, mealworms take in oxygen and release carbon dioxide as they undergo cellular respiration. You can trace the path of O_2 and CO_2 through a mealworm's respiratory system in the illustration below.

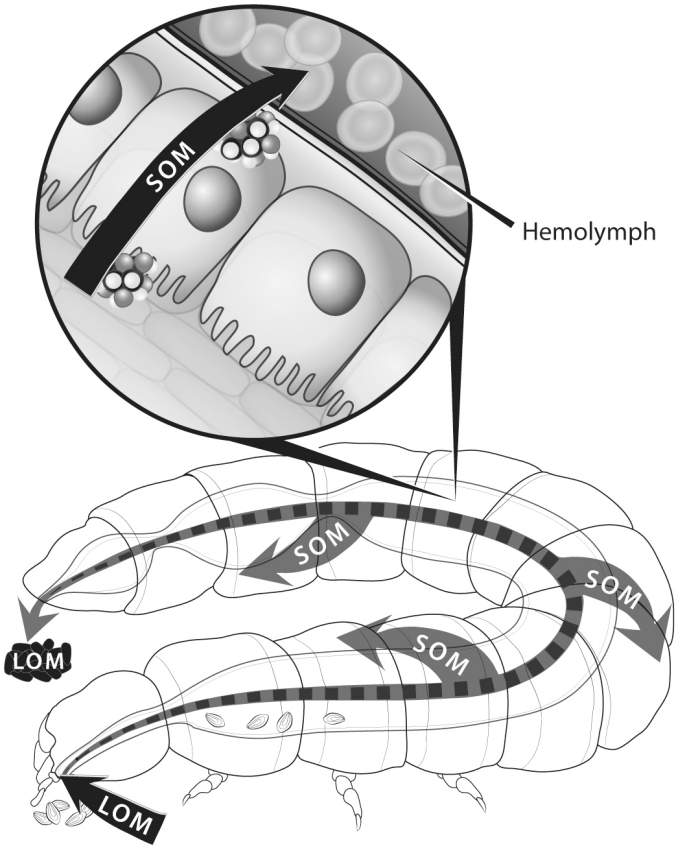


How Do Mealworms Live and Grow?

Like other animals mealworms eat and digest food that contains large organic molecules. Mealworms mostly eat grains and vegetables, but will also eat dead and decaying plants and animals. Amazingly, a recent study found that mealworms can also eat and digest Styrofoam plastic![2]

Mealworms use their food and oxygen that comes through their tracheae to live, move, and grow. We can explain how a mealworm does this in four steps.

Step 1: Mealworms make the large organic molecules in food into small organic molecules through the process of digestion. Mealworms are like cows and humans in that they have a digestive system with enzymes that break the large organic molecules in their food into small organic molecules. Insects don't have blood, but they do have another blue-green liquid, called hemolymph, that carries the small organic materials from their digestive system to all the cells in their body, as you can see in the illustration below.



LOM = Large Organic Molecules

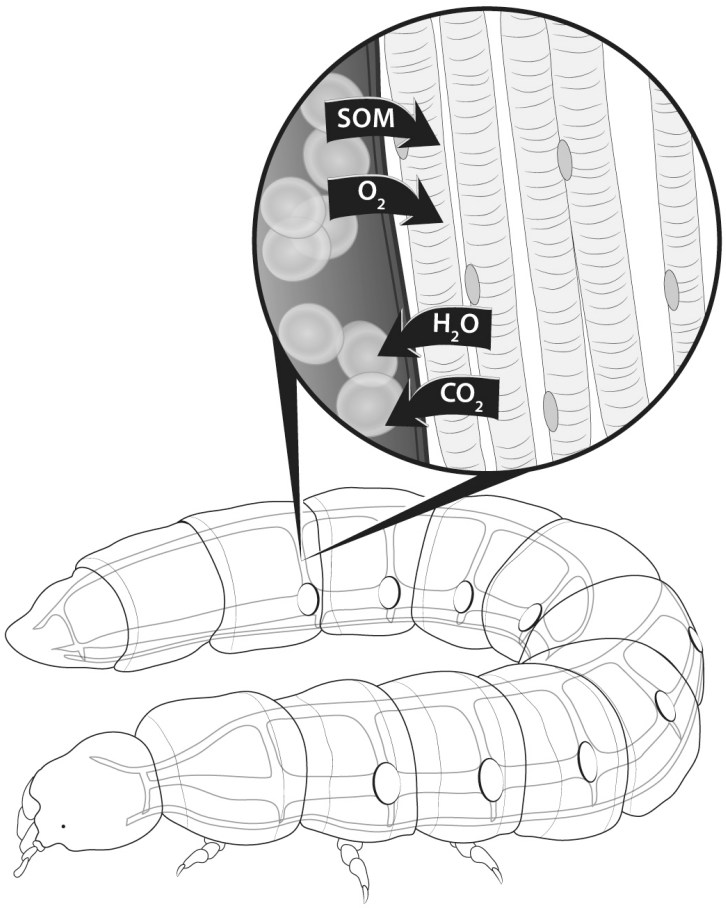
SOM = Small Organic Molecules

Step 2a: Hemolymph carries food to all the cells in the mealworm. The mealworm's circulatory system has small tubes near the digestive system. Small organic molecules, like sugars, from digested food can enter the hemolymph there. The hemolymph carries food to every cell in the mealworm's body.

Step 2b: Tracheae carry oxygen to all the cells in the mealworm. In mammals, birds, and reptiles, blood carries oxygen from the lungs to all cells in their bodies. Mealworms and other insects don't have lungs and hemolymph (insect blood) doesn't carry oxygen. Instead, the respiratory network of tracheae delivers oxygen to every cell in the mealworm's body.

Step 3: All the mealworm's cells get energy by combining small organic molecules with oxygen in the process of cellular respiration. All the cells need energy to carry out their life functions, and they get that energy by combining glucose and other small organic molecules with oxygen. You are familiar with the chemical equation for cellular respiration:

$C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O$



The waste products from cellular respiration are CO_2 and H_2O. In mealworms, CO_2 goes back into the tracheae where it can passively leave the body. The H_2O goes back into the hemolymph where it is excreted in urine in a process similar to that of other animals.

Step 4: Cells grow by making large organic molecules from small organic molecules in the process of biosynthesis. Mealworms grow when their cells grow and divide. In order to grow and divide the cells need to make large organic molecules such as fats and proteins. Each cell combines the small organic molecules from the blood into the large organic molecules that make up the cell and carry out it its functions.

Digging Deeper

Here are some more places that you can go to learn about mealworms:

- [1]Read more about mealworms as food for people: https://blogs.scientificamerican.com/observations/mealworms-the-other-other-other-white-meat/
- [2]Read more about mealworms eating plastic: https://www.sciencenewsforstudents.org/article/mealworms-chow-down-plastic
- Read more about how insects like mealworms breathe without lungs: https://www.thoughtco.com/how-do-insects-breathe-1968478