

## Investigation Four – Observing Mealworms or Earthworms

<b>Standard V</b> Students will understand that traits are passed from the parent organisms to their offspring, and that sometimes the offspring may possess variations of these traits that may help or hinder survival in a given environment.	<b>Standard V</b> _____
<b>Objective 1</b> Using supporting evidence, show that traits are transferred from a parent organism to its offspring.	Objective 1
<b>Objective 2</b> Describe how some characteristics could give a species a survival advantage in a particular environment.	Objective 2
<b>Intended Learning Outcomes</b> <ol style="list-style-type: none"><li>1. Use science process and thinking skills</li><li>2. Manifest scientific attitudes and interests</li><li>3. Understand science concepts and principles</li><li>4. Communicate effectively using science language and reasoning</li><li>6. Understand the Nature of Science</li></ol>	

### Teacher Background

(This Investigation is interesting, but if time is limited, the previous activity may be enough to teach the concepts. You may choose to do only part of this investigation)

Sometimes offspring do not look like the parent organism at first; but as the offspring go through their life cycles they begin to look more like their parent(s). A **life cycle** is the stages a living organism goes through during its lifetime. Many insects go through dramatic changes from eggs to adults. The process is called metamorphosis.

Every organism responds to its **environment**, which is the surroundings in which the organism lives. Some **behaviors** are inherited or instinctual. Other behaviors are not inherited, but can be learned.

#### Caring for Mealworms

During the investigation, keep the mealworms in the container in which you Purchased them.

Feed the mealworms bran cereal and/or oatmeal. For moisture, place a small piece of apple or potato in the container (frequently check the apple or potato to make sure it is not too dry or getting moldy).

Since some investigations need “hungry” mealworms, have a separate container that has no food source available.

Mealworms need to be kept in a warm, but not hot, area. Do not place their container in direct sunlight. Mealworms move slowly when the temperature is below 58°F. They will mature at a faster rate if they are kept in a warm area at 75-85°F.

See “Building a Mealworm Habitat,” p. 12.2.23 for more details.

To be effective, this set of activities needs to be conducted over a time period of several days. The following is a suggested time schedule.

#### Day 1

Conduct the “Invitation to Learn” activity.

#### Day 2

Read the “Background Information” on each organism. Students should gain an understanding of each organism’s normal environment and how their physical characteristics provide a survival advantage. Have students also list behaviors that would be instinctual for each organism.

Place damp paper towels in the freezer (see “Temperature Stimulus” below) for Day 3 investigations.

#### Day 3

Conduct the investigations of how each organism responds to black and white surfaces, light, touch, barriers, moisture and temperature.

#### Day 4

Place the mealworms and earthworms in containers without food for 24 hours so they are hungry.

#### Day 5

Conduct the investigations of how each organism responds to food. Discuss inherited versus learned behaviors. If you are not going to watch the mealworms complete their metamorphoses, compare and contrast mealworm larvae, pupae, and adults.

#### A Two-Week Period

Build a mealworm habitat and watch the mealworms complete their metamorphoses into darkling beetles.

### **Pre-Assessment/Invitation to Learn**

#### **Materials**

For each group

- Live mealworms or live earthworms
- Tray
- Papers
- Pencil

1. Divide students into cooperative groups.
2. Place a live mealworm or a live earthworm on a tray for each group.
3. Allow students to observe these organisms moving around on the tray.
4. Have students sketch each organism, measure how long each is, record how each one moves about and describe any kind of noise made as it moves.
5. Have students discuss which end is the head and which is the tail of each organism. Have them give observable evidence to justify their reasoning.
6. Encourage students to gently pick up each organism and describe what it feels like on their hands.
7. After allowing students to make their initial observations, gather the trays and return the worms to their containers.

# Instructional Procedure

## Investigations

Engage students in the following investigations with mealworms or earthworms. Have them record their observations, questions and conclusions in their science journals.

### Black and white surface stimulus

1. Give each group a tray with half of the surface covered with black paper And the other half with white paper.
2. Have students predict whether the worms will prefer the black or white surfaces and justify their predictions.
3. Place several mealworms directly on the dividing line between black and white.
4. Allow 5-10 minutes for students to observe the worms' behaviors. Have students record their observations with an explanation for the worms' behaviors.

### Light and touch stimulus

1. Have students predict the worms' response to light from a flashlight, and to being gently touched with a chenille stem. Have them justify their predictions.
2. Have students predict the mealworms responses to these barriers. Will they initially go around a barrier? Crawl over it? Burrow underneath it? Try to keep going forward? Go backwards? Will their responses differ for different barriers? Have students justify their predictions.
3. Shine a flashlight directly on the worms and observe their behaviors.
4. Gently touch the worms with a chenille stem that has a small loop at the end and observe their behaviors.
5. Allow 5-10 minutes for students to observe the worms' behaviors. Have students record their observations with an explanation for the worms' behaviors.

### Barrier stimulus

1. Give each group several items to act as barriers (a pencil, a clothespin, a block of wood, a crumbled piece of paper, or a pile of soil, etc.)
2. Have students predict the mealworms responses to these barriers. Will they initially go around a barrier? Crawl over it? Burrow underneath it? Try to keep going forward? Go backwards? Will their responses differ for different barriers? Have students justify their predictions.
3. Give each group a tray and have the students arrange 3 or 4 barriers on it.
4. Place several worms on the tray.
5. Allow 5-10 minutes for students to observe the worms' behaviors. Have the students record their observations with an explanation for the worms' behaviors.

## **Materials**

- 50 live mealworms. (mealworms are very inexpensive and can be purchased at any pet store. Please read "Caring for Mealworms" p. 12.2.14) or,
- 50 live earthworms or night crawlers. Earthworms are very inexpensive and can be purchased at any fishing supply store.
- 1 tray for each group
- 1 metric ruler for each group
- 1 metric ruler for each group
- Black and white construction paper to cover half of each tray
- 1 flashlight for each group
- 2 chenille stems for each group
- Several items to serve as barriers, such as pencils, clothespins, blocks of wood, crumbled pieces of paper, or soil for each group
- Paper towels
- Waxed paper
- 1 pipette or eye dropper for each group
- 1 small container of water for each group
- Bran flakes or oatmeal, carrot tops or celery leaves
- An assortment of mealworm adults, larvae and pupae (if you do not grow mealworm larvae to adulthood) See "Resources" for ordering information.

### Moisture stimulus

1. Have students predict whether the worms will prefer a moist surface or a dry surface and justify their predictions.
2. Give each group a tray with half of the surface covered with a moist paper towel and the other half covered with a dry paper towel.
3. Place several worms directly on the dividing line between moist and dry.
4. Give each group a pipette or eye dropper and a small container of water. Have students gently place one drop of water on each worm and make observations of its response. Have students record their observations in their journals with an explanation for the worms' behaviors.

### Temperature stimulus

#### *Prior Preparation*

1. The day before this activity, place several slightly damp paper towels in a freezer. Place layers of waxed paper in between the damp paper towels for easy separation.
2. Prior to this activity, slightly moisten several paper towels and leave them at room temperature.
3. Just before this activity, place several slightly damp paper towels in a microwave to heat.

#### *Investigation*

4. Have students predict how the worms will react to a cold surface, a room temperature surface, and a hot surface, then justify their predictions.
5. Give each group a tray and a cold, a hot, and a room-temperature paper towel.
6. Place several worms on each paper towel.
7. Allow 5-10 minutes for students to observe the worms' behaviors. Have students record their observations with an explanation for the worms' behaviors.

### Food stimulus

#### *Prior Preparation*

1. The day before this activity put mealworms and earthworms in a container with no food for 24 hours.

#### *Investigation*

2. Have students predict how hungry the worms will react when a food source is placed at the other end of a tray. Will they follow a direct route to the food? Will they meander around until they find it? Will they ignore it?
3. Give each group a tray with a small pile of bran flakes at one end.
4. Place several worms on the opposite end of the tray from the bran flakes.
5. Allow 5-10 minutes for students to observe the worms' behaviors. Have students record their observations with an explanation for the worms' behaviors.

### Discussion

1. As a class, list examples of instinctual and learned behaviors in other organisms and humans.
  - Examples of instinctual behaviors include: wolves living in a pack, moths.

## Comparing Mealworm Life Cycle States

Do one of the following:

- Construct a mealworm habitat and observe mealworm larvae undergo metamorphoses to become adults (see “Building a Mealworm Habitat,” p. 12.2.23)
- Purchase an assortment of larvae, pupae and adults (see “Resources”). Have students observe each of the life stages, comparing and contrasting their similarities and differences.

Acknowledgements:

These investigations were adapted from the *Animal Behavior Teacher Guide*, which provides information about additional explorations. Delta Education, catalog #38-438-4203, \$32.95. 1-800-442-5444, <http://www.delta-education.com>

## Curriculum Extensions

*Science* –

- Training a mealworm (ILOs 1, 4, 6)
  1. Pose the following question to the students: Can mealworms be trained to follow a certain pathway to a food source?
  2. Construct a “T” maze in a shallow box (the lid from a case of copy paper would be ideal)
  3. Release several mealworms at the bottom of the “T” and record how many turn left at the “T” and how many turn right at the “T”.
  4. Repeat this experiment again and place bran flakes at the far side of the left-hand turn. Release the mealworms again and count how many turn left toward the food source.
  5. Allow the mealworms to go without food for 24 hours. Release the mealworms again and count how many turn left toward the food source.
  6. Repeat this process for two more cycles.
  7. On the fourth cycle, do NOT place any food in the maze. Release the hungry mealworms and count how many turn left at the top of the “T”.

## Assessment Suggestions

- Look at their journals carefully for accuracy.
- Discuss or have the students write summaries for each stimulus.
- Have the students write conclusions for their investigations.

Reference to Assessment Section

	Multiple Choice	Constructive Response	Performance Test
Unit Test	3, 4, 6, 8, 9, 10	3, 4	My Favorite Wild Animal

## Resources

Mealworms can be purchased at your local pet store. They are inexpensive and most are sold in amounts of 50, 100, or 200. The large mealworms cost more, but are more lively and easier for students to observe. The large mealworms are often treated with hormones so they will NOT become adult beetles. The small mealworms will change into adult beetles within a month or two. Mealworms are also available from Carolina Science and Math at 1-800-334-5551 or <http://www.enasco.com/rod/Home>) and Berkshire Biological Supply Company (<http://stores.mgfx.com/bb/>).

An assortment of adults, larvae, and pupae can be purchased from Carolina Science and Math for \$9.00. Paper catalog #BA-14-4264, online catalog #WW-14-4262.

Earthworms, or night crawlers, can be purchased cheaply and easily at your local fishing tackle shop. They are sold by the dozen. They can also be purchased from Carolina Science and Math.

The Honey Files, A Bee's Life, A Teaching Guide and video. Available from the National Honey Board, 390 Lashley Street, Longmont, CO, 80501-6045, or <http://wwwhoney.com/kids/video/index.html>. This shows the life stages of bees and their survival behaviors.

Honey Bee Study Prints, twelve over-sized pictures of the life cycle of honey bees. Available from Dadant & Sons, 2765 S. Golden State Blvd, P.O. Box 2837, Fresno, CA, 93745, or toll free: (877)432-3268. \$24.50 plus shipping/handling and tax.

Utah Agriculture in the Classroom. Visit their web site for great lessons on insects and creating insect habitats in the classroom (<http://www.agclassroom.org/ut>).

## Mealworms – Background Information

Introducing *Tenebrio molitor*, otherwise known as the mealworm, the darkling beetle, or the stink bug. Mealworms are part of the very large beetle family of insects. Of the three million species of insects, one million are some type of beetle. An amazing 25% of all species on earth are beetles. The darkling beetle is related to the well-known ladybug and firefly.

The darkling beetle is found worldwide, but is more common in warm, dry climates. In nature, they are found under the bark of decaying logs and trees. They are also found in towns and cities, usually infesting flour, cereals, and grains. Although they are not common in homes, they are often present in flour mills or barns where livestock feed is stored.

Like all insects, the darkling beetle goes through a metamorphosis or change during its life cycle. Like all organisms that go through metamorphosis, the darkling beetle does not initially look like its parent organism. Its life cycle is a sequence of changes from egg to adult. The darkling beetle goes through the following four stages of development.

The egg. The eggs of the mealworm are too small to see with the naked eye. The hatching of these eggs marks the beginning of the larval stage.

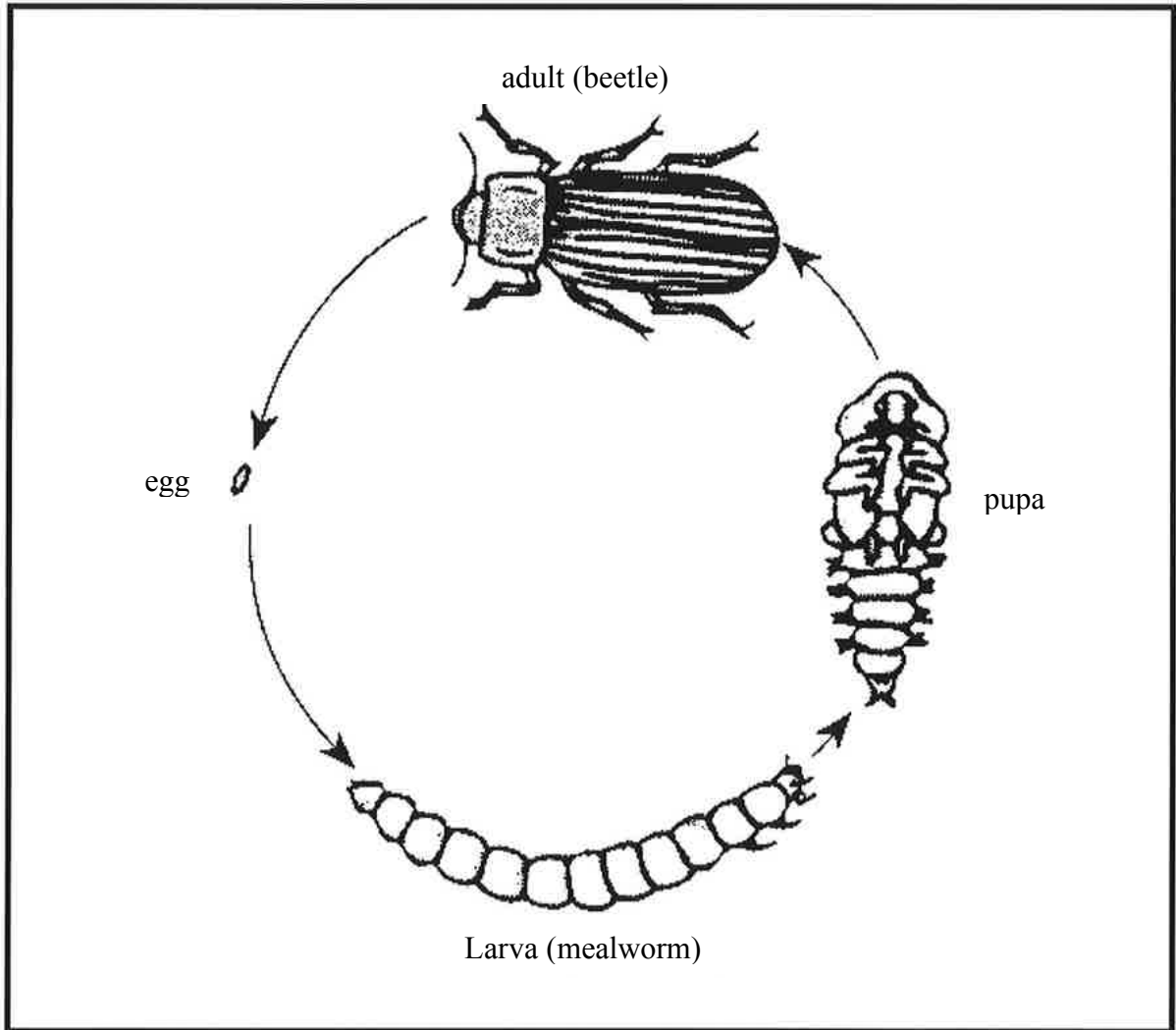
The larva. Most of this insect's life is spent in the larval or food finding stage. The larva stage of the darkling beetle is commonly known as the mealworm. Although it looks very much like a worm, it is not one. It is an immature darkling beetle in the larva stage. Several other organisms also go through a worm-like larva stages. For example, maggots are the larvae of flies, and caterpillars are the larvae of butterflies.

Most animals have specialized structures that help them collect information about their environment. Humans use their senses of smell, touch, hearing, sight, and taste to perceive their surroundings. Mealworms have simple eyes that can sense changes in light brightness but cannot give the mealworm a clear picture of its surrounds. It seems mealworms mainly use their senses of touch to find their way around. They crawl with their legs and appear to sense an edge with both their legs and antennae. A mealworm's survival depends on its finding sufficient food and hiding from predators. Its ability to assess its environment and move depends on its body form and the senses it possesses. Mealworms will shed their skin (molt) several times during the larval stage in order to grow larger. How often they molt depends on the temperature of their environment.

The pupa. During this stage the darkling beetle is relatively inactive and is going through the final change between larva and adult. Some insects pupa stage is spent in a cocoon, but this is not true of the mealworm. The pupa stage lasts about 1-3 weeks. The pupa is inactive but will move if touched. The head structure and other adult body parts can be seen developing.

The darkling beetle. As the pupa first changes into an adult darkling beetle it is beige in color. As it matures, it turns brown and then black. The beetles have wings which are protected by a hard covering. The adults mate and the female can lay about 500 eggs, which begin the life cycle of the next generation.

# Darkling Beetle Life Cycle





## **Earthworms – Background Information**

Earthworms are members of the ringed animals or Annelida. There are approximately 1,800 species of earthworms worldwide. Some species are tiny; no more than 2 centimeters or 1 inch when fully grown. At the other end of the scale are giant earthworms in Australia that average 3 meters or 10 feet in length. The record holder for earthworms is found in South Africa. It measures 7 meters or 22 feet in length. Don't worry though. The largest earthworms or night crawlers in North America grow to about 30 centimeters or 13-15 inches.

Earthworms are fairly simple life forms. They are put together from a number of discrete segments stuck together like a long flexible roll of Lifesavers<sup>TM</sup>. Earthworms do not have an internal skeleton as we do, and they do not have a protective hard exoskeleton as does an insect. They are flexible, long bundles of muscle, especially designed for life underground. The characteristic wriggling of earthworms is done with two kinds of muscles. One set allows the earthworm to become thinner and longer while the other set enables it to become shorter and fatter. Earthworms can move very effectively in either direction, head first or tail first.

Earthworms have specialized structures that help them live very successfully in their environment. Instead of having lungs to pump oxygen, they have five sets of simple hearts. Their blood flows close to their outer surface, absorbing oxygen and releasing carbon dioxide through a thin skin. This is why worms leave the soil and crawl out on the sidewalks during a heavy rain...they are seeking oxygen.

Earthworms have a nervous system that controls their senses and detects vibrations, heat, cold, moisture, light and the presence of other worms. However, they have no brain, so earthworms do not ponder their lowly lot in life, nor do they plan out a strategy for obtaining their next meal or crossing the sidewalk safely.

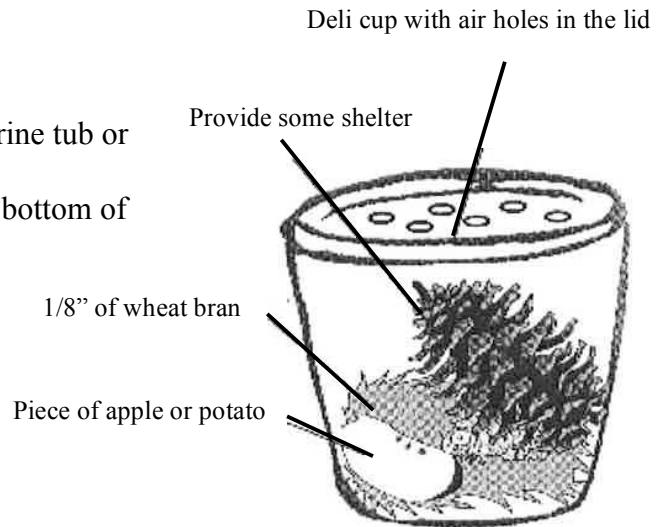
Earthworms are pros at burrowing. They feed on decomposing organic material; mostly vegetation, from the surface of the soil and underneath the soil. As they burrow and feed, they process tons of soil and improve its quality for plants and other animals. So please be considerate of these valuable little animals. The next time you see them on a sidewalk after a rainstorm, help them back into the ground.

# Building a Mealworm Habitat

## GETTING STARTED

### Rearing Habitat

- A clear plastic cup with a cover, or a margarine tub or deli container.
- 1/8 “ wheat bran or crushed wheat flakes in bottom of container.
- A crumpled piece of paper, pinecone or empty film canister and a piece of apple or potato (replace before it becomes moldy).
- Small air holes in the lid, since a dry climate is important.



**Mealworm Habitat**

### Food

Wheat bran, crushed wheat flakes, oatmeal and a piece of apple or potato

### Water

Mealworms do not need water. They will obtain all of the water they need from the piece of potato or apple.

## CARE AND HANDLING TECHNIQUES

### Handling

To pick up a mealworm, use a plastic spoon or a folded 3”x5” card to scoop it up. If you choose to pick it up with your fingers, use your thumb and forefinger on either side of the worm and gently squeeze. Use a firm hold, since they are very smooth and may squirm and wiggle the tip of the abdomens. When holding mealworms, keep your hand over the container or table to avoid dropping the mealworm on the floor.

### Raising Young

Mealworms are very easy to rear in the classroom. The larvae grow to 25 mm before pupating. After pupating, the adults emerge in two to three weeks. In seven to ten days, the females may lay eggs. In about fourteen days, the eggs hatch and the larvae begin to eat and develop.

### Additional Information

Mealworms will not bite. Dead mealworms are stiff and dark brown and should be removed from the container. Provide plenty of room for the large mealworms since they will eat each other in a constrained container. Small mealworms can be stored in a container on a refrigerator door shelf for several weeks to delay pupation or to extend their lives.