Observing Mealworms and Earthworms

Standard V:

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.

Objective 1:

Using supporting evidence, show that traits are transferred from a parent organism to its offspring.

Intended Learning Outcomes:

1. Use Science Process and Thinking Skills

Content Connections:

Science V, Inherited Traits; Language Arts VIII-1, Organizing Information
Math IV-2, Measurement

Science Standard V

Objective 1

Connections

Background Information

All organisms have life cycles. Sometimes offspring do not look like the parent organism at first, but as they go through their life cycle, they begin Lo look more like the parents. Some organisms show direct development. This means they are born looking like the parent organisms, only smaller. As they develop, they change only by increasing in size until they are to the adult stage and look just like their parents. Spiders and earthworms go through direct development. Other organisms go through incomplete metamorphosis, which means they progress through three stages of development: egg, nymph, and adult. At each stage, they look different than they looked in the previous stage. Cockroaches and grasshoppers are two insects that develop through incomplete metamorphosis. A third type of life cycle is called complete metamorphosis. The insects' bodies change dramatically as they go through four stages: egg, larva, pupa, and adult. Mealworms and butterflies develop by going through complete metamorphosis.

Every organism responds to its environment or the surroundings in which the organism lives. Some behaviors are inherited or instinctual, while others can be learned.

The life cycle of mealworms will be observed and a journal will be kept to record their metamorphosis to adulthood, as they become darkling beetles. Caterpillars' life cycles may also be observed and recorded as they change into painted lady butterflies.

Caring for Mealworms:

Mealworms can be kept in a covered plastic shoebox with holes drilled in the lid. Similar containers will work just as well, just so the

mealworms have air holes for breathing. Bran or oatmeal can be used to line the bottom of the box and will serve as the mealworms food source. They will need a slice of apple or potato for moisture. Apples seem to last longer than potatoes. The mealworm habitat must be checked every day because the apple and potato slices tend to mold after a few days.

Mealworms need to be kept in a warm, but not hot, area. Do not place the container in direct sunlight. Mealworms move more slowly when the temperature is below 58° F. If you want to slow their growth process, they can be kept in the refrigerator for a short while. They will mature at a faster rate if they are kept in a warm area of 75° - 85°F.

Mealworms also like to hide under things. A small bowl, similar to the aluminum tins that individual potpies are cooked in, tipped upside down in the habitat works well as a mealworm-hiding place.

An additional habitat option is to use empty Cool Whip containers with holes punched in the lid. Inside the habitat would be the same as with the shoeboxes. Groups of students can have their own group habitats that they can observe.

Before beginning the Invitation to Learn and the investigations, discuss the differences of instinctual and learned behaviors. At the end of the investigations you will go over this again. Your discussion might include the following points:

- Every organism responds to its environment. Some behaviors (how the organism acts) are "built in" or *instinctual.* These are inherited from the parent organism.
- Other behaviors are *learned* because the organism learns them during its life. They can learn them from the parent or through experience.

Research Basis

Haury, D. L & Rillero, P. (1994). Perspectives of hands-on science teaching. TI1e *ERIC* clearinghouse *for scie11ce, malhemaLics, and* environme11tal *education.* Reuieved January 14, 2006, from hnp://www ncrel.orE?/sdrslareasf1SSUes\comenr/cntllreas/science/erideric- 2.hun

Lopez, R. E. & Tuomi, J. (1995). Student-centered inquiry. *Educational Leadership,* 52(8), 78.

Research has shown that hands-on learning in science will help students remember the material better because they are part of the learning process and not just spectators. While this is true for all learners, it can have a profound impact on students with difficulties such as second language barriers and learning and behavior disabilities.

Invitation to Learn

In this activity, the students will be introduced to the mealworms and earthworms. They will study, sketch, measure, observe, record findings, and read about the worms. The students will be divided into pairs. Each pair of students will be given two heavy paper plates. One to three live mealworms will be placed on the first plate and one live earthworm will be placed on the second plate. If lightweight plates are used, make sure to put multiple plates together for sturdiness. Students may pair up to work together.

Next, give each student a copy of the *Mealworm and Earthworm Behaviors* worksheet. Allow the students to observe the worms as they move around on the plates. Have the students follow the directions on the sheet by observing, sketching, coloring, measuring and recording how each worm moves about on the plate and the sounds it makes as it moves. Encourage the students to gently pick up the mealworms and earthworms, then describe and record how they feel in their hands.

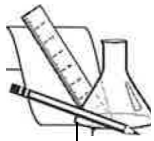
The students will now read information about mealworms and earthworms located on the *Mealworms-Background Information* and *Earthworms-Background* information sheets.

Upon completion of the Invitation to Learn activity, the students will participate in multiple investigations with the mealworms and earthworms by going from station to station using the Mealworm and Earthworm Behaviors sheet. If time is short, the investigations may be conducted on another day.

Instructional Procedures

To complete the investigations, continue using the *Mealworm and Earthworm Behaviors* worksheet. Direct the students to conduct the investigations using the instructions included on the sheet as they move from station to station. Using the information the students read in the background information during the invitation to learn segment, students will determine whether the behavior they observe in the worms is learned or instinctual. At the end of the investigations, discuss with the class what they discovered and lead them to realize that because the worms are lower life forms, their behavior is largely instinctual. Their instinctual behavior was passed to them from their parent organisms (darkling beetles). Also, point out that the mealworms (larva) look entirely different from the adult beetles, while baby earthworms look like the adult worms.

The teacher must set up the time limits for each station. Five to seven minutes should be plenty of time for students to make and



Materials

- ❑ Earthworms
- ❑ Meal worms
- ❑ Black paper
- ❑ White paper
- ❑ Chenille stem
- ❑ Flashlight
- ❑ Pipettes
- ❑ Frozen gel pack

record observations. It is also advised to go through the stations with the students before letting them begin the investigations.

Station I: Black/White using a mealworm &
Station 2: Black/White using an earthworm

1. Students will use a half sheet of white construction paper taped to a half sheet of black construction paper at this station.
2. Students will predict whether the worms will prefer the black surface or the white surface. They must justify their prediction based on the mealworm and earthworm background information they read during the Invitation to Learn activity.

Station 3: Light and Touch Response using a mealworm &
Station 4: Light and Touch Response using an earthworm

1. At this station, students will predict the worms' response to light from a flashlight and to being gently touched with a chenille stem. They must justify their answers, again based on what they have learned so far about the worms.
2. Students will put the worms in the shoebox. Make sure to do this one type of worm at a time.
3. Shine the flashlight into the box. Observe and record the worms' behavior.
4. When this has been repeated with both kinds of worms, have the students put the worms back on the plate and lightly touch them with a chenille stem.
5. Record how the worms reacted to the chenille stem touching them.

Station 5: Barrier Response using a mealworm &:.
Station 6: Barrier Response using an earthworm

1. Give each group of students two paper plates and several items to act as barriers such as clothespin, piece of wood, a pencil, crumpled up pieces of paper, etc.
2. Have the students predict the worms' responses to these barriers. They can answer questions such as: Will the worms go around the barriers? Crawl over them? Burrow beneath them? Try to go through them? Will the mealworms react differently than the earthworms? Students must justify their answers based on what they previously read in the *Mealworms- Background Information* and *Earthworms-Back ground Information* sheets in the Invitation to Learn activity.

3. Have the students arrange the two or three barriers on the plate.
4. Depending on whether the students are at Station Five or Station Six, have them place either mealworms or an earthworm on their plate with the barriers and observe and record the behavior of the worms.
5. Students must record the reasons for the worms' behaviors regarding the barriers.

Station 7: Moisture Response using a mealworm & Station 8: Moisture Response using an earthworm

1. Have students predict whether the worms will prefer a moist surface or a dry surface and justify their predictions.
2. Have a moist rag or paper towels lying right next to a dry rag or paper towels, so they are touching.
3. Students will straddle the worm across the line separating the moist and dry towels and will then observe and record the worms' actions.
4. Supply both stations with one water dropper or pipette each and a small container of water. Instead of using a small container of water, another option is to set these stations up by a sink.
5. Now have the students place the worm on the moist side and gently place one drop of water on the worm, recording its reaction. Students will explain what they think the reasons are for the worm's reactions.

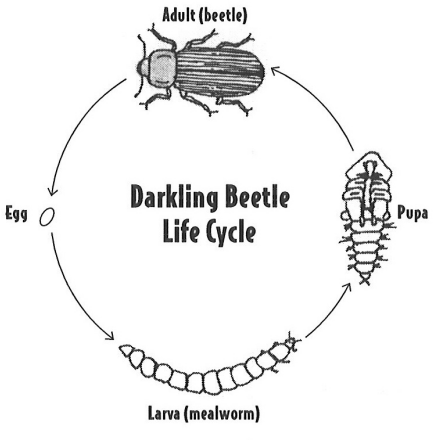
Station 9: Temperature Stimulus using a mealworm & Station 10: Temperature Stimulus using an earthworm

1. The day before doing this activity, place gel packs or several slightly damp paper towels in the freezer. Place layers of waxed paper in between the paper towels for easy separation. Retrieve them from the freezer just before commencing with this activity.
2. Just before this activity, place the rice or corn sacks or the damp paper towels in the microwave to heat. If using heating pads, turn them to warm.
3. To set up this station, place the hot and cold items next to each other with a hand towel or paper towels over the frozen gel pack and heated corn/rice packs or heating pad. This is to protect the worms. If using paper towels, you may want to do the same thing only with additional paper towels.

4. Have the students predict whether the worms will prefer the hot or cold areas.
5. Now have them place the worms on the areas and record their observations.

Discussion after the Investigations

1. As a class, list examples of instinctual behavior in the mealworms and earthworms. Bring up the fact that most, if not all, of the behaviors are instinctual because they are lower life forms.
2. List examples of instinctual and learned behaviors in other organisms and humans. Some examples of instinctual behaviors may include wolves living in a pack, moths and other insects flying toward lights, birds and salmon migration. Some examples of learned behaviors may include riding a bike, dogs whining or scratching to go out of doors, and cats meowing to be fed.
3. Discuss the role that instinctual and learned behaviors might play in providing an organism with a survival advantage or disadvantage in a particular environment.



Observing and journaling Mealworms' Life Cycle Stages

1. Construct a mealworm habitat and observe mealworm larva undergo metamorphoses to become adults. See Caring for Mealworms in the Background section.

2. Have students record their observations in a science journal or spiral bound notebook. They will be comparing and contrasting the four stages the mealworm's experience, as they become darkling beetles. They will be writing about and drawing what they observe.

Assessment Suggestions

- The completeness and accuracy of the *Mealworm and Earthworm Behaviors* worksheet can be used as an assessment.
- Observe the students as they work at the stations, noting the ease or difficulty they have at following the procedures and understanding the content at each station can also be an assessment method.

Curriculum Extensions/Adaptations/ Integration

Additional mealworm and earthworm investigations:

Food Stimulus Station

1. The day before this activity put mealworms and earthworms in a container with no food for 24 hours.
2. Have students predict how hungry mealworms and earthworms will react when they are placed at one end of a paper plate (or tray) and a food source is placed at the other end. Consider these questions in the predictions: Will they follow a direct route to the food? Will they meander around until they find it? Will they simply ignore it?
3. Give each pair of students a paper plate with a small pile of bran flakes or oatmeal at one end.
4. Place several mealworms on the opposite end of the food source on the paper plate.
5. Allow five minutes for students to observe the mealworms' behavior. Have the students record their observations with an explanation for the mealworms' behavior.
6. Repeat the process using carrot tops or celery leaves as the food source for the earthworms.

Training a Mealworm

1. Pose the following question to the students: Can mealworms be trained to follow a certain pathway to food?
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 or oatmeal at the far side of the left-hand turn. Release the mealworms again and count how many turn left toward the food source.
5. Repeat the process for two more cycles.
6. 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".

Painted Lady Butterflies

Observing the metamorphosis of the Painted Lady Butterflies is also a fun extension. Two useful websites are listed in the web sites section for buying and caring for the caterpillars.

Mealworm and earthworm cinquain poems can be written as language arts connection. A cinquain is a simple, five-line verse that follows a specific pattern. The pattern is:

Line 1 - one word of two syllables (usually a noun that names the subject of the poem)

Line 2 - four syllables (two-syllable adjectives describing the noun in line one)

Line 3 - six syllable (showing action)

Line 4 - eight syllables (expressing a feeling or observation about the subject)

Line 5 - two syllables (describing or renaming the subject)

Examples:

Mealworm
Yellow larva
Eating, growing, changing
Will become a darkling beetle
Insect

Earthworm
Humus-maker
Wiggling, squirming, struggling
Trying to escape from the hook
Fish bait

Family connections

- Look for insects in the yard and garden that go through complete metamorphosis.

Additional 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 livelier, making them easier for students to observe. The large mealworms are often treated with hormones to prevent them from becoming beetles. Inquiring whether the mealworms have been treated with hormones may be a good idea. The smaller and untreated mealworms will change into beetles in four to six weeks. Mealworms are also available from Carolina Science and Math at 1-800-334-5551 or http://www.carolina.com . Larvae are $6.70 for a pack of 50. Petco Store sells untreated mealworms $2.57 for 50 and four to five dollars for 100. Petsmart sells three different sizes of mealworms: 50 regular-sized or 35 giant or 25 super mealworms for $2.99 per type.

Earthworms can be purchased from stores that sell fishing tackle.

Books

For an alternative to mealworms and earthworms you could observe pillbugs. Pillbug investigations can be found in:

A Pillbug Project: A Guide to Investigation, Robin Burnett; ISBN 10: 0-87355-109-5

Videos

Eyewitness Butterfly & Moth; director: Derek Hall; producer: Richard Thomson; writer: Brian Meel; http ·//www.dk.com

Web sites

Both of these websites have information about obtaining and caring for Painted Lady butterfly larva:

http://www.insectlore .com

http ://www .worsleyschool.net/science/files/painted/lady.html

Name

Mealworm and Earthworm Behaviors

Sketch and color the MEALWORM. Describe the mealworms, please include: • Physical traits • How it feels when you touch them • Length in mm • The noise they make as they move across the plate With your partner, read the information sheet about the mealworms.	Sketch and color the EARTHWORM. Describe the earthworm, please include: • Physical traits • How it feels when you touch it • Its length in mm • The noise it makes as it moves across the plate With your partner, read the information sheet about the earthworms.
STATION 1: Black/White Predict whether the mealworms will prefer the black or white surface. After reading the mealworm information sheet, why do you think this? Straddle the mealworms across the line of the two papers and observe if it has a side that it prefers. Record your observations. Is this behavior learned or instinctual? *(Circle one)*	**STATION 2: Black/White** Predict whether the earthworm will prefer the black or white surface. After reading the earthworm information sheet, why do you think this? Straddle the earthworm across the line of the two papers and observe if it has a side that it prefers. Record your observations. Is this behavior learned or instinctual? *(Circle one)*

STATION 3: Light and Touch Response	**STATION 4: Light and Touch Response**
Predict how you think the mealworms will respond to light stimulus and to being touched with the chenille stem. Why do you think this?	Predict how you think the earthworm will respond to light stimulus and to being touched with the chenille stem. Why do you think this?
Shine the flashlight into the box. See if the mealworm will stay in the light or to the dark part of the box. Record your observations.	Shine the flashlight into the box. See if the earthworm will stay in the light or to the dark part of the box. Record your observations.
Now touch the mealworms with the rounded end of the chenille stern. How did the mealworms react? Record your observations.	Now touch the earthworm with the rounded end of the chenille stern. How did the earthworms react? Record your observations.
How do you know which end of the mealworm is its head? Record how you know. s	How do you know which end of the earthworm is its head? Record how you know .
Is this behavior learned or instinctual? *(Circle one)*	Is this behavior learned or instinctual? *(Circle one)*

STATION 5: Barrier Response

Predict how the mealworms will respond to a barrier in its way. Write why you think this.

Place the mealworms on the plate. Record you observations about how the worm responds to the barriers placed in its way.

Is this behavior learned or instinctual? *(Circle one)*

STATION 6: Barrier Response

Predict how the earthworm will respond to a barrier in its way. Write why you think this.

Place the earthworm on the plate. Record you observations about how the worm responds to the barriers placed in its way

Is this behavior learned or instinctual? *(Circle one)*

STATION 7: Barrier Response

Predict whether the mealworms will prefer a dry surface or a moist surface. Write why you think this.

Place the mealworms straddling the line between the dry and moist towels. Record your observations as to which side the mealworms prefer.

Now, place the mealworm on the moist towel and gently place one drop of water on it. How did it react to the water? Why? Record your observations here.

Is this behavior learned or instinctual? *(Circle one)*

STATION 7: Barrier Response

Predict whether the earthworm will prefer a dry surface or a moist surface. Write why you think this.

Place the earthworm straddling the line between the dry and moist towels. Record your observations as to which side the mealworm prefers.

Now, place the earthworm on the moist towel and gently place one drop of water on it. How did it react to the water? Why? Record your observations here.

Is this behavior learned or instinctual? *(Circle one)*

STATION 9: Temperature Stimulus	**STATION 10: Temperature Stimulus**
Predict whether the mealworms will prefer a cold or hot temperature. Write why you think this.	Predict whether the earthworm will prefer a cold or hot temperature. Write why you think this.
Place the mealworms on the warm area. Record your observations.	Place the earthworm on the warm area. Record your observations.
Now place it on the cold side. Again, record your observations.	Now place it on the cold side. Again, record your observations.
Which temperature did the mealworm prefer?	Which temperature did the earthworm prefer?
Why do you think this is so?	Why do you think this is so?
Is this behavior learned or instinctual? *(Circle one)*	Is this behavior learned or instinctual? *(Circle one)*

Mealworm and Earthworm Investigations

Black/White Mealworm	Black/White Earthworm
Light and Touch Response Mealworm	Light and Touch Response Earthworm
Barrier Response Mealworm	Barrier Response Earthworm
Moisture Response Mealworm	Moisture Response Earthworm
Temperature Stimulus Mealworm	Temperature Stimulus Earthworm

Mealworms-Background Information

Introducing Tenebrio molitor, otherwise known as the mealworm, the darkling beetle, or the stinkbug. 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 flourmills 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 metamorphoses, 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 surroundings. 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.

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 disk-like segments stuck together like a long flexible roll of Lifesavers TM. 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, headfirst 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.