Warming Up to Worms

Topic Area
Biological Science - Earthworms

Introductory Statement
Students will observe earthworms and record their observations.

Math Skills	Science
Predicting	Observing
Measuring	Comparing
Comparing	Collecting data
	Recording data

Materials
earthworms (2-4 per group)
paper towels
magnifying glasses
measuring tapes, rulers

Key Question
What can we observe about the way earthworms look and behave?

Background Information
The main sense organ of worms is their skin. A worm's skin is very sensitive to moisture, temperature, touch, and light. So, the worm actually uses its skin to see, feel, and detect moisture. The worm breathes by taking air out of the moist soil directly through its skin. (Since its skin is tender, it prefers a smooth environment over a rough one.) Its skin senses light consequently worms can tell when it is day or night. Worms are nocturnal and rarely come out of the ground except at night.

Management
1. Earthworms can be bought at bait shops or in the sporting goods departments of many large discount stores. They can also be found by digging in moist soil.
2. This is meant to be an initial observation time and should take about 20-30 minutes.
3. If working in learning groups, one student can gather and return necessary materials, a second can read observation questions, a third can report the group's observations, and a fourth can report on the observations and other questions from the group.
4. Each group should have two to four worms to observe.

Procedure
1. Distribute worms and observation guides to students.
2. Follow directions on observation guides.
3. Encourage groups to discuss their results.
4. As a class, share and discuss fundings.

Extensions
Formulate other questions about earthworms. Use the following steps to guide you:
1. Problem: What do you wish to find out?
2. Hypothesis: Predict what you think might happen.
3. Materials: What do you need to use?
4. Procedure: What will you do?
5. Results: What happened?
6. Conclusion: What answers did you find?
7. Theory: How does it change how you think about earthworms?

Warming Up to Worms

Place your groups' worms on a paper towel where everyone in your group can observe them. Here are some questions to discuss as you make your observations. Have one person record the group's answers.

1. What color are the worms?

2. What shape is an earthworm? Describe it.

3. About how long are the earthworms? How did you measure them?

4. How does the worm's skin feel?

5. Is there a difference between the top side and bottom side of a worm? If there is, describe what both are like.

Warming Up to Worms

6. Observe your worms with a hand lens. What do you notice that you could not see before?

_____

_____

_____

7. Answer yes or no to each of the following and tell what you observed.

Does an earthworm have:

Eyes? _____

_____

Ears? _____

_____

Legs? _____

_____

Nose? _____

_____

Mouth? _____

_____

8. Can you tell which is the front end of a worm and which is its tail? Is there a difference?

_____

_____

Warming Up to Worms

9. Describe any other special features you notice.

10. How do worms move? Do they ever move backwards?

11. What happens when a worm meets another worm?

12. Put an obstacle in front of one of the worms? Describe its behavior.

13. Hold a worm in your hand. What does it do?

EARTHWORMS

Earthworms are often called "Nature's Plowman" because they live in the ground and tunnel their way through the ground mixing up the different layers of the soil.

WHAT DO EARTHWORMS EAT?

Earthworms eat decayed leaves and plant material. They also swallow soil and little bits of animal material.

HOW DO EARTHWORMS MOVE?

Earthworms have 2 sets of muscles:

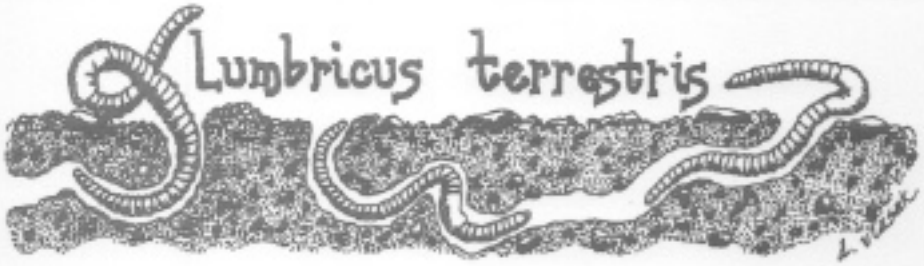
1. Circular Muscles around each segment.
2. Long Muscles that run the length of the body.

When the circular muscles tighten, the earthworm becomes longer and thinner. When the lengthwise muscles tighten, the earthworm becomes shorter & fatter.

HOW DO EARTHWORMS HELP THE SOIL?

1. They mix up the different layers of the soil.
2. They add nutrients to the soil by depositing their waste products or "castings" into the soil.
3. They help to decompose dead plant and animal material into simpler parts that can be used again by new organisms.

Lumbricus terrestris



The earthworm is an invertebrate which has a segmented body. The number of segments in a full-grown earthworm varies between 120 and 175. All segments, except the first which contains the mouth and the most posterior which contains the anus, are similar. The external surfaces of segments 31 to 37 are glandular and swollen. This region is called the clitellum. This is located about one third toward the front end of the worm. This clitellum means that the worm is an adult and can mate and lay eggs.

Earthworms have regenerative powers and are capable of replacing damaged or destroyed segments depending on the region.

Earthworms have to stay moist in order to breathe. They have no lungs, but take oxygen from the air right through their damp skin into the blood vessels. Carbon dioxide moves out of the body the same way. Getting dried out is fatal for an earthworm.

There are bristles on the underside of the worm called setae. There are four pair on all but the first and last segments. The bristles are made of chitin which is the same material the hard outer covering of insects is composed of. These structures help the worm dig into the soil when it moves and help cling to the sides of the burrow when predators try to pull them out.

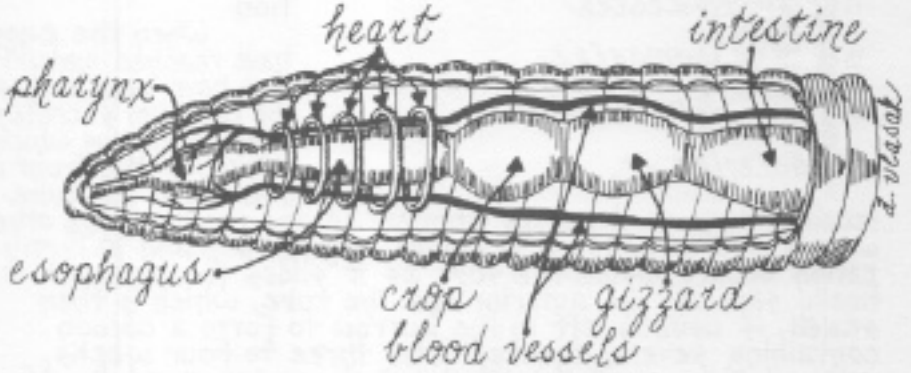
Earthworms do have enemies even though they spend much of their time underground. Their predators include birds, frogs, centipedes, moles, and man. A protective adaptation is the worm's brownish color. This makes the worm harder to see against the soil.

When observing the movement of the earthworm, you'll notice that one part of the worm stretches out, while another part squeezes together. This is because beneath the epidermis is a layer of circular muscle whose contraction decreases the diameter but increases the length of the body. Another muscle layer runs the length of the worm: the longitudinal muscle.

The earthworm has five pair of enlarged tubes which act as hearts. The tubes pump blood through the vessels of the earthworm's body.

As a worm eats enormous quantities of soil, it takes the decaying organic matter (parts of dead plants and animals) for its nourishment. From the pharynx, the food passes into the esophagus. There are several pairs of calciferous glands which secrete calcium carbonate into the esophagus. They function in the neutralization of acid soil as well as the elimination of excess carbonate from the blood.

From the esophagus, the food moves to the crop. The crop serves as a temporary storage place. From here, it passes on to the gizzard. Grains of sand are present here and the thick, muscular walls work the food and sand back and forth until the food is ground up.

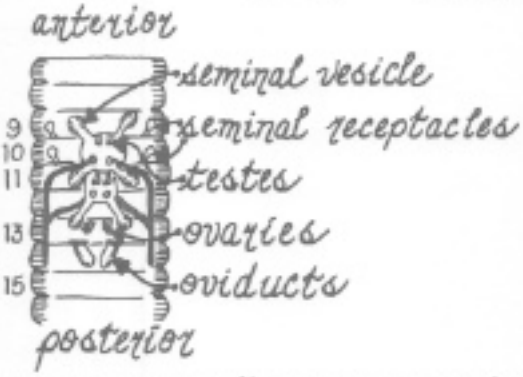


The food is then forced into the intestine, the longest section of the digestive system. The glands here secrete digestive chemicals that complete digestion and the digested food passes through the walls of the intestine and into the

bloodstream. The bloodstream circulates the digested foods to other parts of the organism.

Although the earthworm is sensitive to light and touch, it does not have sense organs. There are light-sensitive cells scattered through the skin. These cells enable the worm to distinguish between light and dark. The worm is also sensitive to vibrations which is a useful adaptation since it's the mole's favorite food.

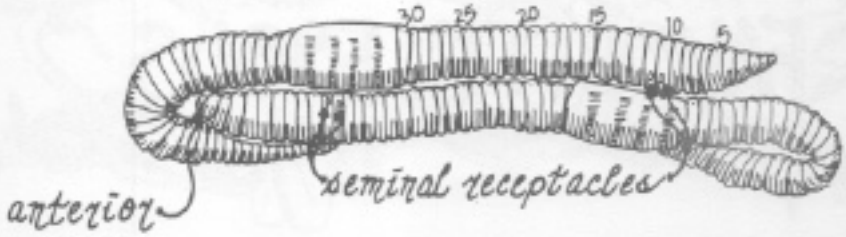
Boy or girl? The earthworm is actually both. It is called a hermaphrodite because it has both ovaries and testes. The two pairs of testes are located in segments 10 and 11, counting from the anterior end, and the pair of ovaries are in segment 13. Self-fertilization cannot take place. The exchange of sperm cells between two mating worms occurs during a process called copulation. Copulation usually occurs at night during moist weather and involves a temporary union of two individuals along their ventral surfaces. A worm is old enough to lay eggs at about one year.



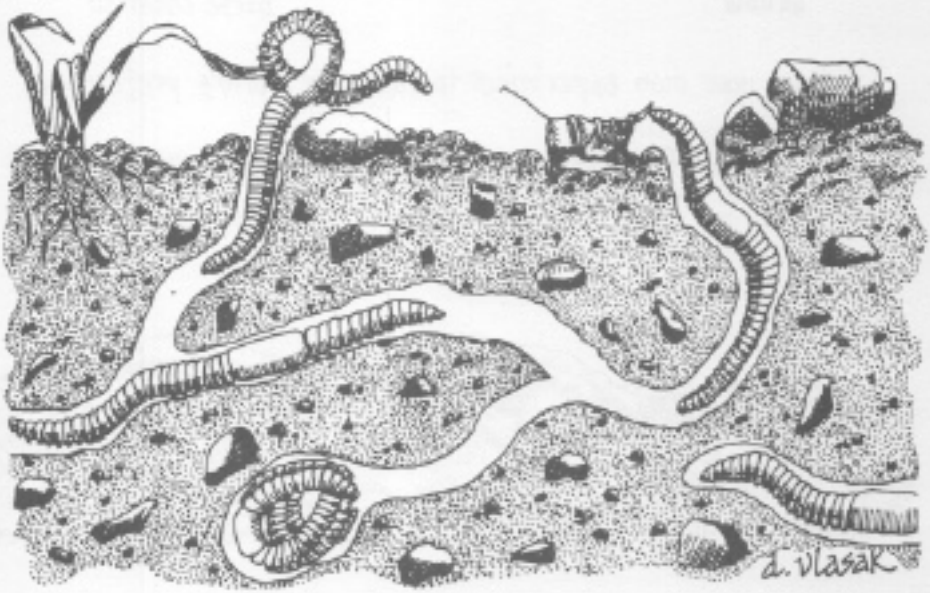
After copulation, the worms separate, each having the other's sperm stored in the seminal receptacles until used for fertilization.

When the eggs have reached maturity and have been released, the clitellum secretes a tube of mucus which slips over the front of the worm. The tube receives eggs as it passes segment 14, and receives the other worm's sperm cells as it passes segments 9 and 10. Fertilization occurs inside the tube as it slides forward until it finally slips off the anterior end. The tube, which is then sealed, is usually left in the burrow to form a cocoon containing several zygotes. After three to four weeks, pale, whitish wormlets crawl out as miniature adults. If the moisture and temperature are not quite right, the eggs can stay in the case for a year or more.

Because the earthworm's source of nutrition is organic matter in the soil, large



quantities of soil are eaten. The undigestible soil passes through their intestinal tract and is eliminated as "worm castings". This helps enrich the soil. Lower levels of earth are brought to the surface which improves the chemical composition. In burrowing, they are also improving farm land as air and water can enter the ground easier. The naturalist Charles Darwin once calculated that an acre of farm land may contain as many as 50,000 earthworms. In the course of a year, those worms could overturn as much as eighteen tons of soil per acre! This is of great significance to agriculture and these creatures should be appreciated for their contribution to farming.



FAVORITE FOODS

Based on scientists' observations of feeding habits, these seem to be favorites among worms

Fresh Leaves

beech
maple
oak
horse chestnut
lime
willow

order of preference

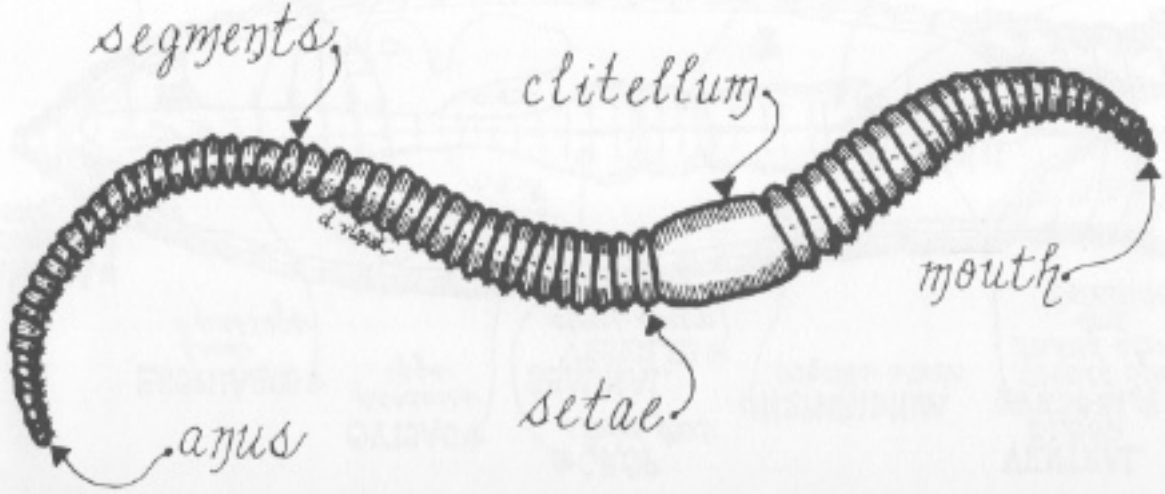
Decaying Leaves

willow
oak
lime
beech
maple
horse chestnut

Set up your own experiment to find your worm's preference.

You can also feed your worms fruit peelings, corn meal, and bread crumbs. Two tablespoonsful every other week should be enough. Do not feed them too much or the food may spoil.

EXTERNAL STRUCTURES

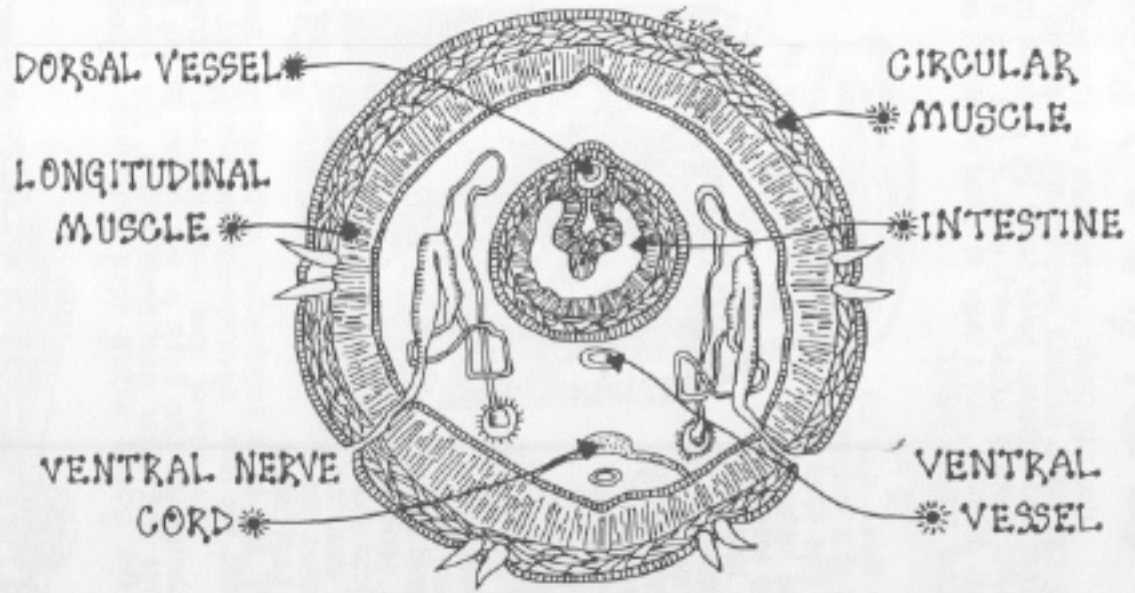


PHYLUM ANNELIDA

ORGANS AND FUNCTIONS

THE MUSCULAR SYSTEM

Muscle cells cause movement by contracting and relaxing. The earthworm has two layers of muscle tissue. One layer circles the worm as the circular muscle. The other layer runs the length of the worm as the longitudinal muscle.

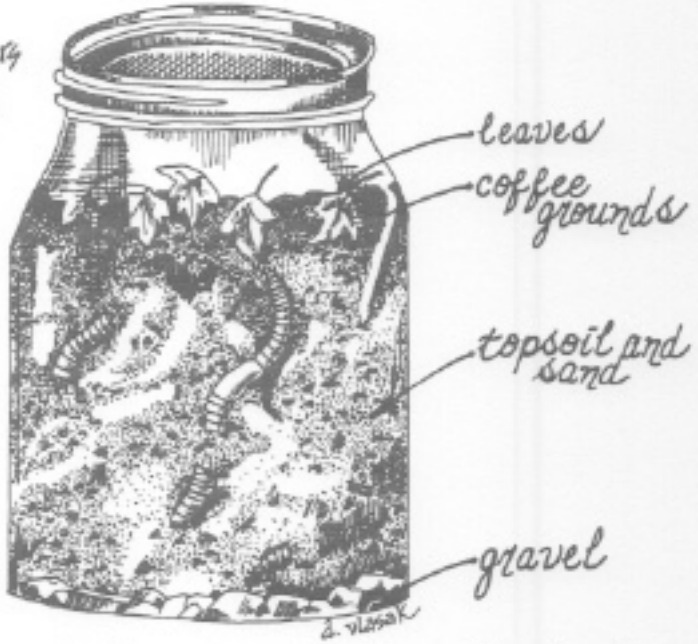


cross section

WORM HOME

You can create a temporary environment for earthworms so you can make detailed observations. A plastic container would be safest and drainage holes could be punched in the bottom. A plastic shoebox would work well. If you use a container that can't have drainage, put a layer of sand or gravel on the bottom to collect excess water.

Fill the jar three quarters full of a mixture of fine sand and good loamy soil. Hard soils are too hard and compact for the worms to burrow through. Keep the soil moist, but not soaked. One teaspoon of coffee grounds and one fourth teaspoon of brown sugar layered on top will serve as a food source. The ideal temperature should be kept about 50°F and black construction paper wrapped around the jar will provide the dark environment the worms like best.

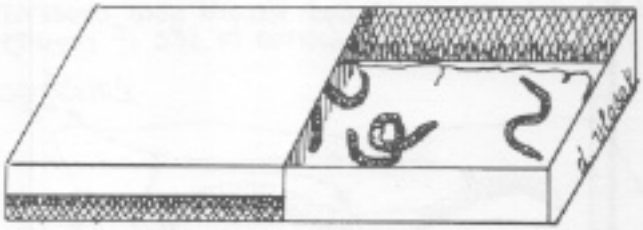


The size of your container will determine the number of worms you can keep. A one gallon jar can hold up to a dozen worms but after your observations, you should return the worms to the ground where they can make a good home.

reaction to light

Do earthworms prefer light or darkness?

Remove the lid from a shallow box and cut in half widthwise. Line the bottom of box with damp paper towels. Place five worms in each half of box and place the lid on top.



After five minutes, record the number of worms in each section.

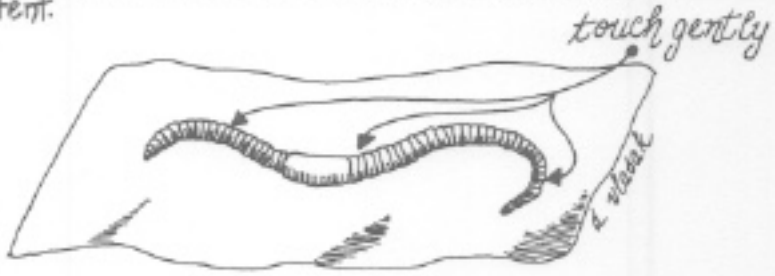
test #	#on light area	# on dark area
1		
2		
3		
average		
ratio		
percentage		

Conclusions:

reaction to touch

Do earthworms react to touch?

Remember to be very gentle with the worm for this experiment. We want to test if a worm is sensitive to touch. Put the worm on a moist paper towel. Very gently touch the worm at the posterior (rear) end and record your observations. Do the same at the middle section and the anterior (front) end. Record your observations. This should be done with several worms to see if results are consistent.



section touched	response
posterior	
middle	
clitellum	
anterior	

What are your conclusions about an earthworm's sensitivity to touch?

reaction to moisture

Do earthworms prefer moist or dry areas?

This test can be done using paper towels or soil. When using toweling, put two side by side: one dampened with water and the other dry. Place five worms on each side and check after five minutes to recount the number on each towel. Test this many times for accuracy and record your results.

TEST	number on dry towel	number on moist towel
1		
2		
3		

percentage of total that preferred the moist environment

%

percentage of total that preferred the dry environment

%

Your conclusion:

NOW YOU SEE THEM, NOW YOU DON'T

I. Topic Area
Earthworms

II. Introductory Statement
Students will determine how long it takes earthworms to burrow into the ground.

III. Math Skills
a. Estimating
b. Measuring
c. Graphing
d. Problem solving

Science Processes
a. Observing
b. Collecting & organizing data
c. Generalizing
d. Hypothesizing

IV. Materials
earthworms
plastic cups of loosely packed soil
watch or clock with a second hand
activity sheets

V. Key Question
How long will it take a worm to burrow into the ground?

VI. Background Information
See worm fact sheets.

VII. Management Suggestions
1. This activity is best done in small groups.
2. Make sure you have enough worms. Each group needs three.
3. The soil used for this activity should be moist (but not too wet) and loosely packed.
4. The worms should be put in one at a time. The students can then make better informed estimates of the time it will take the second and third worms to dig into the soil.

VIII. Procedure
1. Pass out and discuss the activity sheet.
2. Divide the class into small groups and pass out a plastic cup to each group. The cup may already have the soil in it or it can be filled by the students.
3. Pass out three worms to each group.
4. Have students estimate the time they think the first worm will take to burrow into the soil and record their predictions on the activity sheet.
5. Place the first worm in the cup and time how long it takes to completely burrow into the soil. Record that time on the activity sheet.
6. Repeat the above process with the next two worms.
7. Discuss the results and complete the graph.
8. Discuss the question at the bottom of the page and have students explain how they could devise an experiment to find out.

IX. Discussion Questions
1. Did all the worms take the same amount of time to burrow into the soil? Why?
2. What would the effect of packing the soil more tightly have?
3. What would happen if you used different types of soil?

X. Extended Activities
1. Repeat the activity with three cups of the same soil, but varying compactness.
2. Repeat the activity with various types of soil such as moist sand, sandy loam, moist potting soil, etc.

ISOPODS

Cut a 2"x11" strip to cover the answers. Pull down as answers are needed.

- What family do isopods belong to?

Crustaceans
Isopods are invertebrates.

- How do isopods breathe?

Through their gills.

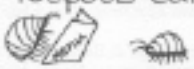
- How many pairs of legs does a newborn isopod have?

6 pairs

- How many pairs of legs does an adult isopod have?

7 pairs

- What do isopods eat?

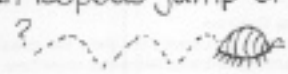


Anything soft, moist. They are scavengers

- Name 2 other crustaceans.

crab, shrimp, lobster

- Can isopods jump or climb?

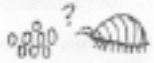


No, they can only walk.

- When does an isopod shed its skin?

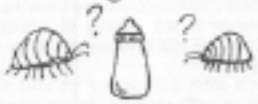
As it grows.

- Where does the female carry her eggs?

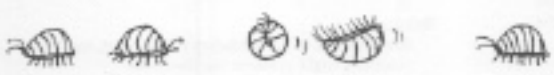


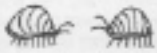
In a pouch on her underside.

- What do baby isopods look like?



They are smaller and lighter colored than adults.





HOT FOOT, COLD FEET

I. **Topic Area**
Critters response to temperature

II. **Introductory Statement**
The students will set up an experiment in which they observe the temperature preference of isopods. This activity can also be used with other invertebrates.

III. **Math Skills**
a. Counting
b. Graphing
c. Predicting

Science Processes
a. Observing
b. Measuring
c. Predicting
d. Recording data
e. Controlling variables

IV. **Materials**
Per group of 4:
3 sandwich size ziplock baggies
1 sheet 12" x 24" aluminum foil
10 critters: sow bugs (isopods), earthworms (night crawlers), mealworms or snails
3 thermometers (optional)
hot water, cold water, room temperature water
plastic wrap

V. **Key Question**
What temperature will the critters prefer: hot, room temperature or cold?

VI. **Background Information**
Temperature is a very important aspect of an invertebrates environment. Invertebrate's do not have the ability to control their body temperature. As a result, their existence is dependent on the temperature of their surroundings. If the environment becomes too cool or too warm the animal cannot adjust to it and will die. Most invertebrates prefer a temperature range between 60° to 90° F. Isopods generally prefer a dark, moist and cool area (65°).

VII. **Management Suggestions**
1. Collect enough isopods beforehand so that each group has ten. Students love to help collect isopods and can usually find them in their yards.
2. This lesson has 2 different group tally sheets. Select the one that best addresses the ability level of your class.
3. You may have to cover the ramp with a box to get the isopods to settle in one spot. In a bright room they tend to be too active and don't settle down.

VIII. **Procedure**
1. Have students discuss what they already know about the critter being used. Record their responses on the board.
2. Have them tell how they have learned about their critter. Many may respond by saying they observed much of what they know about the animals. Stress the importance of observation.
3. Ask the key question.
4. Explain the set up for the experiment. Set up 3 lunch baggies—one filled with ice water, one with room temperature water and the 3rd with hot tap water for each group. Remove as much air as possible from each baggie.
   * Optional: Find the temperature of each of the baggies and record it on the activity sheet next to the baggies marked: hot, room temperature and cold.
5. Teacher:
   a. Demonstrates how to make or use the aluminum foil ramp.
   b. Demonstrate how to put critters into the center of the ramp and then cover ramp with plastic wrap. (there is enough air in the ramp for the critters when covered).
   c. Explain how to time and count the number of critters in each temperature zone and record it on the activity sheets — use the baggies as a reference point for each temperature zone.
6. Be sure to have the students predict the number of critters that will be in each area at the end of 10 minutes.
7. Pass out equipment, answer any questions and begin collecting and recording data.
8. Ask each group to share their final count per temperature zone on their group sheets and graph the data.
   * Optional page 2: Compute the averages for each of the temperatures by dividing each total by the number of groups.
9. Graph the results.
   * Optional: Upper grade students may compute the percentage found in each temperature zone and graph the results.

IX. **Discussion Question**
Were the results consistent throughout the room? If not, what are some possible variables that could have caused these differences?

X. **Extended Activities**
1. Students may try other "Critters" such as: night crawlers (earthworms), snails, mealworms.
2. Students may place equal number of critters in each temperature area and see how many are in that area after 5 minutes.

XI. **Curriculum Coordinates**
Math:
1. Upper grades — compute the % of critters in each temperature group.
2. In which 2 minute period was there the least amount of change in the number of critters in the cold temperature? Hot temperature? Room temperature?

Language:
Write a short commentary on what a small critter might say while choosing the best temperature to live in.

Sciences
Research one of the following: mealworms, sow bugs (isopods), night crawlers (earthworms).

Name _____

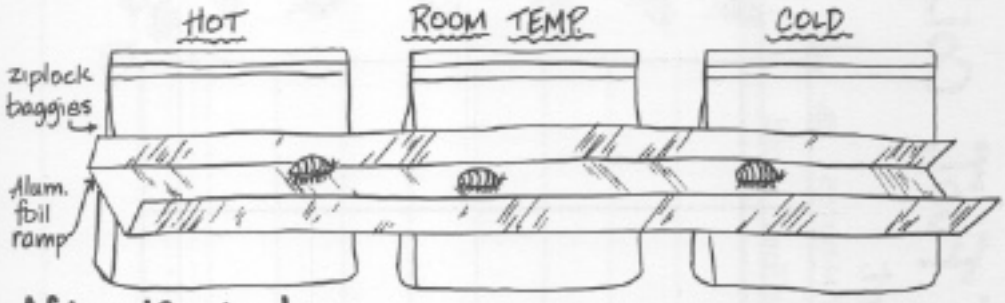
Hot Hot Cold Feet

Question: What temperature do isopods prefer, hot, room temperature or cold?

Hypothesis: _____

_____

Number of Critters: _____



After 10 minutes I predict: # in Hot: _____ # in Room Temp.: _____ # in Cold: _____

Time:	Hot	Room Temp.	Cold
2 min.			
4 min.			
6 min.			
8 min.			
10 min.			

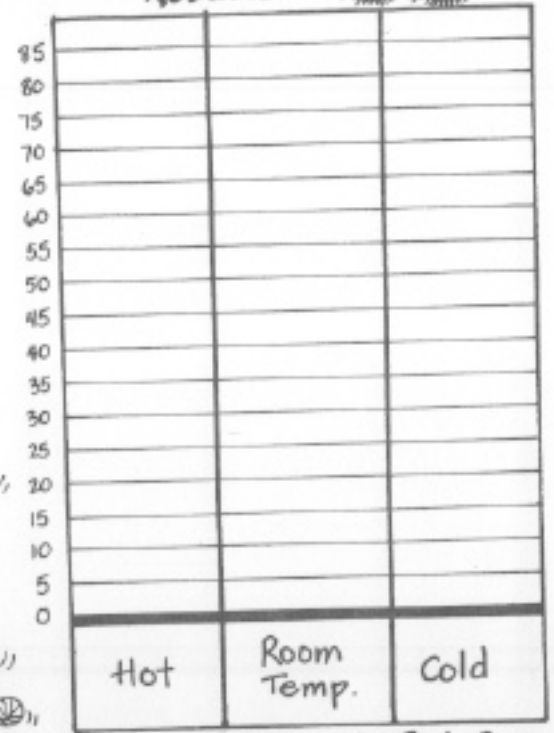
HOT FOOT, COLD FEET

Group Tally Sheet

of Critters After 10 Minutes

Group #	Hot	Room Temp.	Cold
# 1			
# 2			
# 3			
# 4			
# 5			
# 6			
# 7			
# 8			
Class Totals			

Results:



Number of Critters in Each Temp.

Conclusion: _____

_____

HOT FOOT, COLD FEET

Group Tally Sheet

1 # of Critters After 10 Minutes

Group #	Hot	Room Temp.	Cold
# 1			
# 2			
# 3			
# 4			
# 5			
# 6			
# 7			
# 8			
Totals:			
÷ # of groups			
Average			

2

Number of critters in each Temp.	÷	Average Total # of critters	=	Decimal Value	×	100	=	%
Hot ____	÷	________	=	. ____	×	100	=	____%
Room Temp. ____	÷	________	=	. ____	×	100	=	____%
Cold ____	÷	________	=	. ____	×	100	=	____%

3 % of Critters in Each Temp.

Hot	Room Temp.	Cold

Make an Isopod (sowbug)

Directions:

Body

- Cut 7 body segments from grey or brown construction paper.
- Punch a hole in each segment (see mark.)

Connect segments with a brad.

Legs

- Cut 7 pieces of string 2" long.
- Double over each piece of string and tape. 3 loops, evenly spaced, to the underside of the front section and 4 loops to the underside of the last segment.