Modeling Movement

How Do Worms Move?

Introduction

We can move from place to place because our muscles are attached to long levers (bones) and we apply a force to the levers when our muscles contract. An earthworm doesn't have bones (levers). How does a worm get from one place to another? Students can collect data and formulate their own model of how an earthworm moves.

Concepts

- Classification of living organisms
- Animal behavior
- Anatomy and physiology

Materials

Live earthworms
Paper towels
Dissecting pins
Prepared microscope slides (cross section of earthworm, x.s.)
Preserved specimens, earthworm
Dissection pans or other large, flat containers
Scalpels
Probes
Microscopes

Safety Precautions

Wear chemical splash goggles or safety glasses, as well as chemical-resistant gloves when performing dissection activities. Wash hands thoroughly with soap and water before leaving the laboratory.

Procedure

1. Provide each lab group with a live earthworm. Use a large, flat container, such as a dissection pan, lined with wet paper towels. Instruct students to observe the earthworm carefully as it moves across the bottom of the container on the paper toweling. Give students time to observe the worms carefully, discuss the movement of the worms, and write a preliminary explanation for how they think an earthworm moves from one place to another.
2. Have students dissect a preserved earthworm (or dissect one as a demonstration). Carefully cut through the body wall of the worm lengthwise. Open the body cavity of the worm and examine the inside of the worm. Locate the muscles on the inside of the body wall. They will appear as a layer of whitish tissue against the body wall.
3. Have students examine a prepared microscope slide of the cross section (x.s.) of an earthworm with *low* power of a microscope. Students should see two circles of tissue, one inside the other. The smaller, inner circle is the gut in cross section. The outer circle is the body wall and its muscles. Look at the larger, outer circle in more detail. Immediately under the cuticle (skin) on the outer surface circular lines will be visible. These are the *circular muscles* in x.s. Inside this set, thicker pads of somewhat spongy-looking material will be visible. These are the *longitudinal muscles* in x.s.
4. Return to the dissected earthworm. Using forceps pick into the whitish material on the inside of the body wall. Note that it is fibrous and that the fiber runs longitudinally along the length of the body. Gradually pick your way through this thick layer until a layer of fibers is found that runs transversely around the body. Combining the dissection work and the slide examination, it can be discovered that the earthworm has two sets of muscles—one set running the length of the body (longitudinal muscles) and one set running around the body (circular muscles).
5. Have a student feel the surface of a live worm and describe it to the class. The student will feel the "bristles" along the dorsal and ventral surfaces of the anterior part of the worm. These bristle-like structures are called *seta* (pl. *setae*). Have the volunteer describe the feel of the setae while rubbing the worm in different directions.

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6. Now provide students with the following list of facts/data:
   a. Muscles only *contract* (shorten) and *relax* (return to original length), they do **not** expand or get longer.
   b. *Circular muscles* around the earthworm can contract and squeeze the body.
   c. Circular muscles around the earthworm can relax (returning the body to its original "fatness").
   d. *Longitudinal muscles* can contract and shorten the length of the body of the earthworm.
   e. Longitudinal muscles can relax, returning the worm to its original length.
   f. Setae (bristles) provide friction on a crawling surface.
   g. Setae are retracted during circular muscle contraction.
   h. Setae are extended when circular muscles are relaxed.
7. Have students revisit their earlier written explanation and revise their explanation in light of the new discoveries. Have them describe in as much detail as possible the sequence of events that can explain how an earthworm can move from one place to another.

Disposal

Preserved specimens can be disposed of following Flinn Suggested Disposal Method for Type III biological materials in the Biological Waste Disposal Section of your current *Flinn Scientific Catalog/Reference Manual*.

NGSS Alignment

This laboratory activity relates to the following Next Generation Science Standards (2013):

Disciplinary Core Ideas: Middle School
MS-LS1 From Molecules to Organisms: Structures and Processes
LS1.A: Structure and Function
LS1.B: Growth and Development of Organisms
Disciplinary Core Ideas: High School
HS-LS1 From Molecules to Organisms: Structures and Processes
LS1.A: Structure and Function

Science and Engineering Practices
Developing and using models
Planning and carrying out investigations
Constructing explanations and designing solutions

Crosscutting Concepts
Cause and effect
Structure and function

Tips

- Teach this activity as an open-ended, guided inquiry lab. Guide the inquiry by providing the resources but let students formulate their own models.
- Live earthworms will create an initial high level of energy in the laboratory. After the initial, predictable reactions, stu dents become totally interested in observing live earthworms.
- An extension or extra project following this laboratory is to have students use common materials to build working models of a moving earthworm. Extremely imaginative models are likely to result from this assignment!
- The sequence of events when a worm moves goes something like this:

1. Circular muscles contract (while longitudinal ones relax) squeezing the body walls inward. This "squeezes" the body wall and forces the body to get "longer," kind of like squeezing a balloon.
2. During this circular muscle contraction the setae are retracted and there is little friction to prevent the body from elongating out over the moving surface (ground).
3. When the worm is fully extended, the circular muscles relax (the setae on the anterior end become extended providing a grip on the surface) while the longitudinal muscles contract. As the setae on the extended, anterior end of the worm grip the surface, the contraction of the longitudinal muscles "pull" up the posterior end of the worm.
4. The contraction and relaxation of the two sets of opposing muscles in a coordinated and alternating pattern causes the worm to "pull" itself along from one place to another. The coordinated cycle of opposing muscles contracting and relaxing is repeated over and over again.

Materials for *Modeling Movement* are available from Flinn Scientific, Inc.

Catalog No.	Description
LM1103	Earthworms—Live (Lumbricus sp.)
ML1218	Lumbricus, c.s. Slide
PM1040	Preserved Earthworms, Large
AB1077	Pans, Dissecting, Aluminum with Wax

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.