Lab # 7 – Movement, stimulus and response in earthworms

QEP Essential Knowledge
Living Things: Forces and Motion
- How animals move
- Characteristics of living things
  - Movement
  - Respond to environment
  - Stimulus and response

SWBAT
Demonstrate how muscles enable an earthworm to move.
Make a prediction and carry out an investigation to test the prediction.
Identify responses to stimuli in earthworms and explain why they respond as they do.
Explain which kind of stimulus causes a faster response in humans – visual or auditory.

Materials
Earthworms, Magnifying glass, Paper towels, Cotton balls, Vinegar, Dropper, Flashlights
Balloons (to demonstrate earthworm locomotion)

ENGAGE
Today we are focusing on characteristics that organisms have that allow them to move and respond to things in their particular habitats.

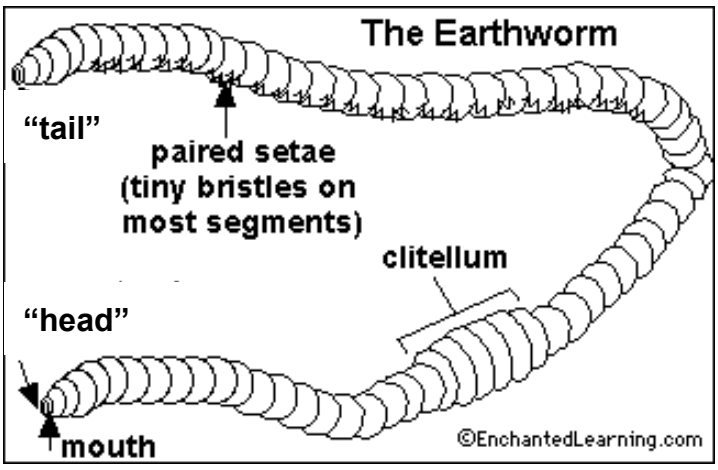
Show a live earthworm. Ask what they know about earthworms [e.g., where they live; what they eat; how they breathe; how they reproduce, etc.] and if they have any ideas about how earthworms move. Do NOT explain these now or correct their ideas; just see what ideas they have on Earthworms. List them on board, if desired.

Explain that they will be studying Earthworms today and looking at how their muscles help them move in their particular habitat and how they move in response to certain stimuli. (I will talk about the earthworm's skeleton in lecture, so you do not need to get into that.)

EXPLORE
Explain that, when using live organisms, they should treat them respectfully. **They should handle the earthworm, but remind them be very careful not to squish, pull, cut, tear, drop the worm on the floor, or let it dry out.**

Instruct students to get into pairs, and obtain a live earthworm at their table.

Students should carefully examine the earthworm using a magnifying glass. Tell them to follow the directions in EXPLORE on the Student Handout (parts A, B & C). Encourage them to focus on observing the Earthworm's structure and movement and describing what they see. Ensure that students notice how the setae (bristles/hairs) are used and how the segments change shape. Circulate and use productive questions to help them notice these important things.



EXPLAIN
Reconvene the whole group.

Place an earthworm on a wet paper towel on the Doc Cam (be careful it does not dry out.)
Ask: What do you observe about the Earthworm's movement? How do the earthworm's segments change shape as it moves? How are the setae used?
Through discussion, help them to figure out how the earthworm moves.

Explain that the earthworms have two kinds of muscles (can refer to diagram in background info). Circular muscles go all the way around each segment. Longitudinal muscles run from front to back of each segment. Demonstrate on balloon.

Using a balloon, demonstrate what happens when the circular muscles contract (segment lengthens), and when the longitudinal muscles contract (segment gets shorter). Connect this to what they observed about segments changing shape and length as the worm moves.
Point out that the balloon does not have setae and without them the earthworm would have a very difficult time moving. The setae anchor it, so its muscle contractions can be effective in pulling the worm along

Ask: What other adaptations does the earthworm have for its habitat? (moist skin through which it gets oxygen, streamlined shape, sensory organs.)
Discuss how the worm's overall shape and other adaptations are well suited for its underground environment.

EXTEND

Ask students to think about how science is done. Remind them that there are many ways to gather information to understand the physical world and to answer questions that we have about things we observe. One way is to make careful observations, like they just did with the Earthworm. Another way is to carry out **a test or an experiment**. (Refer to Chapter 6 reading for this week.) Regardless of the method used, it is important to plan, be systematic, and keep good records.

They should work through the questions in the Student Handout (Extend). Groups testing the same stimulus should confer briefly, so that they are using similar setups for the experiment.
Circulate to help them and to make sure they are treating the worms carefully.

After they do the experiment, compile all the data on the three whiteboards &/or on the Doc Cam. (one for each stimulus)
Discuss the class results. Decide if aberrant results should be excluded.

Ask: Was your group's prediction supported or contradicted by the data? Evidence?

Ask: What did this activity tell you about the stimuli that earthworms are able to respond to? What did this activity tell you about what an earthworm needs (or needs to avoid) in its habitat? Evidence?

Did any groups investigate the same variable and report different results? If so, why might that have happened? (There are many possibilities, e.g., the worms were different and responded differently; the experiments were set up differently; the observations or measurements were made by different people.) Point out that this is why scientists repeat experiments multiple times.

Discuss the idea that it is OK if your data does not agree with the prediction, and that this often happens in science. And even if the data supports the prediction, it does not prove it. Scientists repeat experiments many times and gather much additional data before they make a conclusion, but even then they do not prove anything.

Stimulus and Response in Humans

Explain that they will now investigate stimulus and response in humans and answer the question: Do humans respond faster to visual stimuli to tactile (touch) stimuli?

Demonstrate how to do the activity with the ruler.
Be sure to emphasize:

- Orient the ruler with the 0 cm mark at the bottom.
- To start, hold the bottom of the ruler level with the top of the other person's hand.
- They should read the distance the ruler fell by looking at where on the ruler the top of the index finger was when the person grabbed the ruler.
- If the person fails to catch the ruler, they should record > 30 cm.
- They may need to practice a few time, to get it right, especially in part 2 when they have to touch the person's hand and release the ruler at the SAME TIME.
- They should be sure that they are not giving clues to the person about when they are going to drop it.
- If a trial is "bad", e.g., the ruler hits the person's hand as it falls, or the person dropping it touches the hand at the wrong time in part 2, they should just skip that trial and not record it. It is a do-over.

Put the **table of reaction times** on the Doc Camera for them to use to convert from cm to seconds.

Depending on how the data looks, you can tell them: If they have a measurement that is much higher or lower than the others, they should discard it or repeat that trial. If you want, you can have them average the reaction time measurements, but that may not be needed.

Ask how many pairs found a difference in reaction time between the visual and touch stimuli. Which caused a faster reaction – visual or touch? (Generally, visual will be faster.)

Ask them to think about why this might be the case (i.e., visual faster than touch). You can sketch or demonstrate that with the touch stimuli, the impulse has to travel farther than with a stimulus coming from the eye.

Visual: eye → brain → arm → hand

Touch: hand → arm → brain → arm → hand

(eye → brain) is a shorter distance for the impulse to travel than (hand → arm → brain)