Name _____ Date _____
Period _____

Earthworm Behaviors

Investigating Hydrotaxis, Chemotaxis and Phototaxis

Living organisms are exposed to a multitude of environmental changes over their lifetime. Changes in the environment serve as external stimuli that result in behavioral changes in the organisms. For example, a pill bug will move away from bright light. The light serves as a stimulus for the response, the movement away from the light. The movement of an organism in response to a stimulus is known as a **kinesis** or a **taxis**. A **kinesis** is a behavioral response that produces random movements when a stimulus is present. There are no clear movements towards or away from the stimulus. A **taxis**, on the other hand, is a behavioral response that produces movements either towards or away from a stimulus.

Taxis behaviors are classified according to the stimulus producing the response. The presence of stimuli such as light, gravity, or chemicals can result in taxis behaviors. If the organism moves toward the stimulus, then the movement is referred to as a *positive taxis*. Avoidance or movement away from a stimulus is a *negative taxis*. A **phototaxis** is the response to light. A **hydrotaxis** is an organism's movement in response to moisture. A **chemotaxis** is an organism's response to a specific chemical. A **geotaxis** is an organism's movement in response to gravity.

Materials:

Earthworm
Water
Paper towels
Disposable pipette
Ruler
Dissecting tray
Ammonia
Q-tip
Aluminum foil or flashlight
Watch with a second hand

Part I: General Earthworm Information

1. Earthworms belong to the Kingdom _____ and the phylum _____.
2. List two characteristics of annelids.
3. Name two other organisms that are in the same phylum as the earthworm.
4. Is your earthworm male, female, or hermaphroditic? Give it an appropriate name.

5. Measure your worm's length in centimeters and record in data table 1.

6. Count the number of segments on your worm. (Hint: You may want to count a small section of the worm and multiply.) Record in data table 1.

7. Compare your worm to three other worms in the classroom. Record in data table 1.

Data Table 1: Earthworm Lengths & Segments

	Your Worm	Worm #1	Worm #2	Worm #3
Length (cm)				
# of segments				

8. Do longer worms have more, fewer, or the same number of segments?

9. Locate the thickening of the earthworm's body at about segment 30 (The first segment is the head). This swelling is called the **clitellum**. Is the clitellum located more towards the anterior or posterior end of the worm?

10. On the ventral side of the earthworm are small bristles called **setae**. They are too tiny to see, but you can feel them by running your fingers along the ventral side of the worm. What do you think the function of the setae is?

11. Note the tiny openings around segment 14. These are the **seminal receptacles**, where sperm is exchanged between two mating worms. What is the function of the seminal receptacles?

12. Sketch your earthworm in the space below. Label the **dorsal** & **ventral sides**, **posterior** & **anterior ends**, **clitellum**, **setae**, and **seminal receptacles**.

13. Study the earthworm's head. Does it appear to have any sense organs, such as eyes, ears, nose, or mouth? Make your predictions below of whether or not you think the earthworm is capable of sensing the following senses.

Light? _____ Odor? _____ Sound? _____ Taste? _____ Touch? _____

Part II: Response to Moisture (Hydrotaxis)

1. In this activity you will determine the response of the earthworm to moisture by placing a damp paper towel on one side of your dissecting tray and a dry paper towel on the other side. Record your hypothesis on how you think the earthworm will respond to moisture below.

2. Lay the worm in the tray so that half the worm lies on the damp paper towel and the other half lies on the dry paper towel. Observe the earthworm's response. Which direction does it move? Perform six trials, alternating the head so that half the time it lays on the moist side and half the time it lays in the dry side to start with. Record the worm's responses in the table below.

Data Table 2: <u>Earthworm Response to Moisture</u>

Head starts on dry	**Response (moves towards wet or dry)**
Trial 1	
Trial 2	
Trial 3	
Head starts on wet	
Trial 4	
Trial 5	
Trial 6	

3. Do earthworms exhibit a positive or negative hydrotaxis?

4. Remove the dry paper towel from the dissecting tray and let the worm just move around for a while. Use a pipette to drop a water droplet on its anterior end. Record the worm's reaction.

5. Now place a drop of water on its posterior end and record the worm's reaction.

6. Can the earthworm sense being touched?

Part III: Response to Chemicals (Chemotaxis)

1. In this portion of the lab, you will determine the earthworm's response to ammonia to see if the earthworm can smell. Record your hypothesis below.

2. Carefully wave a Q-tip dipped in ammonia near the worm's posterior end and record the reaction. Do not touch the worm with the ammonia; it is toxic!!!

3. Now wave the ammonia-coated Q-tip near the anterior end. Record the worm's response.

4. Do earthworms have a sense of smell? If so, is the front end or hind end more sensitive to odors?

5. Do the worms display a chemotaxis to ammonia? If so, is it positive or negative?

Part IV: Response to Light (Phototaxis)

1. In this portion of the activity you will determine whether earthworms demonstrate a taxis to light. Formulate a hypothesis in regards to earthworm responses to light.

2. To test the response to light you can cover half of your tray with a piece of foil or shine a flashlight on one side of your tray while darkening the lights. (Use whichever procedure your teacher instructs you to use.) Observe your worm for a one-minute period. Every five seconds, note the location of your worm by placing an X in the data table under the appropriate column.

Data Table 3: Earthworm Response to Light

Time Elapsed (s)	Dark	Light
0		
5		
10		
15		
20		
25		
30		
35		
40		
45		
50		
55		
60		

3. Does your earthworm exhibit a positive or negative phototaxis?

Part V: Conclusions

1. What is the difference between a taxis and a kinesis?

2. What structural adaptations do earthworms possess that allow them to perform a taxis response?

3. How could a negative chemotaxis be beneficial to a bacterium that is exposed to bleach?

4. What type of taxis is represented in the following scenarios? (List + or – and geotaxis, hydrotaxis, chemotaxis, or phototaxis)
    a. A beetle moves away from a bright light _____
    b. The roots of a growing seed turn downward _____
    c. Brine shrimp in a petri dish collect around a light source _____
    d. A meal worm crawls toward a moist potato _____
    e. A snail crawls away from a patch of fertilizer in a flower bed _____
    f. The surface of a leaf tilts toward the sunlight _____

5. Explain the evolutionary advantage of possessing a nervous system that allows the organism to perform a taxis behavior.

*Activity adapted from Laying the Foundation in Biology Planarian Behaviors Lab and Biologycorner.com Observation of a Living Earthworm Lab.