

Squirmin' Worms

Animal Behavior

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Published by *K20 Center*

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Grade Level	9th – 12th Grade	**Time Frame**	3-4 class period(s)
Course	Biology	**Duration**	200 minutes

Essential Question

What causes organisms to react?

Summary

Students will investigate animal behavior by conducting experiments to see how worms respond to stimuli.

Snapshot

Engage

Students will watch a video of worms in clumps on the highway and try to explain the worms' behavior.

Explore

Students will conduct an experiment with live earthworms and observe how worms react to moisture.

Explain

Students will compare their results and come up with a more informed explanation of the worms' behavior in the Engage video.

Extend

Students will conduct fo more experiments with the worms to try to explain the behavior in the video. They will then construct a poster to share their findings with the class.

Evaluate

Students will look at the complex interactions that often occur within an ecosystem and write a persuasive letter to a representative explaining why earthworms are important to the soil ecosystem.

Standards

ACT College and Career Readiness Standards - Science (6-12)

IOD402: Compare or combine data from a simple data presentation (e.g., order or sum data from a table)
SIN301: Understand the methods used in a simple experiment
EMI401: Determine which simple hypothesis, prediction, or conclusion is, or is not, consistent with a data presentation, model, or piece of information in text

Next Generation Science Standards (Grades 9, 10, 11, 12)

HS-LS2-6: Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
HS-LS2-8: Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.

Oklahoma Academic Standards (Biology)

B.LS2.4 : Use a mathematical representation to support claims for the cycling of matter and the flow of energy among organisms in an ecosystem.
B.LS2.4.4: Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded.

Attachments

- All Extend Investigation Options—Squirmin' Worms .docx
- All Extend Investigation Options—Squirmin' Worms .pdf
- Class Data Collection—Squirmin' Worms.docx
- Class Data Collection—Squirmin' Worms.pdf
- Explore Investigation—Squirmin' Worms.docx
- Explore Investigation—Squirmin' Worms.pdf
- Spend A Buck—Squirmin' Worms.docx
- Spend A Buck—Squirmin' Worms.pdf
- The Living Soil—Squirmin' Worms.docx
- The Living Soil—Squirmin' Worms.pdf
- Why Do Earthworms Surface After Rain?—Squirmin' Worms.docx

Materials

- Explore Investigation—Squirmin’ Worms
- Class Data Collection—Squirmin’ Worms
- All Extend Investigation Options—Squirmin’ Worms
- Spend a Buck—Squirmin’ Worms
- Why Do Earthworms Surface After Rain—Squirmin’ Worms
- The Living Soil—Squirmin’ Worms
- Earthworms (3 per student or group of students)—Worms can be purchased at a large department store or bait shops. Once purchased, place them in the refrigerator.
- Paper towels
- Light source (flashlight or lamp)
- Black construction paper
- Scissors
- Tape
- Shoe boxes (or small plastic containers with lids)
- Access to warm water or a microwave
- Access to a freezer
- Tuning fork (optional)

- Vinegar
- Dropper
- Gloves (optional)
- Notebooks or notebook paper
- Poster paper

Engage

Teacher's Note

Behavior is anything an animal does in response to a stimulus. A stimulus is an environmental change that directly influences the activity of an organism. Through this lesson, students can observe animal behaviors by observing earthworm responses to light, odor, temperature, and moisture.

Notebook Use

Even though this lessons comes with all the necessary handouts, it will be better if students collect data in a notebook. In addition, keeping a lab notebook is closer to how scientists initially record data from experiments.

Introduce students to the I Notice/I Wonder instructional strategy. Explain that they will share their observations and questions after watching a short video.

Procedure:

1. Show students "Weird Worms at Eisenhower State Park, Texas," a video of earthworms clumping in the middle of the road.
2. Have students jot down their observations (I Notice), true statements, and any questions they have about what they see (I Wonder) in their notebooks or on a piece of notebook paper.
3. In groups of two or three, have students identify one observation and one question to share with the class.
4. As they share out, record a list of their observations and questions on a poster board or the whiteboard, so that it is visible to all students.
5. Tell the class they are going to be conducting experiments to explain the worms' behavior and answer their questions. Leave the list up and tell students to refer to it throughout the lesson.

Possible Student Responses

Students will notice that the worms are in large clumps in the middle of the road. They will wonder why they are in clumps and why they are in the middle of the road.

Explore

Preparation

Advise students to handle the earthworms with great care since they are living, breathing animals.

Investigation Part 1: How Do Earthworms React to Moisture?

Materials:

- Earthworm chamber (shoebox or plastic container with lid)
- Paper towels
- Black construction paper
- Scissors
- Earthworms (2 per group)
- Gloves (optional)

Procedure:

Ask students to set up the earthworm chambers similar to the one below.



- Students can take a paper towel and fold it in quarters, the one on the left is dry and the one on the right is wet from cool tap water.
- The black strip of construction paper is between the two paper towels to make sure the dry paper towel does not absorb water from the wet paper towel.
- After students have prepared the earthworm chamber, they can place one worm on the dry paper towel and one on the wet paper towel.
- They should cover the container with a lid to allow privacy.

Teacher's Note

Students should cover the containers because earthworms are sensitive to light, but that is an investigation they will conduct later. Fornow, we will tell students it is for privacy. This also allows only one variable to be changed at a time, a component of any good experimental design.

Allow the earthworms to rest for 10 minutes.

While the worms are reacting to the stimuli, have students complete the first portion of the **Explore Investigation**. If your students use a lab notebook in class, they should use it to collect data instead of filling out the lab sheets.

After 10 minutes, have students examine the chamber and document any movement or non-movement the earthworms make by filling out the rest of the handout.

Explain

Pass out the **Class Data Collection** handout, or put it up on the projector and have students put the table in their notebooks. Tell students that they will be collecting class data for many different upcoming earthworm experiments.

Show students how the data collection should look by using tally marks. When using tally marks, four vertical slashes and a diagonal slash across a group of four vertical slashes count as 5.

Divide students into groups of 4, then ask each group to look at their data sheets and report to the class how many worms were on the moist side and how many were on the dry side.

Once the data is collected, the numbers should indicate that the worms prefer the moist paper towel. Discuss students' observations as a class.

Teacher's Note

Earthworms prefer moist soil because it assists them in their breathing process. Earthworms have glands that give off mucus, which helps the earthworm breathe because it keeps the body moist. Oxygen dissolves in the moisture on the earthworm's body, and maintaining moisture in the soil is important for this process.

Next, ask students if they know the definitions of the terms *stimulus*, *response* and *behavior*. They are asked about a stimulus and response on the lab sheets, but are not given definitions. Hopefully, the words will have more meaning to them once they can tie the definition to something they experienced in the lab.

Definitions

Stimulus: An environmental change that directly influences the activity of an organism.

Response: An organism's reaction to a change in its internal or external environment.

Behavior: Anything an animal does in response to a stimulus, very similar to a response. A behavior can be considered a habit an organism exhibits repeatedly in response to conditions it regularly experiences.

Finally, show "Weird Worms at Eisenhower State Park, Texas" again and ask students if what they've learned in the lab so far can help explain the behavior they are witnessing.

Teacher's Note

Students will probably say that they learned worms prefer moist environments. In the video, it looks like there has been a recent rain, which explains why the worms are above ground. As for the other behaviors, clumping, in the middle of the road, etc., those will be investigated through a series of labs in the next phase of this lesson.

Extend

Preparation Note

To prepare for this lab, you will need to place enough wet paper towels in the freezer for each group to have one or two. There are many different ways these labs can be performed. For the full experience and to practice good experimental design and data collection, each group should do each experiment. However, if there aren't enough materials for all of the labs, the teacher can demo them or set up stations and have students rotate.

Pass out the **All Extend Investigation Options** handout. Explain to students that in this phase of the lesson, they are to conduct, in their groups, four experiments with the earthworms.

Ask students to make their observations and record their data for each experiment, either on the handout or in their notebooks (as suggested at the beginning of this lesson) using the handout as a template.

At the end of each experiment, ask each group to share their results with the class.

Investigation Part 2: How Do Earthworms React to Light?

Teacher's Note

Earthworms do not like sunlight because it gives off heat, which applies to the next experiment.

Materials:

- Earthworm chamber (shoebox or plastic container with lid)
- Paper towels
- Black construction paper
- Scissors
- Tape
- Light source (flashlight or lamp)
- Earthworms (3 per group)

Procedure:

Guide students in setting up the earthworm chambers, similar to the one below if they are using a lamp:

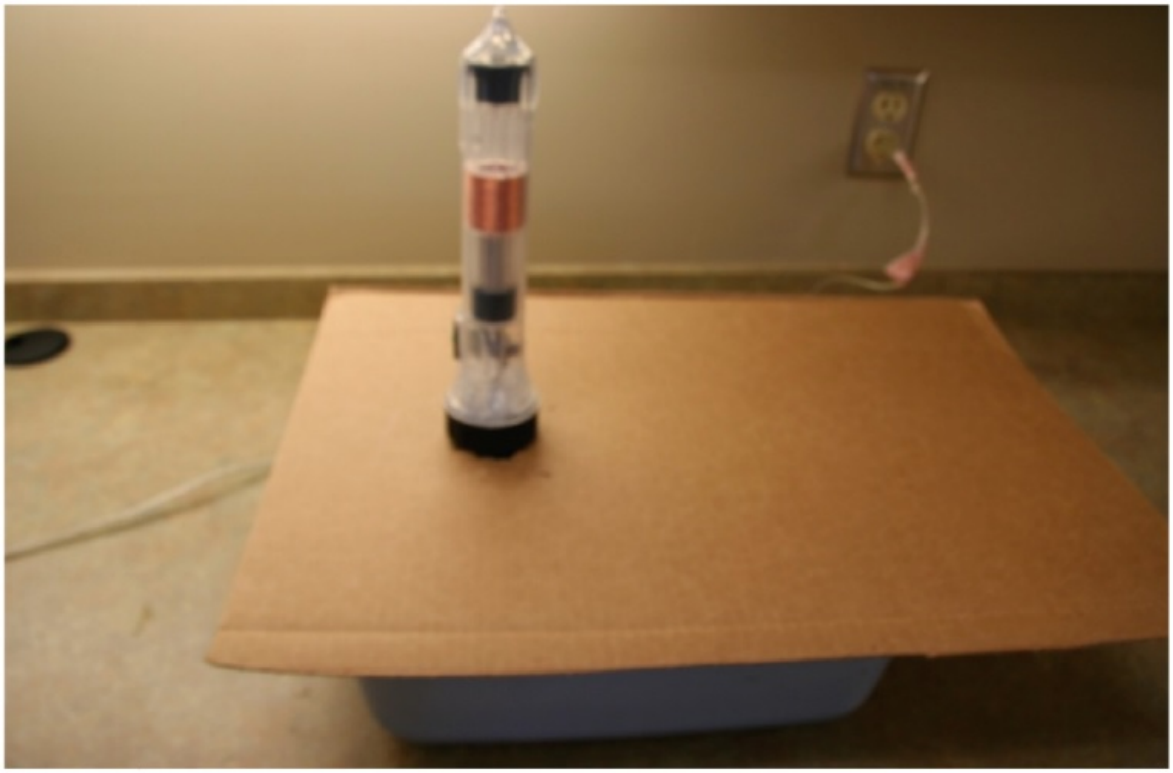


One side of the chamber should be blocked from the light and the other side should allow for exposure to light.

Teacher's Note

Students should make sure moist paper towels are placed at the bottom of the chambers to keep the earthworms moist, which is hopefully something they observed in the Explore investigation. Again, this allows us to change only one variable at a time.

If you are using a shoe box or containers without lids and flashlights, you can use the set-up below:



- After students have prepared the earthworm chamber, ask them to place two earthworms on the midline of the container (or where the dark side of the chamber meets the light side).
- Allow the earthworms to rest for 10 minutes and have students examine the chamber and document any movement or non-movement the earthworms make.
- Ask students to write down their observations and tally the worms' behavior.

Investigation Part 3: How Do Earthworms React to Different Temperatures?

Worm Well-Being

Take precautions to keep from harming this earthworms in this investigation. The hot paper towel should not be scalding hot.

Teacher's Note

Earthworms are more sensitive to warm temperatures than cool ones. Studies have found that earthworms thrive when soils are approximately 68 degrees Fahrenheit (20 degrees Celsius). They can survive for short periods in warmer soils, but prolonged temperatures close to 86 degrees Fahrenheit (30 degrees Celsius) are likely to prove fatal.

Materials:

- Earthworm chamber (shoebox or plastic container with lid)
- Paper towels
- Access to tap water
- Access to hot water or a microwave to heat wet paper towels
- Access to a freezer or access to paper towels that have been wet and frozen. It only takes 5 minutes for them to freeze enough for the purpose of this activity
- Earthworms (3 per group)

Procedure:

Ask students to set up their earthworm chambers similar to the one below:



3 worms are placed directly on the towels for each trial.

1. Paper Towel/Tap Water

- Ask students to moisten a paper towel using tap water at a cool temperature.
- Ask students to place their earthworms directly on the paper towel to observe and document their movement during a five-minute period.
- As in the picture above, the earthworms will probably stay on the towel.
- Ask students to remove the paper towel and the earthworms from the chamber, and prepare the next trial.

2. Paper towel/Frozen

- Ask students to moisten a paper towel and place it in the freezer, or pass out frozen paper towels that you have already prepared.
- Each paper towel should be flexible enough for a student to bend it up and down. You will know they are at the right temperature if they are bendable.
- Have students place their earthworms directly on the paper towel, observe, and document their movement during a five-minute period.
- The earthworms will probably stay on the paper towel, but movement will be more limited than when they were placed on the tap water paper towel. (The body temperature of the worms will drop when they are on the frozen paper towel, decreasing their movement)
- Ask students to remove the paper towel and the earthworms from the chamber.

3. Paper towel/Microwaved or using hot water

- Ask students to moisten a paper towel and place it in the microwave for no longer than one minute, or dip it in hot water, wringing out the excess moisture.
- The paper towel should be hot but not so hot the student cannot touch it or carry it to their earthworm chamber.
- Ask each group to place their earthworms directly on the hot paper towels and observe, documenting their movement during a one- to two-minute period.
- As in the pictures below, the earthworms will probably try to move off of the paper towel as quickly as possible. They may move under it or just off of it, seeking refuge from the heat.
- Ask students to remove the paper towel and the earthworms from the chamber.





As you can see, the earthworms are trying to move off of the hot paper towel.

Teacher's Note

Students will notice the worms' movement is much quicker as compared to the tap water or the frozen paper towels. You could also ask students to notice the temperature of the earthworms as they move them off of the hot paper towel.

Teacher's Note

For the final two experiments, it is best to do the vibrations first and the odors second.

Investigation Part 4: How Do Earthworms React to Vibrations?

Teacher's Note

Earthworm predators cause vibrations, so earthworms move away from vibrations as a defense mechanism.

Materials:

- Earthworm chamber (shoebox or plastic container with lid)
- Paper towels
- Tuning fork (if possible)
- Earthworms (2 per group)

Procedure:

Ask students to set up the chamber similar to the one below:



Two moistened paper towels and placed side by side in the chamber.

- Once students have the chamber set up, ask them to place earthworms on the right-hand side of the container.
- If using a tuning fork, have one student per group hit the tuning fork against a hard surface and lightly touch it to the bottom of the chamber directly underneath the worms.
- If not using a tuning fork, direct one student per group to lightly and quickly tap the bottom of the chamber.
- Tell students to keep tapping the chamber in the same spot, even if the worms move away from the source of the vibrations.
- Ask students to observe the earthworms' reaction for two minutes.
- The earthworms will probably move around the chamber trying to escape the vibrations. At the very least, they will move away from the source of the vibrations.
- Have students remove the worms and prepare for the next experiment.

Investigation Part 5: How Do Earthworms React to Odors?

Teacher's Note

Earthworms do not have noses but they do have cells that detect smells. Avoiding strong smells protects them from ingesting harmful substances.

Materials:

- Earthworm chamber (shoebox or plastic container with lid)
- Paper towels
- Vinegar
- Dropper of some sort to place drops of vinegar on a paper towel
- Earthworms (3 per group)

Procedure:

- Have each group pf students place several drops of vinegar on one paper towel, either on the left or the right side of the chamber.
- Once the chamber is set up, ask students to place the worms in the middle.
- Have students place a lid on the chamber and wait 10 minutes.
- After 10 minutes, as students to remove the lid and document any movement or non-movement the worms made.

Prepare a poster to share data:

After the experiments are conducted and the data gathered, have each group of students display their results from each experiment. To ensure students collect appropriate data, each poster should be based on the handout for each experiment. Each experiment needs its own data table, so each poster should have four data tables on it. The posters *must* have data tables like the ones in their handouts with specific numbers so that the worms' behavior can be quantified as a class. The posters can be made on oversized Post-its, bulletin board paper, or any medium large enough so the class can easily use it to collect data.

Teacher's Note

Groups can work on the poster while they are waiting on worms to react. This will make better use of their time.

After all the posters are complete, have students do a Gallery Walk and gather class totals for each experiment. The data sheet for gathering class-wide data is attached, but again, it would be best if students used their notebooks. After the gallery walk, bring the class back together and have a discussion about their findings. Be sure to have groups who observed different data than everyone else explain how theirs was different, and why they think it may have been different.

Teacher's Note

Be sure to have groups who observed different data than everyone else explain how theirs was different, and why they think it may have been different.

Evaluate

Show students "Weird Worms at Eisenhower State Park, Texas" once again. Ask students to use the Spend a Buck strategy to indicate what stimulus or combination of stimuli they think is/are the most responsible for the worms' behavior in the video, based on what they learned in the labs. Have students work in the same groups as before. The groups will have "$1.00" to spend. Spending the dollar is a way to vote on what the group thinks is the most important factor in the worms' behavior. They do not have to (and probably shouldn't) spend it all on one stimulus. For example, group A may spend $0.70 on moisture, $0.20 on temperature, and $0.10 on vibration. Have each student write a paragraph explaining and justifying their group's decision on how to spend the money. These paragraphs can be collected as an Exit Ticket, if desired. Once they have allocated their funds and completed their paragraph, collect data as a class. Using either your whiteboard, large paper, the attached **Spend a Buck** handout, or the Squirmin' Worms Spend a Buck Google sheet to collect the results as a class, then discuss the results.

Optional: Further Study

If your students would like to learn more about earthworms and their behavior, pass out the two attached readings about earthworms, **The Living Soil** and **Why Do Earthworms Surface After Rain?**

Resources

- K20 Center. (n.d.). Bell ringers and exit tickets. Strategies. https://learn.k20center.ou.edu/strategy/125
- K20 Center. (n.d.). Gallery walk / carousel. Strategies. https://learn.k20center.ou.edu/strategy/118
- K20 Center. (n.d.) I Notice, I wonder. Strategies. https://learn.k20center.ou.edu/strategy/180
- K20 Center. (n.d.). Spend a buck. Strategies. https://learn.k20center.ou.edu/strategy/154
- Squirmin' Worms Spend a Buck, https://docs.google.com/spreadsheets/d/1FMoUv8MXOlL7Uf4AeooZ_y9fiUcuLs3iA9WLW8xNGAs/edit?usp=sharing
- Sustainable Human. (2014, February 13). *How Wolves Change Rivers* [Video]. YouTube. https://www.youtube.com/watch?v=ysa5OBhXz-Q
- Sustainable Human. (2014, November 30). *How Whales Change Climate* [Video]. YouTube. https://www.youtube.com/watch?v=M18HxXve3CM
- Texas Parks and Wildlife. (2015, May 29). *Weird worms at Eisenhower State Park, Texas* [Video]. YouTube. https://www.youtube.com/watch?v=2y584iTnQIw