



# Squirmin' Worms

## Animal Behavior



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<b>Grade Level</b>	9th – 12th Grade	<b>Time Frame</b>	3-4 class period(s)
<b>Course</b>	Biology I	<b>Duration</b>	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 4 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

*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

- [01 Explore Investigation - Spanish.docx](#)
- [01 Explore Investigation - Spanish.pdf](#)
- [01 Explore Investigation.docx](#)
- [01 Explore Investigation.pdf](#)
- [02 Class Data Collection - Spanish.docx](#)
- [02 Class Data Collection - Spanish.pdf](#)
- [02 Class Data Collection.docx](#)
- [02 Class Data Collection.pdf](#)
- [03 All Extend Investigation Options - Spanish.docx](#)
- [03 All Extend Investigation Options - Spanish.pdf](#)
- [03 All Extend Investigation Options .docx](#)
- [03 All Extend Investigation Options .pdf](#)
- [04 Spend a Buck Squirmin' Worms - Spanish.xlsx](#)
- [04 Spend a Buck Squirmin' Worms.xlsx](#)
- [07 Accuweather article - Spanish.docx](#)
- [07 Accuweather article - Spanish.pdf](#)
- [07 Accuweather article.docx](#)
- [07 Accuweather article.pdf](#)
- [08 USDA Article - Spanish.docx](#)
- [08 USDA Article - Spanish.pdf](#)
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## Materials

- Earthworms (3 per student or group of students)--Worms can be purchased at large department store or bait shops. Once purchased, place them in the refrigerator.
- Paper towels
- Light source ( Flash light or lamp)
- Black construction paper
- Scissors
- Tape
- Shoe box (or small plastic containers with lids)
- Access to warm water or a microwave
- Access to a freezer
- Vinegar

- Dropper
- Gloves (optional)
- Tuning Fork (optional)

# 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 lesson 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.

## Attachments

There are 10 handouts with this lesson. They are numbered in the order they are needed in the lesson.

Show students this [video](#) of earthworms clumping in the middle of the road. Using the [I Notice/I Wonder](#) strategy, students will share their observations and questions. Here is procedure for using this strategy with this lesson:

1. Show students the video.
2. Have students jot down notices, true statements, and wonderings (questions they have about what they see).
3. In groups of two or three, have students identify one notice and one wondering to share with the class. As they share out, record a list of notices and a list of wonderings somewhere that is visible to all students.
4. Tell the class they are going to be conducting experiments to explain the worms' behavior and answer their wonderings.

## Teacher's Note

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. Performing the labs in this lesson will help them construct answers for the worms' actions. Leave the list up and tell students to refer to it throughout the lesson.

# Explore

## Teacher's Note

Please advise students that they will be conducting some earthworm investigations and they should handle the earthworms with great care since they are living, breathing animals. In preparing for this lab, several wet paper towels should be placed in the freezer so they can get cold.

### Investigation Part 1: How Do Earthworms React to Moisture?

To conduct the lab, students need the following supplies

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

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



*Set up for the moisture experiment.*

- 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**

They should cover the containers because earthworms are sensitive to light, but that is an investigation they will conduct later. For now, 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.

**Teacher's Note**

While the worms are reacting to the stimuli, have students complete the attached handout about the worm moisture lab. If your students use a lab notebook in class, they should use it to collect data instead of filling out the lab sheets.

As students are completing the lab sheet/setting up their notebook to collect data, have students examine the chamber and document any movement or non-movement the earthworms make.

# Explain

Pass out the whole class data collection sheet or put it up on the projector and have students put the table in their notebooks. This data collection sheet can be found in the attachments section. Tell students that they will be collecting class data for many different upcoming earthworm experiments. 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. 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. Once the data is collected, the numbers should indicate that the worms prefer the moist paper towel.

## 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.

After you've collected data as a class, have a discussion about their observations. Next, ask students about a stimulus, response and behavior. They are asked about a stimulus and response on the lab sheets, but students were not given a definition. Hopefully, the words will have more meaning to them since they can tie the definition to something they experienced in the lab.

## Teacher's Note

**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 this [video](#) 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.

For this phase of the lesson, the groups will conduct four experiments with the earthworms. They will then share either results with the class. Data collection sheets for each individual lab can be found in the attachments. If students use notebooks (as suggested at the beginning of this lesson), they should use the handout as a template for their data collection in their notebooks. Otherwise, students can write on the handouts. Students should be collecting data and making observations for each experiment.

Light Investigation: How Do Earthworms React to Light?

### Teacher's Note

Earthworms do not like sunlight because of its relationship to giving off heat which applies to the next experiment.

To conduct the lab, students need the following supplies:

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

Students should set up the earthworm chambers similar to the one below if they are using a lamp:



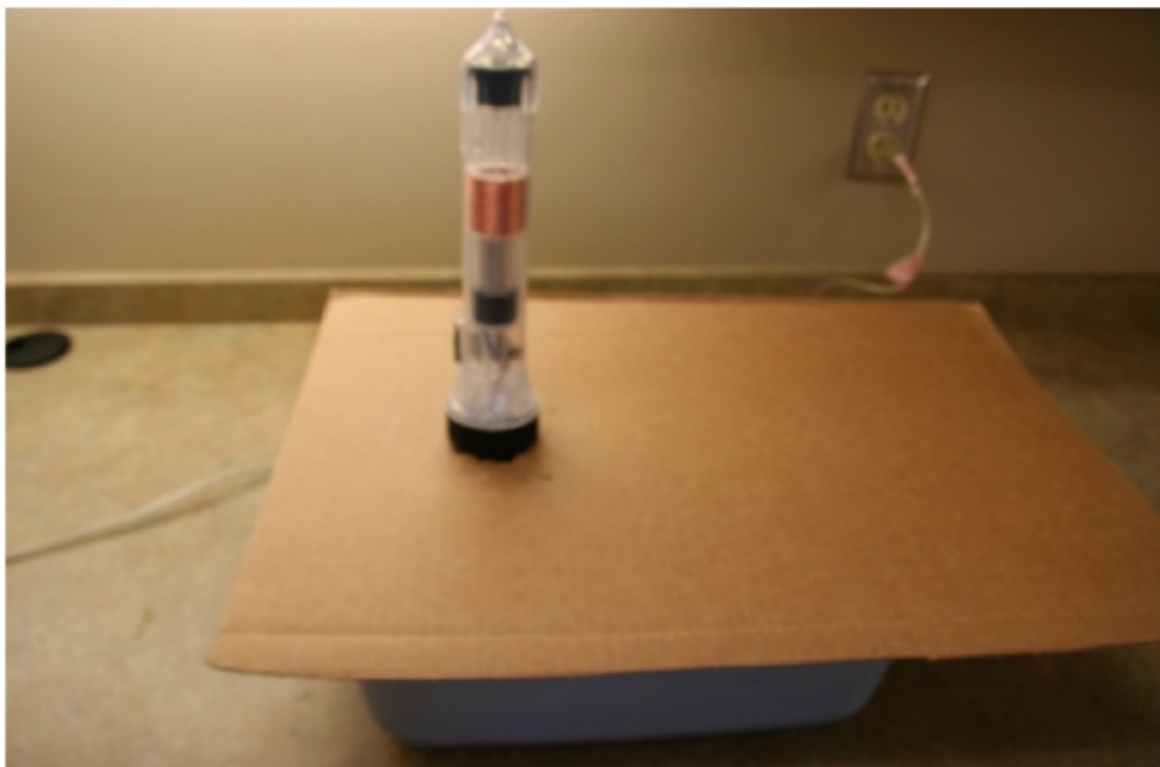
*One chamber should be blocked from the light and the other side should allow for exposure to light.*



### 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, they can 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 made.
- Write down observations and tally the worms' behavior.

Temperature Investigation: How Do Earthworms React to Different Temperatures?

### Worm Well-Being

This investigation could create harm to the earthworms if precautions are not taken during the investigation. Students will be placing earthworms on paper towels of varying temperatures and observing their responses. It will be important that the hot paper towel is not scalding hot or it will cause the earthworm distress. However, if students follow the guidelines below for conducting this investigation, undue harm should not occur to earthworms. The experimental set up was designed with earthworm safety in mind and is an easy way for students to investigate this question.

### 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.

Students will be placing earthworms on a single paper towel with the following treatments at separate times and examining earthworm movement.

Students should have these supplies:

- 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)

Students should 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

- Students should moisten a paper towel using tap water at a cool temperature.
- Then students can 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.
- Then students should remove the paper towel, the earthworms from the chamber, and prepare the next trial.

#### 2. Paper towel/Frozen

- Students should moisten a paper towel and place it in a freezer or retrieve paper towels which have already been prepared by the teacher.
- 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.
- Then students can 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 for the worms will drop when they are on the frozen paper towel, decreasing their movement)
- Then students should remove the paper towel and the earthworms from the chamber.

### 3. Paper towel/Microwaved or using hot water

- Students should 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.
- Then student groups can 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.
- Then students should 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.

## Vibration Investigation: How Do Earthworms React to Vibrations?

**Teacher's Note**

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

Students should have these supplies:

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

Students should set up the chamber similar to the one below:



*Students should moisten two paper towels and place them side by side in the chamber.*

- Once students have the chamber set up, they can place earthworms on the right hand side of the container.
- If using a tuning fork, hit it against a hard surface and lightly touch it to the bottom of the chamber directly underneath the worms.
- If not using a tuning fork, lightly and quickly tap the bottom of the chamber.
- Even if the worms move away from the source of the vibrations, keep tapping the chamber in the same spot.
- Observe the earthworms' reaction for 2 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.
- Remove the worms and prepare for the next experiment.

Odor Investigation: How Do Earthworms React to Odors?

**Teacher's Note**

Earthworms do not have noses but they do have cells which detect smells. Avoiding strong smelling substances 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)

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, students should place the worms in the middle.
- Place a lid on the chamber and wait 10 minutes.
- 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, students should 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, students should 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, the class will come 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 the worm clumping [video](#) once again. Students are going 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. Students should 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 board, large paper, the attached excel file, or the google sheet here, collect the results as a class and then discuss the results.

## **(Optional) Further Study**

If your students would like to learn more on earthworms and their behavior, pass out the two attached readings about earth worms.

## Resources

- YouTube Video. Earthworms clumping video. (2016). Texas Parks and Wildlife Channel. Eisenhower State Park. Retrieved from <https://www.youtube.com/watch?v=2y584iTnQlw>
- I Notice I Wonder Instructional Strategy: K20 Center. Copyright 2015 Board of Regents of the University of Oklahoma. Retrieved from <https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f507d1a7>
- Google Sheet Link: Retrieved from [https://docs.google.com/spreadsheets/d/1FMoUv8MXOIL7Uf4AeooZ\\_y9fiUcuLs3iA9WLW8xNGAs/edit?usp=sharing](https://docs.google.com/spreadsheets/d/1FMoUv8MXOIL7Uf4AeooZ_y9fiUcuLs3iA9WLW8xNGAs/edit?usp=sharing)
- Dowser, Tom, et. al. YouTube Video. How Wolves Shape Rivers. (2016). Sustainable Human Channel. Retrieved from <https://www.youtube.com/watch?v=ysa5OBhXz-Q>
- Schneider, Peter. YouTube Video. How Whales Change Climate. (2016). Sustainable Human Channel and www.underwatercam.tv. Retrieved from <https://www.youtube.com/watch?v=M18HxXve3CM>