# Pre-Lab Information

Purpose Plan an investigation to explore the behavior of an earthworm that has been exposed to different stimuli.

Time Approximately 60 minutes

Question How is earthworm behavior affected by external stimuli?

Hypothesis Write the hypotheses you developed during the laboratory lesson in the space below.

 Part I: How earthworm behavior is affected by dry conditions

 Part II: How earthworm behavior is affected by a strong odor

Summary In the experiment, you will examine how earthworm behavior is affected by external stimuli. This lab will have two hypotheses. In part I, design an experiment to test earthworms’ responses to an environment with different moisture conditions. In part II, design an experiment to examine how earthworms behave when they are exposed to strong odors. It might help to remember that earthworms are animals and share similarities with humans. As you design your experiment, try to think about how humans would respond to different stimuli.

# Safety

* Always wear a lab coat and safety goggles when performing an experiment.
* Behavior in the lab needs to be purposeful. Do not pull, twist, throw, or otherwise play with the earthworms.
* Use cotton swabs to handle ammonia. Do not taste, smell, or directly touch the ammonia.
* Handle earthworms gently, with care and respect.
* Keep earthworms moist at all times.
* Moisten your hands with water before handling earthworms.
* Wash your hands thoroughly after completing the lab.
* Report all accidents—no matter how big or small—to your teacher.

# Introduction

Organisms are living things. One of the characteristics of living things is that they respond to stimuli. In this lab, you will observe how earthworms behave in response to multiple stimuli. Earthworms can respond to a number of things involving touch, sound, and smell. Please remember that earthworms are living creatures that require moist skin in order to breathe. Please treat all living things with respect, even when working with them in a laboratory setting.

# Example Scenarios

***Part I:* *How earthworm behavior is affected by dry conditions***

Ever wonder why you don’t see worms wiggling around on the ground during sunny days? What happens on a very rainy day? The worms come out of the ground in large numbers and seek shelter from the rising water.

***Part II:* *How earthworm behavior is affected by a strong odor***

Have you ever seen an earthworm poke its anterior end in the air and wiggle it around a bit, almost like it’s looking for something? If earthworms don’t have eyes, how do they know where they are going? Like other animals without eyes, earthworms have to rely on their other senses to learn about the environment around them.

# Lab Procedure

Here is an outline of the steps you should follow to plan your investigation for each part of this lab. Later in the guide, you will have writing space to develop your ideas, collect data, analyze and discuss results, and draw conclusions. Run through these steps twice, once for each part of the lab.

1. **Determine what types of data you will gather and what tools of measurement you will use to collect the data.**

How will you gather data for your experiment? If gathering quantitative or numerical data, you may want to devise a table in which you can record your results in an organized manner. Also, consider how you will record any qualitative or descriptive data in addition to your numerical results.

1. **Design an experiment to examine how earthworm behavior is affected by dry conditions or strong odors.**

Develop the main steps and your method for running the experiment. Your teacher will guide you as to what instruments are available for the experiment. How can you use them to develop an experiment that will investigate how earthworm behavior is affected by dry conditions or strong odors? Determine the materials you will need for your experiment.

1. **Gather materials and set up your experiment.**

Now that you know what you will do, gather the necessary items. Besides the objects you will experiment with, make sure you have the necessary equipment to take measurements. If you are working with lab partners, make sure each person knows his or her role in running the experiment. Check your setup and make sure everything is in order before you proceed.

1. **Run your experiment.**

As you proceed with your experiment, make sure you record all necessary data. If you are working in a group, also record each student’s role in the experiment. Make sure all elements of your experiment are complete. Do not forget to clean up when you are done!

1. **Use the Middle School Lab Report Guide to write your lab report.**

# Part I: How Earthworm Behavior Is Affected by Dry Conditions

1. **Determine what types of data you will gather and what tools of measurement you will use to collect the data.**

Make a list of the data sections or tables. List the tools or devices used to make measurements.

1. **Stop. Have your teacher sign off on Step 1 before you continue the investigation.**
2. **Design an experiment to examine how earthworm behavior is affected by dry conditions.**
**Write the steps of your experiment. Include a sketch of your experimental setup.**
3. **Stop. Have your teacher sign off on Step 3 before you continue the investigation.**
4. **Gather materials and set up your experiment.**
5. **Run your experiment.**

Record your data, sketches, and observations in the space below.

1. **Use the Middle School Lab Report Guide to write your lab report.**

# Part II: How Earthworm Behavior Is Affected by a Strong Odor

1. **Determine what types of data you will gather and what tools of measurement you will use to collect the data.**

Make a list of the data sections or tables. List the tools or devices used to make measurements.

1. **Stop. Have your teacher sign off on Step 1 before you continue the investigation.**
2. **Design an experiment to examine how earthworm behavior is affected by a strong odor.**
**Write the steps of your experiment. Include a sketch of your experimental setup.**
3. **Stop. Have your teacher sign off on Step 3 before you continue the investigation.**
4. **Gather materials and set up your experiment.**
5. **Run your experiment.**

Record your data, sketches, and observations in the space below.

1. **Use the Middle School Lab Report Guide to write your lab report.**

# Purpose

Students will plan an investigation to explore the behavior of an earthworm that has been exposed to different stimuli.

# Student Guide

A PDF of the Student Guide is provided to students during the instruction. The Student Guide gives students a general outline to follow when developing their investigations. Be sure to provide copies to students or enable them to print the guides themselves when they reach the instructionphase of the lab lesson.

# Background Information

Organisms are living things. One of the characteristics of living things is that they respond to stimuli. In this lab, students will observe how earthworms behave in response to multiple stimuli. Earthworms can respond to a number of things involving touch, sound, and smell. Please remind students that earthworms are living creatures that require moist skin in order to breathe. Please remind students to treat all living things with respect, even when working with them in a laboratory setting.

# Real-World Applications

One beneficial earthworm behavior is their tendency to burrow into the ground. This helps aerate soil and promotes plant growth. It also allows for water to soak into the soil, which in turn allows water to flow back into the water table instead of forcing the water to flow along the surface.

# Preparation/Alternatives

* Check the list of materials. If students are working in multiple groups, be sure to acquire sets of materials sufficient for each group, if feasible.
* Earthworms may be purchased from bait shops, science supply companies, or stores that carry composting materials.
* An aquarium or other container can be used to create a habitat for earthworms in the classroom. Fill the habitat with rich organic soil, decaying leaves, and other plant or vegetable material. Make sure to keep the habitat moist and dark. If necessary, cover the sides of the aquarium.
* Remind students which end of an earthworm is the anterior end and which is the posterior end. Also remind them which side is the dorsal side and which is the ventral side.
* Earthworms always seek the dark. Dim the lights in the room to prevent this from being the only observed behavior.
* You may provide students with plastic or vinyl gloves for handling the earthworms. Students should moisten the gloves before handling the earthworms.
* Students can store untested worms in small plastic trays or paper bowls.
* As an alternative to conducting the experiments on trays, use shoeboxes or disposable aluminum cake pans.
* As an alternative to using water in spray bottles, place water in small bowls for students to keep their hands moist.
* As an alternative to ammonia, use vinegar.
* Because students plan their own investigations, there are many possible materials they might wish to use. You will very likely need to determine what is feasible for your lab or classroom ahead of time, and constrain the materials they have to work with. This will make the lab much more manageable. However, be sure to choose materials that allow students to improvise.

# Monitoring the Lab Procedure

* Ensure that students keep the worms moist at all times. Earthworms need moist skin in order to breathe.
* Ensure that safety procedures are followed at all times.
* Encourage students to record their observations in pencil. Using ink can result in scribbled and messy lab guides—and pencil is erasable.
* Ensure that students do not touch the earthworms with the ammonia-soaked cotton swab.
* Ensure that students treat the earthworms humanely.
* Counting the number of segments on an earthworm can be challenging, especially for long earthworms. If students are having difficulty with this, they can count the number of segments in one centimeter and then multiply the number of segments by the length of the earthworm.
* If the trays are large enough, it is possible to test all four earthworms at one time; however, they need to be kept spread apart, as they will try to curl up with one another.

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Here is an outline of the steps students should follow to plan their investigation for each part of this lab. Later in the Student Guide, students will have writing space to develop their ideas, collect data, analyze and discuss results, and draw conclusions. They will run through these steps twice, once for each part of the lab.

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1. **Gather materials and set up your experiment.**

Now that students know what they will do, they will gather the necessary items. Besides the objects the students will experiment with, make sure you have the necessary equipment to take measurements. If the students are working with lab partners, make sure each person knows his or her role in running the experiment. Check their setup and make sure everything is in order before the students proceed.

1. **Run your experiment.**

As the students proceed with their experiments, make sure they record all necessary data. If they are working in groups, make sure they record each student’s role in the experiment. Make sure all elements of the experiment are complete.

1. **Use the Middle School Lab Report Guide to write your lab report.**

Students will use the same lab report guide as the one for the wet lab to generate their report. The same rubric used to assess the wet lab report can be used to assess this lab as well.

# Extension Activities

Here are some variations that may lead to an increased understanding of how different stimuli affect earthworm behavior.

* Combine the results from the entire class for a more comprehensive data set.
* Perform the experiment with warm (not scalding) water and cold water to test earthworms’ response to temperature.
* Perform the experiment with fresh water and salt water.
* Perform the experiment with half of the tray covered to create a dark area, and shine a flashlight on the other half to test earthworms’ response to light.
* Perform the experiment with different colors of light. This can be accomplished by using a rubber band to secure different colors of cellophane over the flashlight.
* Perform the experiment with cloth and sandpaper to test earthworms’ response to texture. Both the cloth and the sandpaper should be moist during the experiment.
* Increase the number of trials by performing the experiment with more earthworms.