Science Fair Kit:
Pill Bug Habitat

Project Summary: Why Would Pill Bugs Infest Your Home?

For this project, you will be observing pill bugs in their preferred habitat, and testing different changes to their habitat to determine what their preferences are for different features in a controlled environment.

Difficulty:
Easy to Moderate, suggested for grades K-4 (with adult supervision).

Time Required:
One week, longer if you choose.

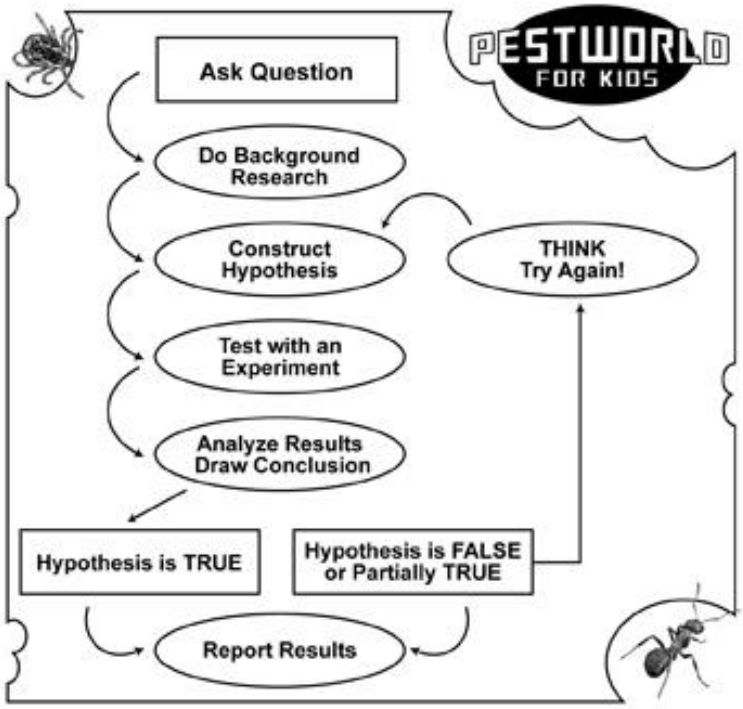
Safety:
Pill bugs are safe and ideal for scientific investigation. They do not bite. They are not known to transmit disease to humans.

Time of Year:
Spring or summer for outdoor observations.

Material Availability:
Most materials are readily available in your home. Pill bugs can be found in your backyard under leaf litter or logs. They can also be ordered and delivered by mail during winter months.

How Scientists Think

The great thing about scientific investigations is that there can be many answers to a single **question**. To figure out which answer is most correct, scientists follow a process called *The Scientific Method.* The Scientific Method is a series of steps that helps scientists identify a question, think of a possible answer (the **hypothesis**) and then use **experiments** to test that answer (the **hypothesis**) to see if it is true.



The important thing to remember is that all scientists often need to try several experiments until one can be sure a hypothesis (a possible answer) is true or not.

The next few tasks will walk you through how to think like a scientist. As you think like a scientist, you'll test one or more changes in the pill bugs environment to observe its preferences.

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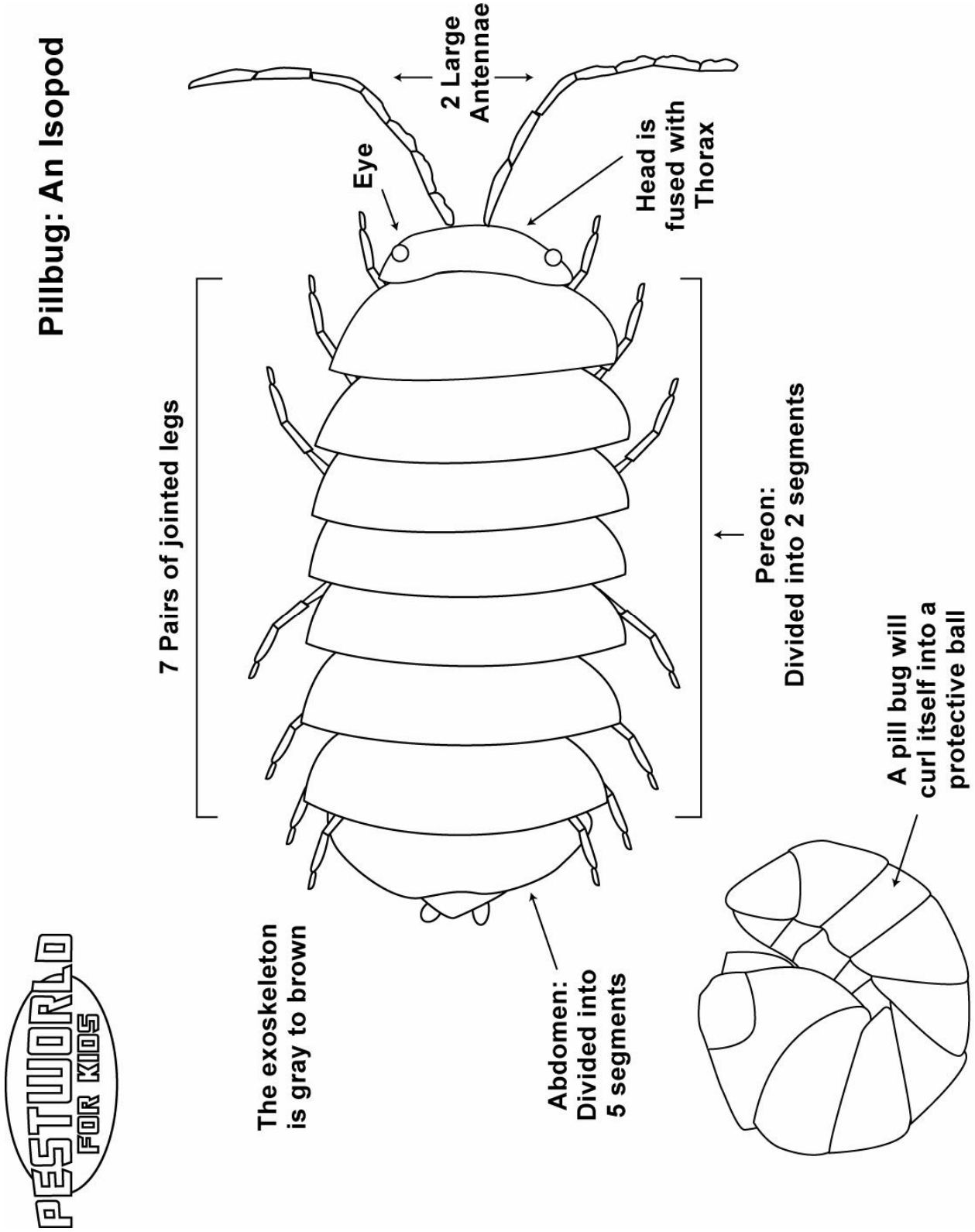

Ask a Question:

Each scientific investigation begins by asking a question. Picking a good question to ask helps you to define the problem you want to investigate and develop a hypothesis to test. A good question meets the following criteria:

- Is the answer to the question something you can measure?
- Does the question ask one or more of the following: who, what, when, where, why, how, or which?

Before deciding on a question, consider the difficulty level of the project you'd like to undertake as well as the amount of time you have. Here are some from which you can choose:

Easy:

- Where can I find pill bugs?
- Which environment do pill bugs prefer? Warm or cold? Moist or dry? Bright or dark?

Moderate:

- What types of food do pill bugs prefer to eat?
- What types of ground cover do pill bugs prefer to live on?

Do Background Research

Next, you'll need to do a little background research to find necessary information about the organism.

To answer your question, you'll need both general information about pill bugs as well as specific information about their diet, habitat, impact and how to prevent an infestation.

Glossary | Terms To Know

It will be helpful to know some or all of these terms so you can be sure to understand everything you read. You can research these terms in the PestworldforKids.org glossary [www.pestworldforkids.org/glossary], using another online dictionary like Merriam-Webster.com [www.merriam-webster.com] or at a local library.

- Controlled Experiment
- Crustacean
- Decompose
- Environment
- Environmental Factor
- Habitat
- Isopod
- Leaf Litter
- Pill Bug
- Sow Bug

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General Information on Pill Bugs

This animal is the only **crustacean** that can spend its entire life on land. Their shells look like armor and they are known for their ability to roll into a ball. Sometimes children call them rollie-pollies. Most pill bugs live for up to two years. They are most active at night. Sow bugs are very similar to pill bugs, however they cannot roll up into a ball.

Pill bugs do not bite. They can withstand being dropped and some rough handling. They respond quickly to environmental changes and are easy to care for.

If you are unable to find pill bugs in leaf litter or other areas of organic materials in your yard, you can set a "potato trap." Cut a potato in half lengthwise, and hollow out part of the center with a spoon. Place the potato halves, skin side down, in an area where pill bugs would be expected to live, for instance in moist leaves, compost piles or overturned decaying logs. Wait a day and return to your potato traps to find any pill bugs that have found them. Collect the pill bugs with a spoon and place in a plastic film container or other small plastic container.

Size:	¾"
Shape:	Oval; round when rolled up
Color:	Dark brown to black
Legs:	7 Pair
Wings:	
Antenna:	Yes

Common Name:	Pill Bug
Kingdom:	Animalia
Phylum:	Arthropoda
Class:	Malacostraca
Order:	Isopoda
Family:	Armadillidiidae
Genus Species:	Armadillilium vulgare

Diet
Pill bugs mostly eat rotting vegetation like vegetables.

Habitat
Pill bugs live in wet locations. They are found under damp objects or in organic garbage. If pill bugs enter a building, they will often dry out and die.

Impact
Pill bugs do not spread diseases or contaminate food.

Prevention
Keep your homes and the areas around your home clean and dry.

Construct a Hypothesis

A hypothesis is an educated guess about how things work. A good hypothesis is based on research that gives you the information to make the best guess possible. Once you've gathered as much information as you can, you are ready to make a prediction or guess about what you think the answer will be to your question.

To put together the best possible guess that might answer your question, consider these factors:

- Which habitat do pill bugs prefer?
- What information did you find in your background research that helped you to come to this hypothesis?
- What evidence do you have to test this hypothesis?

You should state your hypothesis (guess) in a way that you can **easily measure**. For example:

If **I _____, *then*** **_____ *will*** **_____.**

If I place 10 pill bugs in the moist half of the testing box and 10 pill bugs in the dry half of the testing box, ***then*** after one hour all of the pill bugs will be found in the moist half.

Test Hypothesis with an Experiment

Testing with an experiment is the fourth part of the Scientific Method. There are two extremely important tasks you should be sure you do.

1) Make sure the test you are using is a **fair** test. A **fair test**, or experiment, is one that clearly changes only one factor (variable) while keeping all other conditions the same. The steps in your experiment should be clear and specific so that anyone could follow them and answer your question the same way you did.

2) It is also important to start with some **baseline observations**. For example, observe the pill bugs in their preferred habitat outside. What do you notice about their habitat? Is it in a shady or sunny location? Is it dry or moist? In this experiment you will select one (or more) changes to the pill bugs environment and test their preferences. Once you decide what to test, you will need to make your **baseline observations** so you know with what to compare your end results. To begin to put together your experiment, consider the following:

- Do pill bugs prefer the light or dark?
- Do pill bugs prefer being warm or cold?
- Do pill bugs prefer their habitat to be moist or dry?
- What type of environment do pill bugs prefer?
- What environmental factors affect pill bugs?
- What types of foods do pill bugs prefer to eat?
- How do pill bugs react to dry leaves versus wet leaves?

Materials and Equipment

- Observation and test site (this can be your backyard or other location outdoors).
- Clear Shoe box and additional cardboard to create a two-sided compartment
- Masking or Duct Tape
- Spoon
- Leaves, preferably leaf litter
- Soil
- Wood chips or saw dust
- Water
- Plant Mister
- Paper Towels
- Small Plastic Container (1 pint deli style is good)
- Food for your pill bugs: potatoes, apples, carrots or fish flakes
- Lamp or flashlight
- Black construction paper
- Ice or Cold pack and/or Warm pack
- Room Thermometer
- Notebook and pencil for data collection
- Magnifying glass to observe the pill bugs up close
- Stop Watch or clock with second hand
- Digital Camera (optional)
- 20 pill bugs

Procedure

Observe Natural Habitat

1. First, observe your yard for areas where you think pill bugs might be living. Check in the leaf litter, along fences, under logs, in the compost pile, etc…
2. Once you've found some pill bugs, sit and observe them for several minutes, perhaps 10 minutes. Record any observations about their habitat and their behaviors in their natural habitat in your notebook.

   Is the area wet, damp or dry? What types of plants are present? If no plants are present, what is present? Is it shady or sunny?

   Record the temperature near the ground in your notes as well. Is it warmer or colder than the air temperature in other parts of the yard?

   Your notebook should have a chart in it that looks something like this:

Observations of Pill Bugs in their Natural Habitat		
Circle which word best describes the habitat in each of the next two rows		
Wet	Damp	Dry
Sunny	Partial Shade	Shady
Temperature in pill bug habitat		
Temperature in other parts of yard		
List all other observations:		

3. If you are unable to find pill bugs in leaf litter or other areas of organic materials in your yard, you can set a "potato trap". Cut a potato in half length-wise, and hollow out part of the center with a spoon. Place the potato halves, skin side down, in an area where pill bugs would be expected to live. Look for places with moist leaves, compost piles or overturned decaying logs.

   Wait a day and return to your potato traps to find any pill bugs that have found them.

Collect Pill Bugs

1. Prepare a small plastic container with some soil and food (a small piece of potato or apple is good).
2. Collect your pill bugs when you are ready to proceed with the next steps. A spoon is usually a good way to capture them. You will need 20 pill bugs.

Prepare Experimental Habitat

Prepare your “habitat testing box”, use a plastic shoe box with a lid.

1. Cut a piece of cardboard to act as a wall between two halves of the box. The cardboard needs to have a small opening cut into it so the pill bugs can move back and forth from one side to the other.
2. Make sure that the cardboard fits snugly or is secured in place with tape.
3. The lid should have small holes in it to allow for air to circulate into and out of the box. See the picture below for an example.

Begin Experiment

The first experiment will test whether your pill bugs prefer a damp or dry habitat.

1. Place one piece of dry paper towel in a single layer (tear it or cut it to fit your box) on one side of the "habitat testing box". The paper towel should cover the entire surface of the bottom of the "dry" side. Then place a damp (but not dripping wet) single layer of paper towel on the other side.
2. Place 10 of the pill bugs in your dry side of the "habitat testing box" and 10 on the damp side. You should leave the lid on while you are observing. Record the number of pill bugs on each side of the "habitat testing box" at the beginning of the experiment.
3. Record the number of pill bugs on each side of the "habitat testing box" every 30 seconds for 10 minutes. If you are unable to count your pill bugs by looking through the side, remove the lid for a quick count and then replace it. You may need to carefully lift the paper towel for an accurate count. See chart below:

Number of Pill Bugs in each half of "Habitat Testing Box"
(30 second intervals)

	0:00	0:30	1:00	1:30	2:00	2:30	3:00	3:30	4:00	4:30	5:00
Dry	10										
Damp	10										
	5:30	6:00	6:30	7:00	7:30	8:00	8:30	9:00	9:30	10:00 min.	
Dry											
Damp											

4. Remove all of the pill bugs to your small plastic container and prepare your "habitat testing box" for the next test. The next test will be to determine the pill bugs preference for a dark or light environment.
5. Remove the paper towels on each side of the "habitat testing box". Dry out the box if necessary. Add damp paper towels (in a single layer) to each half of the testing box, you might want to mist them after placing the towels into the box, try to have each side equally damp.
6. Cover the outside of one half of the box with black construction paper, to make the "dark" side. You will use the flashlight to illuminate the other half, the "light" side.
7. Place 10 pill bugs in the dark half and 10 in the light half and replace the lid.
8. Turn on the flashlight, and point it across the box, but not facing into the hole/opening that the pill bugs will use to move back and forth. Remember the lid needs to stay on the box in between your observations.

9. Record how many pill bugs were in each half of the "habitat testing box" at the beginning of the experiment in your notebook. See chart below.

Number of Pill Bugs in each half of "Habitat Testing Box" (at 30 second intervals)											
	0:00	0:30	1:00	1:30	2:00	2:30	3:00	3:30	4:00	4:30	5:00
Dark	10										
Light	10										
	5:30	6:00	6:30	7:00	7:30	8:00	8:30	9:00	9:30	10:00 min.	
Dark											
Light											

10. Record the number of pill bugs on each side of the "habitat testing box" every 30 seconds for 10 minutes. Again, you may need to lift the paper towels to make an accurate count. See chart below:
11. Remove all of the pill bugs to your small plastic container and prepare your "habitat testing box" for the next test.

The next test will be to determine whether the pill bugs prefer a warm or cold environment.

12. Remove the black construction paper from the outside of the "habitat testing box." You may want to mist the paper towels to be certain both sides are equally moist.
13. Place a cold pack (or warm pack) under one half of the "habitat testing box." The other half will remain at room temperature.
14. Wait about ten minutes so the temperature on each side stabilizes. Then measure the temperature on each side and record it in your notebook.

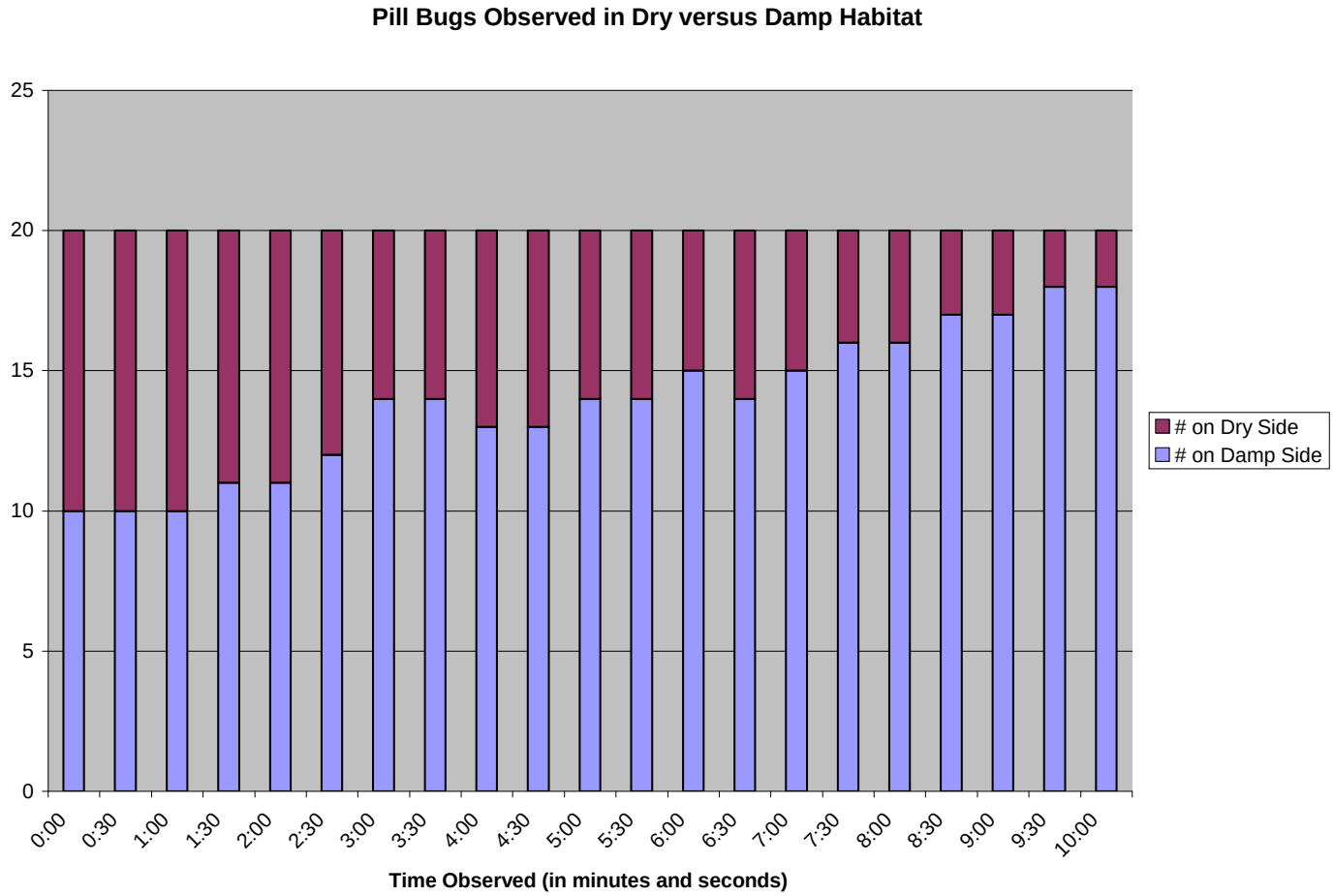
15. Place 10 pill bugs in the cold (or warm) half and 10 in the room temperature half and replace the lid. The lid needs to stay on the box in between your observations. Record how many pill bugs were in each half of the "habitat testing box" at the beginning of the experiment in your notebook. See chart below.

Number of Pill Bugs in each half of "Habitat Testing Box" at 30 second intervals											
	0:00	0:30	1:00	1:30	2:00	2:30	3:00	3:30	4:00	4:30	5:00
Cold (or warm)	10										
Room Temp	10										
	5:30	6:00	6:30	7:00	7:30	8:00	8:30	9:00	9:30	10:00 min.	
Cold (or Warm)											
Room Temp											
Temperature at start of experiment					Temperature at end of experiment						

16. Record the number of pill bugs on each side of the "habitat testing box" every 30 seconds for 10 minutes. Remember to check under the paper towels when you make your observation.
17. Measure the temperature at the end of the experiment as well, for both halves, and record in your notebook. Remove pill bugs to your small plastic container. Feed them some more potato if necessary and mist the soil if it seems dry. Clean up your "habitat testing box" and all other materials.
18. When you are ALL done writing up your report (see "Communicating Results" below), remember to return your pill bugs back to the place you found them, their outdoor habitat.

Analyze Data

Do you think your hypothesis (guess) was correct? Analyzing (reviewing) your data is the fifth step of the Scientific Method. Once you gather all of your data together you can figure out whether your experiment proves your hypothesis as true or disproves your hypothesis as false.



1. Make a bar graph of your data to evaluate what type of habitat pill bugs prefer. Label the bottom (X-axis) as the times you observed. Make the side (Y-axis) the number of pill bugs observed. Pick one color for damp (blue) and another color (red) for dry.
2. Make a second bar graph comparing dark vs. light and a third bar graph comparing cold (or warm) vs. room temperature.
3. Review the graphs. Do they show that your pill bugs had a preference for one type of environment or another?
4. Think about how your data confirm or challenge your hypothesis?

5. Are you satisfied with the results? Is there something you could do differently in the experiment to get a different answer?
6. If you're not completely satisfied with the results, consider doing the experiment AGAIN but trying something slightly different. For instance, alter the temperature test to have a wider temperature range, warm versus cold.
7. REMEMBER, scientists often change one little thing and repeat an experiment to be sure the data is providing enough information to conclude whether a hypothesis is true or not.
8. Once you're confident you have enough evidence to say your hypothesis is true or not, you're ready to communicate your results.

Communicate Results

Share what you found out. The final step of the Scientific Method is to pull together everything you learned into a presentation to teach others.

Gather your data, pictures, and graphs. Then follow these steps to create your poster, written report, or other project:

1. Restate your question,
2. List your background research
3. State your hypothesis
4. List your procedure and all the data you collected.
    a. Be sure to include any additional tests you did in case you weren't satisfied with the first test.
5. Write up a concluding statement of 2 – 3 sentences that summarizes whether your predictions about pill bugs habitat preferences were correct.
6. Include additional questions you (or other scientists) could research in the future. See the variations for further research listed in the "variations" section for possible ideas to include.

Make sure to label each step of the Scientific Method in your poster, report, or project:

- Ask a Question,
- Background Research,
- Hypothesis,
- Experimental Procedure,
- Analyze Results and Draw Conclusions.

Variations

- Test whether pill bugs have a sense of smell and what types of smells they are attracted to and what smells might repel them.
- Measure the amount of time it takes a population of pill bugs to move from a dry environment to a moist environment.
- Test any of the three environmental changes for a longer test period, or differing amounts of moisture, light or temperature.

Correlations with NSTA Science Education Standards:

This kit correlates with the following National Science Teacher Association standards for grades K-4:

Life Science Content Standard C: The Characteristics of Organisms:

Organisms have basic needs. For example, animals need air, water, and food; plants require air, water, nutrients, and light. Organisms can survive only in environments in which their needs can be met. The world has many different environments, and distinct environments support the life of different types of organisms.

The behavior of individual organisms is influenced by internal cues (such as hunger) and by external cues (such as a change in the environment). Humans and other organisms have senses that help them detect internal and external cues.

Students observe an organism in its natural habitat and test changes to their environment in a controlled experiment to determine its preferences.

Science as Inquiry Standards

Abilities necessary to do scientific inquiry

- *Ask a question about objects, organisms, and events in the environment.*
- *Plan and Conduct a simple investigation.*
- *Employ simple equipment and tools to gather data and extend the senses.*
- *Use data to construct a reasonable explanation.*
- *Communicate investigations and explanations.*

Understanding about scientific inquiry

- *Scientific investigations involve asking and answering a question and comparing the answer with what scientists already know about the world.*

Students design and implement a scientific investigation, including all steps of the scientific method and graphing the data they collect.