

AP Lab #11: Animal Behavior

Introduction

Animals exhibit a variety of behaviors, both learned and innate, that promote their survival and reproductive success in a variety of ways.

In this laboratory you will:

1. Make detailed observations of an organism's behavior.
2. Design and execute a controlled experiment to test a hypothesis about a specific case of animal behavior.

Key Concepts

Behaviors may be **innate** or **learned**. Many behaviors have both genetic and learned components. **Orientation behaviors** place the animal in its most favorable environment. In **taxis** the animal moves toward or away from a stimulus. Taxis is most often exhibited when the stimulus is light, heat, moisture, sound or chemicals. **Kinesis** is a movement that is random and does not result in orientation with respect to a stimulus. If an organism responds to bright light by moving away, that is taxis. If an animal responds to bright light by random movements in all directions, that is kinesis.

Scientists study behavior and other aspects of organisms through observation and controlled experiments. In science classes you have done many laboratory activities that someone has written for you. Now you will be asked to think like a scientist, recording your own observations and designing your own controlled experiment.

Exercise 11A General Observation of Behaviors: Pill bugs

In this lab you will be working with terrestrial isopods commonly known as pill bugs or roly-polies. These organisms are members of the Phylum *Arthropoda*, Class *Crustacea*, which also includes shrimp and crabs. Most members of this group respire through gills.

In the first part of this exercise, you observe pill bugs inside a Petri dish for 10 minutes and record what you see. Below are some questions to think about as you watch them. Some of these questions you can answer through observation; others require you to read about pill bugs and crustaceans or think about what you already know.

- How do the pill bugs seem to sense their environment?
- Are they all the same species?
- Can you tell differences in males and females?
- How many eyes do they have?
- How many legs?
- Do they exhibit any dominance behaviors?
- How do they respire?
- How do they grow?
- What are some stimuli they seem to respond to?

One way to record your observations of an organism is to make a sketch of it.

Scientific Sketching

When you make a sketch of a pill bug, don't just draw an oval with a few squiggly legs — you are expected to do a scientific illustration similar to the sketch of an earthworm below. You will need to draw your organism from various angles in order to record all the details.



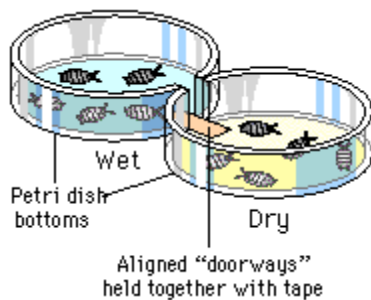
Here are some tips for making an accurate sketch of your pill bug:

1. Determine the relative proportions:
 - a. width : length;
 - b. height : length;
 - c. distance between eyes : width of body;
 - d. length of antennae : length of body.
2. Count the number of body segments.
3. Count the number of legs.
4. Locate the eyes.
5. Label the body parts.
6. Note the size of the pill bug.

Now go on to study the pill bugs' response to their environment.

Response to the Environment

You can now construct an experiment to observe how pill bugs respond to their environment. You place the pill bugs in a choice chamber, half in the side lined with dry filter paper and the other half in the side lined with wet filter paper.



Procedure

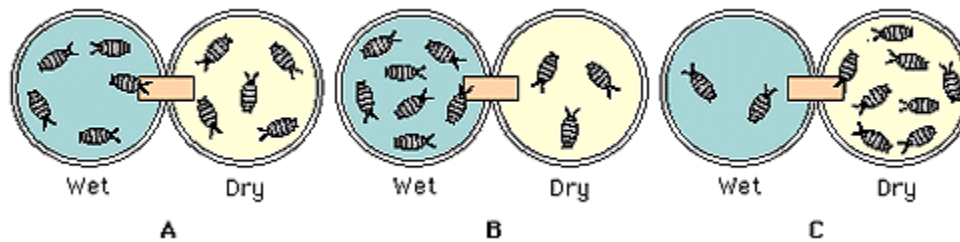
1. Prepare a choice chamber (or behavior tray). The choice chamber can be made of two Petri dishes taped together with an opening cut between them. Cut the opening with scissors and use tape to hold them together. Line one chamber with a moist piece of filter paper and the other with a dry piece of filter paper. Label one side A and the other side B.
2. Place five pill bugs on each side of the chamber.
3. Count how many pill bugs are on each side of the choice chamber every 30 seconds for 10 minutes. Record your data in Table 11.1. Continue to record even if they all move to one side or stop moving. Calculate the average number on each side of the tray during the 10-minute period for the taxis behavior.
4. Graph both the number of pill bugs in the wet chamber and the number in the dry chamber on the same graph. Determine which are the independent and dependent variables. Remember to use the correct units and give your graph a title.

Table 11.1 Pill Bug Taxis

Time (minutes)	Number of Pill bugs in Side A	Number of Pill bugs in Side B	Observations
(1-10)			
Average			

Analysis of Results

After the pill bugs have been in the choice chamber for 10 minutes, you might observe one of these situations:



Pill bugs are crustaceans, and they respire through gills. Because of this characteristic, which situation would you predict to occur — A, B, or C? Most people would predict situation B. This is often what occurs, but not always! Situations A and C are also common.

This brings us to an important consideration: The pill bug exercise is not a controlled experiment. Could there be more light at one end of the choice chamber? More activity and vibration? A chemical residue on one side? Any of these conditions and more could possibly influence the organism's behavior. Without a control, it is very risky to state a conclusion. In the second part of the Animal Behavior lab, you design a controlled experiment.

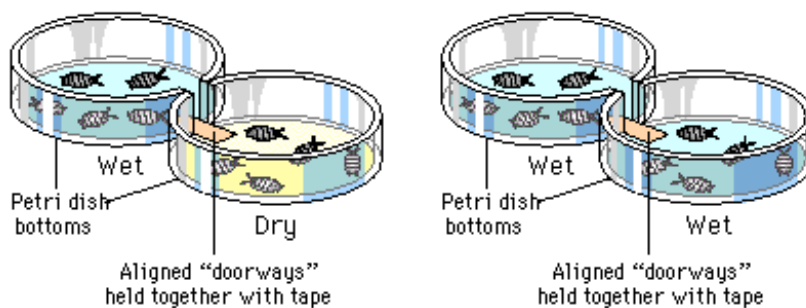
Design of the Experiment: The Hypothesis

A controlled experiment begins with a hypothesis, a proposed solution for the problem being investigated. A hypothesis is often written as an IF, THEN statement that predicts the outcome we should expect if the hypothesis is correct. A hypothesis should not only predict results; it must be testable.

Example

Poor: I think pill bugs will move toward the wet side of a choice chamber.

Better: If pill bugs prefer a moist environment, then when they are randomly placed on both sides of a wet/dry choice chamber and allowed to move about freely for 10 minutes, most will be found on the wet side.



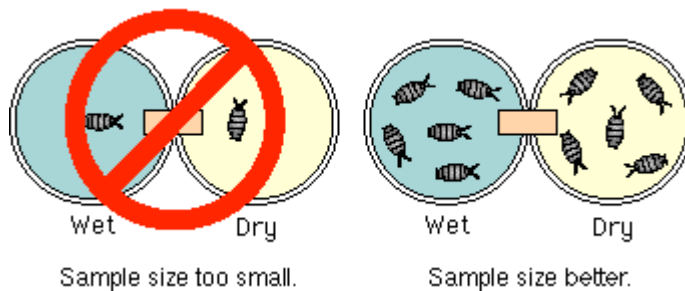
	EXPERIMENT		CONTROL	
	Left compartment	Right compartment	Left compartment	Right compartment
MOISTURE	wet	dry	wet	wet
LIGHT	25 Watts	same	same	same
FILTERPAPER	#1 Whatman	same	same	same
TEMPERATURE	20°C	same	same	same
NUMBER OF BUGS AT START	5	same	same	same

In a controlled experiment, you must explicitly keep all variables constant except the one you are manipulating. For instance, if you want to test response to wet vs. dry conditions, the light, temperature, chemicals in the filter paper or on the dish surface, and movement of the table must all remain constant. In addition, all the experimental organisms must be of the same approximate age, size, and state of health.

It is not enough to say you will hold all variables constant; you must explain how you will do this, and do it!

Sample Size, Results, and Replication

- To be meaningful, your experiment must include a large enough sample size to be representative of a general condition.



- Your results must be measurable! Are you going to count, measure, find the mass? You must devise some way to quantify the results.
- You must also replicate — do several repetitions of — the experiment. Like a large sample size, this lets you verify your result.

Student-Designed Experiments

Next observe **chemotaxis** of pill bugs using an altered environment: changes in temperature, pH, background color, light, etc.

1. Select one of the variable factors listed. Develop a hypothesis concerning the pill bugs' response to this factor.
2. Design an experiment to test your hypothesis.
 - a. state the objective of your experiment
 - b. list the materials you will use
 - c. outline your procedure
 - d. decide what data you will collect; make a data sheet
3. Run your experiment. Record your data in Table 11.2.
4. Make a graphical representation of your data.
5. Write a conclusion based on your experimental results.

Exercise 11 Questions

1. What conclusions do you draw from your data? Explain the physiological reasons for the behavior observed in this activity.
2. Obtain results from all of the lab groups in your class. Which type of environment do isopods prefer? How do the data support these conclusions?
3. How do isopods locate appropriate environments?
4. If you suddenly turned a rock over and found isopods under it, what would you expect them to be doing? If you watched the isopods for a few minutes, how would you expect to see their behavior change?
5. Is the isopods' response to moisture best classified as kinesis or taxis? Explain.

Sample AP Lab #11 Exam Questions:

1. A student wanted to study the effect of nitrogen fertilizer on plant growth, so she took two similar plants and set them on a windowsill for a two-week observation period. She watered each plant the same amount, but she gave one a small dose of fertilizer with each watering. She collected data by counting the total number of new leaves on each plant and also measured the height of each plant in centimeters.

Which of the following is a significant flaw in this experimental set-up?

- a. There is no variable factor.
 - b. There is no control.
 - c. There is no repetition.
 - d. Measurable results cannot be expected.
 - e. It will require too many days of data collection.
2. Students placed five pill bugs on the dry side of a choice chamber and five pill bugs on the wet side. They collected data as to the number on each side every 30 seconds for 10 minutes. After 6 minutes, eight or nine pill bugs were continually on the wet side of the chamber, and several were under the filter paper. Which of the following is NOT a reasonable conclusion from these results?
 - a. It takes the pill bugs several minutes to explore their surroundings and select a preferred habitat.
 - b. Pill bugs prefer a moist environment.
 - c. Pill bugs prefer a dark environment.
 - d. Pill bugs may find chemicals in dry filter paper irritating.
 - e. Pill bugs demonstrate no significant habitat preference.
3. If a student wanted to determine whether pill bugs prefer a moist or a dry environment, what would be the best way to analyze data from the experiment?
 - a. Total the number of pill bugs on the dry side throughout the entire experiment and compare this with the number on the wet side throughout the experiment.
 - b. After waiting 5 minutes for the pill bugs to acclimate, count the number of pill bugs on the dry side every 30 seconds for 5 minutes. Total and average the results, and compare this with the number of pill bugs on the wet side during this same time interval.
 - c. Compare the number of pill bugs on the dry side at the end of 10 minutes with the number of pill bugs on the wet side at the end of 10 minutes.
 - d. Divide the number of pill bugs on the dry side throughout the experiment by the number on the wet side throughout the experiment.
4. Which of the following hypotheses is stated best?
 - a. If pill bugs are allowed free movement, then more will be found in a moist environment than in a dry environment.
 - b. If pill bugs like a moist environment, then they will move to the wet side of a choice chamber.
 - c. If an experiment with pill bugs is run for 10 minutes, then more pill bugs will be found in the most favorable environment.
 - d. Pill bugs are found in moist habitats, so I predict that more will be found where it is wet.

AP Lab 11: Animal Behavior write-up

(Written portion must be typed, using 12 pt Times New Roman font, 1-inch margins)

Question:

What is the objective and/or problem being tested?

Hypothesis:

Briefly describe the experimental design and the predicted animal behavior. (Use "If ..., then" statement.)

Procedure:

Write: *See lab handout*

Data:

- 10-minute observations: include appearance, movements, interactions, etc.
- Labeled Diagram(s) of Pill Bug (Write: *See Attached Diagram*)
- Movement in Pill bugs table 11.1 & graph 11.1 (Write *See Attached Table & Graph*)
- Student Designed Experiment on separate sheet submitted for preapproval; includes question, hypothesis, materials, procedure, and data (Write *See Attached*)

Analysis:

Answer exercise 11 questions #1-5 and sample exam questions #1-5

Conclusion:

Paragraph 1: (Overview of Findings/Data) Statement of findings/behaviors (data/observations) you made. Give actual numbers and figures from the two experiments.

Paragraph 2: (Hypothesis & Explanation) Explain how the evidence supports your hypothesis in both experiments (OR give possible explanation for why the evidence does NOT support your hypothesis). Name any variables in the experiment that can influence the results (control, constant, independent/dependent).

Paragraph 3: (Errors & Future) Describe any sources of errors or other factors that could have led to unexpected results. Explain how you could reduce sources of error and ambiguous data collection. Briefly describe what further experiments should be done and why.