AP Biology **Name:**

Date: **Period:**

Pill Bug Behavior Lab

Objectives:

- Conduct experiments examining the responses of isopods to various environmental factors
- Design and conduct an investigation of animal behavior
- Develop basic experimental design skills

Background Information

Terrestrial ispods are land dwelling crustaceans, commonly known as sowbugs or pillbugs (or rollypollys). They are related to lobsters, crabs, and shrimp, which means terrestrial isopods breathe with gills and have many other body parts that are similar to marine crustaceans (see the two diagrams above). While they look similar, sow bugs are different from pill bugs. Pill bugs will curl into a ball when threatened whereas sow bugs will attempt to flee.

Ethology is the study of animal behavior. **Behavior** is an animal's response to sensory input and falls into two basic categories: **learned** and **innate** (inherited). Many behaviors involve movement of the animal within its environment. In this exercise, you will investigate some innate behaviors of isopods.

Orientation describes how animals position themselves with respect towards things in their environments. **Taxis** involves the turning of an animal's body either toward or away from something in their environment (like moving towards food or away from a fire). **Kinesis** is a random turning or movement of an animal in relation 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.

Think about the following example: A researcher places a dead rotting mouse in the center of a test area and adds a carrion beetle (an insect that eats dead animals) somewhere on the surface. The beetle crawls forward for three seconds, turns and crawls in a different direction for three seconds, and so on. The researcher concludes that the beetle is moving randomly in relation to the dead mouse. Continued observation reveals that the beetle crawls faster (and covers more ground) when it happens to turn in the direction of the dead mouse. In addition, the beetle crawls more slowly (and covers less ground) when it happens to crawl away from the mouse. In this way, the beetle's random movements will eventually bring it to the dead mouse. It is important to take in details such as time spent crawling in one direction or another when observing the movements of the animals.

Materials:

Isopods Filter Paper Choice Chambers

Procedure:

Part A: Initial Observations

1. Place 10 pillbugs and a SMALL amount of bedding material in a petri dish. Pillbugs generally do not climb, but if they do, you may cover the dish with plastic wrap or the petri dish cover.

2. Observe the pillbugs for **5 minutes**. Make notes on their general appearance, movements about the dish, and interactions with each other. Notice if they seem to prefer one area over another, if they keep moving, settle down, or move sporadically. Note any behaviors that involve 2 or more pillbugs. These may include **agonistic** behavior. Agonistic behavior is exhibited when animals respond to each other by aggressive or submissive responses. Often the agonistic behavior is simply a display that makes the organism look big or threatening. It is sometimes studied in the laboratory with *Bettas* (Siamese Fighting Fish). Another behavior you may see is **mating behaviors.** These may involve a complex series of activities that facilitate finding, courting, and mating with a member of the same species.

Try to make your observations without disturbing the animals in any way. Do not prod or poke or shake the dish, make loud sounds, or subject them to bright lights. You want to observe their behavior, not influence it or interfere with it.

Observations: _____

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3. Make a detailed sketch of a pillbug that fills this space. Make sure your drawing has the correct number of legs, proportions.

Part B: Orientation of Isopods in Response to Moisture

You will be conducting an experiment to figure out if isopods prefer a moist or dry environment or have no preference. To do this, you will be putting 10 isopods into a choice chamber (two Petri dishes that are connected by a door) and observing them for 10 minutes.

1. Begin with a hypothesis, often written as an IF-THEN statement, or "EXPLANATION, PREDICTION"

Poor: I think isopods won't show a preference of a choice chamber.
Better: IF-THEN: If isopods do not have a preference for moist or dry, then when they are randomly placed on both sides of a wet/dry choice chamber and allowed to move about freely for 10 minutes, the average number on either side will be close to 5. Or: EXPLANATION, PREDICTION: Pillbugs are adapted to live in conditions that go through both periodical rain and drying out. This means that they will spend roughly equal amounts of time in both the dry and moist chambers.

Hypothesis:_____

_____

_____

_____

2. **Set** up your behavior chamber so that you have one side moist and one side dry by **placing** filter paper on either side. Make sure the moist filter paper does not touch the dry filter paper to keep the dry side dry.

    a. Why is it important to put dry filter paper on the dry side, why not have one side with wet filter paper and the other side with dry plastic? (Hint, what's the purpose of the dry side?)

    b. Identify two other variables that are being held constant between the two sides of the choice chamber.

3. Carefully **put** 5 isopods on either side so there is a total of 10 isopods in your choice chamber. **Cover** each side with an upside down Petri dish. Be careful, the isopods are likely to try to escape during your experiment if you leave any gaps.
4. **Count** how many isopods are on each side of the choice chamber every 30 seconds for 10 minutes, and then **record** your data in **Table 1**. Continue to record even if they all move to one side or stop moving. If anything unusual happens (some isopods stop moving for a long time, some escape, etc), be sure to record it in the table
5. **Return** your isopods to the Petri dish you used to gather them initially.
6. **Graph** both the number of isopods in the wet chamber and the number in the dry chamber using graph paper over the 10 minutes. **Staple** this to the back of the lab. From the data table, identify the:
    a. Independent variable (this goes on the X-axis: _____
    b. Dependent variable (this goes on the Y-axis): _____

Be sure to put the following on your graph (which should be at least half a page in size:

a. **Title**
b. **X axis label and units**
c. **Y axis label**
d. **Legend/key for the two lines**

7. Write a conclusion to your experiment. Be sure to address the following points:
    a. Was your hypothesis right, wrong, or are your results uncertain/inconclusive? (Example: "My hypothesis was that the isopods would prefer the moist side, but I was wrong, they spent more time on the dry side.")
    b. Specifically, how does your data support your conclusion? (Example: "There was an average of 6.8 isopods on the dry side vs. 3.2 on the moist side")
    c. Why do you think they might have that preference (or lack of preference)? (Example: "The isopods probably had no preference because there was a crack in the middle that allowed them to escape, something more important to them than the amount of moisture")

Conclusion: _____

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Table 1: Preference of Isopods for moisture.

Time (Min)	Number in wet chamber	Number in dry chamber	Other notes
0			
0.5			
1.0			
1.5			
2.0			
2.5			
3.0			
3.5			
4.0			
4.5			
5.0			
5.5			
6.0			
6.5			
7.0			
7.5			
8.0			
8.5			
9.0			
9.5			
10.0			
Average			

Part C: Student Designed Experiment

You will pick an environmental variable from the following list (or come up with your own) and design an experiment using the choice chamber and isopods to determine what preference the isopods have for that variable: Temperature, Background color, Light/Dark, Texture

1. After picking your variable, make a hypothesis about the isopods' preference.

Hypothesis:_____

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2. Decide how you will set up experiment and what materials you will use.

Materials:

3. Outline your procedure below in numbered steps. Be sure to clearly identify what is your control, and identify at least 2 variables you're holding constant between the two sides.

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4. Design your own data table, making sure you put a title and column headings **BE SURE TO STAPLE THIS ON THE BACK OF THE LAB**
5. Run your experiment and record your data in your table.
6. Make your own graph. **BE SURE TO STAPLE THIS ON THE BACK OF THE LAB**
7. Return your isopods to where you got them.
8. Share your results with other groups
9. Write your conclusion and answer the analysis questions

Write your conclusion, remembering to indicate if you were right/wrong, how your data supports your conclusion, and possible reasons for your results.

Conclusion: _____

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Analysis Questions:

1. Did every group get the same results for the moist/dry experiment? _____ Why do you think that is?

2. If you gathered the results for the moist/dry experiment from the entire class before you made your conclusion, do you think your final conclusion would be more or less dependable?

3. If a student group decided it would be easier to use only 2 isopods for 4 minutes, would that make their experiment better or worse? Explain why.

4. Why did you need to have two Petri dishes in the choice chamber, why not just have one and decide if the isopods like it based on how much they move?

5. Based on the class's results, do the isopods show kinesis or taxis towards moist/dry conditions?

6. Did any other group do an experiment similar to yours? _____ If so, did their results agree with yours, or not, and why do you think that is?

7. Based on the results of the class's experiments, describe the kind of environment you'd expect to find isopods in. Cite the data that supports your conclusion.