Animal Behavior

Behavior in animals involves a motor response to sensory input. In multicellular animals, these functions are divided among different cells and organs. Some behaviors are innate, that is, they are inherited and do not require any learning. Other behaviors require learning. For example, suckling by young mammals is innate; walking for most hoofed animals is also innate, however, walking in humans requires learning. Specific behaviors are often essential for survival such as sunning behavior of ectotherms and the instinct in some animals to "freeze" upon detecting a predator. Some animals seek conditions more suited to survival, such as warmer, moister, or darker places in their environment. In order to accomplish this, animals need to detect the conditions, and then move in appropriate directions. We will explore this type of behavior in pill bugs.

Exercise 1a- Moisture level choice of pill bugs

Pill bugs are crustaceans, that is, in the same group as shrimp and lobsters. You probably have seen these under rocks or leaf litter. When disturbed, they roll up into a ball protected by their exoskeleton.

In this experiment, you will provide the pill bugs a choice between wet or dry areas. Before you do the experiment, write down your hypothesis of which conditions they will prefer. Then write a prediction based on your hypothesis. This can be written as "If my hypothesis is correct, then the results of the experiment will be…." Decide before the experiment how you will score the results. That is, how close does the pill bug need to be to a paper towel to consider it to be on that paper towel?

Procedure

1. Cut a paper towel into 4 pieces that are the same size and shape that will fit in the Petri dish with plenty of space between them and no paper towel in the center.

2. Place the paper towel in the Petri dish, and gently moisten 2 of the pieces with water. Be careful not to make it too wet or the dry paper towel may get wet.

3. Place 8-10 pill bugs in the center of the dish. Replace the Petri dish cover. Then cover the Petri dish with several thicknesses of paper towel, so that the pill bugs will be in the dark, and let them do their thing for 5 minutes.

4. After the 5 minutes are up, uncover the dish and immediately note the location of the pill bugs. Why is it important to record the location of the pill bugs as soon as they are uncovered?

Did you get clear results? Did the results of the experiment fit with your prediction? You may want to modify how you score the results after you see how the experiment works. Repeat the experiment a couple more times. In this way, you can be more confident in your results and more prepared to plan your own experiment.

Exercise 1b

Now that you have done a simple test of pill bug behavior, plan a modification of the first experiment to answer a question. Some questions might be:

Does light make a difference in the behavior?
Do pill bugs prefer paper of different color?
Do pill bugs prefer water of different pH or chemical composition?

Of course, you can form your own question.

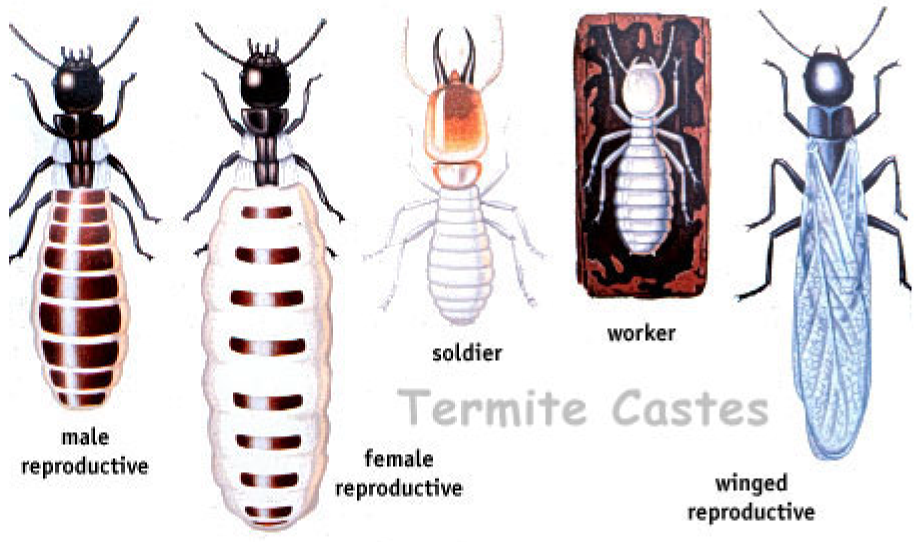
Write your hypothesis and prediction as before. Then plan the experiment and write how you will carry it out, i.e., a procedure like that above. Of course, the experiment you design should not harm the pill bugs in any way.

Then do the experiment and repeat it a number of times until you are confident of your results. What conclusion can you draw from your experiment? Can you think of how this behavior fits in with pill bug survival?

Exercise 2 - Chemical communication and behavior in termites

Animals may communicate by auditory signals, such as a dog barking, or visual signals, like flashing of red feathers by redwing blackbirds. They may also employ tactile, electrical, or chemical signals to communicate. In the next exercise, we will explore chemical sensing and attendant behavior in termites.

Termites are highly social animals and some of their most interesting behavior is centered around communication within a termite colony. The colony is composed of one family produced by a reproductive female, the queen, and a reproductive male, the king. The progeny are organized into castes, or types of termites, including workers, soldiers, and winged reproductive individuals.



The majority of individuals in the colony are workers. They feed the rest of the colony and also dig tunnels and maintain the temperature/humidity of the colony by building and repairing tunnels and vents. In some species, they “farm” fungi for food! Only workers can digest cellulose by symbiotic protozoa in their gut, so they feed the rest of the colony by regurgitation or by their feces! Soldiers are larger than workers and have an armored head with well-developed mandibles for defense. If disturbed, soldiers can even bite people! Both workers and soldiers are sterile and do not have wings.

The winged reproductive individuals are the way in which termites colonize new areas. These winged reproductives eventually swarm and when a male and female land at a new site, they drop their wings and become the primary reproductive female and males of a new colony. The queen becomes an “egg-laying machine” with enlarged abdomen and cannot even move! Workers attend to her every need.

It is dark inside a termite mound or inside of wood where they feed, so termites communicate by chemical and tactile means. They lay down pheromone trails and also bang their heads to produce vibrations that can be felt by other individuals. At least one function of banging their heads is to issue an alarm to the colony. (This banging can be heard and has been used to detect termite infestations!) There are different pheromones for communicating alarm, aggregation, etc. Workers lay down trail pheromones to lead other workers to a food source.

Interestingly, the drying agents in some ink pens resemble trail pheromones of termites. We will test different pens to see which ones contain chemicals that termites respond to and observe the trailing behavior induced by trailing pheromones.

Exercise 2a- Determine which pen contains trail pheromone-like chemical

1. On a sheet of paper, draw a long line - about 12 inches - with each pen. Make the lines parallel and space them at least 11/2 inches apart.

2. Gently place 1-2 termites on the paper with a paintbrush. (Note, termites are easily squished! Be very gentle! Carefully use the paintbrush to lift and move the termites from the dish to the paper and around on the paper.)

3. Place a termite at the end of the first line. Observe its behavior. If the termite follows the line, it has probably detected a pheromone-like chemical. If the termite wanders off randomly, re-place it on the beginning of the line. Repeat several times. If after several tries the termite does not follow the line, it is likely that the termite does not detect a trailing pheromone.

4. Try the termites on the other pen lines and note if they seem to follow lines made with certain pens and not others.

Now that you have seen how this experiment works, design an experiment to determine if termites follow certain brands or colors of pen. Remember the importance of repeating the experiment so that you have confidence in your results.

Do the experiment you have planned, write down the results of your experiment. Did you get consistent results upon repeating the experiment?

Exercise 2b - What shape of trail can termites follow better?

Now that you have identified pen(s) that contain a chemical that termites follow, do an experiment to see how well they can follow curves or sharp angles in the trail. There are different ways to test this. Following are some examples.

> Draw a trail with a fork in the path and make one side of the fork at a more acute angle than the other, or curve rather than a sharp angle, and determine which path termites take more often.
>
> Draw paths of the same length, one straight, another with a gentle curve, and a third with a sharp angle, and measure how fast termites navigate the three paths.

You may come up with other ways to test termites' ability to follow different lines. Whatever your experimental design, it is important to quantify both the characteristics of the alternative paths, and the behavioral response.

What conclusion can you draw from your experiment? Can you think of how this behavior fits in with the termite way of life?