ACTIVITY 7

Foraging Frenzy

Imagine you are in the market for a car. Many factors will influence the kind of car you decide to buy: How much money you have now; how much money you plan to make in the near future; your ideal car's aesthetics; how much you will drive the car; the conditions in which you will drive the car; how long you plan to own the car; how much you want to drive a trendy car; and so on. As you evaluate each of these factors you will need to weigh their relative importance in order to come to a final decision.

Making complex decisions is a task people do many times a day—often without even realizing it. Which route will you take home? In which spot will you park? Which grocery store line will be the fastest? How will you allocate your time after dinner? As you weigh the costs and benefits for each decision, you get closer and closer to reaching the optimal solution for you. Complex decision making is not restricted to people. Many animals constantly make complex decisions of their own.

This Activity simulates the decision-making process of an animal foraging for food. Foraging animals consider many factors as they search for their next meal. How much time will they spend searching for food? What is the best place to find food? What kind of food will they look for? Unlike some of the decisions mentioned above, the decisions an animal makes about the food it gathers have a significant impact on its ability to survive and reproduce.

In this Activity, participants in a group take on the role of foraging animals. Their resource of choice is beans. Their goal is to gather as many beans from the feeding stations as they can in a given amount of time.

MODELING CONCEPTS

- Discover the challenges involved in assessing resource availability.
- Learn about some of the foraging decisions that animals must make when gathering resources.
- Study a simple model of optimization.
- Gain experience in formally analyzing the decision-making process.

MATERIALS

- (Uncooked!) kidney beans—about 1 pound per 10 participants
- Three stopwatches or digital watches
- Large notepad or blackboard for recording line lengths
- Jelly beans

RUNNING THE ACTIVITY

Start this Activity by designating two participants as the "food dispensers." Give each of the food dispensers a bowl of dried kidney beans and a watch. Instruct the food dispensers to hand out the beans to the students at different rates—one dispensing at a rate of one bean every 5 seconds and the other at the rate of one bean every 10 seconds. Only the food dispensers should know about the two rates. The two dispensers should be fairly close together.

Instruct all of the other participants (the "foragers") to try to get as many beans as possible. The foragers can only obtain their beans by waiting in line and receiving a bean when it is their turn. They should not be told anything about the differences between the two food dispensers. The foragers are allowed to switch lines at any time, but after they get a bean or switch lines they must go to the back of the line. Let them collect beans for approximately 5 minutes while you, or another designated participant, record how many people are in each line at 30-second or 1-minute intervals.

At the end of the foraging time, ask the participants whether they noticed anything about the two lines. Did anyone notice the rate differences? Can anyone describe the approximate rates of distribution in the two lines? If none of the foragers discovered the distribution rates, then ask the dispensers to share the rate information with the group. Have everyone think about the two rates, and then allow the foragers to continue their foraging. Be sure to note the time at which you gave out this information in the line length recordings.

After several more minutes of foraging, bring the group together and ask them to discuss their observations of the line lengths. Do they think that knowing the exact rates at which the dispensers were distributing beans affected which line they decided to stand in?

RUNNING THE ACTIVITY—EXTENSIONS

Try one or more of the following modifications to see how they affect line length:

- Increase or decrease the ratio of the two distribution rates.
- Make the two lines far apart, or place some obstacles in between them, lengthening the amount of time it takes to get from one line to the other.
- Increase the number of beans distributed per handout on one line.
- Add a third line that combines one or more of these factors.
- Distribute jelly beans in one line and kidney beans in another.

Bring the group back together, and see if they can come up with a theory that describes the length of the lines with respect to the rate and quality of food distribution, the cost of traveling between lines, and the foragers' ability to assess these factors. You might discuss some of the following questions:

- Who got the most beans? What was his/her strategy? Would that strategy be effective if *everyone* adopted it? Who gathered the least beans? Why?
- How does the number of foragers in a line relate to the rate at which food is dispensed in that line?
- Were the participants able to assess the rate at which the beans were being distributed? How does the magnitude of the difference between the number of people in each line (or the ratio of one line's length to the other) influence this ability?
- Did the tendency to leave one line for the other line change as it took longer and longer to get from one line to the other? What would happen if it cost the foragers one or more beans to change lines?
- Were all beans created equal? Was quantity the only important factor or were the jelly beans "worth" more than the kidney beans? How is this analogous to real-life foraging?
- How was the ability to assess the distribution rates and travel times affected by the addition of a third station?

FACTS FOR FACILITATORS

You should encourage participants to exchange information as they learn it. However, try to keep track of the times when information is disseminated. It is interesting to assess whether or not the discovery of new information about the system influences the line lengths.

This experiment is based on the Ideal Free Distribution theory of Fretwell and Lucas (1970). Their theory states that under perfect conditions (complete knowledge of rates, no time between stations, and no interference from other foragers) the number of foragers at a feeding station will be proportionate to the rate at which food becomes available. Thus, if a feeding station produces food at twice the rate of another station, it should have twice as many foragers. Do not worry if the participants in this experiment never reach an exact ratio (of distribution rate to line length) across all of the lines. It can be just as informative to discuss why equal ratios were not reached. You can find more information on this theory in most ecology and animal behavior textbooks.

Students can also conduct a similar experiment by designing feeding stations with differential bread distribution rates for ducks at a pond or pigeons in a park. Encourage them to think carefully about how they want to design their experiments.