Striking a Balance

Overview
The sun's energy is captured by individual plants and transferred to animals through food chains. Students will participate in an activity that demonstrates the principles and dynamics of food chains.

Suggested Grade Level
9 - 12 (10 students minimum)

Estimated Time
45 minutes

Objectives
The students will be able to:

1. learn to predict a likely food chain for a given habitat.
2. understand that energy is lost through breathing, heating and moving.
3. understand that energy is transferred when it passes from one organism to another.

Background
Feeding relationships are often difficult to observe. In this activity, students gain some understanding of these relationships by assuming the roles of animals, playing tag, and simulating feeding relationships. Popcorn is spread over a lawn, park, or playground area. The kernels of popcorn represent plants, which are the food sources for the plant eaters. Some students play grasshoppers (plant eaters or herbivores), some students play frogs (grasshopper eaters or carnivores), and some students play hawks (frog eaters or carnivores).

The object of the game is for each animal to eat without being eaten before the "day" (five minutes) is over. In nature, the populations of plants and animals are usually large enough to insure continuation of the species if some are lost. In this game, populations (popcorn "plants", grasshoppers, frogs, and hawks) are so small that the survival of one of each kind will be considered an indication of a "balanced" ongoing community. You can repeat the game many times in one activity session, but encourage the students to change the rules of behavior and the numbers of each kind of animal until a "balance" is achieved in your plant - grasshopper - frog - hawk food chain.

Materials

For the whole group:

1. 2 –3 gallons of popped popcorn
2. 1 marking pen
3. 1 kitchen timer, watch, or stopwatch
4. plastic sandwich bags, one for each student plus a few extra, as follows:

- sixty percent (60%) of the class will be grasshoppers and given "stomachs," plastic sandwich bags marked with a line 1.5" from the bottom of the bag.
- twenty-five (25%) of the class will be frogs, and given "stomachs," plastic sandwich bags marked with a line 2.5" from the bottom of the bag.
- fifteen percent (15%) of the class will be hawks, and given "stomachs," plastic sandwich bags marked with a line 2.5" from the bottom of the bag (same as frogs).

5. sashes in three different colors, plus a few extra of each color:
   color 1 = 60% of sashes for grasshoppers
   color 2 = 25% of sashes for frogs
   color 3 = 15% of sashes for hawks

6. site selection: a lawn, park, or playground approx. 50' x 50' or larger.

Activity

Striking a Balance Game – The objective is to survive as an animal in a make-believe food chain by getting enough to eat while avoiding being eaten.

1. Introduce food chains by asking students if they know what mice eat and what eat mice. (Mice eat seeds and snakes eat mice.) Diagram the relationship they describe and introduce it as a food chain. Arrows point in the direction that energy transfers within the food chain (sun → seeds → mice → snakes). Ask the students if they can think of other food chains, including a food chain that contains humans (i.e., sun → grass → beef → humans).

2. Tell students that you will be distributing plants (popcorn) that grasshoppers eat. ***(Save some for later!)*** Ask students what plant popcorn comes from!

3. Consider a random drawing to determine students' roles. Be sure to change sashes and stomachs if students' roles change.

4. Hand out a grasshopper stomach and sash **(color 1)** to 60% of the group.

5. Hand out a frog stomach and sash **(color 2)** to 25% of the group.

6. Hand out a hawk stomach and sash **(color 3)** to 15% of the group.

7. When the game begins, the grasshoppers pick up (eat) popcorn and place it into their stomach bags. Frogs try to tag (eat) the grasshoppers. When a frog eats a grasshopper, the grasshopper's stomach contents are transferred to the stomach of the frog. (While the transfer is taking place, both the grasshopper and the frog are safe from other frogs and hawks.) Hawks try to tag (eat) the frogs. When a hawk eats a frog, the frog's entire stomach contents are transferred to the stomach of the hawk. (While the transfer is taking place, the frog is safe from other hawks.) Hawks do not eat grasshoppers in this game. **NOTE:** Animals that are eaten rejoin the game (to simulate reproduction) and continue to gather food. Once a grasshopper or a frog has filled its stomach to the marked line, it has survived. A hawk must have the equivalent of one frog to survive. Only then can they go to the safe area (tree, post, etc.) as "survivors."

8. Set the timer for 5 minutes and start the game. At the end of the first game, analyze what happened. How many animals survived? If at least one of each kind of animal survives, you have an ongoing food chain. Return the popcorn to the activity area after each game.

9. *Instant Replay* – Ask for suggestions on rule changes that might result in more of a balance after the five-minute game. Usually <u>one</u> rule is changed for each replay. When you have settled on your new rules, play again. Suggest some of the following changes if the students do not offer any. A) Change the number of grasshoppers and/or frogs and/or hawks. B) Time releases: let grasshoppers forage unmolested; one minute later release frogs, and later the hawks. C) Spread out more popcorn.

10. After each game, analyze the results. How many grasshoppers, frogs, and hawks survived? Encourage students to compare game results after each rule change, and to comment on how the game "balance" compares with balance in the real world. In nature's balance, there are more plants than plant eaters, and more plant eaters than animal eaters. What would happen if there were 50% less popcorn plants? What would happen to the animals that depend on those plants? If there were no frogs, what would happen to the plant population? …the grasshopper population? …the hawk population? Do hawks need plants to survive? Have students describe some food chains in which they are a part? Are there any plants or animals that are <u>not</u> part of any food chain?

Adapted from the Outdoor Biology Instructional Strategies (OBIS), Lawrence Hall of Science, University of California, Berkeley, CA 94720.