Striking a Balance

Standards of Learning
Science 6.2, 6.7, LS.4, LS.6, LS.7, LS.9, LS.11, LS.12

Objective
Students will:

- Demonstrate an understanding that energy is lost through breathing, heating and moving and that energy is transferred when it passes from one organism to another

Materials

- 2-3 gallons of popped popcorn
- Marking pen
- Timer
- Plastic baggies, marked
- 3 colors crepe paper
- Lawn or outdoor area
- Rulers

Background Knowledge
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 play ground 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. The game may be repeated 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 the plant-grasshopper-frog-hawk food chain. In nature's balance, there are more plants then plant eaters, and more plant eaters then animal eaters.

Procedure

1. Using rulers, have students make marks on the sandwich bags. These bags represent the animal's stomachs, so mark as follows:
    - 60% of the class will be grasshoppers. Grasshopper stomach bags need to be marked 1.5"from the bottom of the bag.
    - 25% of the class will be frogs. Frog stomachs need to be marked 2.5" from the bottom of the bag.
    - 15% of the class will be hawks. Hawk stomachs need to be marked 2.5" from the bottom of the bag (just like the frog).
2. Cut crepe paper in the same fashion. This paper is a form of identification and can be tied around the student's waist to indicate animal type.

- 60% light green crepe paper for the grasshoppers
- 25% dark green crepe paper for frogs
- 15% gold crepe paper for hawks

3. Divide class into three groups according to the percentages above.
4. Begin classroom discussion about food chains. Create a class diagram of a simple chain.
5. Discuss the energy transfer found in found chains. Using the class diagram, indicate energy transfer with an arrow. For example:
   sun → grass → beef → humans
6. Hand out grasshopper stomach baggies and identification sashes to first group. (60%)
7. Hand out frog stomach baggies and identification sashes to second group. (25%)
8. Hand out hawk stomach baggies and identification sashes to third group. (15%)
9. Designate a "safety" area at game area.

Rules of the Game

a. The grasshoppers pick up (eat) the popcorn and place the pieces in the stomach baggies.
b. Frogs try to tag (eat) the grasshoppers. When a frog "eats" a grasshopper, the grasshopper's stomach contents are transferred to the frog's stomach baggie. While this exchange is taking place, the grasshopper and frog are safe from other players.
c. Hawks try to tag (eat) the frogs. When a hawk "eats" a frog, the frog's stomach contents are transferred to the hawk's stomach baggie. Again, while this transfer is taking place, the frog is safe from other hawks.
d. Note – in this game, hawks do not eat grasshoppers.
e. Animals that are eaten can rejoin the game to simulate reproduction and continue to gather food.
f. Once a grasshopper and/or a frog have filled its stomach baggie to the marked line, it has survived. A hawk must have at least one frog to survive. Once the stomach is filled these animals may travel and stay at the designated safety area.

Playing the Game

1. Set a timer for 5 minutes and start the game.
2. Analyze the results by asking questions such as
   - How many animals survived?
   - Is the food chain still complete?
   - Can the game be continued?
   - Did any specie die out?
   - Is this a balanced cycle?
3. Return the popcorn to the activity area for another round.
4. Change one rule of the game. For example:
   - the number of grasshoppers, frogs and/or hawks
   - time releases: allow grasshoppers to forage for 30 seconds before frogs are introduced and wait 30 seconds before hawks are then released
   - use more activity area
   - spread out more/less popcorn

   (Only one change should be made during reach round.)
5. Analyze results of each game. Keep information in data format.

6. Return indoors and discuss/write about the results. Discussion questions may include:
    - 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 and the hawk population?
    - Do hawks need plants to survive?

Extension

- Research other food chains.
- Create a similar game using other food chains.
- Research whether there are any plants/animals that are not part of any food chain.
- Research, discuss and illustrate the energy transfer within various food chains.

Adapted from USDA Agriculture in the Classroom – www.agclassroom.org