Energy Game

Overview

Students will gain an understanding of the flow of energy between producers, consumers, and decomposers in an ecosystem by playing a freeze tag game. Students will summarize the different paths of energy flow by diagramming a food web.

Concepts

1. The living parts of an ecosystem are categorized according to how they get their energy: The three main categories are producers, consumers, and decomposers.
2. Energy flows through these components in an ecosystem.
3. The term "food web" describes the complex ways that energy is transferred within an ecosystem.

Time

1 hour and 30 minutes

- Introduction: 10 minutes
- Classroom Model of the Energy Game: 20 minutes
- Playing the Energy Game: 30 minutes
- Closure: 10 minutes
- Journal Exercise—Spin a Food Web—20 minutes

Materials

For each student:

- Ecosystem Explorations Journal

For the whole class:

- 4 different colored markers (indelible markers preferable)
- about 300 beans to represent energy bundles
- 28 plastic bags (at least quart size)
- 22 pieces of masking tape or construction paper (2" x 12")
- 1 box (shoe box size or larger)
- 1 whistle or noise maker
- 1 piece of butcher paper or portable white board
- playing field about 50 feet by 50 feet

Teacher Preparation

1. Label the following number of bags for each category in the marker color indicated.
   - 12 Producers (plants): green
   - 4 Herbivores: red
   - 2 Carnivores: blue
   - 4 Decomposers: brown
2. Put two beans in each bag.
3. Make armbands with masking tape or construction paper in the same colors and numbers as indicated above. Color the masking tape or cut the construction paper to size.
4. Label the box SUN.
5. Review the directions for the energy game, as there are many steps.
6. Make a chart on butcher paper to use during the Energy Game to record the numbers of Plants, Herbivores, Carnivores, and Decomposers that survive each round of the game.
7. Select a playing field about 50 feet by 50 feet and clearly mark the boundaries.

Note: This game set-up provides roles for 23 players.

Background

This activity models how **energy** flows through an ecosystem. All organisms function by using energy. Energy is used by an organism for growth, reproduction, and survival needs. **Producers** (plants) convert the energy of the sun into sugar compounds through the process of **photosynthesis**. These sugar compounds are stored energy. **Consumers** include **herbivores**, **carnivores**, and **omnivores**. They get energy by feeding on other organisms. When an herbivore eats a plant, it gains some of the plant's stored energy for its own growth, reproduction, and survival needs. When a carnivore eats an herbivore, the energy is transferred again and used by the carnivore for its own growth, reproduction, and survival needs. Lastly, **decomposers** (fungi and bacteria) obtain their energy from organisms that are no longer alive. Decomposers eventually break the organism into its basic components, in essence recycling nutrients back into the ecosystem.

Energy transfer from one organism to another is very inefficient. For example, a plant uses some of the energy it collects from the sun to make food. This energy is no longer available to the herbivore that eats the plant. Similarly, the herbivore uses some of the energy it gains from the plant to move around or to keep warm. This energy is not available to the carnivore. This energy is not destroyed: it is just unavailable to transfer from one organism to another.

The term **food web** describes the complex ways that energy is transferred within an ecosystem. A food web is the combination of many food chains. In a natural ecosystem, food chains do not exist separately, but are interconnected. Because of the intercon-

nections among the many parts of a food web, an impact on one part of the food web affects many other parts of the food web. A sample food web is included as part of the Journal Exercise.

The term **population** refers to organisms of the same species living in a defined area. For example, all of the mule deer in one ecosystem, such as the Sandia Mountain ecosystem, are a population of mule deer. Any given ecosystem will have populations of producers, consumers, and decomposers. Different ecosystems can support different populations of organisms depending on the resources available.

Procedure

Overview of game: This is a freeze tag game in which each player is either the Sun, a Producer, an Herbivore, a Carnivore, or a Decomposer. The object is to survive by obtaining energy beans from the appropriate source. After three minutes play stops and players count their beans to see which players survived. The number of players surviving at the end of a round is recorded in a table.

Introduction

1. Review the living and non-living parts of the ecosystem with the class as introduced in the "Ecosystem Discovery" lesson.
2. Write the following words on the board: Producers (plants), Consumers (Herbivores, Omnivores, Carnivores), and Decomposers. Have students brainstorm examples of living things and list each student's response in the appropriate category.
3. Use the following questions to guide a discussion of how these groups of living things obtains their energy.
    - How do the producers get their energy? [Plants use the energy of the sun to produce food in their leaves through the process of photosynthesis. Have everyone repeat the word "photosynthesis" as it will be used in the game.]
    - How do consumers get their energy? [Consumers eat plants and animals.]
    - What kinds of consumers are there and how do they get their energy? [Herbivores, which eat plants, carnivores, which eat animals, and omnivores, which eat both plants and animals.]
    - How do the decomposers get their energy? [Decomposers break down dead animals and plants into their basic components.]

Classroom Modeling

Before going to the playing field, model the players' roles for the Energy Game in the classroom.

1. Choose five students, one student to demonstrate each role.
2. Assign each student a role by giving her or him a labeled bag (Producer, Herbivore, Carnivore, or Decomposer) or the box labeled Sun. Also, provide each player with the appropriately colored armband.
3. Make sure that there are two beans representing energy in each player's bag.

Place the rest of the beans in the Sun's box.

4. Walk through the following scenario to model the processes involved in the tag game.
   - A plant (Producer) goes to the Sun, says "photosynthesis," and receives four energy beans from the Sun.
   - An Herbivore tags the Producer. The Producer must freeze once it is tagged. The Producer gives the Herbivore half of its energy beans and then sits down to show that it is dead.
   - A Carnivore tags the Herbivore. The Herbivore must freeze once it is tagged. The Herbivore gives the Carnivore half of its energy beans and sits down to show that it is dead.
   - A Decomposer unfreezes anybody who has been tagged (Herbivore or Producer). The Decomposer receives the remaining energy beans from the frozen player.
   - When a player is unfrozen, she or he represents a new producer or herbivore and may return to the game to obtain energy from the appropriate source.

Playing the Energy Game

Set-up

1. Pass out one bag and the appropriate armband to each student. There are 12 Producers, 4 Herbivores, 2 Carnivores, and 4 Decomposers. Have all students stay in their groups on the sidelines until play begins.
2. Give one person the Sun box with the energy beans and place that person in the playing area.
3. Point out all boundaries to the students.

Actual Play

1. Release the Producers onto the field. Producers must go to the Sun and say, "Photosynthesis" to receive four energy beans. Producers can then disperse but can continue to return to the Sun at any time to receive more energy beans.
2. Release the Herbivores onto the field. The Herbivores tag Producers. Herbivores take half of the energy beans from each Producer they tag. When the Producer is tagged it sits down, showing that it is dead.
3. Release Carnivores onto the field. The Carnivores tag Herbivores. Carnivores take half of the energy beans from each Herbivore they tag. When the Herbivore is tagged it sits down, showing that it is dead.
4. Release the Decomposers onto the field. Decomposers unfreeze frozen players who are sitting down on the field. Decomposers take the remaining energy beans from every frozen player they tag. When a player is unfrozen, he or she represents a new producer or herbivore and should return to the game to obtain energy from the appropriate source.

5. After about three minutes of play, blow the whistle. All players must stop and regroup into their assigned roles. All Producers stand together, all Herbivores stand together, all Carnivores stand together, and all Decomposers stand together.
6. Each player counts the number of energy beans in his or her bag. Each player needs to have at least 10 beans in order to survive.
7. Players who have enough energy beans remain standing to show that they have survived. Players who do not have enough energy sit down to show that they have not survived.
8. Record the number of players in each group that survived for each round played.
9. Have players give all but two energy beans to the Sun and play another round of the energy game. Players may trade roles to experience different parts of the food web.
10. Remind students that this game models what is happening in an ecosystem. What other roles or changes could we add to the game to make it more realistic? [Omnivores could be included. Carnivores could eat carnivores. Also, producers do not always die when they are eaten. Other roles could include human hunters or developers.]

Closure

1. Display the data on the numbers of players to survive during each round.
2. Have students make a line graph in their journal (or use the chalkboard as a class) to illustrate the data. Set the x and y axis as round number and number of surviving individuals. Use a different color for each line on the graph (one line for producers, one for herbivores, one for carnivores, and one for decomposers).
3. Use the following questions to wrap-up and review the concepts illustrated in the game.
   - Why did different numbers of players from each group survive in each round? [As in a natural ecosystem the number of individuals that survive is constantly changing.]
   - What happened when an organism did not have enough beans at the end of the game? [The organism died because it did not have enough energy to survive.]
   - What would happen if the entire population of herbivores died? [The carnivores would begin to die too, and the entire ecosystem would be affected.]
   - Why are there fewer herbivores than plants in the system? Why are there fewer carnivores than herbivores in the system? [It takes many producers to support one herbivore. It takes many herbivores to support one carnivore.]
   - Why are decomposers important to the ecosystem? [Decomposers recycle the nutrients of dead animals and plants back to the ecosystem.]
   - What are some of the ways that producers and consumers use energy? [Energy is used for growth, reproduction, and survival needs.]

- Why is it better to think of this energy flow as going through a web and not a chain? [Herbivores eat a variety of different plants and carnivores eat a variety of animals. It is not always one chain with the same producer, herbivore, carnivore order. The journal exercise will expand on this concept.]

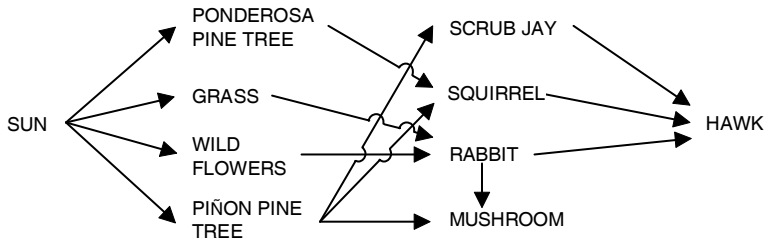
Adaptations for Students with Limited English Proficiency

This lesson introduces many new terms. Previewing this vocabulary in the student's primary language will aid comprehension. Have pictures available for all of the key words and show the picture when introducing each word. In Spanish, many of these words are cognates (similar in spelling and meaning with English words), therefore writing the word on the board will be beneficial for literate Spanish speakers. Ensure that LEP students understand the modeling of the tag game and check with them to ensure that they know their role in the game.

Key Words: energy: la energía; producers: los productores; photosynthesis: el fotosíntesis; consumers: los consumidores; herbivores: los herbíveros; carnivores: los carníveros; omnivores: los omníveros; decomposers: los descomposedores; population: la población; food web: la red de alimentos

Journal Exercise—Spin a Food Web

The following is a list of organisms that are found in the Sandia Mountains. Students should use this list to "spin" a food web. For example:



New Mexico Plants and Animals

Producers	Herbivores	Carnivores	Omnivores	Decomposers
Grass	Cottontail	Mountain Lion	Coyote	Fungus
Ponderosa Pine	Mule Deer	Red-tailed Hawk	Black Bear	Bacteria
Juniper Tree	Abert's Squirrel	Golden Eagle	Common Raven	
Wildflowers	Pocket Gopher	Rattlesnake	Hummingbird	

Assessment

Evaluate student participation and behavior during the game and the follow up discussion. Use the journal food web diagram to assess content understanding.

Extensions

Play more rounds of the Energy Game and experiment with different populations of producers, consumers, and decomposers. Use the same procedures as before, but with the new ratios of players. Record the final number of players who survive and compare the numbers with results in previous rounds.

Look up on the web for the breakdown of the diversity of organisms. Often this can be found in the form of a pie-chart. Ask the students why they think there are so many more of some types of organisms. [There need to be more plants than herbivores because all the energy in a plant doesn't transfer to the herbivore that eats it. Some is lost. The same thing happens when a carnivore eats an herbivore.]