Topic
Food chains

Key Question
How is energy passed along a food chain from link to link?

Learning Goals
Students will:
- learn about the predator/prey relationship in a food chain, and
- play a game of tag to experience this relationship.

Guiding Documents
Project 2061 Benchmarks
- *Animals eat plants or other animals for food and may also use plants (or even other animals) for shelter or nesting.*
- *Almost all kinds of animals' food can be traced back to plants.*
- *Some source of "energy" is needed for all organisms to stay alive and grow.*
- *Two types of organisms may interact with one another in several ways: They may be in a producer/consumer; predator/prey, or parasite/host relationship. Or one organism may scavenge or decompose another. Relationships may be competitive or mutually beneficial. Some species have become so adapted to each other that neither could survive without the other.*
- *All organisms, including the human species, are part of and depend on two main interconnected global food webs. One includes microscopic ocean plants, the animals that feed on them, and finally the animals that feed on those animals. The other web includes land plants, the animals that feed on them, and so forth. The cycles continue indefinitely because organisms decompose after death to return food materials to the environment.*

NRC Standards
- *All animals depend on plants. Some animals eat plants for food. Other animals eat animals that eat the plants.*
- *Organisms have basic needs. For example, animals need air, water, and food; plants require air, water, nutrients, and light. Organisms can survive only in environments, and distinct environments support the life of different types of organisms.*
- *An organism's patterns of behavior are related to the nature of that organism's environment, including the kinds and numbers of other organisms present, the availability of food and resources, and the physical characteristics of the environment. When the environment changes, some plants and animals survive and reproduce, and others die or move to new locations.*

Science
Life science
  food chains
    predator/prey relationship

Integrated Processes
Observing
Comparing and contrasting
Collecting and recording data
Identifying and manipulating variables
Generalizing
Analyzing

Materials
Brown, yellow, and red yarn (see *Management 3)*
Large bag of plain popped popcorn
Plastic sandwich bags, one per student
Scissors
Thread
Tape
Student page
Cheese popcorn, optional

Background Information
All foods contain chemical energy. A food chain shows the transfer of energy through the chain. Energy is released from the sun and converted by green plants (producers in the food chain) that use light to make food through photosynthesis. Primary consumers are dependent on green plants, and thus the sun, for food energy. Higher level consumers are dependent on the animals that eat plants or other animals, thus the energy is passed from link to link in the food chain. All links are ultimately dependent on the sun for their food energy. Some energy is lost between each link in a food chain. Because of the energy loss, each higher level has fewer living things than the level below it. This means that food chains rarely exceed four or five links.

A pyramid of energy, or biomass pyramid, illustrates the energy transfer between predators and prey. Animals at the top of the pyramid are fewer in number and need to eat many smaller animals to get enough energy to survive. The primary consumers that feed on green plants are much more numerous. In a well-balanced ecosystem, the producers and consumers at each level have numbers that are large enough to ensure their survival without depleting their food supply, thus the pyramid effect with many producers and primary consumers and few of the highest level consumers.

Management

1. Find an area with well-defined boundaries for this outdoor activity.
2. Stress safety and demonstrate the proper way to tag. Make sure students understand the rules before going outside.
3. You will need yarn in brown, red, and yellow cut into pieces about 40 cm long. Cut enough brown for half the class, enough yellow for one-third of the class, and enough red for one-third of the class.
4. Use the student page after the final round of play.

Procedure

1. Review food chains and food webs, if appropriate. Discuss predator/prey relationships.
2. Tell students they are going to play a game of tag that will simulate a natural food chain and illustrate a biomass pyramid.
3. Divide the class into three even groups. Each group will be assigned a different color of yarn. Hand out the yarn and have students help each other tie the yarn around their wrists in a bow that can be easily removed at the end of the game.
4. Explain that the animals the students are simulating are represented by the colors of yarn. Students with brown yarn are grasshoppers, those with yellow yarn are lizards, and those with red yarn are hawks.
5. Discuss the predator/prey relationships in this food chain. Hawks hunt only lizards. Lizards hunt only grasshoppers. Grasshoppers eat only grass (which is represented by the popcorn).
6. Give each student a plastic bag to be used as a stomach and explain how the game will work. Those students who are grasshoppers must gather popcorn from the ground and put in their plastic bags. The students playing lizards will try to tag the grasshoppers. If they are successful, the grasshopper is "dead" and the contents of his/her bag are emptied into the lizard's bag. (The empty bag stays with the grasshopper to be used again in the next round.) The students playing hawks will try to tag the lizards, and get the contents of their bags if successful. Lizards and hawks may not pick up popcorn from the ground.
7. For the animals to survive, they must not be tagged during the game and their stomachs (plastic bags) must be filled by the game's end as follows:
   grasshoppers—1/3 full
   lizards—2/3 full
   hawks—full
8. Go outdoors and select an area to be the ecosystem. For the first round, the area should be small so that the students can experience the effects of crowding on animal populations. Students may not leave the area during the game.
9. Set up two or three safe zones within the selected area. These zones should be large enough for two students at a time. Whenever a new student enters a safe zone, the one who has been there longer must leave. Animals may not prey on each other in these zones. Select another area in which the "dead" animals can wait for the next round.
10. Spread out a large bag of popped popcorn over the ecosystem.
11. Signal the primary consumers, the grasshoppers, to begin eating grass (gathering popcorn). After 30 seconds, allow the lizards to enter the area. After 30 more seconds, allow the hawks to enter the ecosystem. Allow the students to play for several minutes or until no prey are left. At the end of play, all remaining animals must have the right amount of food in their plastic bags or they too are dead. Note the length of time the game lasted.
12. After this first round, ask why the game only lasted a few minutes. Discuss crowding and the number of predators vs. the number of prey. Write down the number and kinds of animals that are still alive.
13. Play the second round in the same area as the first one with the following changes: have half the students play grasshoppers, and divide the other half so that two-thirds of them are lizards and one-third are hawks. Play the game again. Discuss the effects that changing the population numbers had on the time the game lasted.
14. For the third round, leave the animal populations as they were in round two, but greatly enlarge the area in which the game is played. Discuss the effects of the larger area on the time the game lasted.
15. Return to the classroom. Use the activity sheet to illustrate the numbers of predators and prey in an ecosystem and to make a biomass mobile. Discuss the energy flow from the producers to the higher level consumers. Emphasize that the energy in a food chain originates from the sun. A biomass pyramid could also be made by centering and gluing the pieces, one on top of another.

Connecting Learning

1. Why did the games end? [All the prey were dead.] Which games were the shortest? [those with the fewest prey] …longest? [those with the most prey] Why? [The more prey there are the longer it takes for the predators to eat them all.]
2. What numbers of predators and prey worked the best? [more prey, fewer predators]
3. How does area affect predator/prey relationships?
4. How is this game like a real ecosystem? [It shows one food chain and how the predator/prey relationship works.] How is it different? [There would be more variables in a real ecosystem.]
5. Where does grass get energy? [the sun]
6. Where does the grasshopper get energy? [grass] …the lizard [grasshopper] …the hawk? [lizard]
7. How is the mobile related to the predator/prey game? Why are green plants so important in a food chain?
8. What are you wondering now?

Extensions

1. Mix some cheese popcorn in with the regular popcorn to represent a pesticide. Do not tell students what it represents until the end of the game. When the round is over, inform them that any animal with three or more pieces of cheese popcorn in its stomach is dead due to toxic poisoning.
2. Create a variety of food chains using other animals.
3. Play the game introducing predator/prey behaviors such as camouflage, hunting techniques, decoying, running speed, freezing, and playing dead.

Curriculum Correlation

Geography

Research various geographical areas and list several food chains found there that are different than those found in your area.

Art

Design a poster illustrating food chains and food webs.

Catch Me if You Can

Key Question

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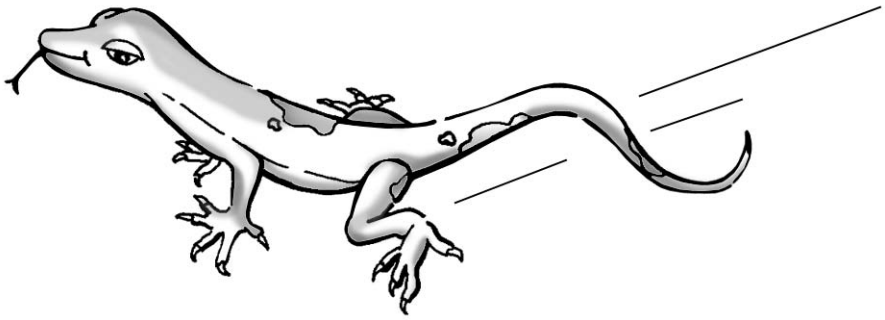


Catch Me *if You Can*

Square	Length	Width	Area
A	x	=	
B	x	=	
C	x	=	
D	x	=	

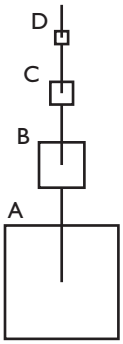
Find the length, width, and area of each square below. Record this information in the table.

Imagine that the squares are part of an ecosystem that includes grass, grasshoppers, lizards, and hawks. Think about the numbers of living things in a balanced ecosystem and color the squares according to this key.

lizards = yellow grasshoppers = brown grass = green hawks = red

A

Make a mobile by cutting out the squares and connecting them with a piece of thread.



B

C

D

Catch Me if You Can

Connecting Learning

1. Why did the games end? Which games were the shortest? …longest? Why?
2. What numbers of predators and prey worked the best?
3. How does area affect predator/prey relationships?
4. How is this game like a real ecosystem? How is it different?
5. Where does grass get energy?
6. Where does the grasshopper get energy? …the lizard …the hawk?
7. How is the mobile related to the predator/prey game? Why are green plants so important in a food chain?
8. What are you wondering now?

Thank you for your purchase!

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