Lesson Plan: 6-8.3

Grade Levels:
Grades 6, 7 & 8

California State Framework: Grade 6 Standard Set 5. Ecology
Grade 7 Standard Set 7. Investigation; Grade 8 Standard Set 9. Investigation

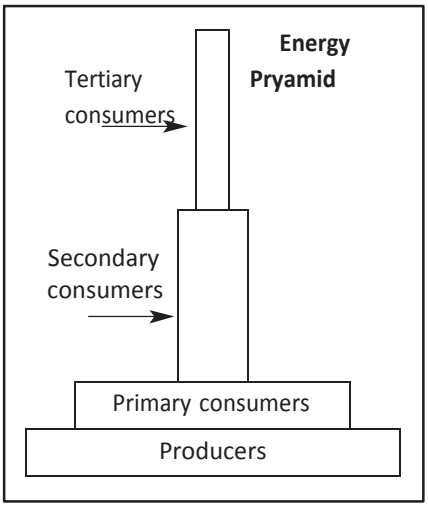
Climbing the Energy Pryamid

Background

Energy flows and nutrients cycle. These are fundamental concepts in ecology and can be thought of as major services provided by the biosphere.

In almost every ecosystem on earth, energy originally comes from the sun and is captured by photosynthesis in a green plant or photosynthetic microorganism. It is captured in the chemical bonds of the sugars made in photosynthesis, transforming it from light to chemical energy. It is then assimilated into plant tissues or used by the plant in cellular respiration to free the energy for use in its daily activities, such as growth and seed production. When the plant is eaten by an animal, the chemical energy in its tissues may be used by the animal for cellular respiration or stored in the animal's tissues.

The energy pyramid shows this movement of energy through the ecosystem in graphic form. The bottom level represents producers, the photosynthetic organisms. The next level is for primary consumers (herbivores), the one above that is for secondary consumers (carnivores) and the one above that (the fourth level) is for tertiary consumers (top carnivores). These are called trophic levels (trophic = feeding).



The pyramid shape is extremely significant, showing that less energy is present at each level. That is because each time the energy changes form, some is lost as heat.

To demonstrate this, consider the heat generated as biological processes work on the organic materials present in a compost pile. Or, ask your students to describe the physical characteristics of someone who has just run around the track several times. The answer — sweaty and flushed — points to ways the body dissipates the waste-heat generated when the runner's body changes chemical food energy into the mechanical energy of running.

Due to the heat loss, the amount of energy available at each level of the energy pyramid decreases compared to the level before. Some energy is also tied up in wastes or in inedible parts of a carcass (i.e., bone, tooth, hair). It is common for only 5 to 15% of the energy in one trophic level to pass on to the next level. Though not specifically shown on the energy pyramid, decomposers at work on the wastes and inedible bits will obtain some of the energy for their own use, again losing some in the form of heat.

Goal

In this lesson, students will learn that energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis and then from organism to organism through food webs. Students will be able to describe the passing of energy from one organism to another in the food chain and explain what happens to the missing energy.

continued...

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Climbing the Energy Pryamid continued...

Before Your Visit

On the accompanying Energy Flow worksheet, students can number the pictures in an order that demonstrates their understanding of the energy pyramid. They can then write an explanation on the back of the sheet, addressing these issues:

- Where does the missing energy go?
- Why do very few land-based energy pyramids have more than four levels?
- Which kind of organisms, if they were to suddenly disappear or go extinct, would cause the widest-reaching impact on the food web in that ecosystem?

Alternatively, have students create and present a skit to the class demonstrating and explaining one of the above issues.

Materials to Bring

Students should come with a notebook or paper with a clipboard and a pencil.

At Safari West

Ask your students to list the animals they see at Safari West. Suggest to students that they ask the guides about the interactions between the exotic species and native species. For example, what about predation by mountain lions and coyotes?

Back in the Classroom

After you return to the classroom, have students construct food chains that include the animals they listed at Safari West. Ask them to designate the trophic level (primary or secondary consumers) of each. Ask which level(s) is/are missing? Except for cheetah, top predators were not brought into Safari West from exotic locales. Ask students to speculate about reasons for their absence.

Also, ask your students why it is often difficult to tell an animal's trophic level. Many animals of course eat a variety of things from various other trophic levels. Remind students that the energy pyramid is a concept that helps us understand the movement of energy through an ecosystem, but it may be difficult to apply in certain situations.

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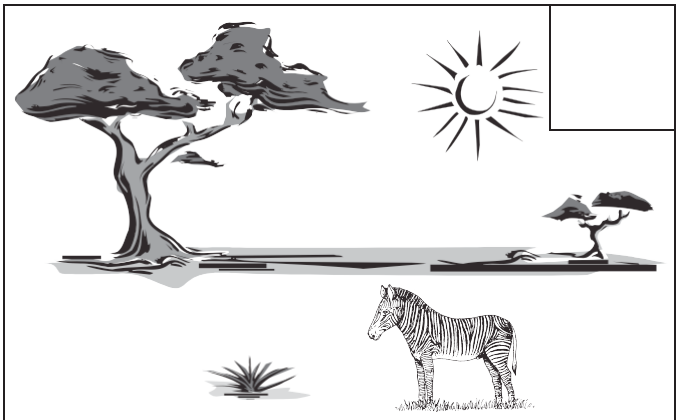
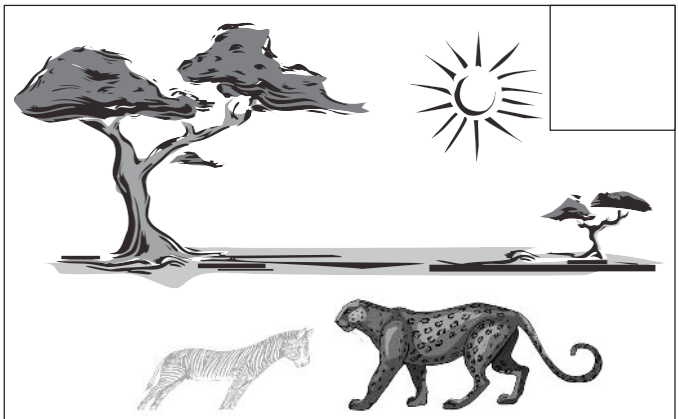
Worksheet: Energy Flow

Number the pictures (1-5) to show energy flow through the ecosystem.

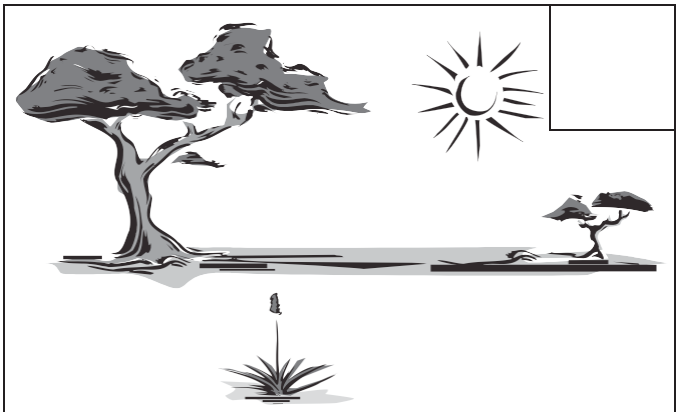


Plant is ingested by zebra. 100,000 energy units available for zebra's needs.

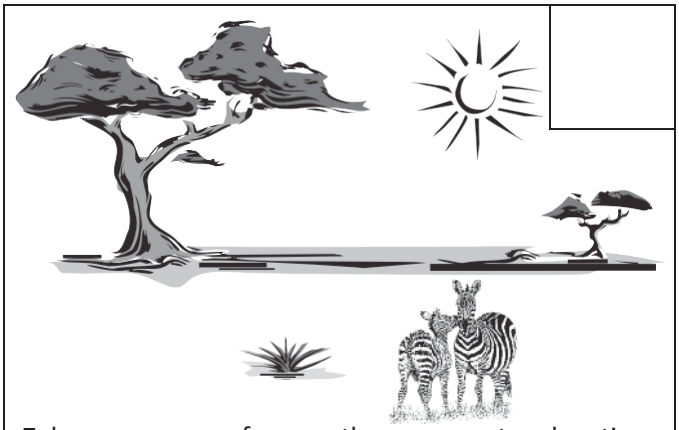
Predator's tissues retain 1,000 units of energy.



Predation occurs with transfer of energy to predator.



Light energy is converted to 100,000 units of chemical enrgy retained in plant tissue.



Zebra uses energy for growth, movement and mating. 10,000 units are retained in zebra's tissue.

Questions:

What percentage of energy at one level is transferrred and retained at the next level?

Why does the predator retain only 1,000 units of energy?

In what form does energy from the organisms enter the atmoshphere?