



**Lesson Title:** Energy Pyramids and Food Webs

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**Grade Level:** 7<sup>th</sup> (Mid-school Life Science)

**Type of Lesson:** STEM

**BVSD Essential Understandings Addressed:**

**Science Standard 3:** Students know and understand the characteristics and structure of living things, the processes of life, and how living things interact with each other and their environment.

- ✓ Explains how matter cycles and energy flows through ecosystems and describes the significance of photosynthesis and respiration to these processes.
- ✓ Analyzes implications of interactions among organisms, populations, and their environment.

Essential Questions Addressed:

- How does energy make its way from the Sun to the muscle cells in a person's body?
- What would happen if all photosynthesis on the planet stopped?
- Why do people say that energy flows but matter cycles through living systems?

Enduring Understanding: Matter cycles and energy flows through living systems. Photosynthesis and respiration are the key biochemical processes on which most organisms rely to obtain and use energy.

Essential Learning: LS9

- f Compares and contrasts food webs within and between different ecosystems;
- g Infers the number of organisms or amount of energy available at each level of an energy pyramid.

**Objectives:** Students will

1. identify the sun as the source of virtually all of the energy available to living things on Earth;
2. understand the direction of flow within an energy pyramid;
3. understand that energy pyramids get smaller toward the top because energy is inefficiently transferred from one level to the next;
4. know that only about 10% of the energy available actually makes it to the next pyramid level;

5. create food webs of their own in small groups;
6. know that if one member of a food web is disrupted or altered, that perturbation is felt throughout the entire web;
7. compare their food webs in class;
8. be able to draw a food web with arrows indicating the direction of flow of energy.

**Background Information:** This lesson can be and was used as an introduction to the last unit of the year, ecology. If used in that way, a brief discussion of ecology and an ecosystem can be helpful. An example of this is provided below in the lesson description.

Information for the teacher:

- Eco- comes from the Greek *oikos*, meaning home, and -ology is simply the study of, thus ecology means the study of our home.
- An ecosystem includes all the living and non-living components and their interactions within a given area. For the purposes of energy pyramids and food webs, we are primarily talking about energy from the sun (non-living) and how it gets distributed among the biotic members of a system.

**References:**

Cornell, J. B. 1979. Sharing Nature with Children: A Parents' and Teachers' Nature-awareness Guidebook. Ananda Publications.

**Lesson Vocabulary:** ecosystem, ecology, energy pyramid, food web.

**Materials Required:** enough string for food webs to be constructed by each of the groups into which the class is divided. Groups of 5 to 10 are recommended.

**Preparation:** None.

**Safety Information:** None.

**Engagement:** Start by asking the students if they have ever heard the word ecology. For those who have, ask them what it means? Then, introduce the concept of an ecosystem and provide examples. For instance, the city/town in which you live could be considered an ecosystem (urban). Streams and the vegetation they support are ecosystems (riparian). This leads to one aspect of ecosystems, a way in which members of the system interact. The Earth is an ecosystem (global).

So, today we're going to learn one way in which parts of an ecosystem interact. To do that, let's answer the question: why do things eat? You can show the picture below (also in associated presentation) while asking the question; it garners attention.



Let students answer this question. There are several answers to this question and they should be acknowledged, but this lesson will focus on *getting energy*.

Next, show a picture or have the students think of a field of grass. Ask where the grass gets its energy; hopefully, they are able to arrive at the answer, the sun, on their own. This is a good point to emphasize that virtually ALL of the energy on the earth comes from the sun and is made available through photosynthesis.

Have the students think about a bison that comes along and eats the grass. Then, a human comes along and eats the bison. Ask, which way is energy moving? This can be tricky for some and the point will need to be emphasized at a few points throughout the lesson. Energy moves from what is being eaten TO the eater.

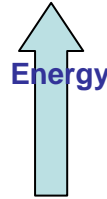
Now, tell the kids to suppose that one bison has 100 units of energy in it (I called it 100 Es for ease). Ask, how many bison would a person need to eat to get all 100 Es? After allowing some time for them to generate answers, tell them that a person would have to eat 10 bison. Now, show them an energy pyramid built from our example:



Explain that the reason why the pyramid gets smaller toward the top is because only a small amount of the energy available at the level below is passed to the level above. The rate of energy exchange is about 10%, so if there are 1000 Es in the grass, the bison gets about 100 Es and the person in turn gets about 10 Es. The remaining energy (90%) is either

- 1) lost as heat (invoke cellular respiration here if you have covered it already);
- 2) not consumed (we don't eat every single part of the bison); or
- 3) lost via excretion (it starts with an 'S' and ends with a 'T,' it comes out of you and it comes out of me...).

And, energy is flowing upward.



You might want to ask where all the Es are coming from again to emphasize the idea that the energy is originating with the sun. This is why we say that energy “flows.” It comes to us from space (the sun) and returns to space (as lost heat). It comes in, it leaves. It does not cycle the way that water, for instance, does.

**Exploration:** Now that we have covered energy pyramids, we are going to discuss food webs. Provide the students with a list of 5 or 6 organisms that could compose a food web. Have them draw a food web using the organisms using arrows to indicate the direction of energy flow. Students often want to have the arrow going from the predator to their prey showing what is eating what. When this happens, ask the student, “which way is the energy flowing?” That is the direction in which the arrow should be oriented.

Now, break the class into smaller groups; the size does not matter particularly, but at least 5 per group would be good (this activity is from Cornell 1979). Have each group think of and choose an ecosystem. Now, ask the group members to think of a plant or tree in that ecosystem. Have the individual who thought of the plant first take one end of the string. Next, ask the remaining members of the groups to think of something that relies upon that plant. Run the string from the first group member to the student who first comes up with an organism. Continue this process until the string is connecting all members of the group. You have created a food web.

Now, think of some kind of a disturbance to one of the points of the food web, say a fire burns all of one of the plants. Have whichever group member was affected pull on the string. Then ask every group member who felt the tug to tug on the string. Repeat that instruction until all group members are tugging on the string.


**Explanation, Evaluation and Wrap-up:** Bring students back as a group. Emphasize the idea that with the food webs they created, when one part of the food web was disturbed, the whole food web felt the effects. Provide an example. For instance, if a farmer kills all

the insects in an area, all of the birds that eat the insect will have to look for other food, the plants that rely on the insect for pollination will be affected, etc.

Recap the key points to the day's lesson:


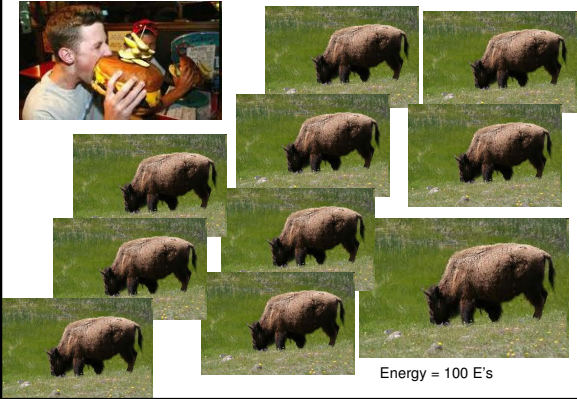
- 1) Nearly all of the energy available to living things on the Earth comes from the sun;
- 2) Only a small portion of the energy, about 10% on average, available at one level of an energy pyramid gets passed along to the level above (that's why it's an energy pyramid and not an energy box);
- 3) When drawing a food web, arrows point in the direction that energy flows;
- 4) When one member of a food web is disturbed, the whole food web feels it.

### Why do we eat?




To get **ENERGY**

### Stuff eating stuff

Energy = 100 E's


### Energy Pyramid



10 E's  
100 E's  
1000 E's

Energy

### Data: Draw a food web with these



Grasshopper      Hawk      Grass  
Chickadee      Chipmunk