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## Food Web Energy Pyramid – Trophic Levels Activity

### NGSS LS2B Grades 6 - 12

#### Background

Organisms within an ecosystem are dependent on the survival of the other organisms because energy is passed from one organism to another. The Sun's energy cycles through ecosystems from producers through consumers and back into the nutrient pool through decomposers.

A trophic level describes the feeding level that an organism belongs to. Producer, primary consumer, secondary consumer, and tertiary consumer and decomposer are all trophic levels that can be used to describe an organism's place in an ecosystem.

Roughly 10% of the energy is transferred from one trophic level to the next, thus preventing a large amounts of trophic levels. There must be higher amounts of biomass at the bottom of the pyramid to support the energy and biomass requirements of the higher trophic levels.

An energy pyramid provides a graphic model that shows the flow of energy within a food web from one trophic, or feeding, level to the next.

Gray wolves, being top predators, occupy the top trophic level. Understanding the flow of energy through the levels helps the students to better understand the interconnectedness of each trophic level. For the pyramid (ecosystem) to be balanced, a healthy population at all trophic levels must exist.

**Prerequisite:** An understanding of food chains.

#### Objectives -

1. Students will understand the difference between producers and consumers.
2. Student will be able to differentiate primary, secondary and tertiary consumers.
3. Students will gain an understanding of how energy is passed from one organism to the next and how a break in the food web affects an entire ecosystem
4. Students will be able to apply this pyramid to the Yellowstone ecosystem.

**Materials include:** Energy Pyramid master copy  
Energy Pyramid worksheet  
Energy Pyramid Advance (provides a graphic for a deeper study of the concepts of energy lost and gained within each trophic level)

## **Terms to know:**

**Food Chain** – Basically, what eats what. Follows just one path of energy as animals find food.

**Food Web** – A connection of multiple food chains. Shows how plants and animals are connected in many ways to help them all survive.

**Trophic Level** - The feeding level that an organism belongs to

**Trophic Cascade** - The occurrence of a predator suppressing the population size of lower trophic levels.

**Producers:** Primary producers are principally green plants and certain bacteria. They convert energy from the sun to make their own food and provide energy for the rest of the ecosystem.

**Primary consumers:** Herbivores - these organisms gain energy by eating producers.

**Secondary consumers** - Carnivores and omnivores which eat herbivores (primary consumers) as well as producers.

**Tertiary consumers** – Top predators who eat primary and secondary consumers and keep the food chain in balance. Top predators are animals who have no natural predators and are therefore at the top of the food chain. Tertiary consumers can be either fully carnivorous or omnivorous.

**Decomposers**, such as bacteria and fungi, are organisms that consume dead organisms and release nutrients from dead plants and animals into the soil, water, and atmosphere. This is what continues the exchange of energy.

## **Activity:**

1. **Food chains:** Review food chains by asking students to think of food chain examples, starting with the sun. Why the sun? Provide an example of a simple food chain out of order. Students place it into sequential order – ie. sun - tree – aphids – birds – eagle Explain the sequence.

A wolf related food chains: Three level: sun -tree – elk – wolf. Four level” sun -grass – grasshopper – mouse – wolf

2. **Energy Pyramid** - Explain that another way to show the food chain is through what is called an energy pyramid. Draw a four level pyramid on the board – include the sun with an arrow pointing to the first level. Label each level Producer/ Primary consumer/ Secondary consumer/ Tertiary consumer. Students copy the pyramid on their paper. Using the food chain examples in step 1, walk the students through placing these organisms within the pyramid. The added feature to the energy pyramid is the inclusion of arrows depicting the flow of energy.

By showing the trophic (feeding) levels of the ecosystem, students can easily visualize how energy is transferred from producers to consumers. The most energy is available at the lowest end of the pyramid. Only about 10% of energy at any given level is transferred to the next (Rule of 10s).

**3. Trophic Level activity** – pass out the Energy Pyramid worksheet representing the Yellowstone ecosystem. Students are to place the animals/plants in the appropriate levels of the pyramid. (they can write the name, number or draw) Some organisms can belong in more than one trophic level, depending on what they eat. For example, when a hawk eats a mouse, it is a secondary consumer. But when it eats a snake—that ate a beetle that ate plants—it is a tertiary consumer. In this pyramid, the songbird, which eats both plants and insects, can belong on the primary or secondary levels. At each link in a food web, some energy is stored within an organism but most energy is lost to the environment as heat.

### **Follow-up Questions:**

- Why do the arrows point up rather than down?
- Is there any animal who could belong to more than one trophic level? Ie. the songbird Explain why. Which is a more energy efficient food – the seed or the insect? Why? Another example: grizzly bear (carnivore and omnivore)
- What does the wolf primarily eat – how do they get their energy? (Wolves occasionally eat berries)
- If a species becomes extinct, how might this affect the trophic level above and/or below it?
- What is the main role of the producers and tertiary consumers in the ecosystem?
- The pyramid demonstrates that the energy level of the plants and animals at the lower levels is larger than animals at the top levels. Why would this be?
- Why isn't there a trophic level for decomposers? Where would you place them? (On the side of the pyramid with arrows pointing to it from each level and an arrow pointing back to below the first level.)
- Bringing it home – list the last three foods that you ate – what type of consumer were you – at what trophic level? Which food provided you with the most energy? Are people at the top of the food web? <https://www.smithsonianmag.com/science-nature/where-do-humans-really-rank-on-the-food-chain-180948053/>