Energy Pyramids

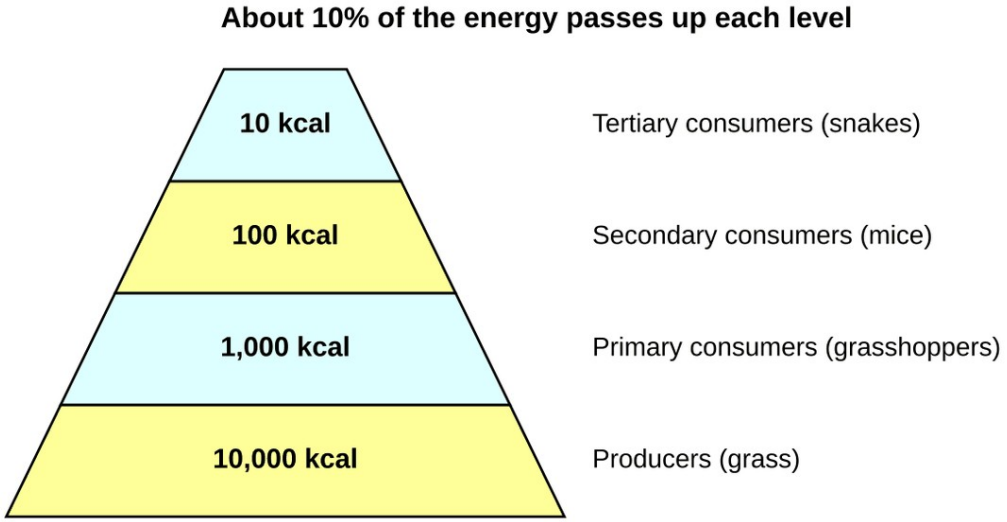
Essential Question

Why is less energy available at each higher trophic level?

Energy Pyramids

The 10 Percent Rule

- About 10% of energy passes to the next level
- About 90% is not passed on
- Up one level: × 0.10. Down one level: × 10

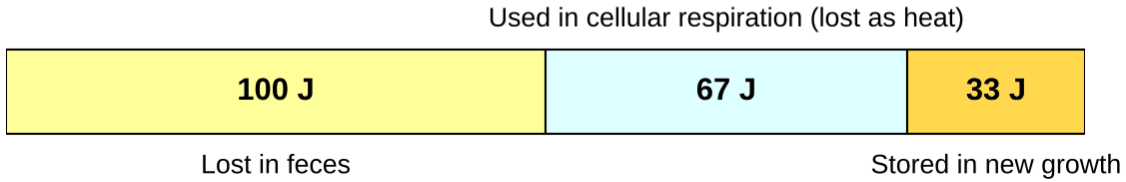


Energy Pyramids

Where Does the Energy Go?

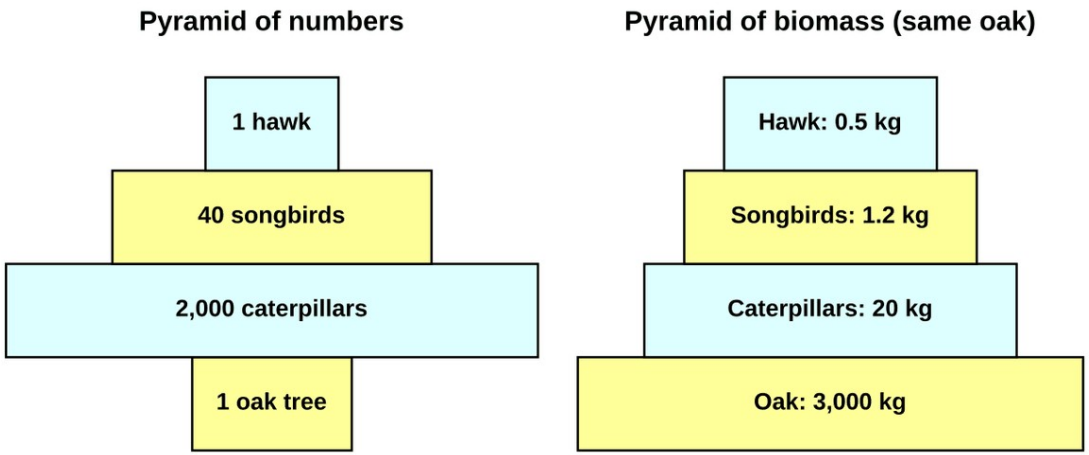
- Some food is not eaten or not digested
- Cellular respiration releases energy as heat
- Only energy stored in growth passes on

A caterpillar eats 200 J of leaf. Where does the energy go?



Pyramids of Numbers and Biomass

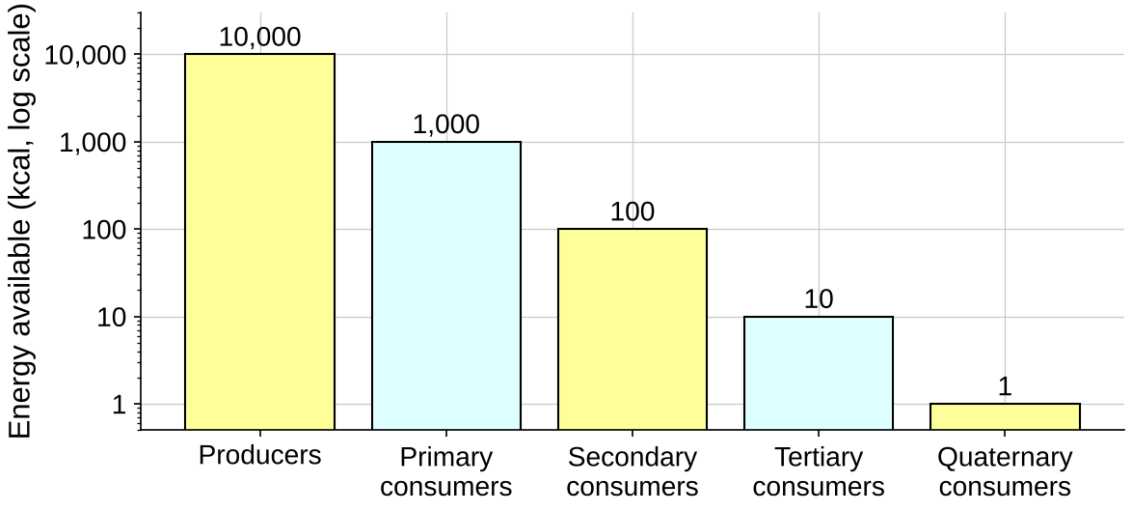
- Pyramid of numbers: how many organisms
- Pyramid of biomass: total mass of living things
- A pyramid of numbers can be upside down



Energy Pyramids

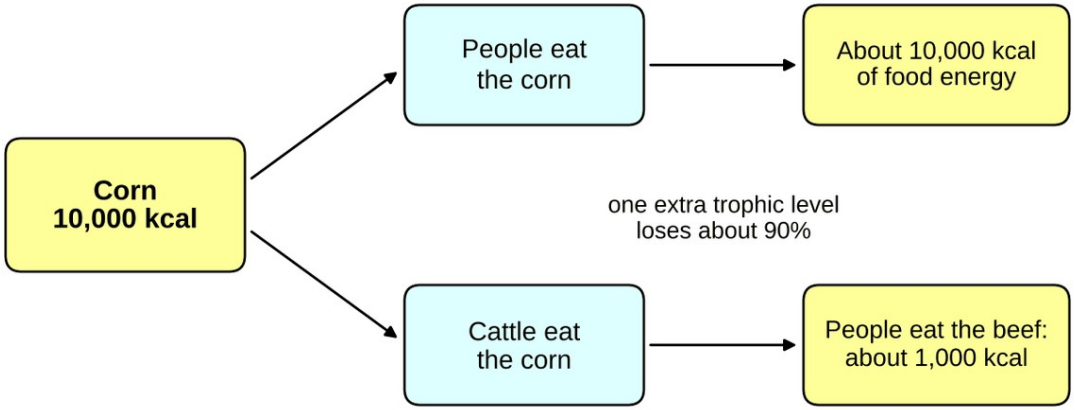
Why Food Chains Are Short

- Each level gets about 10% of the level below
- After four or five levels, little energy is left
- Top predators are few and need large areas
- Persistent chemicals, such as DDT, can build up in top predators



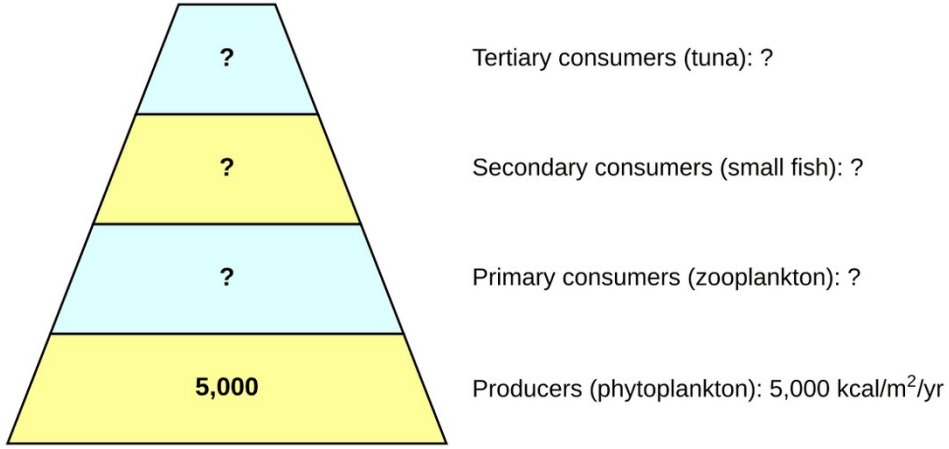
Eating Lower on the Food Chain

- Eating plants skips a trophic level
- About 10 times as much food energy reaches people
- More people can be fed from the same land



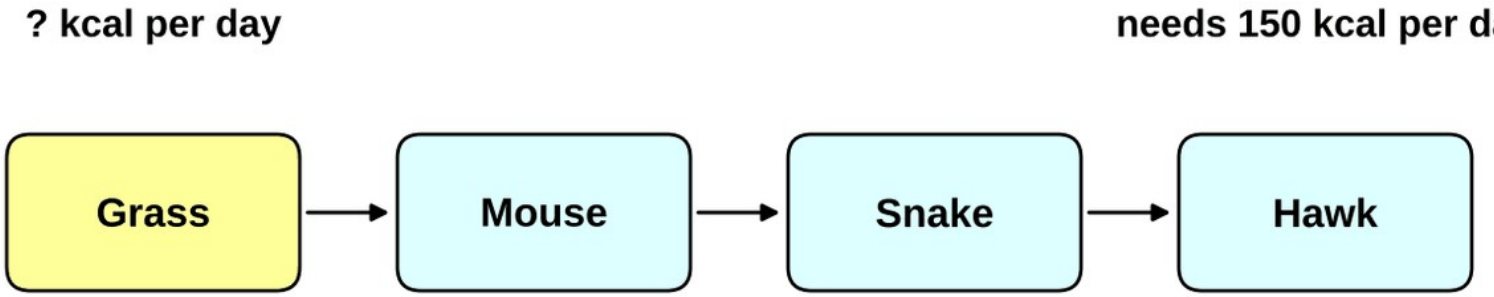
Example: Energy Up an Ocean Food Chain

Phytoplankton in a coastal area of ocean capture 5,000 kcal/m^2 of energy per year. Use the 10 percent rule to find the energy available to the zooplankton, the small fish, and the tuna.



Example: Feeding a Hawk

A hawk needs about 150 kcal of energy per day from its food. In the food chain grass → mouse → snake → hawk, how much energy must the grass capture each day to support it?



Example: A Deer's Energy Budget

A deer eats plants containing 10,000 kJ of energy. Of that, 4,000 kJ passes out in feces and 5,800 kJ is used in cellular respiration. How much energy is stored in new growth? What percent is that? Explain why it is less than the caterpillar's 17%.

Where the energy goes	Energy (kJ)
Eaten	10,000
Lost in feces	4,000
Used in cellular respiration	5,800
Stored in new growth	?

Energy Pyramids

Big Ideas

- About 10% of energy passes to the next level
- Energy not passed on is lost as heat or left in wastes
- An energy pyramid is widest at the bottom
- Little energy is left after four or five levels
- Persistent chemicals can build up in top predators