What is Energy Flow Through Trophic Levels?

Worksheet

Energy flow is the one-way transfer of energy through an ecosystem's trophic levels; on average only about 10% of the energy at one level is passed on to the next, with the rest lost as heat.

$$E_n = 0.1 \times E_{n-1}$$

Questions

1. About what percentage of energy passes from one trophic level to the next?

A) 1%
B) 10%
C) 50%
D) 90%

2. Which trophic level holds the most available energy in a typical ecosystem?

A) Producers
B) Primary consumers
C) Secondary consumers
D) Tertiary consumers

3. Why does an ecosystem lose energy between trophic levels?

A) Energy is destroyed
B) Energy is lost as heat through respiration and unused biomass
C) Producers hoard all the energy
D) Predators return energy to the sun

4. Which organisms occupy the first trophic level?

A) Producers (plants, algae)
B) Herbivores
C) Carnivores
D) Decomposers only

5. Producers in a meadow ecosystem fix 10,000 kcal of energy. How much energy is available to the primary consumers (10% efficiency)?

6. Secondary consumers (trophic level 3) in a lake have 45 kcal available. Using the 10% rule, estimate the energy originally fixed by producers.

7. A grassland pyramid starts with 8,000 kcal at the producer level. Find the energy at each of the next three trophic levels.

8. Define: What is a trophic level?

9. Define: What is the 10% rule?

10. Define: Why do energy pyramids get narrower at the top?

Answer Key

1. B) 10% - On average about 10% of energy is transferred; the rest is lost mostly as metabolic heat.

2. A) Producers - Producers capture the most energy directly from sunlight; each subsequent level has less.

3. B) Energy is lost as heat through respiration and unused biomass - Energy isn't destroyed (law of conservation) - most is dissipated as metabolic heat, and some biomass is never eaten.

4. A) Producers (plants, algae) - Producers, which make their own food via photosynthesis, form the base of every energy pyramid.

5. E(1) = 10,000 kcal (producers) E(2) = E(1) (10/100) = 10,000 0.10 = 1,000 kcal

6. E(3) = E(1) (0.10)^2 45 = E(1) 0.01 E(1) = 45 / 0.01 = 4,500 kcal

7. Level 2 (primary consumers) = 8,000 0.10 = 800 kcal Level 3 (secondary consumers) = 800 0.10 = 80 kcal Level 4 (tertiary consumers) = 80 0.10 = 8 kcal

8. A feeding position in a food chain - producer, primary consumer, secondary consumer, and so on.

9. On average, only about 10% of the energy at one trophic level is transferred to the next; ~90% is lost as heat, respiration, and unused biomass.

10. Because usable energy shrinks at every transfer, fewer organisms can be supported at higher trophic levels.