SCIENCE FOUNDATIONS

Energy transfer in ecosystems

Difficulty level: Intermediate

Science Foundations

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Overview of the concept

This is how you see why a field of grass can feed many rabbits but only a few foxes, since most of the energy is lost at each step up the food chain. A fishery manager knows that catching the big predator fish matters less than protecting the small fish and plankton below them. A farmer growing food for people directly gets more food from the same field than one feeding the crops to cattle first. Knowing energy transfer tells you why top predators are always rare, and why every food chain is a pyramid.



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Rule

Energy transfer in ecosystems: only about 10 percent of the energy at one level passes to the next level, so each level holds about $\frac{1}{10}$ of the energy of the level below it. Producers are eaten by primary consumers, which are eaten by secondary consumers, and so on up to the top consumers.

The rest is lost, mostly as heat and in waste, which is why food chains stay short.

Worked examples

EXAMPLE 1

Q **Producers capture 10000 units of energy. How much reaches primary consumers?**

SOLUTION

Use the 10 percent rule:

$\frac{1}{10}$ passes on.

Compute:

$\frac{1}{10} \times 10000 = 1000$ units

10000 ÷ 10 = 1000 units reach the primary consumers.

The result is about 1000 units.

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EXAMPLE 2

Q Same system: how much reaches secondary consumers?

SOLUTION

Apply the rule again:

$\frac{1}{10}$ of 1000 units.

Compute:

$\frac{1}{10} \times 1000 = 100$ units

1000 ÷ 10 = 100 units reach the secondary consumers.

The result is about 100 units.

Practice questions

1 Producers capture 6000 units of energy. How much reaches the primary consumers?

- **A** About 600 units
- **B** About 6000 units
- **C** About 60 units
- **D** About 60,000 units

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2

Producers capture 2000 units of energy. About how much is lost before it reaches the primary consumers?

- A About 1800 units
- B About 200 units
- C About 2000 units
- D About 20 units

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Primary consumers hold 400 units of energy. How much reaches the secondary consumers?

- A About 40 units
- B About 400 units
- C About 4 units
- D About 4000 units

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4 Secondary consumers hold 50 units of energy. About how much energy did the producers capture?

- **A** About 5000 units
- **B** About 500 units
- **C** About 5 units
- **D** About 50,000 units

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5 About what percent of energy passes to the next level?

- **A** About 10 percent
- **B** About 90 percent
- **C** About 50 percent
- **D** About 1 percent

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6

Where is the rest of the energy lost?

A Heat, movement, waste

B Light, sound, heat

C Movement, waste, light

D Heat, light, sound

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Energy decreases from level to level. Why are food chains short?

A Too little energy reaches higher levels

B Energy increases at each level

C Producers capture more energy each year

D Top consumers eat less than producers

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8

In an energy pyramid, producers are at the bottom and consumers are above. Which level has the most energy?

A Producers

B Primary consumers

C Secondary consumers

D Top consumers

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9

Which level usually has the fewest organisms?

A Top consumers

B Producers

C Primary consumers

D Secondary consumers

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10

Producers hold 10000 units of energy. About how much energy reaches the secondary consumers?

A About 100 units

B About 1000 units

C About 10 units

D About 10,000 units

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ANSWER KEY

1. About 600 units

2. About 1800 units

3. About 40 units

4. About 5000 units

5. About 10 percent

6. Heat, movement, waste

7. Too little energy reaches higher levels

8. Producers

9. Top consumers

10. About 100 units

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