Energy transfer and pest control

Student activity • observation and reasoning

YEAR 11 / LESSON 107 / BIOLOGY + SCIENCE (DOUBLE AWARD)

The question

Why is only part of one trophic level's energy available to the next?

Use the supplied examples, record your reasoning and correct it using evidence.

Equipment

- Student booklet, pencil and ruler
- Energy-flow diagram and crop-pest scenario cards

Paper, modelling and written reasoning only. No chemicals or biological samples are handled.

Course coverage: Shared Biology / Double Award: 4.7–4.9 and 5.4. Transfer efficiency and crop protection.

Plan, model or apparatus sketch

Draw and label the apparatus or biological model; identify one limitation.

Method and reasoning

Read the whole sequence before starting

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1. Draw pathways for energy in eaten biomass: assimilation, egestion, respiration and new biomass.

2. Explain that uneaten material and wastes can enter decomposer pathways rather than the next consumer level.

3. Calculate efficiency as energy in new consumer biomass divided by the relevant input ×100.

4. Use hypothetical values of 10000 kJ and 800 kJ to calculate 8%, explaining that 10% is a rough generalisation rather than a universal constant.

5. Compare pesticide and biological-control approaches for a fictional crop pest, considering effectiveness, non-target effects, resistance and control of introduced organisms.

6. Explain why pest removal can increase crop yield but decisions need evidence and ecological context.

Cleanup

- Return models and keep the corrected work.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Respiration transfers energy for life processes and ultimately dissipates heat; not all consumed material becomes new biomass. The 10000/800 kJ example is invented for arithmetic. Biological control is not automatically risk-free, and pesticides are not all identical. Fictional decision case: aphids are damaging a cabbage crop. Compare a proposed pesticide with a proposed aphid predator; name the effectiveness and non-target evidence needed before deciding. No insects or pesticides are issued.

Example / trial	Observation / evidence	Explanation / limit
Evidence / comparison		
Explanation		
Limit / correction		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Calculate the example efficiency.

2. Why is not all food assimilated?

3. What happens to much energy used in respiration?

4. Must transfer efficiency equal 10%?

5. Give one pesticide disadvantage.

6. Give one biological-control limitation.