5.1 Adaptation: a function in an environment

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

KEY WORDS adaptation • acclimatization

Objective

Adaptation: a function in an environment. Original classroom practice for IB SL; not an official IB paper.

1 Key knowledge and worked examples

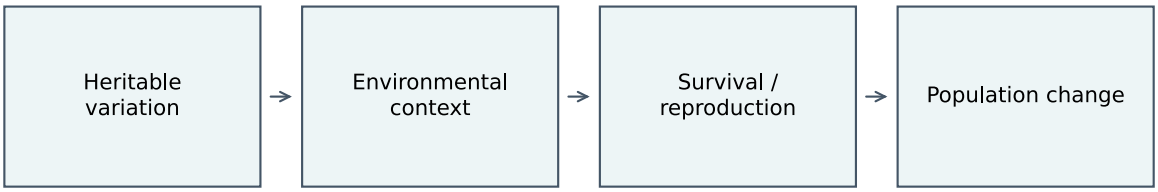
What would explain this observation?

- Leaves in dry environments often have features that reduce water loss. The value of a feature depends on environmental conditions and trade-offs.

Build the model

- An **adaptation** is a heritable feature associated with improved survival or reproduction in particular conditions.
- A thick cuticle can reduce evaporation; stomatal control affects gas exchange and water loss.
- **Acclimatization** is an individual response during life and is different from evolutionary adaptation.
- adaptation: A heritable feature benefiting survival or reproduction in a context.
- acclimatization: An individual adjustment to changed conditions during life.

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Choose evidence that can test it

- Explain both a benefit and a cost.
- Reducing stomatal opening conserves water but can limit carbon dioxide entry.
- A feature cannot be judged as universally best without its ecological context.

In the lab: Compare replicated observations across a measured environmental gradient. Account for relatedness, leaf area and age. Use local permitted plant observations rather than removing protected species.

Work from known quantities

- Known: water loss is 12 g from 0.20 square metres of leaf area over 2 h.
- Area-time-normalized rate = $12/(0.20 \times 2) = 30$ g/(m^2 h).
- Comparisons require the same humidity and temperature.

Your turn: Water loss is 8 g from 0.20 m^2 over 2 h. Calculate rate per area per hour.

Check the conclusion and its limits

- An individual organism does not evolve a new inherited trait because it needs it.
- A plausible story about function is a hypothesis requiring evidence.

Not true: Every useful individual response is evidence of a newly evolved inherited trait. Evolution acts on populations over generations through heritable variation and selection. An individual's useful acquired response is not inherited and is not evidence that a new trait evolved.

Key:

- An adaptation is a heritable feature associated with improved survival or reproduction in particular conditions.
- Explain both a benefit and a cost.
- Watch for: an individual organism does not evolve a new inherited trait because it needs it.

■ **Write from a rate of 10 grams per square metre per hour**

- Water loss is 9 g from 0.30 square metres over 3 hours.
- Find the rate per area per hour. One useful response in one individual is not a newly evolved inherited trait.

2 Practice

2.1 Which statement distinguishes acclimatization? Choose one answer.

- **A** It always produces a new species
- **B** It must change the allele frequency of a whole population
- **C** It is an individual adjustment during life [1]

2.2 Water loss is 8 g from 0.20 m^2 over 2 h. Calculate rate per area per hour. Show the relation, substitution and units. [2]

2.3 Decide whether this claim is true and justify: Evolution acts on populations over generations through heritable variation and selection. [2]

2.4 A heritable feature benefiting survival or reproduction in a context: write the technical term. [1]

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3 Exam-style questions

3.1 Fictional plants lose 12 g from 0.20 m^2 in 2 h and 9 g from 0.10 m^2 in 3 h. Compare normalized rates. Can this alone prove which is better adapted? [4]

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Solutions

2.1 C Acclimatization is a reversible physiological adjustment by an individual during its lifetime, like making more red blood cells at altitude. It changes no allele frequencies and creates no species - those are population-level evolutionary changes.

2.2 rate=mass/(area×time)=8/(0.20×2)=20 g/(m^2 h).

2.3 True. True. Evolution acts on populations over generations through heritable variation and selection. An individual's useful acquired response is not inherited and is not evidence that a new trait evolved.

2.4 adaptation. adaptation means A heritable feature benefiting survival or reproduction in a context.

3.1 Both give 30 g/(m^2 h). Match humidity, temperature and plant condition; equal recorded water loss is not proof of equal survival or adaptation. Repeat with representative samples.

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