

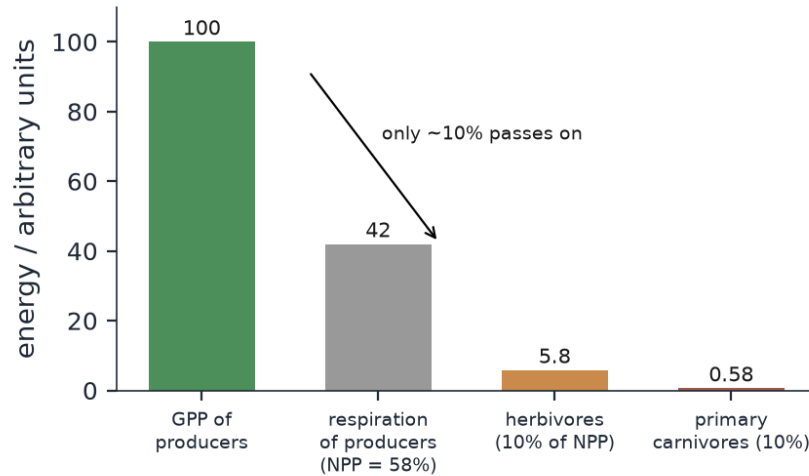
Exercise walk-through

4.10

Decomposition, PCR, DNA profiling and time of death (statements 6.16–6.20)

Pearson Edexcel · International A-Level · Biology

Ten per cent, four losses



- 1 **Fix** grassland fixes 45 000 kJ per square metre per year
- 2 **Subtract** respiration spends 19 000, so $NPP = 26\ 000$
- 3 **Transfer** cattle keep about 2 600; humans eating cattle keep 260

Selection filters, isolation splits

Directional : one extreme favoured,
the mean shifts - resistance alleles spread

Stabilising : the average favoured, both extremes trimmed

Isolation : barrier (allopatric) or behaviour (sympatric) stops gene flow

Speciation : diverged populations can no longer interbreed

Check yourself

Your turn

Grassland NPP is 40 000 kJ per square metre per year. At 10% per transfer, what reaches second-order consumers?

- A. 400 kJ - two transfers of 10%
- B. 4 000 kJ - one transfer
- C. 40 kJ - three transfers
- D. 400 000 kJ - the food chain multiplies energy

Exercises 2.1·2.3

2.1 Name the enzyme used in PCR and the temperature of the extension step. [2]

2.2 Explain why short DNA fragments travel further than long ones in gel electrophoresis. [2]

2.3 State two factors that affect the rate of decomposition. [2]

Exercises 2.1·2.3

2.1 Name the enzyme used in PCR and the temperature of the extension step. [2]

2.1 Taq DNA polymerase; 72 °C.

2.2 Explain why short DNA fragments travel further than long ones in gel electrophoresis. [2]

2.2 The gel's mesh resists movement; shorter fragments thread through the pores more easily, so at the same charge they migrate faster and further in a given time.

2.3 State two factors that affect the rate of decomposition. [2]

2.3 Any two: temperature, oxygen, moisture, presence of scavengers or insects.

Exercises 3.1·3.2

3.1 Describe the three steps of one PCR cycle with their temperatures, explain why the polymerase must survive 95 °C, and calculate the copies produced from one double-stranded template after 12 cycles. [5]

3.2 A DNA profile shows a child sharing 11 of 16 bands with the mother. Explain how the remaining bands identify the father, and why a single shared band alone cannot prove parentage. [4]

Exercises 3.1·3.2

3.1 Describe the three steps of one PCR cycle with their temperatures, explain why the polymerase must survive 95 °C, and calculate the copies produced from one double-stranded template after 12 cycles. [5]

3.1 Denaturation at about 95 °C separates the strands; primer annealing at 50-60 °C lets primers bind the template ends; extension at 72 °C, Taq polymerase adding nucleotides 5'→3'. The enzyme must withstand 95 °C each cycle – a mesophilic polymerase would denature itself. $2^{12} = 4096$ copies.

3.2 A DNA profile shows a child sharing 11 of 16 bands with the mother. Explain how the remaining bands identify the father, and why a single shared band alone cannot prove parentage. [4]

3.2 The child's other bands must have come from the father – every band absent from the mother should be present in him. One shared band could occur by chance in the population; probability falls only as more unmatched bands are excluded, so single-band matches prove nothing.

Exercise 3.3

3.3 A body found at noon has a core temperature of 31°C in still air of 12°C , mild rigor in the jaw only, and blowfly eggs at the eyes and nostrils. Estimate the time of death with reasons, and state one factor that would make the temperature estimate too short. [6]

Exercise 3.3

3.3 A body found at noon has a core temperature of $31\text{ }^{\circ}\text{C}$ in still air of $12\text{ }^{\circ}\text{C}$, mild rigor in the jaw only, and blowfly eggs at the eyes and nostrils. Estimate the time of death with reasons, and state one factor that would make the temperature estimate too short. [6]

3.3 Temperature: $(37 - 31) \approx 6\text{ }^{\circ}\text{C}$ fall at about $1\text{ }^{\circ}\text{C}$ per hour suggests ~6 hours before noon – death near 06:00. Rigor beginning in the jaw (small muscles first) is consistent with 6-12 hours. Blowfly eggs laid within hours of death, not yet hatched to maggots, fit the same window. Heavy clothing or a warm environment slows cooling, which would make 6 hours an underestimate – true interval longer.