



ANSWER BOOK

Resistance, drift and the evidence: selection where you can watch it happen

Evolution and speciation · Unit B19

AQA 3.4.4, 3.7.3 · OCR A 4.2.2, 6.1.2 · Edexcel A Topic 4, Topic 6 · CAIE 17.2, 17.3

6 questions · 20 marks

NAVY EDITION

SECTION A · Short, 1 to 2 marks

- A1** **B1** a sharp reduction in population size that leaves the survivors carrying only a fraction of the original genetic diversity. **B1** northern elephant seals, hunted down to a few dozen animals in the 1890s, now number well over a hundred thousand and remain strikingly uniform genetically. [2]
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SECTION B · Standard, 3 to 5 marks

- B1** **B1** vertical transfer passes the gene from a parent cell to its daughter cells at binary fission, whereas horizontal transfer passes it between bacteria that are not parent and offspring. **B1** vertical transfer raises the frequency of the allele within one population as resistant lineages increase, whereas horizontal transfer puts the gene into cells that never carried it and never mutated. **B1** vertical transfer is confined to descendants of the original resistant cell, whereas a plasmid passed through a conjugation tube can carry the gene to bacteria of a different species, which is how a gene first seen in a harmless gut bacterium turns up later in a pathogen. **B1** a single plasmid may carry resistance to several antibiotics, so horizontal transfer can produce multiple resistance in one step, which vertical transfer cannot. [4]
- B2** **B1** the fossil record places organisms in an order, with simple prokaryote-like forms in the oldest rocks and major groups appearing in a sequence matching that predicted by their anatomy, including transitional forms such as *Tiktaalik* between lobe-finned fish and tetrapods. **B1** comparative anatomy: the forelimb of a human, a bat, a whale and a horse contains the same bones in the same arrangement doing entirely different jobs, which modification of one ancestral limb explains and independent design does not. **B1** comparative biochemistry: all life uses the same genetic code, the same twenty amino acids and ATP, and conserved molecules such as cytochrome c differ at more positions between more distantly related species. **B1** these lines come from fields that could have contradicted one another and do not, so their agreement is the argument; any single line taken alone is far weaker than several that converge on the same branching order. [4]
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- B3** **B1** the alleles reaching the next generation are a sample of those present in this one, decided by which individuals happen to breed and which gametes happen to meet. **B1** events such as which juvenile happens to be standing under a falling branch have nothing to do with fitness, so the frequencies shift with no selection acting at all. **B1** a small sample deviates further from what it is drawn from than a large one, for the same reason that ten coin tosses stray further from half than a thousand do, so the change each generation is larger in a small population. **B1** drift can therefore fix one allele and lose the other altogether, including a mildly beneficial one, because in a small population chance overwhelms a small difference in fitness, and a lost allele returns only by mutation or migration. [4]
- B4** **B1** the bacteria in an infection are not all equally susceptible, and the most susceptible cells are the ones killed first. **B1** if treatment stops when the symptoms go, the cells left alive are a biased sample: the least susceptible ones, including any carrying partial resistance. **B1** those cells reproduce, so the population that regrows is less susceptible than the one treatment started with, whereas finishing the course removes the tail of the distribution as well as its head. [3]
- B5** **B1** the refuge produces no toxin, so susceptible insects go on breeding there in large numbers instead of being killed. **B1** a rare resistant survivor emerging from the treated crop is therefore far more likely to mate with a susceptible insect than with another resistant one. **B1** the offspring of such a pairing are heterozygous, and because resistance is recessive the toxin still kills them, so the allele is not passed on and its frequency rises far more slowly. [3]