

## 6.4 Evolution, genetics and evidence

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

Total: 22 marks

KEY WORDS fossil • speciation • antibiotic resistance

### Objective

Tell the history of evolution and genetics, explain fossils, extinction and antibiotic resistance. Biology only. Original questions for spec statements 4.6.3.

### 1 Key knowledge and worked examples

**Darwin:** after a round-the-world expedition, experiments and discussion, proposed **evolution by natural selection** – variation within a species; the best-suited survive and breed; their characteristics are passed on. Published *On the Origin of Species* (1859). Accepted only gradually because:

- it challenged the idea that God made all animals and plants;
- there was **insufficient evidence** at publication;
- the **mechanism of inheritance was unknown** until 50 years later.

**Lamarck** – changes acquired during an organism's lifetime are inherited – now known wrong in almost all cases.

**Wallace:** independently proposed the theory; **joint 1858 publications** with Darwin prompted Darwin to publish; best known for **warning colouration** and pioneering **speciation**.

**Mendel:** mid-19th-century pea breeding – each characteristic inherited through 'units' passed on unchanged; importance unrecognised in his lifetime. Then: chromosomes observed (late 19th c.) → 'units' behave like chromosomes → **genes on chromosomes** (early 20th c.) → **DNA structure and gene function** (mid 20th c.).

**Evidence for evolution:** characteristics passed on in genes; **fossils**; **antibiotic resistance** in bacteria.

**Fossils form:** (1) parts **not decayed** – a decay condition absent; (2) parts **replaced by minerals** as they decay; (3) **preserved traces** – footprints, burrows, rootlet traces. Early soft-bodied life left few traces, mostly destroyed by **geological activity** – so how life began is uncertain. Fossils show how much or little organisms have changed; **evolutionary trees** combine classification and fossil data.

**Extinction** – no individuals of a species remain: new diseases, new predators, new

competitors, environmental change, catastrophic events.

**Resistant bacteria:** bacteria reproduce fast → **mutations** produce new strains; a resistant strain survives antibiotics, reproduces and spreads (people are not immune; no effective treatment) – MRSA. Reduce the rate: doctors avoid **inappropriate prescribing** (non-serious/viral infections); patients **complete the course**; restrict **agricultural use**. New antibiotics are costly and slow, unlikely to keep pace.

**Worked example (4 marks).** Explain why patients must complete a course of antibiotics.

Stopping early leaves bacteria alive; the survivors may include mutants with partial resistance; these reproduce, forming a resistant strain; completing the course kills all the bacteria, leaving none to mutate and multiply.

## 2 Practice

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**2.1** Give two reasons Darwin's theory was accepted only gradually. [2]

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**2.2** What was Mendel's key observation, and what do we now call his 'units'? [2]

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**2.3** Give the three ways fossils form. [3]

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## 3 Exam-style questions

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**3.1** Explain how fossils provide evidence for evolution, and why scientists cannot be certain how life on Earth began. [5]

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**3.2** Explain how a strain of MRSA becomes resistant and spreads, and give three measures that slow resistance. [6]

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**3.3** Describe how Wallace's work relates to Darwin's, and one reason joint publication mattered. [4]

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## Solutions

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**2.1** Any two: it challenged the idea that God made all animals and plants; insufficient evidence at the time of publication; the mechanism of inheritance and variation was unknown for 50 years.

**2.2** Each characteristic is determined by 'units' passed on unchanged to descendants; genes.

**2.3** From parts that have not decayed, because a condition for decay is absent; parts replaced by minerals as they decay; preserved traces such as footprints, burrows and rootlet traces.

**3.1** Fossils are the remains of organisms from millions of years ago found in rocks; their sequence shows how organisms have changed/developed over time – evolution; evolutionary trees built from fossils show relatedness. Certainty is impossible because many early life forms were soft-bodied and left few traces; and many of those traces were destroyed by geological activity.

**3.2** Bacteria reproduce rapidly and mutations occur continuously, producing new strains; a mutation may give resistance, so the antibiotic does not kill that bacterium; it survives and reproduces, so the resistant population rises and spreads – people are not immune and no treatment works. Measures: doctors do not prescribe antibiotics for non-serious or viral infections; patients complete the course so all bacteria are killed; agricultural use of antibiotics is restricted.

**3.3** Wallace independently proposed the theory of evolution by natural selection; he published joint writings with Darwin in 1858; this prompted Darwin to publish *On the Origin of Species* in 1859; Wallace's own evidence – gathered worldwide, e.g. warning colouration and speciation – supported the same theory.