

Solutions

Each answer shows the steps, then the **result**.

2.1

- evolution is the change in the gene pool / allele frequencies of a population over many generations, leading to new species

2.2

- allopatric — populations separated by a geographical barrier; sympatric — populations in the same area separated by behaviour/ecology

3.1 B

- Very similar DNA suggests a recent common ancestor

3.2 A

- A geographical barrier causing speciation is allopatric

3.3

- a geographical barrier separates the population into two; each population faces different conditions and undergoes different selection / mutations / drift; their gene pools change in different ways; eventually they are so different they can no longer interbreed to produce fertile offspring — two species

3.4

- the more similar the DNA base sequences, the more recently the species shared a common ancestor; large differences indicate they diverged longer ago

3.5

(a)

- A species is a group of organisms with similar features that can **interbreed to produce fertile offspring**. These populations can do so in the laboratory, so by that definition they remain one species; but they are reproductively isolated in the wild, so they are diverging and would be described as incipient species or subspecies

(b)

- **Sympatric** speciation — the two populations occupy the same geographical area; they are separated by a behavioural or ecological barrier, here breeding depth. Allopatric speciation instead begins with a **physical** barrier such as a river or mountain that geographically separates the populations

(c)

- Sequence the same gene in both populations and count the number of base differences; mutations accumulate at a roughly constant rate over time — the molecular clock; so the number of differences, divided by that rate, estimates the time since the populations shared a common ancestor

(d)

- Appearance can mislead in two opposite ways: unrelated species may evolve similar features because they face the same selection pressure — convergent evolution; and closely related species may look very different if their environments differ. DNA is the actual heritable material, so the number of sequence differences reflects ancestry directly, and it can compare organisms with no visible features in common at all