Topic 4: Natural Selection and Genetic Modification

Edexcel · GCSE Biology · Revision Notes

Specification reference: 4.1–4.7

Note: Sections marked ★ HIGHER TIER ONLY are for Higher tier students only. Foundation tier students should focus on the unmarked sections.

4.1–4.3 Natural Selection and Evolution

Darwin and Wallace independently proposed natural selection as the mechanism for evolution.

- 1. Variation in population (from mutations and sexual reproduction).
- 2. Competition for resources.
- 3. Better-adapted individuals survive and reproduce.
- 4. Advantageous alleles inherited by offspring.
- 5. Over generations, population adapts to environment.

Evidence for evolution: fossil record (showing gradual change), comparative anatomy, DNA similarities between related species, antibiotic resistance in bacteria (observable evolution).

4.4 Speciation

Speciation occurs when a population becomes isolated and evolves differently until they can no longer interbreed.

- Geographic isolation (e.g. by a mountain range or sea) separates populations.
- Different environments lead to different selection pressures.
- Gene pools diverge over generations.
- Eventually the groups are so different they cannot interbreed — a new species has formed.

Key Terms

Speciation: Formation of a new species through reproductive isolation and divergent evolution

4.5–4.7 Selective Breeding and Genetic Engineering

Selective breeding: humans select individuals with desirable traits to breed. Repeated over many generations.

- Examples: wheat with high yield, cows producing more milk, dogs bred for temperament.
- Risk: reduces genetic diversity — population more vulnerable to new diseases.

Genetic engineering: transferring genes between organisms.

- Restriction enzymes cut out the gene from donor DNA.
- Gene inserted into plasmid (vector) using ligase.
- Plasmid introduced into host cell.

- Host cell expresses the new gene and produces the desired protein.
- E.g. human insulin gene in bacteria; herbicide-resistant GM crops; golden rice.
- Cloning: tissue culture (plants), embryo splitting, adult cell cloning (Dolly the sheep).

Exam Tip: In exams: state the name of the enzyme that cuts DNA (restriction enzyme) and the one that joins DNA (ligase).