

# 17.2 Natural and artificial selection

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

Total: 25 marks

**KEY WORDS** natural selection • selective breeding  
 • hardy–weinberg principle • founder effect • genetic drift

## Objective

Build the skills to answer exam questions on **natural and artificial selection** – **natural selection**, types of selection, the **founder effect** and **genetic drift**, the **Hardy–Weinberg principle** – , and **selective breeding**.

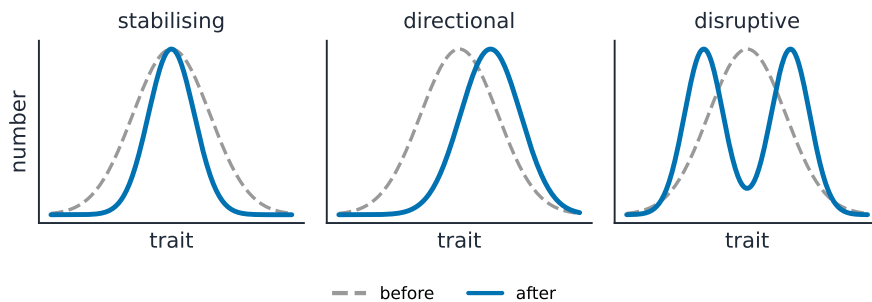
You must be able to:

- explain natural selection and how it acts as a stabilising, directional or disruptive force
- explain the founder effect, genetic drift and the bottleneck effect
- use the Hardy–Weinberg principle and describe selective breeding

## 1 Key knowledge and worked examples

### ■ Natural selection and its forces

Populations make more offspring than can survive, so they **compete**; the best **adapted** survive, reproduce and pass on their alleles, so helpful alleles become more common.



stabilising: favours the mean • directional: one extreme • disruptive: both extremes

*Stabilising favours the average; directional favours one extreme; disruptive favours both extremes*

### ■ Changing allele frequencies



*A bottleneck (or founder effect) leaves few alleles; genetic drift changes frequencies by chance*

**Antibiotic resistance** is natural selection: a chance mutation makes some bacteria resistant; the antibiotic kills the rest; the resistant survivors reproduce.

### ■ Hardy–Weinberg

With  $p + q = 1$  and  $p^2 + 2pq + q^2 = 1$ , you can find allele and genotype frequencies (when the population is large, mating random, and there is no mutation, migration or selection).

### ■ Selective breeding



*Humans choose which organisms breed, so useful features (e.g. disease resistance, milk yield) increase*

## 2 Practice

2.1 Name the type of selection that favours the average and removes the extremes. [1]

2.2 State **two** conditions under which the Hardy–Weinberg principle holds. [2]

### 3 Exam-style questions

**3.1** A change that favours one extreme of a range, shifting the mean, is: [1]

- ☐ **A** stabilising selection  
**B** directional selection  
**C** disruptive selection  
**D** genetic drift

**3.2** The bottleneck effect reduces a population's: [1]

- ☐ **A** mutation rate  
**B** genetic variety (allele variety)  
**C** birth rate  
**D** number of chromosomes

**3.3** In a population, the recessive phenotype (genotype  $q^2$ ) occurs in 16% of individuals.

(a) Calculate the frequency of the recessive allele,  $q$ . [2]

(b) Calculate the frequency of heterozygotes ( $2pq$ ). [2]

**3.4** Explain how the overuse of antibiotics leads to a resistant bacterial population, using the idea of natural selection. [3]

**3.5** A population of moths on an island is normally pale. After a volcanic eruption darkened the tree bark, the proportion of dark moths rose from 3% to 78% in twelve generations.

(a) Explain this change in terms of natural selection, in the correct order. [5]

(b) Name the type of selection shown, and describe how it differs from stabilising selection. [3]

(c) A small group of these moths is blown to a second, unaffected island and founds a new population there. Name and explain the effect this is likely to have on that population's allele frequencies. [3]

(d) Explain **one** way in which artificial selection differs from natural selection. [2]