

17.2 Natural and artificial selection

Name: _____ Class: _____ Date: _____

Total: 25 marks

KEY WORDS natural selection 自然选择 • selective breeding 选择育种

• hardy–weinberg principle 哈迪 • founder effect 奠基者效应 • genetic drift 遗传漂变

Objective

Build the skills to answer exam questions on **natural and artificial selection** — **natural selection** 自然选择, types of selection, the **founder effect** 奠基者效应 and **genetic drift** 遗传漂变, the **Hardy–Weinberg principle** 哈迪-温伯格原理, and **selective breeding** 选择育种.

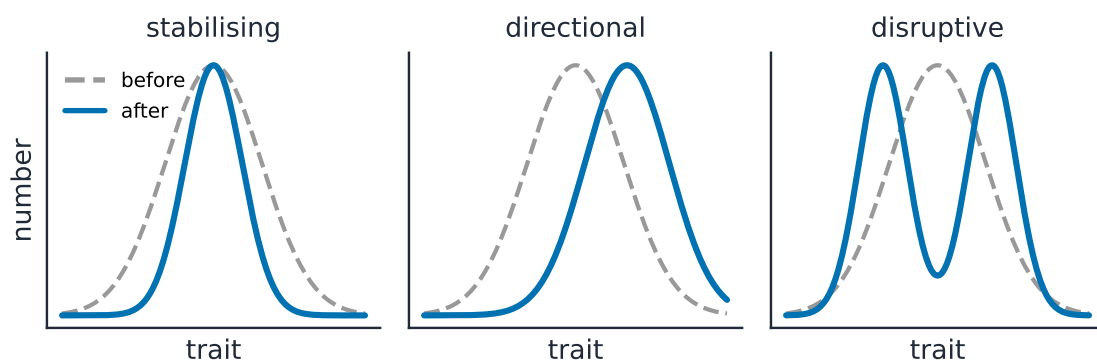
You must be able to:

- 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 Worked examples

■ Natural selection and its forces

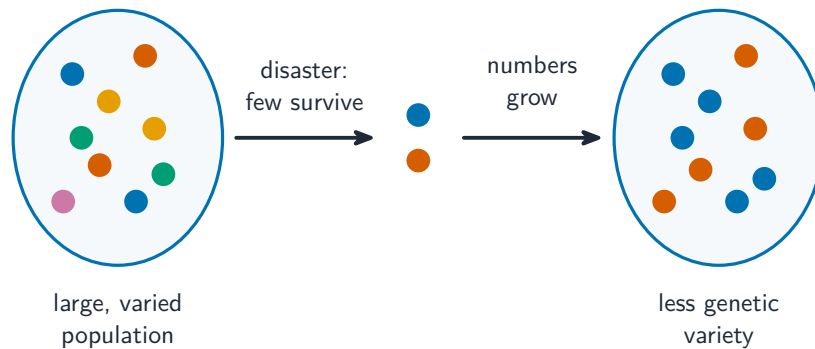
Populations make more offspring than can survive, so they **compete** 竞争; the best **adapted** 适应 survive, reproduce and pass on their alleles, so helpful alleles become more common.



directional: favors one extreme • stabilising: favors mean • disruptive: favors 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	B
C	D

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

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

A	B
C	D

- 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]
