

Selection & Evolution

A-Level Biology ■ Topic 17

A-Level Biology



Selection & Evolution

What we will cover

- 1 Variation
- 2 Natural selection
- 3 Types of selection
- 4 Changing allele frequencies
- 5 Selective breeding
- 6 Speciation

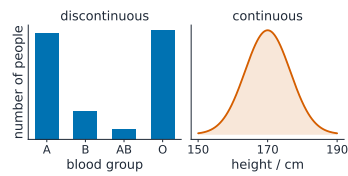


striking natural variation

1 Variation and selection

Selection & Evolution
└ Variation and selection

Variation



Variation 变异 comes from genes, the environment, or both.

- **discontinuous** 不连续变异 – separate groups (blood group)
- **continuous** 连续变异 – a smooth range (height)

The **t-test** t 检验 compares two sample means.

Selection & Evolution
└ Variation and selection

Natural selection

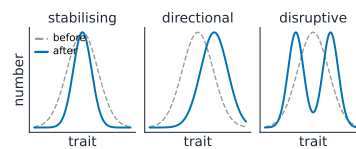


Too many offspring **compete** 竞争; the best **adapted** 适应 survive & **reproduce** 繁殖, passing on their alleles.

Over generations, helpful alleles become common – **natural selection** 自然选择. **Antibiotic resistance** 耐药性 is the same process.

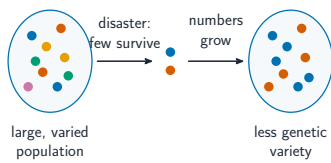
Selection & Evolution
└ Variation and selection

Types of selection



- **stabilising** 稳定选择 – favours the average
- **directional** 定向选择 – shifts the mean one way
- **disruptive** 分裂选择 – favours both extremes

Changing allele frequencies



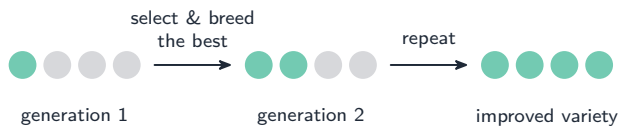
- **founder effect** 奠基者效应 – a few start a new population
- **genetic drift** 遗传漂变 – chance change in small populations
- **bottleneck** 瓶颈效应 – a crash cuts variety

The **Hardy-Weinberg** 哈迪-温伯格原理 principle calculates allele frequencies.

2 Breeding and evolution

Selective breeding

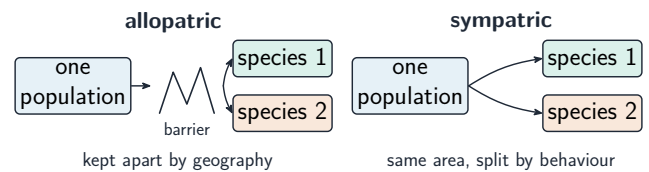
In **selective breeding** 选择育种 (**artificial selection** 人工选择), humans choose which organisms breed. Used to breed **disease resistance** 抗病性 into crops and raise milk **yield** 产量 in cattle.



Speciation

Evolution 进化 changes a population's **gene pool** 基因库 over time; DNA shows how closely species are related.

- **allopatric** 异域物种形成 – a physical barrier
- **sympatric** 同域物种形成 – same area, different behaviour



3 Recap

Worked example – Hardy-Weinberg

A recessive condition affects 1 in 100 people. Find the frequency of carriers.

- Affected are homozygous recessive
 $\Rightarrow q^2 = 0.01$.
- $q = \sqrt{0.01} = 0.1$, and $p = 1 - q = 0.9$.
- Carriers are **heterozygous**:
 $2pq = 2 \times 0.9 \times 0.1$
- $= 0.18 \Rightarrow 18\%$ – 18 times more carriers than affected people.

Two equations: $p + q = 1$ and $p^2 + 2pq + q^2 = 1$. Always start from q^2 – the **recessive phenotype** is the only frequency you can count directly.

Topic 17 – key takeaways

1 Variation

discontinuous (groups) vs
continuous (range)

2 Natural selection

the best-adapted survive &
reproduce

3 Selection types

stabilising, directional, disruptive

4 Speciation

allopatric (barrier) vs sympatric
(behaviour)

Check yourself

- 1 Blood group is which pattern of variation?
- 2 Which selection shifts the mean to one extreme?
- 3 What reduces variety after a population crash?
- 4 Speciation by a mountain range is which type?



Answers 1. discontinuous 2. directional 3. a bottleneck 4. allopatric