A-LEVEL BIOLOGY • EXERCISE SHEET

17.1 Variation

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

Objective

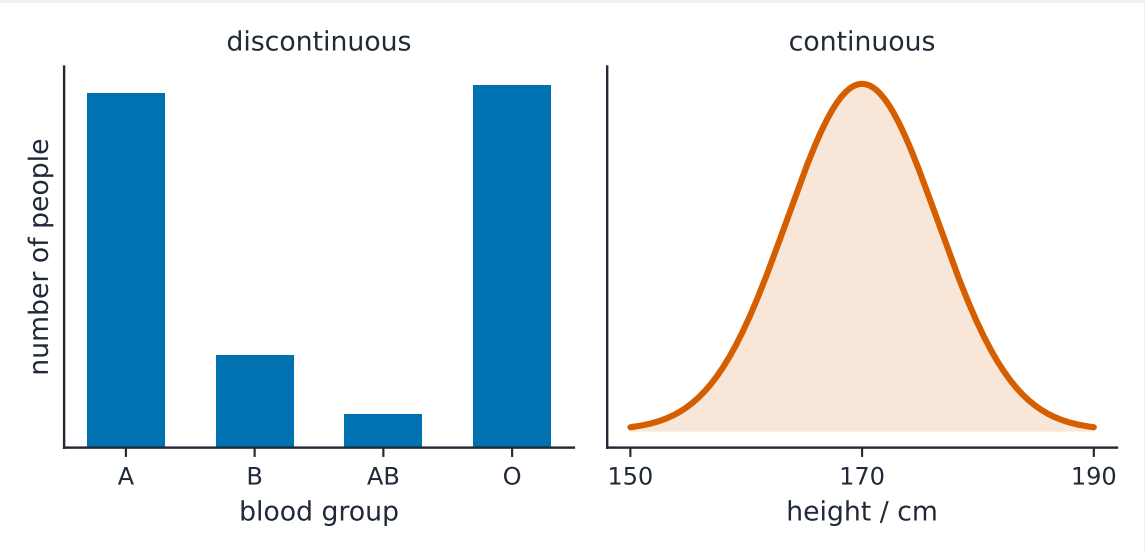
Build the skills to answer exam questions on **variation** —**genetic** 遗传 and **environmental** 环境 causes, **continuous** 连续 and **discontinuous** 不连续 variation, and comparing samples with the **t-test**.

You must be able to:

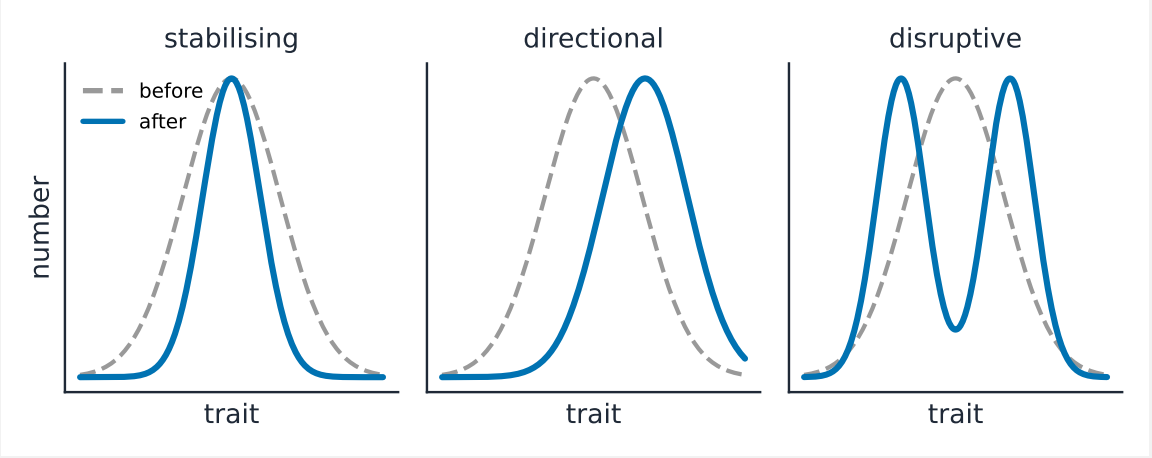
- explain genetic, environmental and combined causes of phenotypic variation
- explain continuous and discontinuous variation and their genetic basis
- use a t-test to compare the means of two samples

1 Worked examples

Causes and patterns of variation



Discontinuous variation falls into separate groups; continuous variation is a smooth range



Variation is acted on by the types of selection

- **genetic only** —set by alleles (e.g. blood group); **environmental only** —set by surroundings (e.g. a scar); most features are a **combination** (e.g. height).
- **discontinuous**: separate categories, controlled by one or a few **genes** 基因, little environmental effect.
- **continuous**: a smooth range, controlled by **many genes** plus the environment.

The t-test

The **t-test** compares the **means** of two samples to see whether their difference is real or just chance. A large t (beyond the critical value) means the difference is significant; a small t means it could be due to chance.

2 Practice

2.1 State whether each is continuous or discontinuous variation: human height; ABO blood group. [2]

2.2 Give **one** example of a feature caused by both genes and the environment. [1]

3 Exam-style questions

3.1 Which feature shows discontinuous variation? [1]

- **A** body mass
- **B** ABO blood group
- **C** height
- **D** skin colour

3.2 Continuous variation is usually caused by: [1]

- **A** a single gene only
- **B** many genes together, plus the environment
- **C** the environment only
- **D** a chromosome mutation

3.3 A student measures the heights of plants grown in sun and in shade and wants to know if the difference in mean height is significant.

(a) Name a statistical test the student should use. [1]

(b) The calculated t value is greater than the critical value at $p = 0.05$. State what this tells the student. [2]

3.4 Explain why two genetically identical plants can still differ in height. [2]

4 Go further

You are now ready for the real exam questions on this subtopic. Open the **17.1 Variation** past-paper sheet in the Library, or try this in **Practice mode**:

- 9700/41 N25 —Q2 (variation, structured calculation)

Solutions

2.1 height —continuous; ABO blood group —discontinuous.

2.2 e.g. height / body mass / skin colour.

3.1 B. ABO blood group falls into separate categories.

3.2 B. Continuous variation is polygenic and affected by the environment.

3.3 (a) the t-test.
(b) the difference between the means is significant; it is unlikely (less than 5% probability) to be due to chance.

3.4 the environment differs (e.g. light, water, minerals); environmental factors affect the phenotype as well as the genes.