Variation and selection

IGCSE Biology

Variation

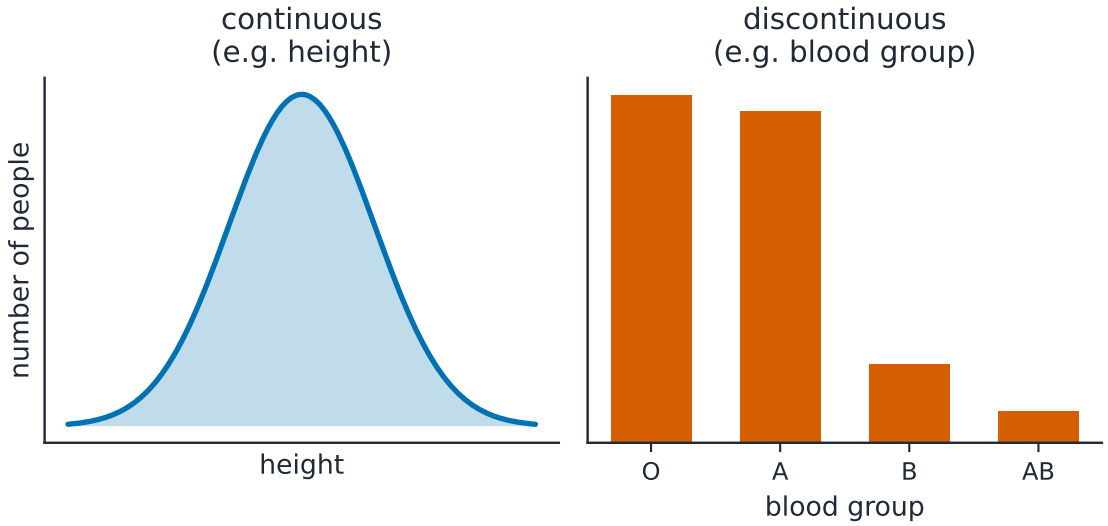
People show wide variation in many inherited features.

Image: Yann Kemper, CC0 (commons.wikimedia.org)

Variation 变异 means the differences between individuals of the same **species** 物种. There are two types:

- **continuous variation** 连续变异—a smooth range of **phenotypes** 表现型 between two extremes (for example body length and body mass).
- **discontinuous variation** 不连续变异—a few separate phenotypes with nothing in between (for example **ABO blood groups** 血型, or seed shape in peas).

Discontinuous variation is usually caused by **genes** 基因 only. Continuous variation is caused by **both** genes and the **environment** 环境—for example, your height depends on your genes and also on your diet.



Continuous variation is a smooth range; discontinuous variation falls into separate groups

Mutation

A **mutation** 突变 is a genetic change. Mutations are the way **new alleles** 等位基因 are made, so they are the original source of all variation. **(Supplement)** A **gene mutation** 基因突变 is a random change in the **base sequence** 碱基序列 of DNA.

Ionising radiation 电离辐射 (such as X-rays) and some chemicals raise the **rate** 速率 of mutation. **(Supplement)** Other sources of genetic variation are **meiosis** 减数分裂, random mating and random **fertilisation** 受精.

Adaptive features

An **adaptive feature** 适应特征 is an **inherited** 遗传 feature that helps an organism to **survive** 生存 and **reproduce** 生殖 in its **environment**.

(Supplement)

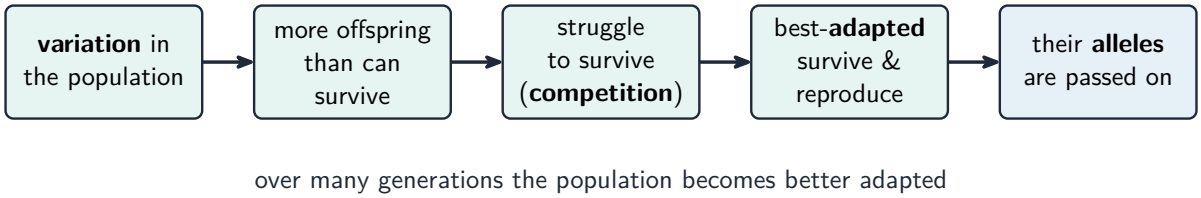
- **hydrophytes** 水生植物 (water plants) have features such as air spaces to help them float, and stomata on the upper leaf surface.
- **xerophytes** 旱生植物 (desert plants) have features such as a thick waxy cuticle, few small stomata, and the ability to store water —all to reduce water loss.

Natural selection

Natural selection 自然选择 explains how a species becomes better suited to its environment:

1. there is genetic variation in a population (caused by mutation).
2. organisms produce **many offspring** 后代—more than can survive.
3. there is a struggle to survive, with **competition** 竞争 for **resources** 资源 such as food and space.

4. the individuals that are better **adapted** 适应 are more likely to survive and reproduce.
5. they pass on their alleles, so the helpful alleles become more common in the next generation.



Natural selection: the best-adapted survive, reproduce and pass on their alleles

The dark (melanic) form of the peppered moth —the form favoured on soot-darkened bark

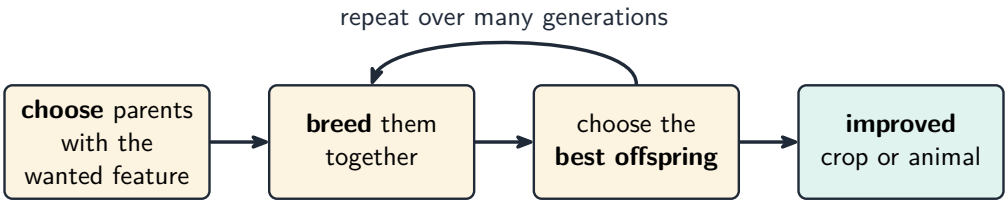
Image: Chiswick Chap, CC BY-SA 3.0 (commons.wikimedia.org)

(Supplement) Over many generations this makes the population more suited to its environment; this process is called adaptation. A clear example is **antibiotic** 抗生素-resistant **bacteria** 细菌: a few bacteria carry a **resistant** 耐药 allele and survive the antibiotic, then multiply, until the whole population is resistant.

Selective breeding

In **selective breeding** 选择育种 (also called **artificial selection** 人工选择), humans choose which organisms breed:

1. choose the individuals that have the features you want.
2. cross them to produce the next generation.
3. choose the offspring that show those features, and repeat over many generations.



In selective breeding, humans choose which organisms breed, over many generations

This is used to improve **crops** 农作物 (for example a higher yield) and farm animals (for example cows that give more milk).

(Supplement) The key difference: in natural selection the **environment** decides which individuals survive; in artificial selection **humans** decide.

Exam tips

- Continuous variation = a range (genes + environment); discontinuous = separate groups (genes only).
- Mutation makes new alleles —the source of all variation. Radiation and some chemicals raise the mutation rate.
- Natural selection: variation → too many offspring → struggle and competition → the best-adapted survive and reproduce → they pass on their alleles.
- Antibiotic resistance in bacteria is natural selection in action.
- Selective breeding (artificial selection): humans pick the parents; in natural selection, the environment ”picks”.