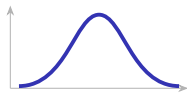


Variation & Selection

IGCSE Biology ■ Topic 18

IGCSE Biology



Variation & Selection

What we will cover

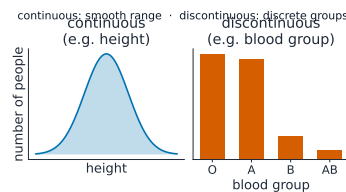
- 1 Variation
- 2 Mutation & adaptation
- 3 Natural selection
- 4 Examples
- 5 Selective breeding

1 Variation

Variation & Selection

└ Variation

Variation



- **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).

Variation & Selection

└ Variation

Mutation is where new variation comes from

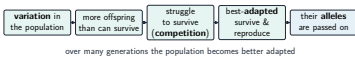
original: A T G C A
mutated: A T T C A → a change in the bases = a new allele

A **mutation** 突变 is a genetic change. It is how **new alleles** 等位基因 are made, so it is the original source of *all* variation.

- **ionising radiation** 电离辐射 (X-rays) and some chemicals raise the **rate**
- **(Supplement) meiosis** 减数分裂, random fertilisation and random mating then *shuffle* what mutation created

2 Selection

Natural selection



Natural selection 自然选择:

- 1 variation in the population
- 2 more offspring than can survive
- 3 **competition** 竞争 to survive
- 4 **best-adapted** 适应 survive & breed
- 5 helpful alleles spread

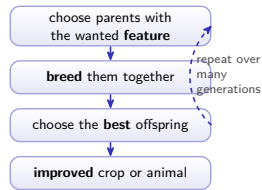
Examples



The dark **peppered moth** 桦尺蛾 was favoured on soot-darkened bark.

Antibiotic 抗生素-resistant bacteria are natural selection happening fast.

Selective breeding



humans choose which breed (not the environment)

In **selective breeding** 选择育种, humans choose which organisms breed, over many generations (better crops & animals).

Natural selection: the **environment** decides. Selective breeding: **humans** decide.

Adaptive features



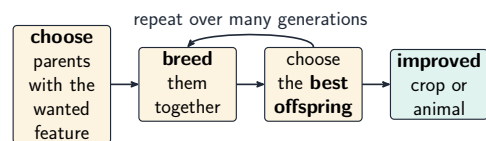
A camel is adapted to desert life: it stores fat in its humps and can survive a long time without water

Plants adapted to too much water, and to too little

hydrophytes 水生植物	water plants – air spaces to help them float, and stomata on the upper leaf surface, where the air is
xerophytes 旱生植物	desert plants – a thick waxy cuticle, few small stomata, and the ability to store water
the xerophyte logic	every feature reduces transpiration 蒸腾作用, because water is the scarce resource 资源
the hydrophyte logic	water is abundant, so the problems are floating and gas exchange instead
further xerophyte features	sunken stomata, rolled leaves, hairs – all trapping humid air next to the stomata

State the feature, then **what it does about water**. "Thick waxy cuticle" alone is a description; "so less water evaporates from the leaf" is the mark.

Selective breeding, continued



humans choose which breed (not the environment)

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

Selective breeding, step by step

- 1. select** choose the individuals with the **desired characteristic**
 - 2. cross** breed them together to produce the next generation
 - 3. select again** choose the offspring showing the characteristic most strongly
 - 4. repeat** over **many generations**, until the characteristic is reliable
- used for crops 农作物** a higher yield, disease **resistance 抗性**, or better taste
- and for animals** cows that give more milk, sheep with more wool

The difference from natural selection is **who does the selecting**: a farmer choosing, against the environment choosing. The mechanism is otherwise identical.

Variation & Selection

Variation, continued



People show wide variation in many inherited features.

Variation & Selection

Two kinds of variation

- variation 变异** the differences between individuals of the same **species 物种**
- continuous 连续变异** a range of values with no distinct groups – height, mass. Affected by genes *and* environment
- discontinuous 不连续变异** a small number of **distinct** categories – blood group, ability to roll the tongue. Genes alone
- where new variation comes from** **gene mutation 基因突变** – a change in the base sequence **碱基序列** of DNA
- the plot** continuous data give a bell-shaped histogram; discontinuous data give separate bars

If the categories can be counted, it is discontinuous; if the values fall anywhere on a scale, it is continuous. That test decides the graph you draw.

Variation & Selection

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".

3 Recap

Variation & Selection

Worked example – explaining natural selection

Dark moths became common in a sooty industrial area. Explain using natural selection.

- Variation**: the population already had pale and dark moths (from mutation).
- Soot darkens the bark, so **dark moths are better camouflaged**.
- Birds eat more pale moths ⇒ dark moths **survive and reproduce**, passing on the allele.
- Over many generations, **the dark allele becomes more common**.

Four steps, always: **variation** → **selection pressure** → **the better-adapted survive and breed** → **the allele's frequency rises**. Name the pressure.

Topic 18 – key takeaways

1 Variation

continuous (range) vs
discontinuous (groups)

2 Mutation

makes new alleles – the source of
variation

3 Natural selection

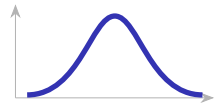
best-adapted survive & pass on
alleles

4 Breeding

humans choose the parents

Check yourself

- 1 Which variation gives a smooth range?
- 2 What is the original source of all variation?
- 3 Who survives in natural selection?
- 4 Who chooses the parents in selective breeding?



Answers 1. continuous variation 2. mutation 3. the best-adapted 4. humans