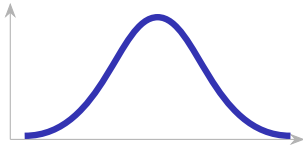


Variation & Selection

IGCSE Biology ■ Topic 18

IGCSE Biology



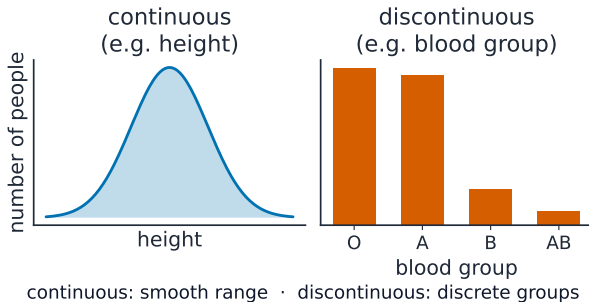
What we will cover

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

1

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).

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

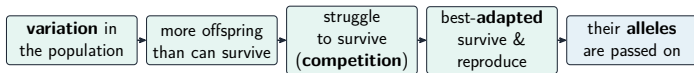
A **mutation** 突变 is a genetic change. It is how **new alleles** 等位基因 are made, so it is the original source of *all* variation.

- **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



over many generations the population becomes better adapted

Natural selection 自然选择:

- 1 variation in the population
- 2 more offspring than can survive
- 3 **competition** 竞争 for **resources** 资源 – food, water, space
- 4 **best-adapted** 适应 survive & breed
- 5 helpful alleles spread

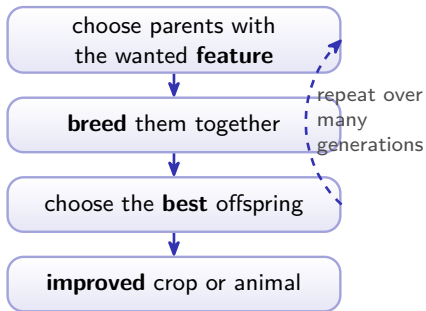
Examples



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

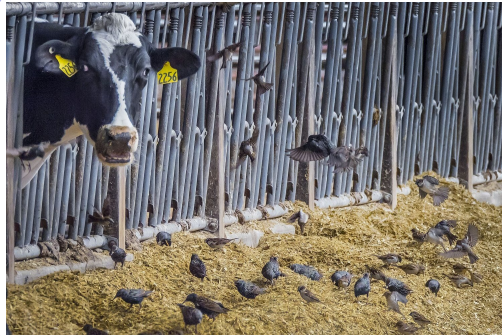
water is abundant, so the problems are floating and gas exchange instead

further xerophyte features

sunken stomata, rolled leaves, hairs – all trapping humid air next to the stomata

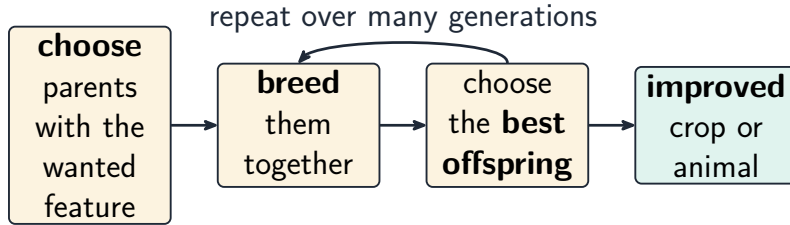
State the feature, then what it does about water. “Thick waxy cuticle” alone is a description; “so less water evaporates from the leaf” is the mark.

Selective breeding in practice



Dairy cattle: generations of selective breeding for milk yield

Choosing which organisms breed



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 in people



People show wide variation in many inherited features.

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 <i>and</i> 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.

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

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 $\Rightarrow$ dark moths **survive and reproduce**, passing on the allele.
- Over many generations, **the dark allele becomes more common**.

Four steps, always: **variation** $\rightarrow$ **selection pressure** $\rightarrow$ **the better-adapted survive and breed** $\rightarrow$ **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

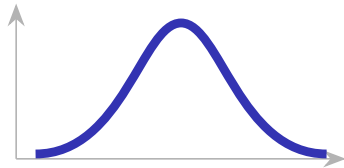
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Breeding

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