

Selection

Revision notes · Natural selection and adaptation, antibiotic-resistant bacteria, selective breeding and how natural and artificial selection differ.

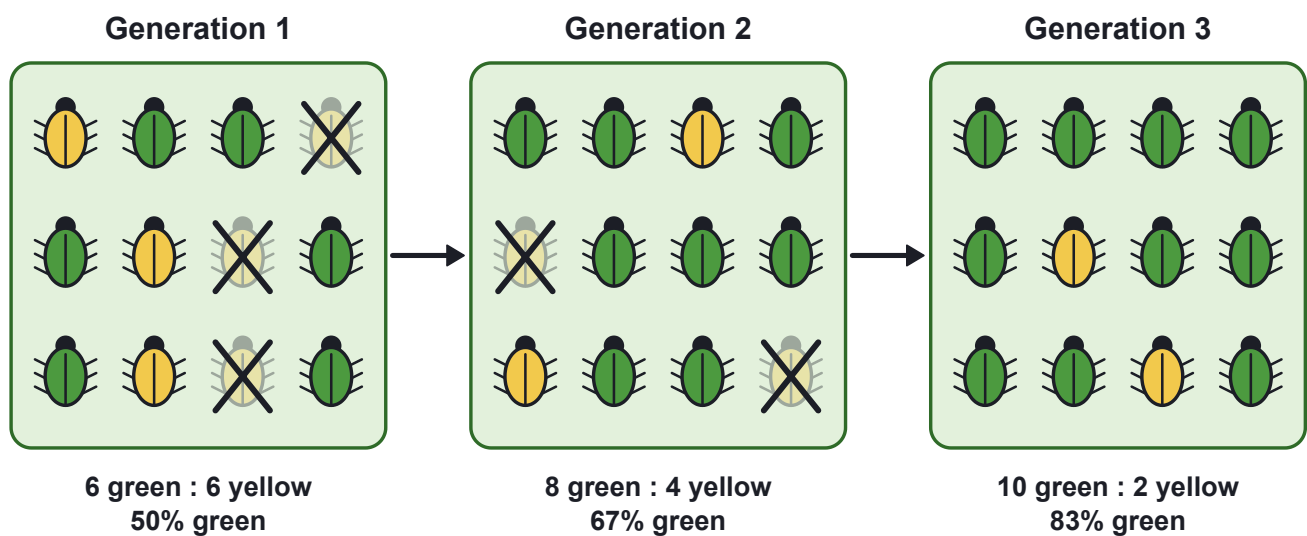
For Cambridge IGCSE Biology 0610 (and 0970, which has the same content). **Supplement** is Extended content, only examined on Papers 2 and 4.

Selection Spec 18.3.1-18.3.6

Natural selection and adaptation Spec 18.3.1, 18.3.4

Natural selection is the process by which individuals that are better adapted to their environment survive and pass on their alleles. It can be described in five steps.

1. There is genetic variation within populations: individuals have different alleles.
2. Organisms produce many offspring, more than the environment can support.
3. There is a struggle for survival, including competition for resources such as food, water and mates, and pressure from predators and disease.
4. Individuals that are better adapted to the environment have a greater chance of surviving and reproducing than others.
5. These individuals pass on their alleles to the next generation, so the alleles for helpful features become more common.



= eaten by birds. Yellow beetles are easier to see on green leaves, so they are more likely to be eaten. Green beetles are more likely to survive, breed and pass on their alleles, so the proportion of green beetles rises.

Over generations the proportion of the better-adapted (green) beetles rises.

Supplement

Adaptation is the process, resulting from natural selection, by which populations become more suited to their environment over many generations.

Supplement

Notice that individuals do not change. It is the population that changes, because the proportion of individuals with helpful alleles increases from one generation to the next.

Common mistake: Do not write that organisms 'adapt because they need to' or that a mutation 'happens because it is needed'. Mutations are random. The environment only selects which individuals survive.

Antibiotic-resistant bacteria Spec 18.3.5 Supplement

The development of strains of **antibiotic-resistant bacteria** is an example of **natural selection**.

1. Among a population of bacteria, a random mutation produces a new allele that makes one bacterium resistant to an antibiotic.
2. The antibiotic is used. It kills the non-resistant bacteria.
3. The resistant bacterium survives because it is better adapted in the presence of the antibiotic, and it has less competition.
4. It reproduces, and passes the resistance allele to its offspring.
5. Over time, most of the population is resistant and the antibiotic no longer works.

Bacteria can reproduce very quickly, so a resistant strain can become common in a short time. Overuse of antibiotics increases the chance that resistant strains are selected.

Supplement

Common mistake: Say the bacteria are resistant, not the person. The antibiotic does not cause the mutation; it selects the bacteria that already have the resistance allele.

Selective breeding and artificial selection Spec 18.3.2, 18.3.3, 18.3.6

Selective breeding (artificial selection) is when humans choose which organisms breed so that the next generation has desirable features.

1. Humans select individuals with desirable features.
2. These individuals are crossed (bred together) to produce the next generation.
3. Offspring showing the desirable features are selected, and the process is repeated.

This is repeated over **many generations**. Each generation has more of the desirable features. It is used to improve crop plants and domesticated animals.

Examples of selective breeding

Organism	Desirable features that may be selected
Crop plants (wheat, rice)	higher yield, disease resistance, larger seeds or fruits, shorter stems
Dairy cattle	high milk yield
Beef cattle	large muscle mass, fast growth
Hens	large numbers of eggs, large eggs

Percentage increase in milk yield

A herd of cows had a mean milk yield of 4000 dm³ per year. After many generations of selective breeding the mean yield is 5200 dm³ per year. Calculate the percentage increase.

1. Increase = 5200 – 4000 = 1200 dm³

2. Percentage increase = (increase ÷ original) × 100 = (1200 ÷ 4000) × 100

Answer: 30%

Supplement

Natural and artificial selection compared

Supplement

Natural selection and artificial selection

	Natural selection	Artificial selection
What selects	the environment	humans
Features selected	those that help survival and reproduction	those that humans want
Purpose	organisms become better adapted to their environment	to improve crops and domesticated animals for human use
Speed	usually slow: takes a very long time	usually faster, because humans choose every breeding pair in each generation

Exam tip: In selective breeding questions state what is selected, that the selected individuals are crossed, that offspring with the feature are chosen, and that it is repeated over many generations.

Quick check

1. Give two things organisms compete for.
2. What happens to the alleles of better-adapted individuals?
3. Name the three stages of selective breeding.
4. **Supplement** Define adaptation.
5. **Supplement** Who or what selects in natural selection and in artificial selection?

Quick check answers

Selection

1. Any two from food, water, light, space, mates.
2. They are passed on to the next generation.
3. Select individuals with desirable features; cross them; select offspring showing the desirable features.
4. The process, resulting from natural selection, by which populations become more suited to their environment over many generations.
5. The environment selects in natural selection; humans select in artificial selection.