Selective breeding

4.6.2.3 · Inheritance, variation and evolution · revision notes

Selective breeding (artificial selection) is humans breeding plants and animals for particular genetic characteristics. You need the steps, examples and the problem of inbreeding. Questions include 'describe how a farmer could breed...' and explaining or evaluating its impact.

Key facts

- Selective breeding = artificial selection: humans breed organisms for particular genetic characteristics
- Examples: disease-resistant crops, more meat or milk, gentle dogs, large or unusual flowers
- Natural selection: the environment decides which individuals survive to breed. Selective breeding: humans choose
- Steps: choose parents with the characteristic → breed → select the best offspring → breed → repeat over many generations
- Inbreeding → breeds prone to disease and inherited defects

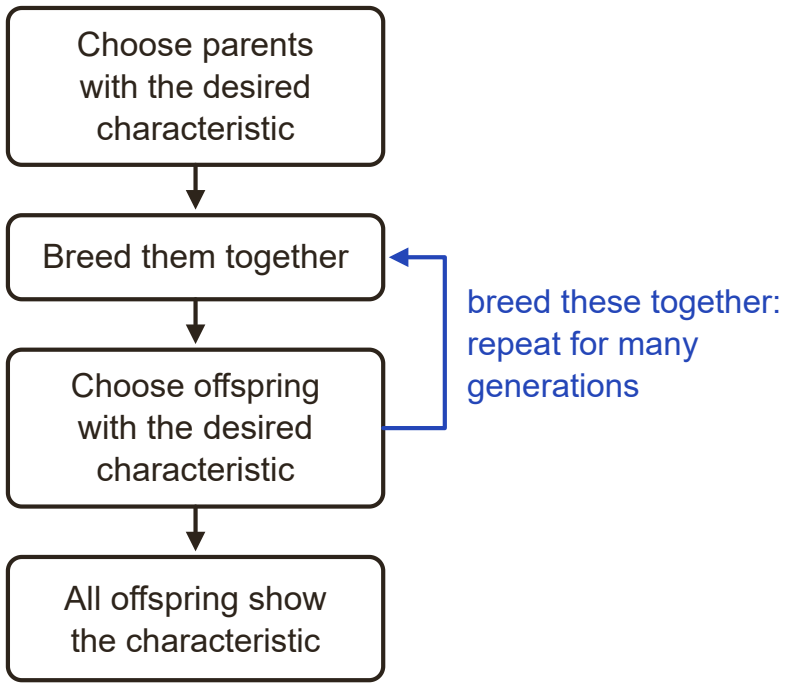
Notes

What selective breeding is

- **Selective breeding** (artificial selection) is the process by which humans breed plants and animals for particular genetic characteristics.
- Humans have done this for **thousands of years**, since they first bred food crops from wild plants and domesticated animals.

The steps

- Choose **parents** with the desired characteristic from a mixed population.
- **Breed** them together.
- From the offspring, choose those with the desired characteristic and breed them together.
- Repeat over **many generations** until all the offspring show the desired characteristic.



Selective breeding: select, breed, repeat.

Characteristics that are chosen

- Characteristics can be chosen for **usefulness** or for **appearance**.
- **Disease resistance** in food crops.
- Animals that produce **more meat or milk**.
- Domestic dogs with a **gentle nature**.
- **Large or unusual flowers**.

Impact: benefits and problems

- Benefits: more food from the same land (higher-yielding crops, more meat or milk) and less of a crop lost to disease.
- Selective breeding can lead to **inbreeding** (breeding closely related individuals), so some breeds are particularly **prone to disease or inherited defects**.
- Inbreeding reduces genetic variation, so offspring are more likely to inherit two copies of a harmful recessive allele. Grade 7+ only
- With little variation, a new disease or a change in the environment could affect all the individuals in a breed.
- Ethical issues: some animals suffer because of the features bred into them, for example dogs bred for very flat faces can have breathing problems.

How to answer each type of question

Describe how to selectively breed for a characteristic

3 to 4 marks | Grade 5

1. Choose parents that show the characteristic.
2. Breed them together.
3. Select the offspring with the characteristic and breed them.
4. Repeat over many generations.

Example. A farmer wants to produce a herd of cows that produce a large volume of milk.
Describe how the farmer could use selective breeding to do this. [4 marks]

Model answer. Choose the cows that produce the most milk, and a bull from a line of high-yielding cows (1). Breed these cattle together (1). Select the offspring that produce the most milk and breed them together (1). Repeat this over many generations (1).

Explain the problems of selective breeding

2 to 3 marks | Grade 5

1. Say that it can lead to inbreeding (closely related animals are bred together).
2. This reduces variation.
3. So there is a greater risk of inherited defects and disease, and a new disease could affect them all.

Example. Some breeds of dog have been selectively bred from a small number of closely related animals.
Explain why dogs of these breeds are more likely to have inherited disorders. [3 marks]

Model answer. Breeding closely related dogs is inbreeding (1). This reduces genetic variation in the breed (1). So the dogs are more likely to inherit two copies of a harmful recessive allele (1).

Compare selective breeding with natural selection

2 to 3 marks | Grade 7

1. Give a similarity: in both, individuals with certain characteristics breed and pass on their alleles over many generations.
2. Give the key difference: who or what does the choosing.
3. Add what is selected: characteristics useful to humans, or characteristics that help survival.

Example. Compare selective breeding with natural selection. [3 marks]

Model answer. In both, individuals with certain characteristics breed and pass on their alleles over many generations (1). In selective breeding, humans choose which individuals breed, whereas in natural selection the environment determines which individuals survive to breed (1). Selective breeding selects characteristics that are useful to humans, whereas natural selection selects characteristics that help survival in that environment (1).

Don’t lose marks

- Leaving out 'over many generations'. Selective breeding takes a long time.
- Confusing selective breeding with genetic engineering. No genes are moved between organisms in selective breeding.
- Saying selective breeding creates new alleles. It only selects from the variation that already exists.
- Saying inbreeding directly causes disease. It makes inherited defects more likely because variation is reduced.
- Saying 'breed the same parents again'. Each generation you breed the selected offspring, not the original parents.

More tips

Memory tricks

- Selective breeding recipe: select, breed, select, breed... for many generations.
- Inbreeding = breeding within the family: less variation, more inherited defects.
- Artificial selection = humans choose; natural selection = the environment chooses.

Exam technique

- In 'describe' questions, give the steps in order, including selecting the offspring and repeating.
- Use the organism and characteristic in the question (e.g. 'cows that produce the most milk').
- For 'evaluate' questions, give benefits and problems, then a conclusion.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 3 — **Define selective breeding**
Humans breeding plants and animals for particular genetic characteristics.

Grade 4 — **Give examples of chosen characteristics**
Disease resistance in crops, more meat or milk, gentle dogs, large or unusual flowers.

Grade 5 — **Describe the steps of selective breeding**
Choose parents with the characteristic, breed them, select the best offspring, and repeat over many generations.

Grade 5 — **Explain the problems caused by inbreeding**
Breeds become prone to disease or inherited defects because variation is reduced.

Grade 7 — **Compare selective breeding with natural selection**
In selective breeding humans choose which individuals breed; in natural selection the environment decides which survive to breed.

Grade 7 — **Evaluate the impact of selective breeding**
Weigh benefits such as more food against inbreeding and reduced variation.

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