7.1 Biological Change Over Time

P. 282 - 287

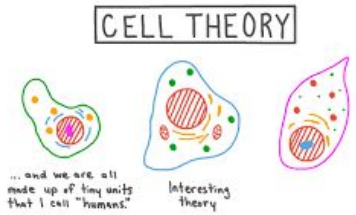
Thoughts:

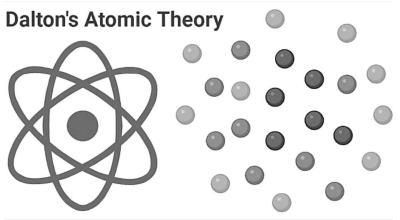
How does a scientific theory differ from a hypothesis?

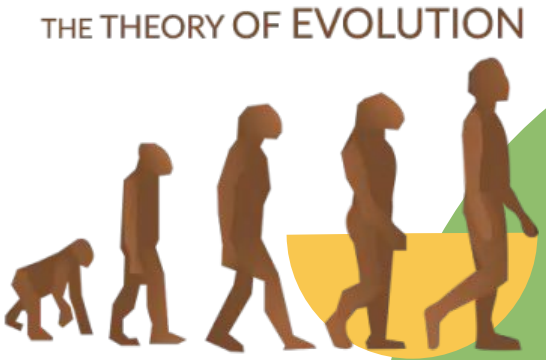
Students, write your response!

What is a Scientific Theory?

- A **scientific theory** is much more than an educated guess or hypothesis.
  - an explanatory model that accounts for a **large body of evidence**
  - considered **tentative and open for revision** as new evidence is gathered
  - used to make accurate and precise **predictions**







Biologists are convinced that entire species change over time.

E.g. Snowshoe hares have evolved to...

- Turn white in the winter (camouflage)
- Have wider feet for moving on snow

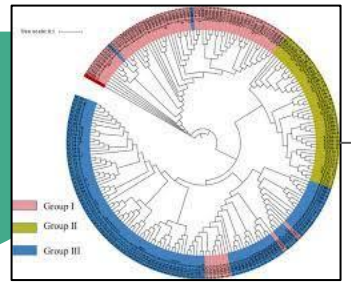
Thoughts:

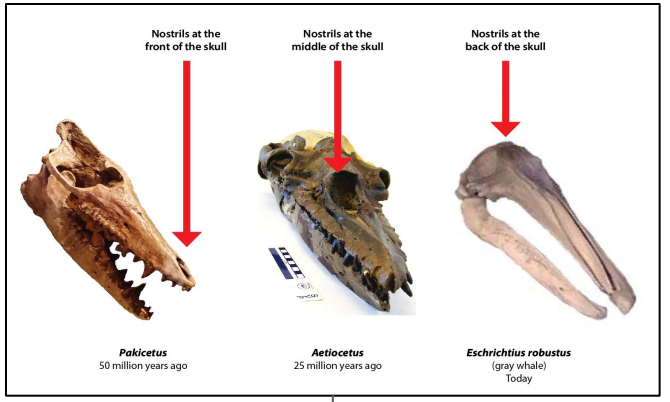
Can you think of what evidence there is for the theory of evolution?

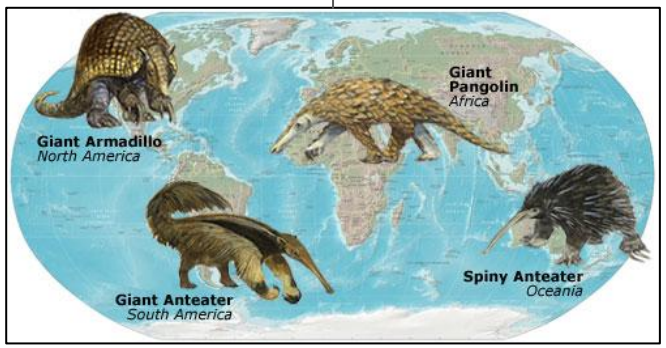
Students, write your response!

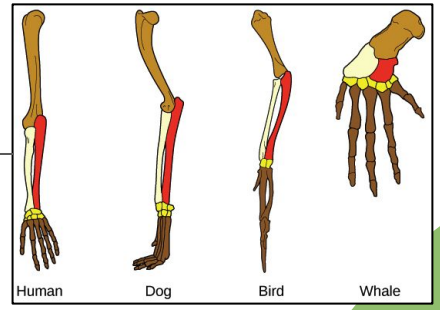
The Theory of Evolution

- The **evidence** supporting the theory of evolution is based on:
  - fossils of ancient life forms
  - genetic analysis
  - comparative anatomy
  - distribution of living things on Earth









How do these changes come about?

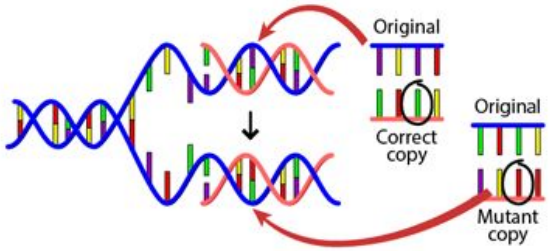
→ Mutations!!

Mutations

A **mutation** is a change in the genetic information

alters **genes,** which in turn alter protein formation

- has an immediate and direct effect on **individuals**
- has the potential to influence **future generations** if it is **inherited** (passed down)



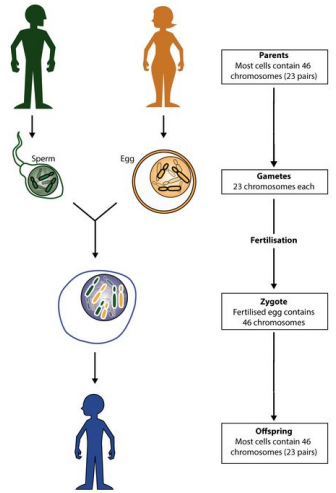
Mutations alter genes

Harmful Mutations

Neutral Mutations

Beneficial Mutations

Mutations can have a negative, neutral or positive effect on the individual



*Mutations can be passed down possibly affecting entire species (over time) **only if** the mutation occurs in the sex cells.*

Thoughts:

Which do you think is more likely to be passed down - a harmful or helpful mutation?

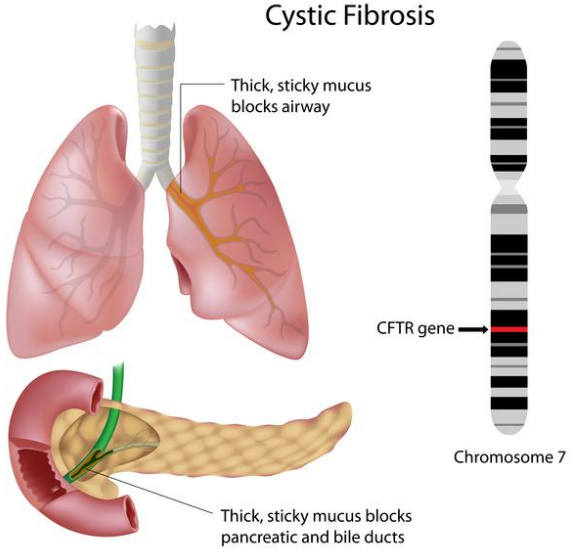
Explain.

Students, write your response!

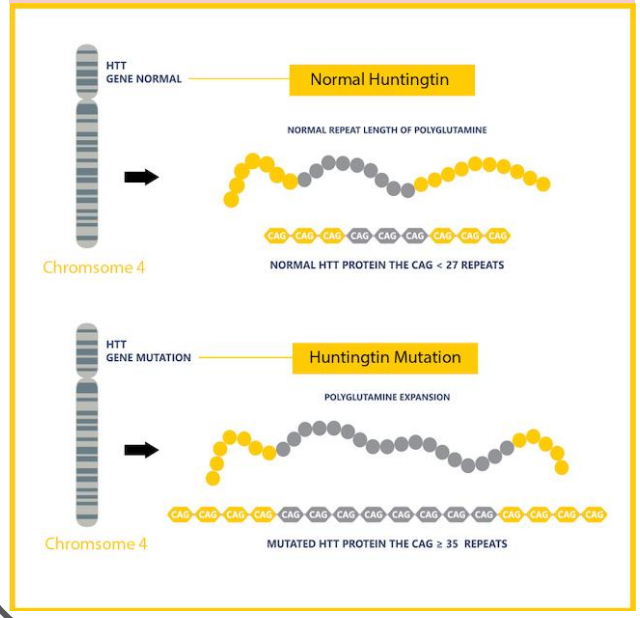
Harmful Mutations

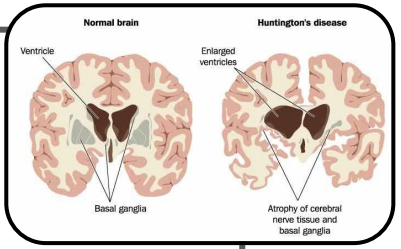
- **reduces** the **reproductive success** of an **individual**
  - **does not accumulate** over time in a population

E.g. Mutation Causing Cystic Fibrosis



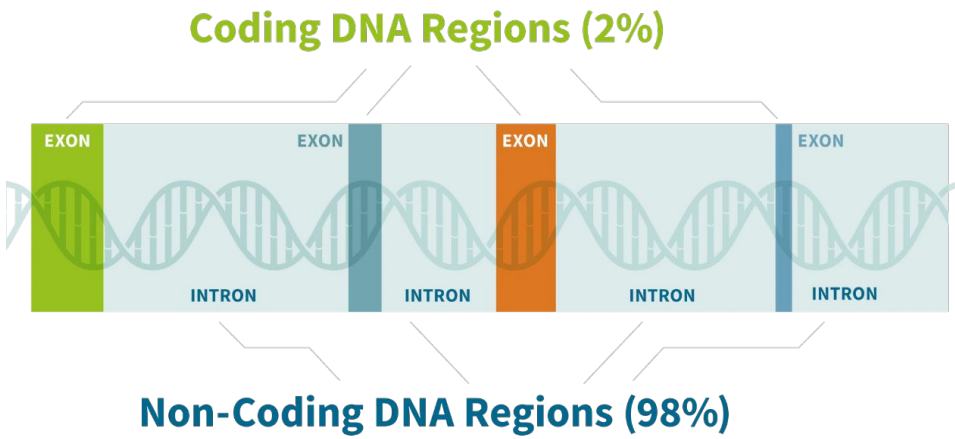
E.g. Mutation Causing Huntington's





Neutral Mutations

- **does not** result in any selective advantage or disadvantage
  - change in the DNA has **no immediate effect**
  - **most common**

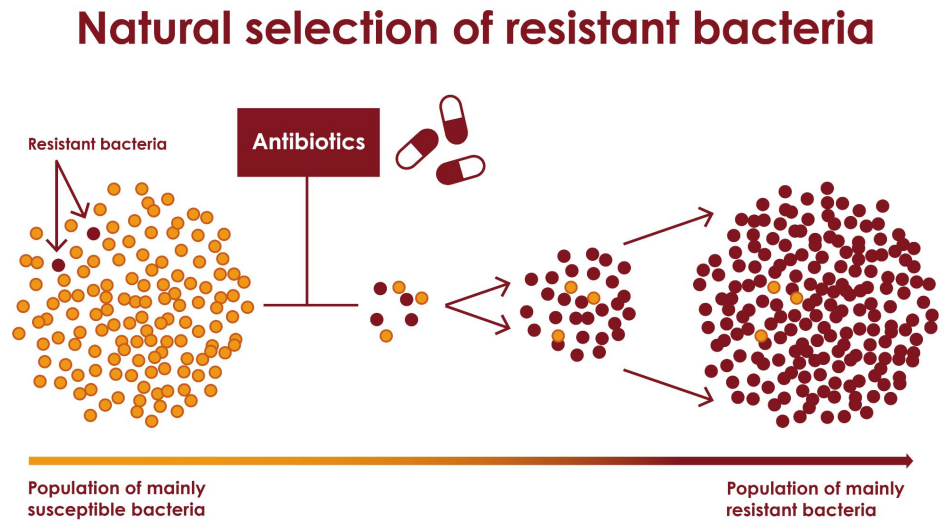


E.g. a change in the portion of DNA that does not **code for a gene** (or **protein**) is neutral. *(98% of DNA is non coding so this type of mutation is most common!)*

Helpful Mutations

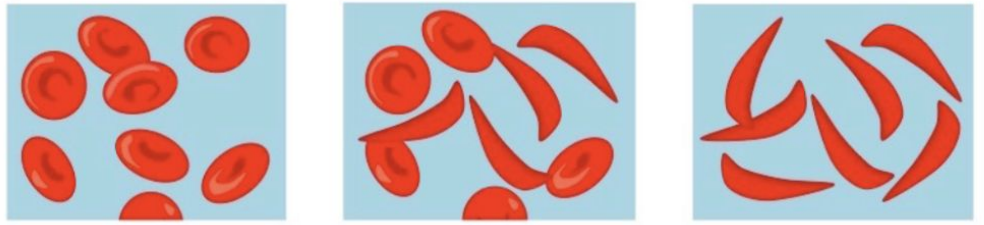
- Increases the **reproductive success** of an organism
  - results in a **phenotype** that is **favoured** by natural selection
  - **accumulates over time** in a population

E.g. Bacterial Resistance (beneficial for bacteria)

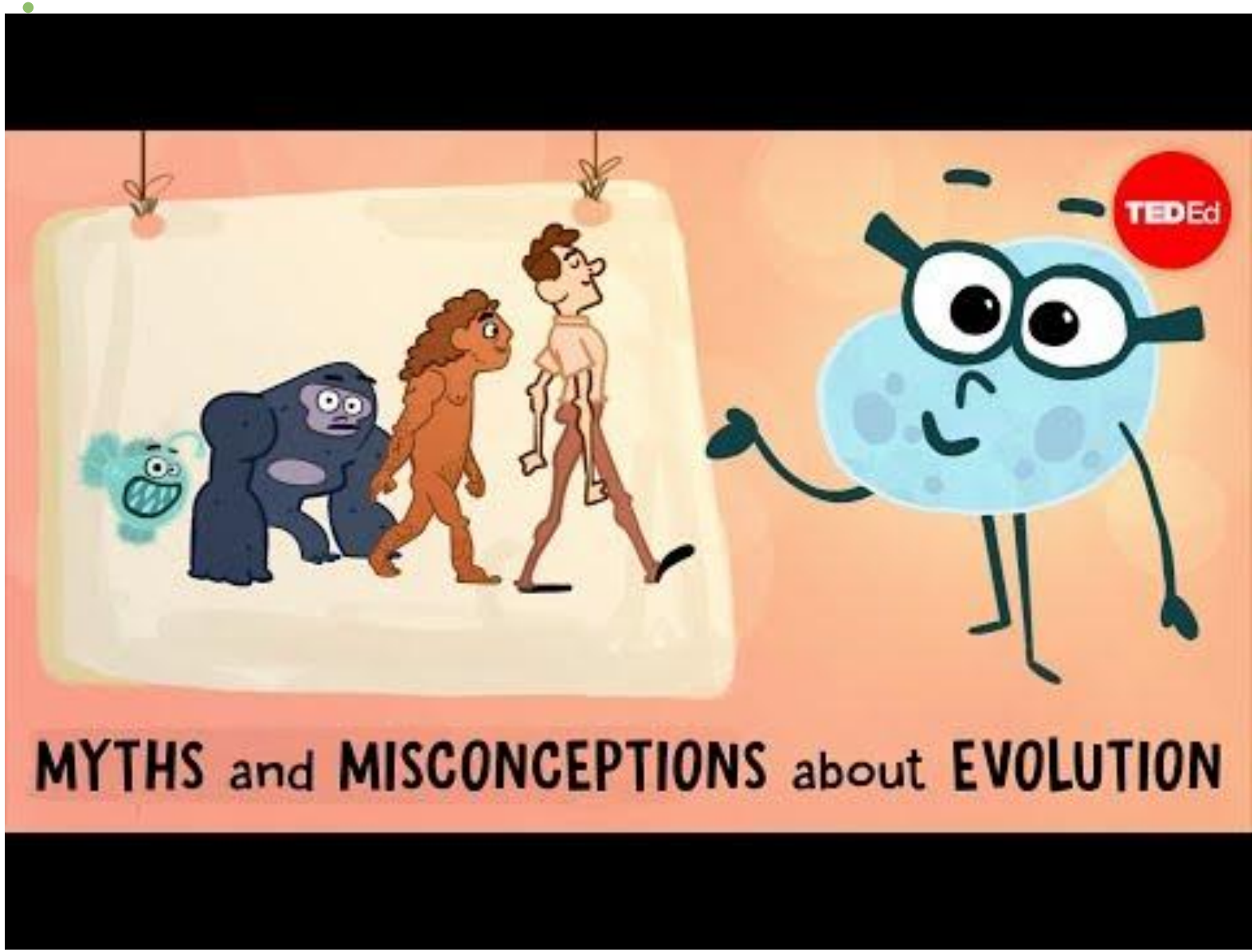


E.g. *Individual bacteria with a* ***random mutation*** *that gives them antibiotic resistance* ***survive and reproduce*** *passing on their resistant gene to* ***future generations****.*

Sickle Cell Anemia



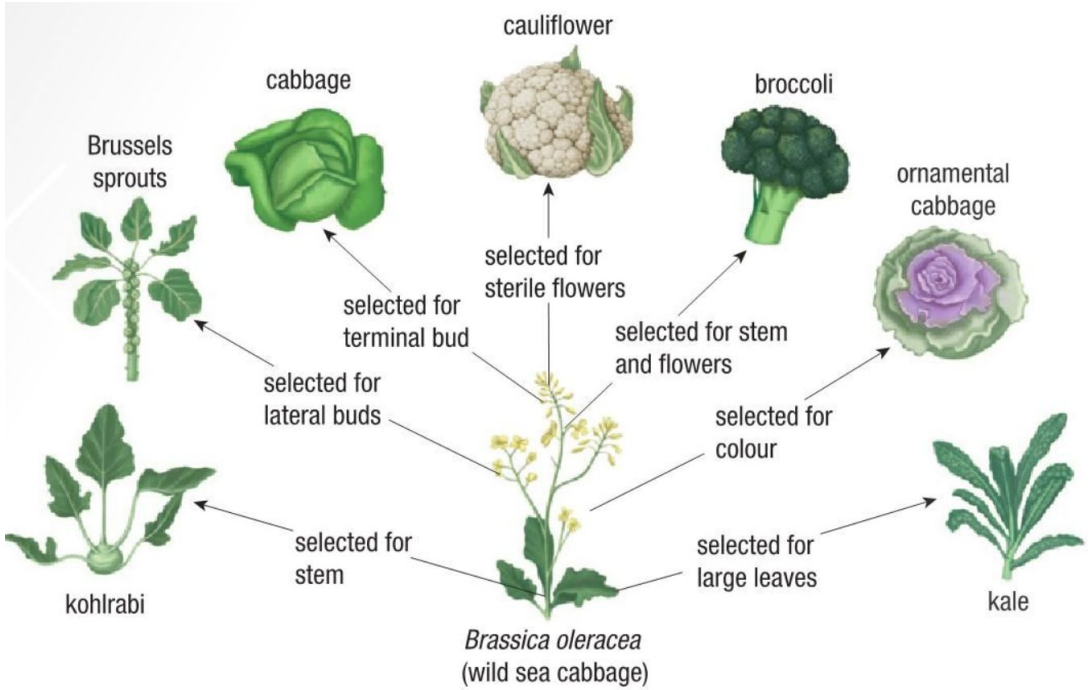
- **The bad and the good.**
  - Inheriting a sickle cell gene from **each parent** (aa) results in the offspring having sickle-shaped red blood cells that are rigid and sticky (fatal)
  - However, inheriting only **one gene** (allele Aa) results in only a **mild** form of the disease. These individuals that carry the gene have **resistance to malaria.**



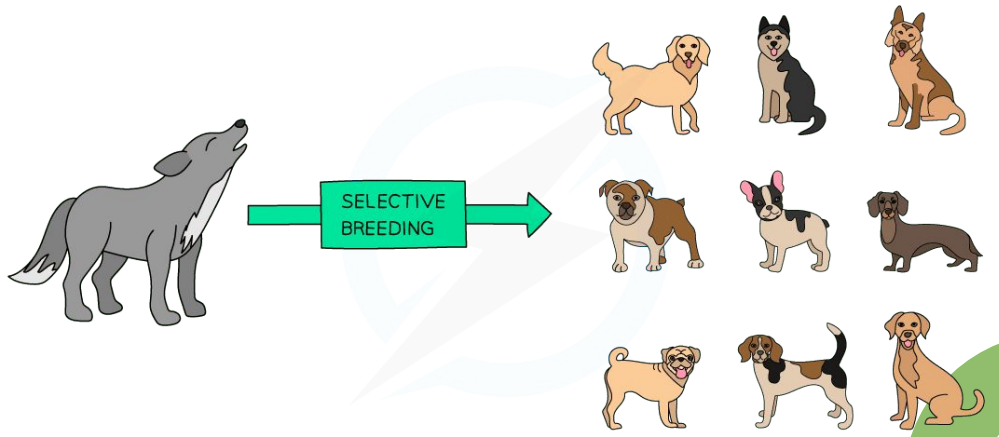
Selective Breeding

Artificial selection:

- Breeding where parents of the next generation are **chosen** based on **specific traits**
- Used to produce **new breeds** or **varieties** of plants and animals
- Artificial because it occurs in **captivity**

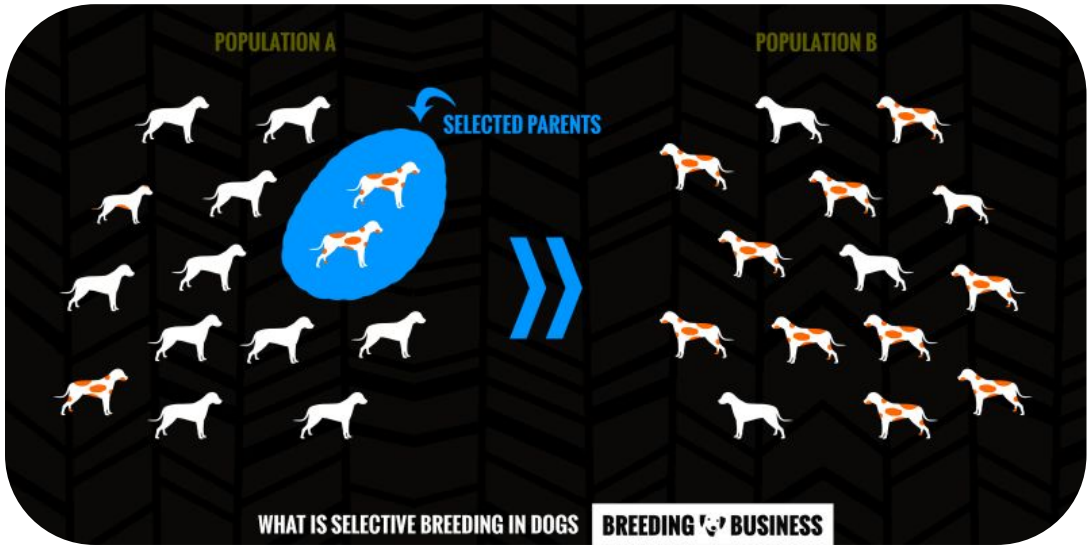


Wild mustard has been artificially selected for specific desired traits producing a wide array of common vegetables.



The Science of Breeding

Each time a breeder attempts to develop a new breed, they are testing a hypothesis and following a common set of procedures.



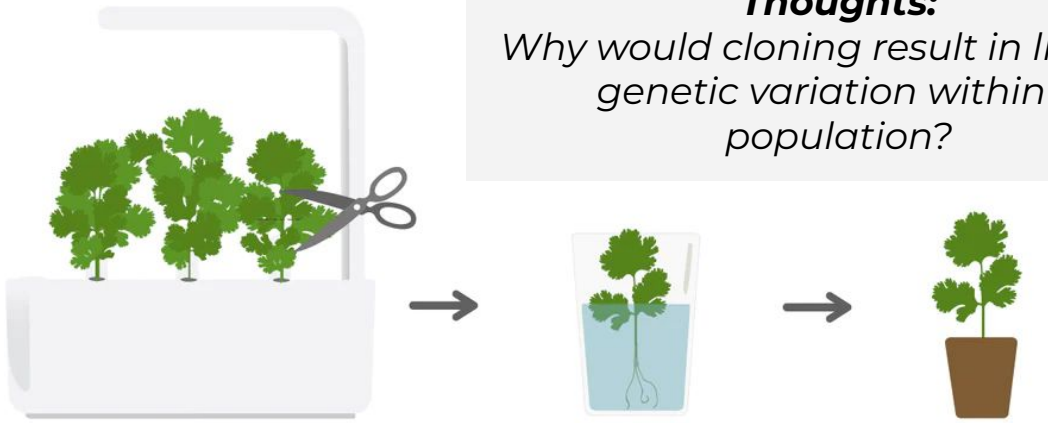
Hypothesis:
Breeding selected individuals with certain favoured traits will result in the favoured traits becoming more prevalent and more pronounced.

- **Independent Variable:** selected breeding population
- **Dependent Variable:** appearance of favoured trait in the population

The Science of Breeding

When selective breeding is **successful**, the resulting offspring with the desired traits may be **mass-produced** by **cloning**.

- This could result in a population with **little or no genetic** diversity.



Thoughts:
Why would cloning result in little-no genetic variation within a population?

The Power of Artificial Selection P1

- Production of individuals that have traits **far beyond** the **natural variability** seen in the **original population**

(E.g. Wolf → Chihuahua)

The Power of Artificial Selection P2

- Reduced genetic diversity within the population
  - Increased susceptibility to disease

Thoughts:
Why do you think less genetic diversity increases a population's susceptibility to disease?

Students, write your response!

The Power of Artificial Selection P3

- **Other traits** inherited with favoured traits may be linked to **detrimental alleles**
  - E.g. Large breeds of dogs, including great danes, are at an increased risk of hip dysplasia (loosening of hip joint).

Artificial Selection: Limitations

Artificial selection is not a perfected science...

- **not all** attempts at artificial selection are successful
- breeders **cannot create traits** that do not already exist within the population
    - E.g. no mutation causing roses to be blue, so breeders cannot specifically breed blue roses (unless they were to genetically modify them)
- sometimes favourable mutations are inherited along with **unfavourable ones**