

What Forces Drive Evolution?

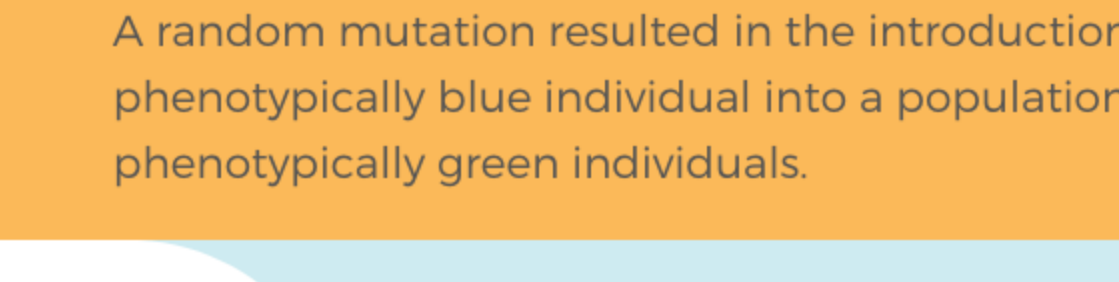


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Traditional 4 Mechanisms

1. MUTATIONS

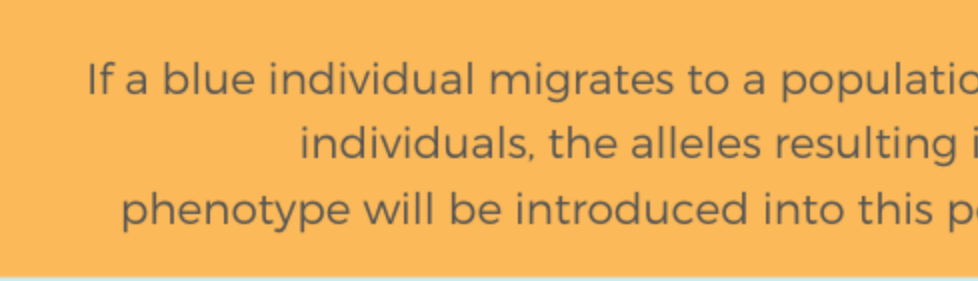
Random heritable changes in the DNA of an individual that can get passed onto offspring.



A random mutation resulted in the introduction of a phenotypically blue individual into a population of phenotypically green individuals.

2. GENE FLOW

Transfer of genetic material from one population to another due to the **migration** of individuals or gametes.



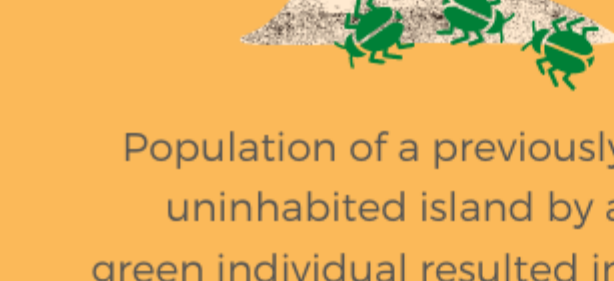
If a blue individual migrates to a population of green individuals, the alleles resulting in the blue phenotype will be introduced into this population.

3. GENETIC DRIFT

Random changes in the relative frequencies of **existing alleles** in a population over time due to **chance**.

FOUNDER EFFECT

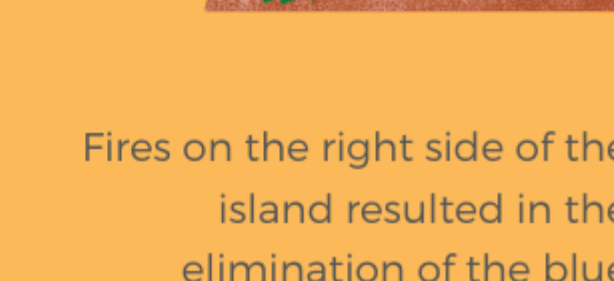
Reduced genetic diversity in a population descended from a **small number of colonizing ancestors**.



Population of a previously uninhabited island by a green individual resulted in a solely green new population.

BOTTLENECK EFFECT

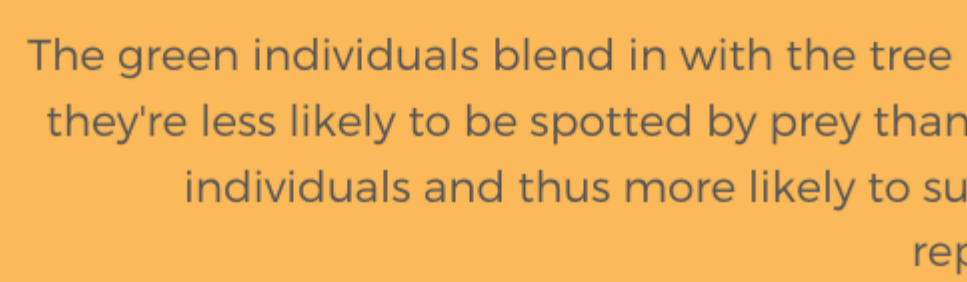
Changes in allele frequency in a population following a **catastrophic random event**.



Fires on the right side of the island resulted in the elimination of the blue phenotype, and the survival of the green phenotype individuals on the left side.

4. NATURAL SELECTION

"Survival of the Fittest", where certain alleles/allele combinations make the organism more able to survive and reproduce in a certain environment.



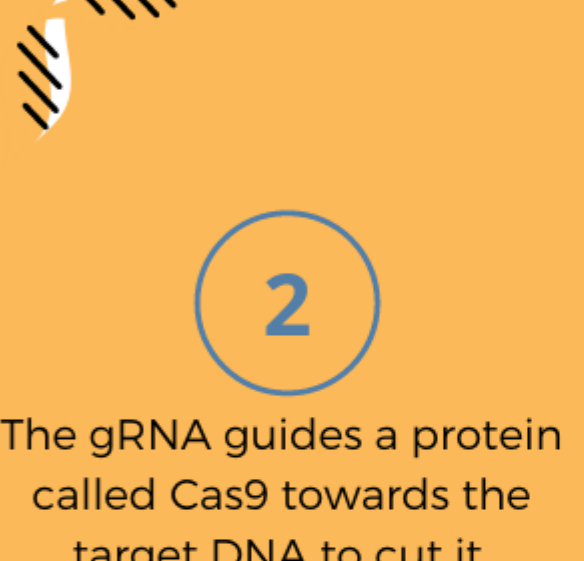
The green individuals blend in with the tree better, so they're less likely to be spotted by prey than the blue individuals and thus more likely to survive and reproduce.

5th Mechanism of Evolution

5. GENE EDITING AND ARTIFICIAL SELECTION

Medicinal advances and **gene-editing technology** have made it possible for specific aspects of an organism's genome to be selected for or enhanced through human intervention.

CRISPR-CAS9 GENE EDITING

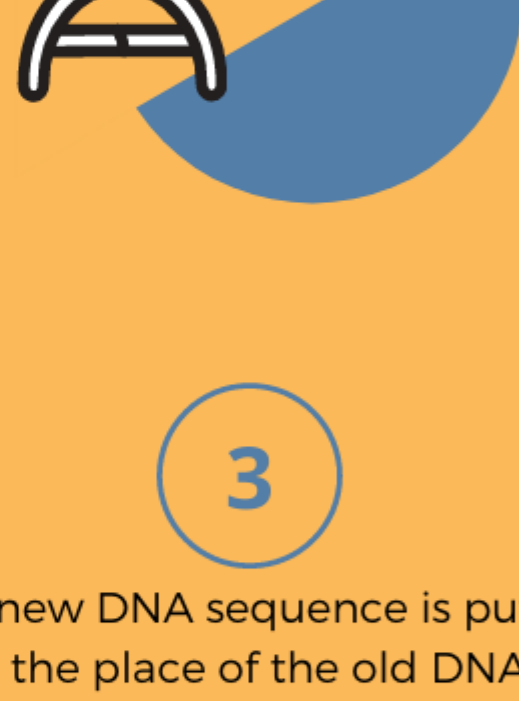


1

Scientists create a guide RNA sequence (gRNA) that matches the target DNA sequence to be modified.

2

The gRNA guides a protein called Cas9 towards the target DNA to cut it.



3

A new DNA sequence is put in the place of the old DNA and enzymes repair the cuts.



This results in the introduction of genetically enhanced individuals with artificially selected alleles to the population.

Why Should You Care??

These traditional four mechanisms have driven the evolution of all present-day species, but the development of a 5th mechanism can have broad implications on future evolution.

CRISPR BABIES

In 2018, gene-editing technology was used to make two human embryos **resistant to HIV**. The implications of this modification are unknown.



SUPERBUGS



Hospitals are an **environmental niche** that favor the emergence of bacteria, fungi, parasites, and viruses **resistant** to antibiotics and treatments for the infections they cause.

CHANGING DEFINITIONS

Gene-editing technology **challenges** Darwin's argument that evolution does not progress towards a certain **goal**.



SOURCES

- 1) <https://www.khanacademy.org/science/biology/her/heredity-and-genetics/a/hardy-weinberg-mechanisms-of-evolution>
- 2) [https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_\(Boundless\)/19%3A_The_Evolution_of_Populations/19.2%3A_Population_Genetics/19.2C%3A_Gene_Flow_and_Mutation](https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_(Boundless)/19%3A_The_Evolution_of_Populations/19.2%3A_Population_Genetics/19.2C%3A_Gene_Flow_and_Mutation)
- 3) <https://www.zenclines.com/crispr-cas9/>
- 4) <https://www.sciencealert.com/china-s-failed-experiment-proves-we-re-not-ready-for-human-gene-editing>
- 5) <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6155606/>

