

# Mechanisms of Evolution: Comparison & Analysis

## By Miss Maha Saleh

### Support Materials: Fill in the Blanks

**Instructions:** Select the correct word from the word bank to complete each sentence.

**Word Bank:** allele | Hardy-Weinberg | genetic drift | founder | bottleneck | gene flow | random | mutation | small | one (1)

1. Evolution occurs when \_\_\_\_\_ frequencies change from generation to generation.
2. The \_\_\_\_\_ principle states that allele frequencies remain constant if certain conditions are met.
3. A random change in allele frequencies in a population is called \_\_\_\_\_.
4. The \_\_\_\_\_ effect occurs when a small group separates from a larger population to start a new colony.
5. A large population decline, such as after a natural disaster, causes a \_\_\_\_\_ effect.
6. The movement of genes into or out of a population is called \_\_\_\_\_.
7. For a population to remain in equilibrium, mating must be completely \_\_\_\_\_.
8. A \_\_\_\_\_ is a change in the DNA sequence that introduces new genetic variation.
9. Genetic drift has a much larger and more noticeable impact on \_\_\_\_\_ populations.
10. In the Hardy-Weinberg equation,  $p + q$  always equals \_\_\_\_\_.

## Support Materials: True or False

**Instructions:** Read each statement carefully. Write **True** if the statement is correct, or **False** if it is incorrect.

11. Genetic drift is an intentional process guided by natural selection. \_\_\_\_\_
12. Gene flow can increase genetic variation within a receiving population. \_\_\_\_\_
13. The bottleneck effect usually increases the genetic diversity of a population. \_\_\_\_\_
14. The founder effect happens when a few individuals leave to start a new isolated colony. \_\_\_\_\_
15. True Hardy-Weinberg equilibrium is very common in natural wild populations. \_\_\_\_\_
16. Gene flow tends to reduce the genetic differences between two interacting populations. \_\_\_\_\_
17. A storm that randomly kills 90% of a population is an example of gene flow. \_\_\_\_\_
18. The term  $p^2$  in the Hardy-Weinberg equation represents the frequency of homozygous dominant individuals. \_\_\_\_\_
19. Small populations are much more heavily affected by genetic drift than large populations. \_\_\_\_\_
20. The migration of animals between different habitats is an example of genetic drift. \_\_\_\_\_

## Comparative Analysis: Genetic Drift vs. Gene Flow

Complete the table below to synthesise your understanding of how different mechanisms influence allele frequencies in a population. Focus specifically on distinguishing between the two types of genetic drift and gene flow.

Mechanism	Definition & Description	Effect on Genetic Variation (Does it increase or decrease variation within the population?)	Specific Example
<b>Genetic Drift</b> ( <i>Founder Effect</i> )			
<b>Genetic Drift</b> ( <i>Bottleneck Effect</i> )			
<b>Gene Flow</b>			

## The Hardy-Weinberg Principle

The Hardy-Weinberg principle serves as a null hypothesis for evolution. It states that allele frequencies in a population will remain constant from generation to generation in the absence of other evolutionary influences.

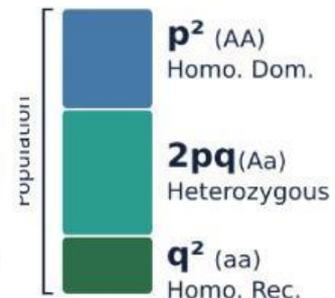
### Equations:

- $p + q = 1$  (Allele frequencies)
- $p^2 + 2pq + q^2 = 1$  (Genotype frequencies)



**Remember:** Ideally, for a population to be in equilibrium, **five specific conditions** must be met. If these are violated, evolution is occurring.

$$p^2 + 2pq + q^2 = 1$$



### Questions: Core Concepts

**21.** List the five conditions required for a population to remain in Hardy-Weinberg equilibrium.

**22.** In a population of Arabian Oryx, the allele for straight horns (S) is dominant over curved horns (s). If 16% of the population has curved horns (recessive phenotype):

- What is the value of  $q^2$ ?
- Calculate the frequency of the dominant allele ( $p$ ).

 **Advanced Analysis & Critical Thinking**

**Part A: High-Order Thinking**

**23.** Compare and contrast how the founder effect and bottleneck effect reduce genetic variation. Provide one unique example for each.

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**24.** If 36% of a population is homozygous recessive ( $q^2 = 0.36$ ), calculate the frequency of heterozygous individuals. Show your working.

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**25.** Explain how continuous gene flow between two partially isolated populations might prevent them from becoming separate species.

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**26.** Predict the long-term evolutionary consequences for a wild animal population that has survived a severe bottleneck event.

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**27.** Propose a specific scenario where the founder effect could actually be beneficial for the survival of a small, isolated plant population.





