Name:_____ Date:_____

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.

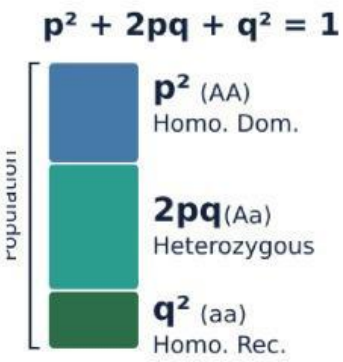
Mechanism	Definition & Description	Effect on Genetic Variation (Does it increase or decrease variation within the population?)	Specific Example
Genetic Drift *(Founder Effect)*			
Genetic Drift *(Bottleneck Effect)*			
Gene Flow			

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.

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 $\mathbf{q^2}$?
- 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.

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

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

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

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

Part B: Critical Thinking

28. "Hardy-Weinberg equilibrium is a theoretical concept that never truly exists in wild populations." Defend this statement using the five required conditions.

29. Evaluate the impact of human-made physical barriers (such as major highways or dams) on gene flow and genetic drift in local wildlife.

30. If a lethal recessive allele exists in a population, why doesn't natural selection completely eliminate it over time? Relate this to the Hardy-Weinberg equations.

31. Analyze a situation where a very large population experiences constant gene flow from a much smaller neighboring population. How significantly will the larger population's allele frequencies change, and why?

32. Synthesize how genetic drift and gene flow might interact in a fragmented habitat (e.g., several small, separated forest patches).