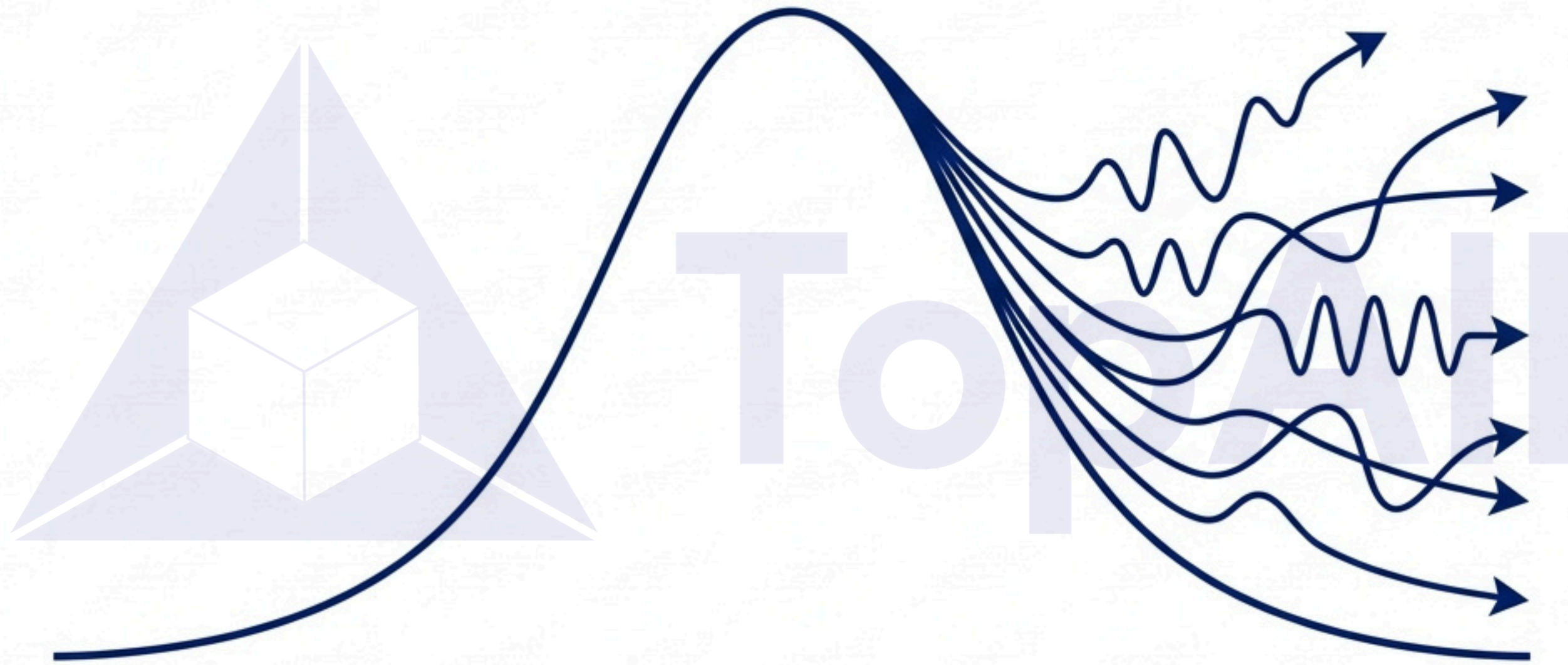
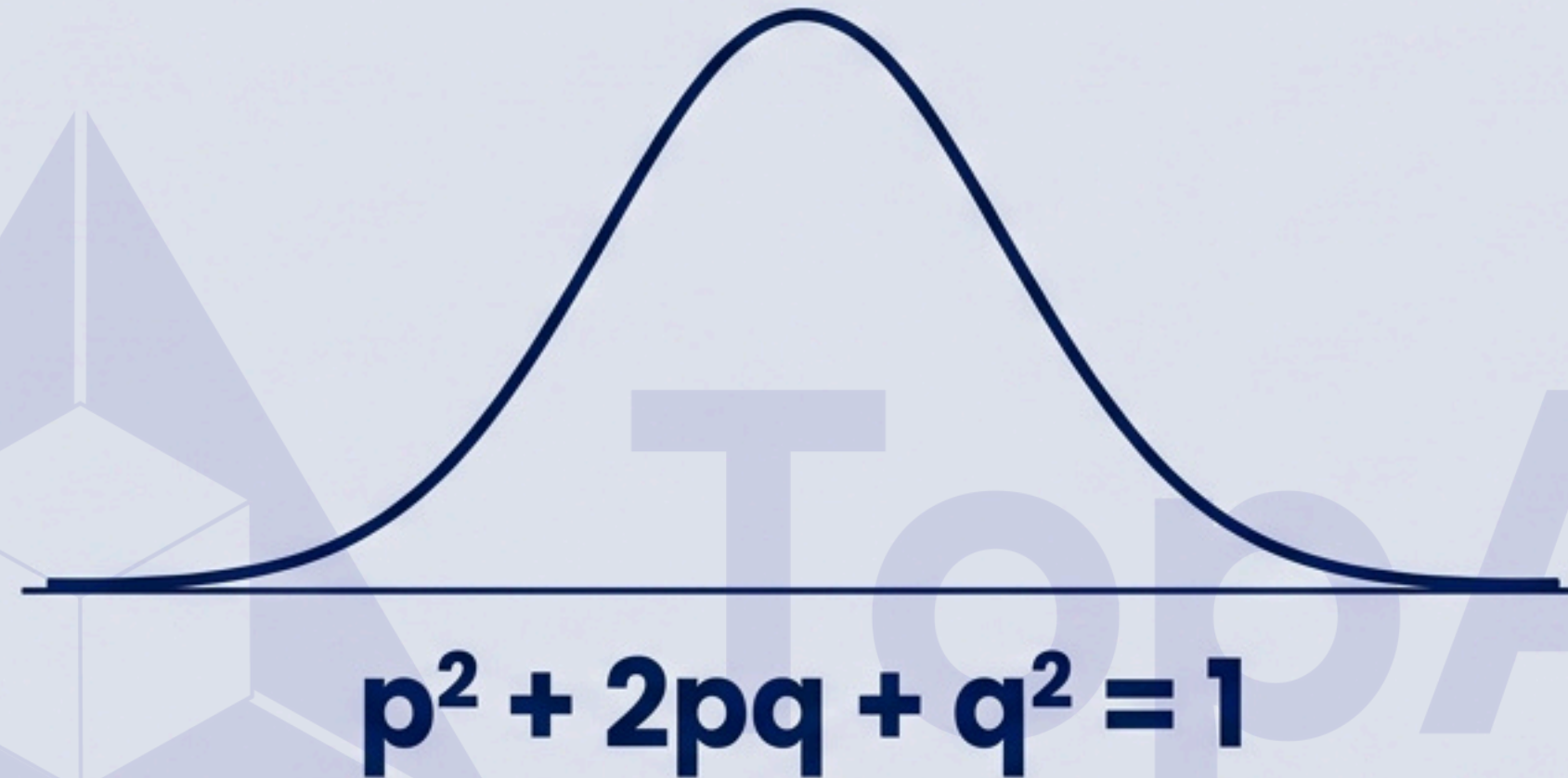


Forces That Disturb Genetic Equilibrium



Understanding the five mechanisms that drive evolutionary change in a population.

The Baseline: Hardy-Weinberg Genetic Equilibrium



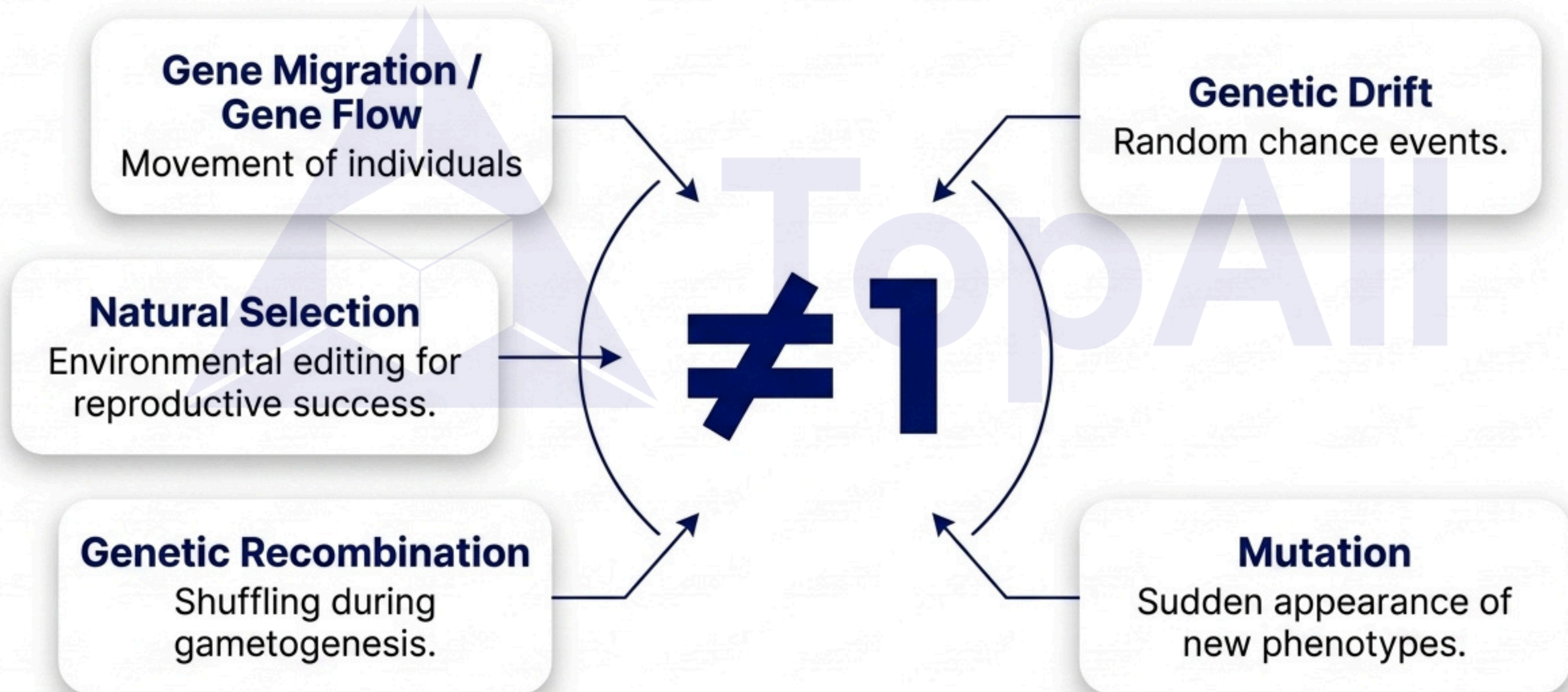
- In a stable population, the frequency of alleles and the total gene pool remain constant from generation to generation.
- Sum total of all the allelic frequencies is exactly 1.

➤ Quick-Tip

NEET Concept: When measured allele frequencies differ from expected Hardy-Weinberg values, the direction and extent of this difference indicate evolutionary change.

The 5 Agents of Evolutionary Change

Disturbance in genetic equilibrium—the change of **allele frequencies** in a **population**—results in evolution. Here are the five forces responsible.



Force 1: Gene Migration & Gene Flow



→ Quick-Tip:

Definition: If this migration happens multiple times continuously, it is termed Gene Flow.

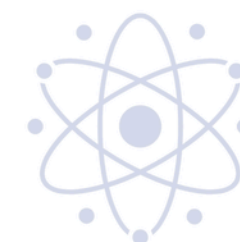
→ Common Confusion:

Do not confuse gene flow with genetic drift. Gene flow is driven by physical movement/migration, not random chance.



You've Learned the Theory. Let's Test Them Now.

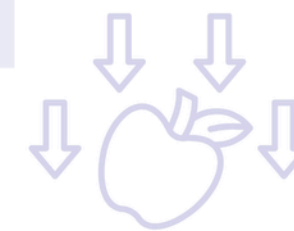
$$E=mc^2$$



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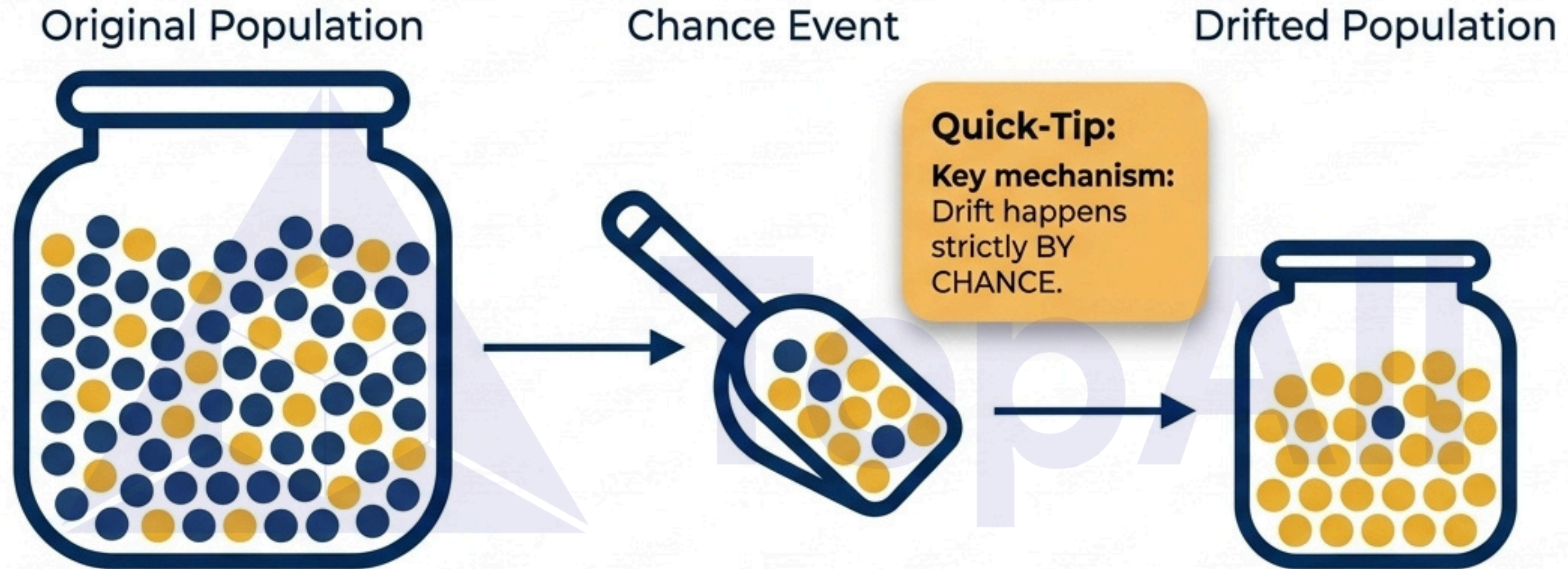
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Force 2: Genetic Drift & The Founder Effect



Key Explanation:

- Sometimes the change in allele frequency is so drastically different in the new sample that they become a completely different species.

Key Explanation:

- The **Founder Effect**: The original drifted population becomes the founders of this new evolutionary path.

Forces 3 & 4: Generating Variation

Mutation



Pre-existing advantageous mutations, when selected, result in the observation of new phenotypes over a few generations. Ultimately leads to speciation.

Genetic Recombination



The shuffling of genetic material that occurs naturally during gametogenesis (meiosis), resulting in a changed frequency of genes in future generations

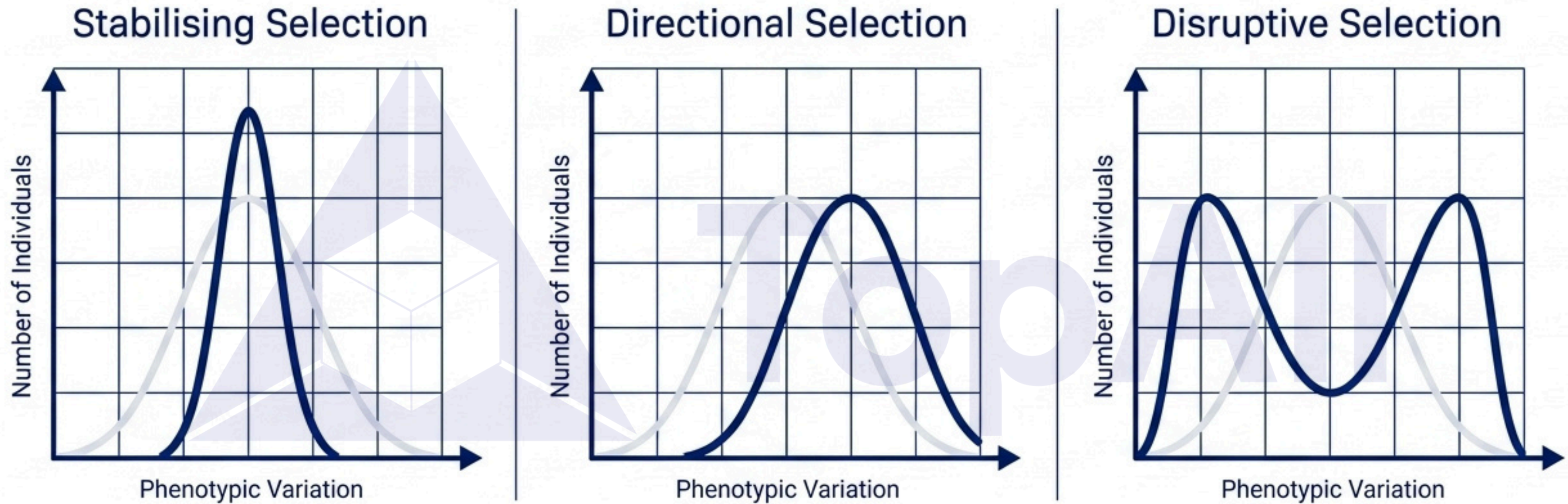
Force 5: Natural Selection



Natural selection is a process in which heritable variations enabling better survival enabled to reproduce and leave a greater number of progeny.

Coupled with enhanced reproductive success, natural selection makes the resulting group look and function like a different population.

The Three Curves of Selection



More individuals acquire the mean character value.
(Outliers are eliminated).

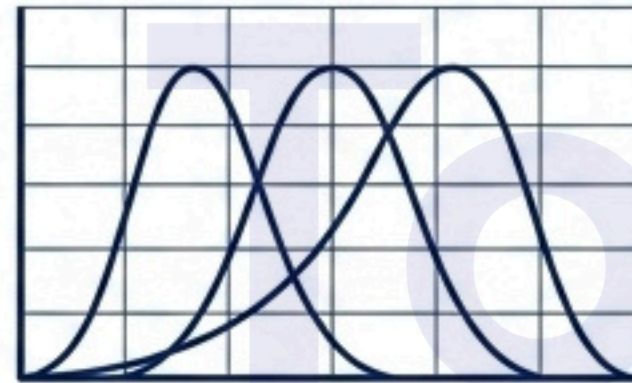
More individuals acquire a value other than the mean character value.

More individuals acquire peripheral character values at both ends of the distribution curve.

The Blueprint of Evolution



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



Evolution is not random chaos; it is the mathematical consequence of genetic equilibrium being disturbed. When **migration, drift, mutation, recombination, or selection** break the Hardy-Weinberg baseline, the population is forced to adapt, shift, and evolve.



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