

Breaking Independent Assortment

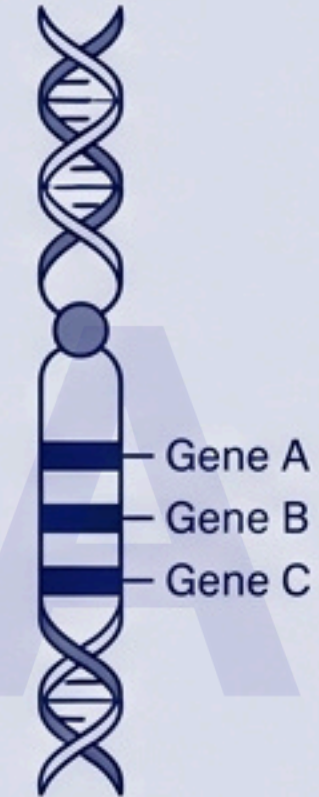
How Morgan's *Drosophila* experiments revealed the mechanisms of genetic linkage and recombination.

The Expectation

9:3:3:1

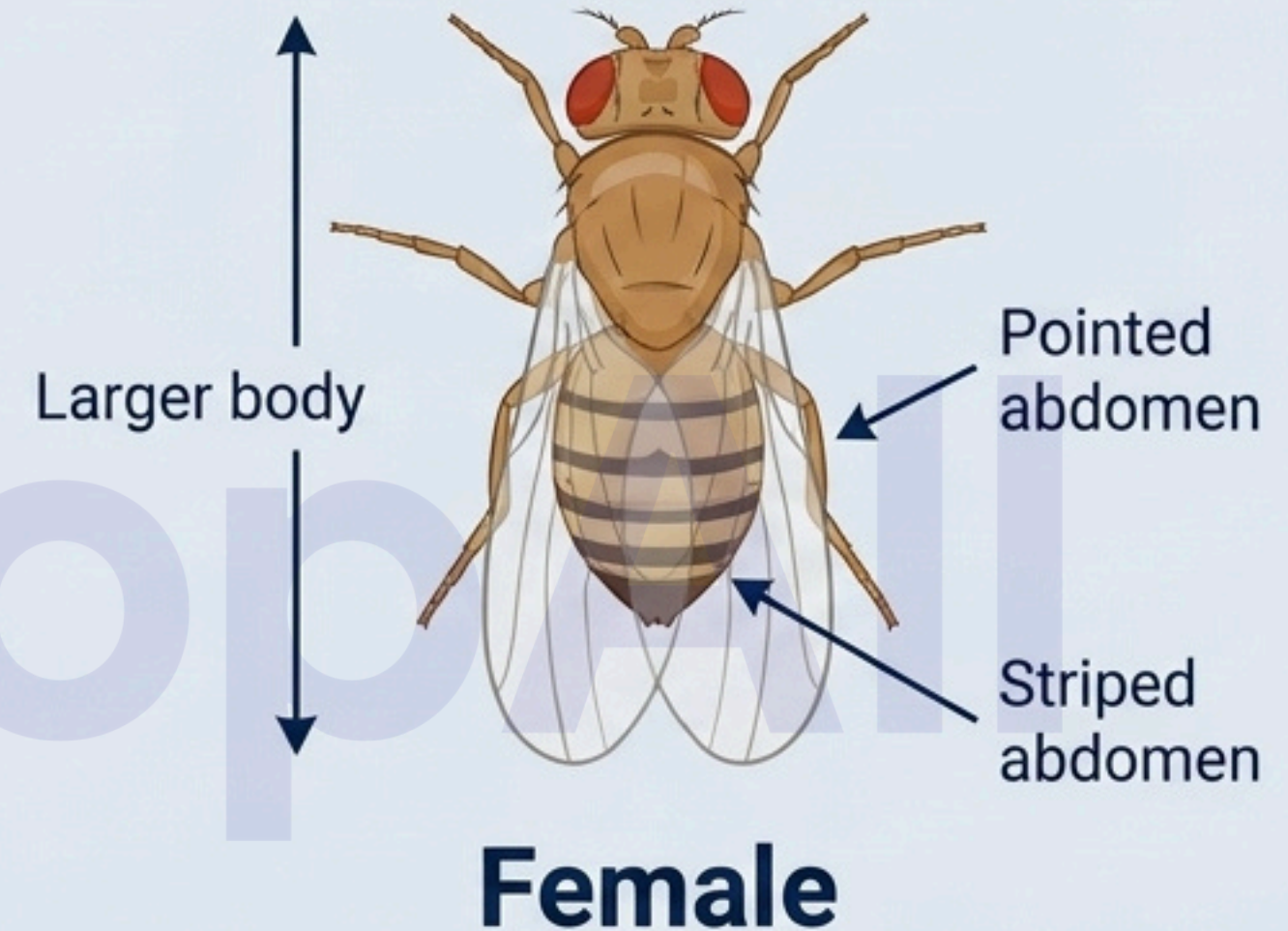
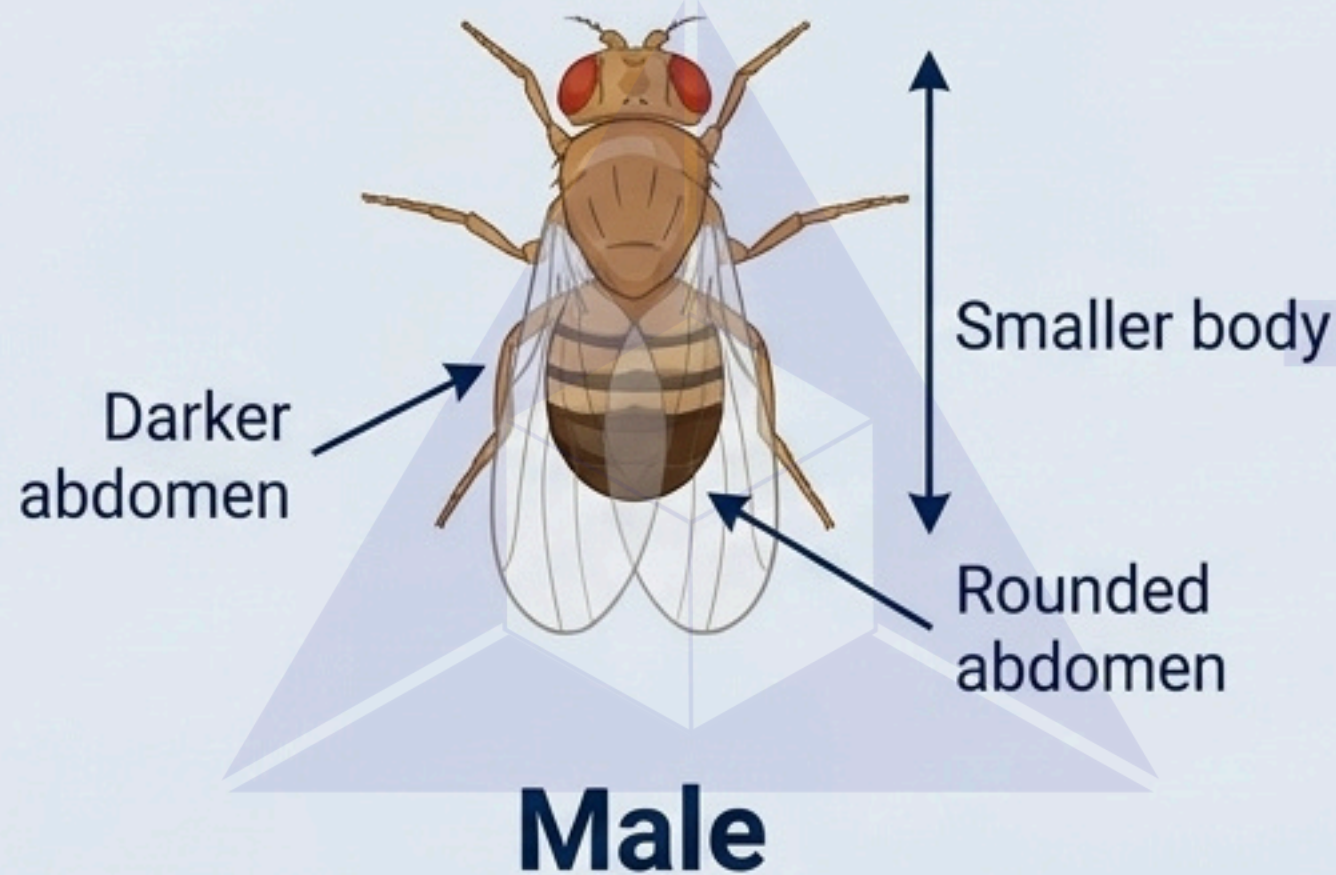
Assumption: All genes assort independently during meiosis.

The Physical Limit



Mendel's math breaks down when two genes are physically located on the same chromosome. They cannot assort independently; they travel together.

The Ideal Model Organism



Why Fruit Flies? Grown on simple synthetic medium, complete life cycle in ~2 weeks, single mating produces large numbers of progeny, and clear sexual dimorphism.



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

$$E=mc^2$$



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Practice Now



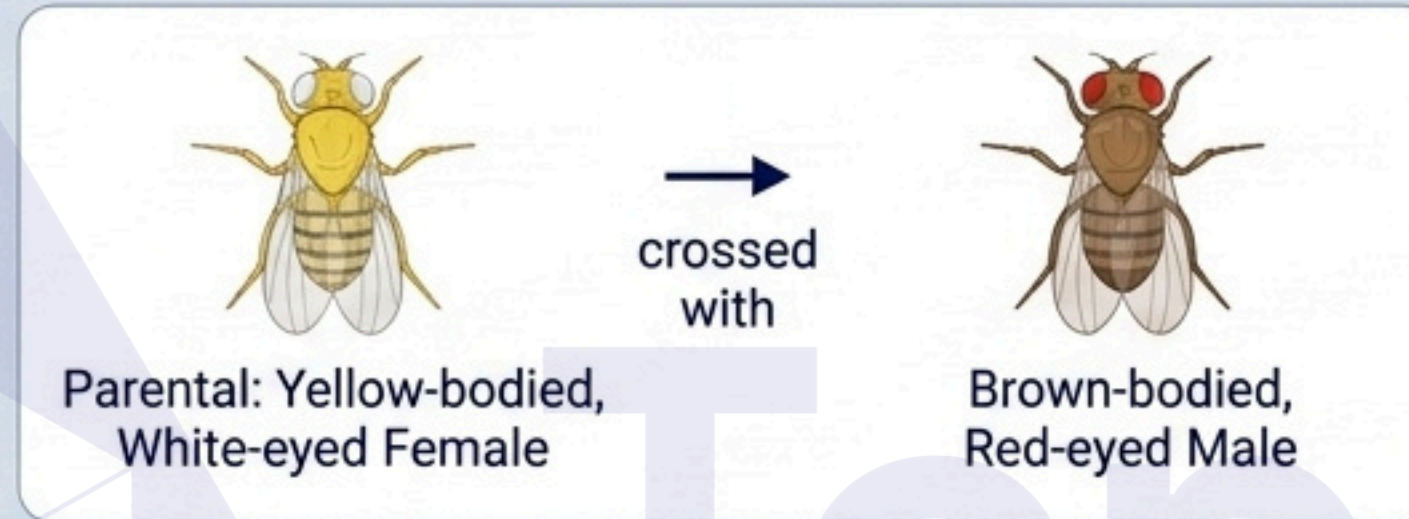
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Key Highlights

- » Free Study Material, Videos & Infographics
- » Push Your Limits with Level-Based Challenges
- » Climb the Leaderboard Among Fellow Aspirants
- » Practice Unlimited MCQs for NEET & JEE
- » Get Clear Explanations, Not Just Marks
- » Track Your Performance Smarter



Morgan's Dihybrid Cross Anomaly



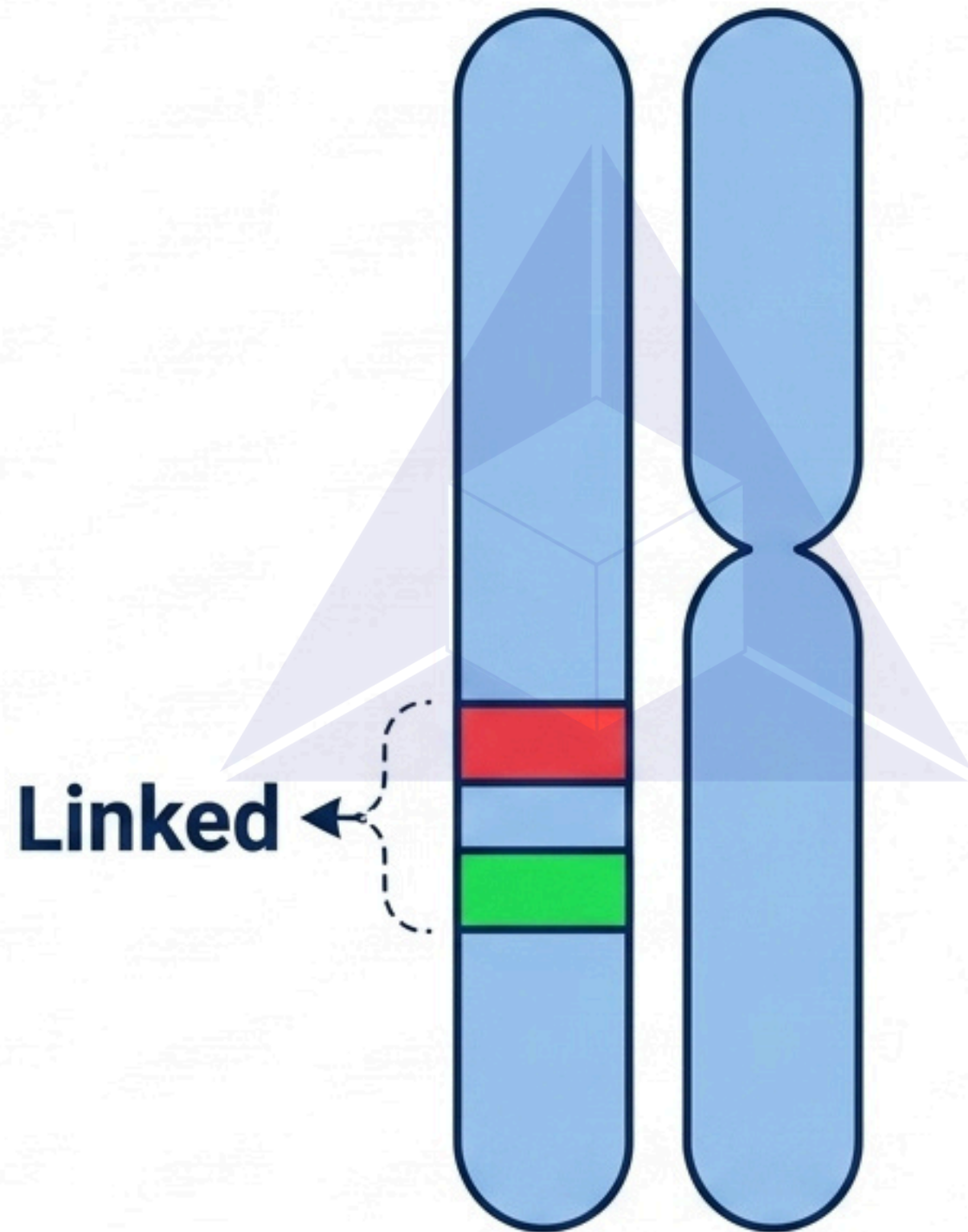
F1 Progeny: Intercrossed.

The F2 ratio deviated significantly from the expected 9:3:3:1.



Morgan knew these genes were located on the X chromosome. The proportion of parental gene combinations was much higher than expected.

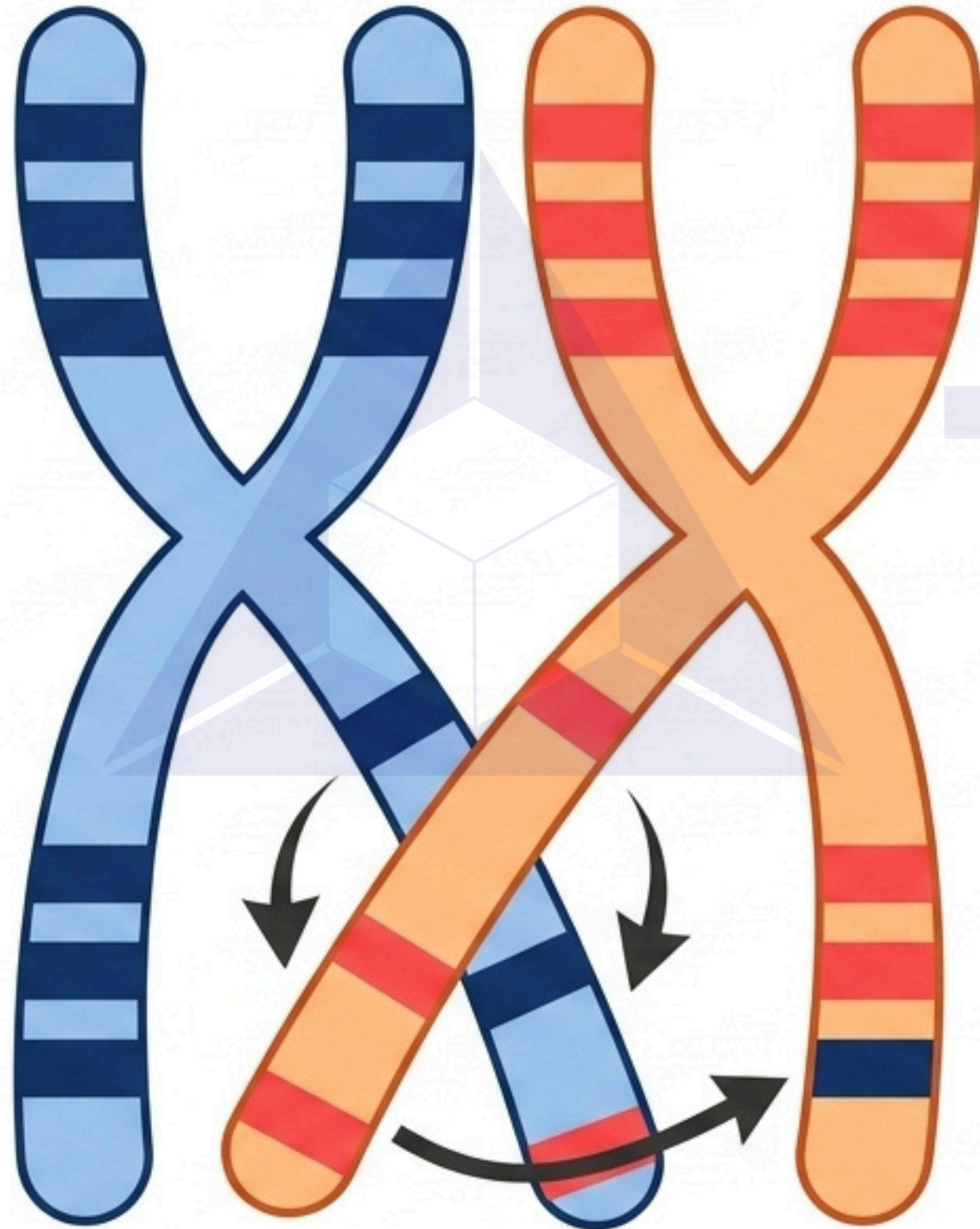
The Mechanism of Linkage



Linkage is the physical association of genes on a chromosome.

- Because they are physically tethered, **linked genes tend to be inherited together**, resulting in highly stable **parental combinations**.

The Mechanism of Recombination

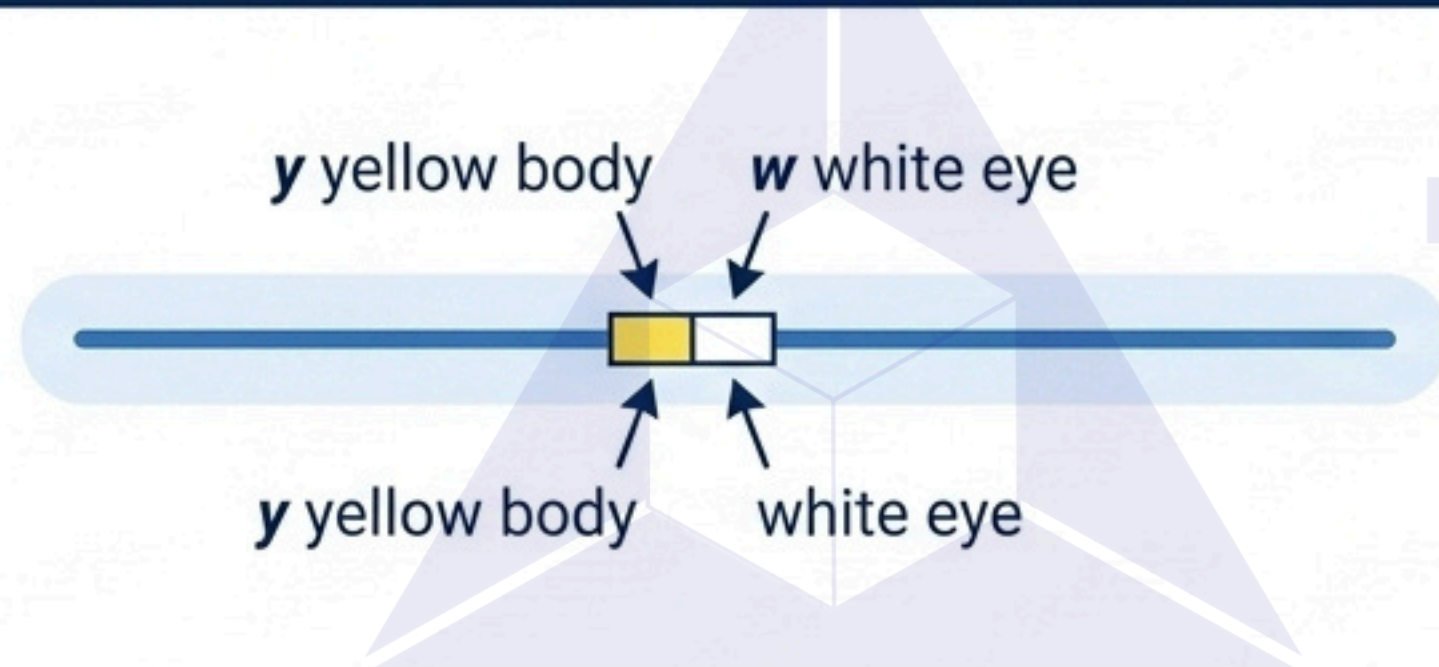


Recombination is the generation of non-parental gene combinations.

- During meiosis, crossing over can break the physical association of linked genes, creating new genetic variations.

Comparing Linkage Strengths

Cross A: Tight Linkage



Parental Type:

98.7%

Recombinant Type:

1.3%

Cross B: Loose Linkage



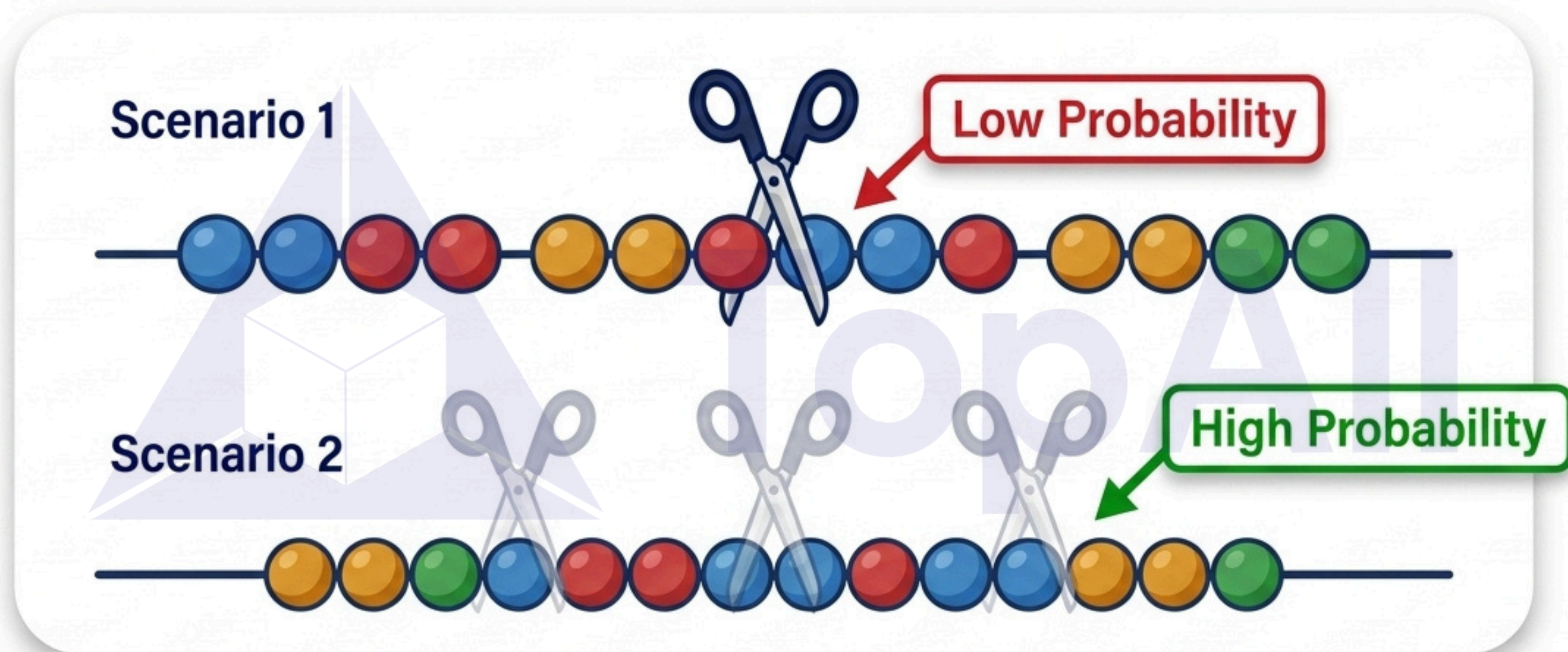
Parental Type:

62.8%

Recombinant Type:

37.2%

The “Beads on a String” Metaphor



The physical distance between two genes dictates the mathematical probability of a crossover event occurring between them.

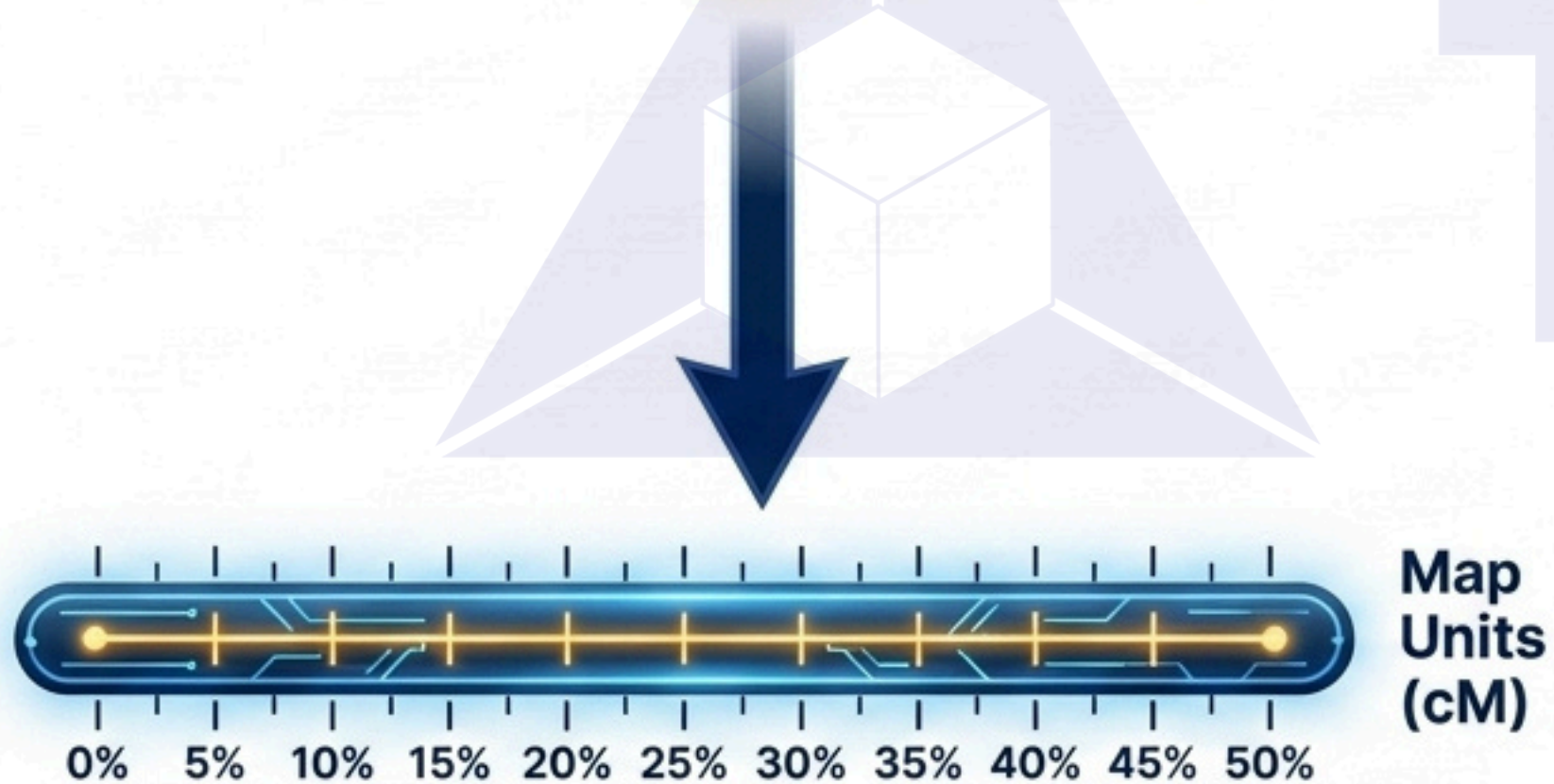
The Linkage Spectrum



Key Takeaway: Closer genes show lower recombination.

From Anomaly to Genetic Mapping

9:3?3:1



Alfred Sturtevant utilized this exact universal rule to map chromosomes.

- He used the frequency of recombination between gene pairs as a direct measure of physical distance.
- This conceptual breakthrough became the starting point for sequencing whole genomes, including the Human Genome Project.



You've Learned the Theory.

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