Dihybrid Cross

Crossing Two Traits Simultaneously

Parent 1		Parent 2
RrYy	×	**RrYy**
Round, Yellow		Round, Yellow

↓ Gamete Formation (Independent Assortment)

RY	Ry	rY	ry

16 Possible Combinations in F2 Generation

	RY	Ry	rY	ry
RY	RRYY	RRYy	RrYY	RrYy
Ry	RRYy	RRyy	RrYy	Rryy
rY	RrYY	RrYy	rrYY	rrYy
ry	RrYy	Rryy	rrYy	rryy

Phenotypic Ratio: 9 : 3 : 3 : 1

● Round Yellow ● Round Green ● Wrinkled Yellow ● Wrinkled Green

Dihybrid Cross Punnett Square

RrYy × RrYy (Round/Wrinkled & Yellow/Green)

	RY	Ry	rY	ry
RY	RRYY	RRYy	RrYY	RrYy
Ry	RRYy	RRyy	RrYy	Rryy
rY	RrYY	RrYy	rrYY	rrYy
ry	RrYy	Rryy	rrYy	rryy

Phenotypic Ratio: 9:3:3:1

9	3	3	1
Round Yellow	Round Green	Wrinkled Yellow	Wrinkled Green

Test Cross

Determining Unknown Genotype by Crossing with Homozygous Recessive

Purpose: To determine if an organism showing a dominant phenotype is homozygous dominant (TT) or heterozygous (Tt) by crossing it with a homozygous recessive individual (tt).

Case 1: Homozygous Dominant

TT × tt

	t	t
T	Tt	Tt
T	Tt	Tt

Result: All offspring show dominant phenotype

Ratio: 4 Tall : 0 Short

Case 2: Heterozygous

Tt × tt

	t	t
T	Tt	Tt
t	tt	tt

Result: Offspring show both phenotypes

Ratio: 2 Tall : 2 Short (1:1)

Conclusion: If all offspring show the dominant trait, the parent is homozygous dominant (TT). If offspring show a 1:1 ratio, the parent is heterozygous (Tt).

Back Cross

Crossing F1 Hybrid with Either Parent

Definition: A back cross involves crossing an F1 hybrid offspring with one of its parents (either homozygous dominant or homozygous recessive).

Difference from Test Cross: Test cross specifically uses homozygous recessive parent to determine genotype, while back cross can use either parent for breeding purposes.

Incomplete Dominance

Neither allele is completely dominant - heterozygote shows blended phenotype

Key Concept

- Heterozygote phenotype is **intermediate** between two homozygotes
- Results in a **blended** appearance
- Phenotypic ratio matches genotypic ratio: **1:2:1**

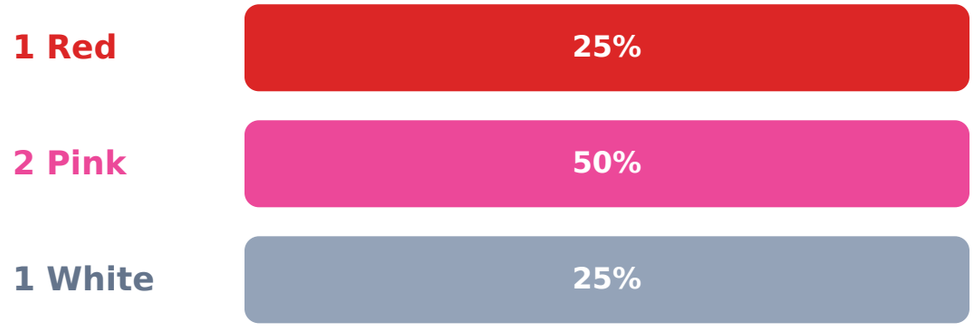
Snapdragon Flower Example

Red (RR) | Pink (Rr) | White (rr)

F1 Cross: Pink × Pink

	R	r
R	**RR** Red	**Rr** Pink
r	**Rr** Pink	**rr** White

Phenotypic Ratio: 1:2:1

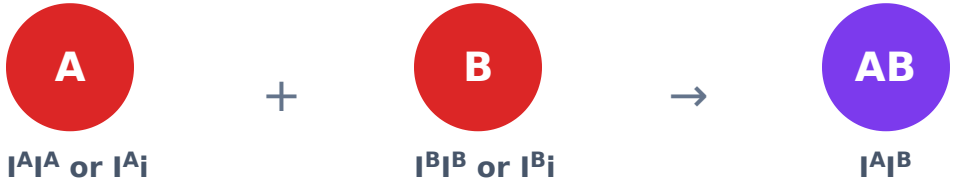


Codominance

Definition

Both alleles are **fully expressed** in the heterozygote. Neither allele is dominant or recessive - both contribute equally to the phenotype.

Example: ABO Blood Type



Punnett Square

	I^A	i
I^B	I^AI^B AB	I^Bi B
i	I^Ai A	ii O

Cross: $I^Ai \times I^Bi$

Comparison

- **Codominance:**
  Both alleles fully expressed. Heterozygote shows **both traits simultaneously** (AB blood type).
- **Incomplete Dominance:**
  Neither allele dominant. Heterozygote shows **blended phenotype** (pink flowers).

Key Difference: Codominance = Both traits visible | Incomplete = Blended trait

Multiple Alleles

Definition

A gene that exists in more than two allelic forms in a population. While each individual can only carry two alleles, the population as a whole has multiple variants.

ABO Blood Group System

Three Alleles in Population

Dominant Dominant Recessive

Genotypes → Phenotypes

I^AI^A or I^Ai	→ **Type A**
I^BI^B or I^Bi	→ **Type B**
I^AI^B	→ **Type AB**
ii	→ **Type O**

Inheritance Example

Type A (I^Ai) × Type B (I^Bi)

	I^A	i
I^B	I^AI^B **AB**	I^Bi **B**
i	I^Ai **A**	ii **O**

Phenotypic Ratio

1 AB : 1 A : 1 B : 1 O

Mendel's Contributions to Genetics

The Father of Modern Genetics

Particulate Inheritance

Established that traits are inherited as discrete units (genes), not blended

Foundation of Genetics

Laid groundwork for chromosome theory and molecular genetics

Evolutionary Impact

Provided mechanism for Darwin's natural selection theory

Timeline of Recognition

1866

Published Work

Experiments on Plant Hybridization

1900

Rediscovered

By de Vries, Correns, and von Tschermak

Today

Modern Legacy

Foundation of Genetic Science

Modern Applications

Agriculture

Crop improvement, hybrid vigor, disease resistance breeding, GMO development

Medicine

Genetic counseling, disease prediction, gene therapy, personalized medicine