

Mendelian Genetics

Gene A → Trait 1, Trait 2, Trait 3

Genotype: Rr, RR

Diagram illustrating the inheritance of a trait (Gene A) through generations, showing the separation of alleles and the resulting phenotypes (Trait 1, Trait 2, Trait 3).

II. Mendel's Work

A. Advantages of garden peas

1. Easy to cultivate
2. Short generation time
3. Can be cross-pollinated and self-pollinated

B. Mendel cross-pollinated two plants at a time.

1. P1 generation is the parental generation.
2. F1 generation is the first-generation offspring.
3. F2 generation is the second-generation offspring.

Diagram illustrating Mendel's pea plant experiment, showing the removal of stamens from a purple flower, the transfer of pollen from a white flower, and the resulting F1 generation (purple flowers) and F2 generation (purple flowers).

I. Gregor Mendel

A. An Austrian monk.

B. Formulated two fundamental laws of heredity in the early 1860s.

C. Previous theories based on the Blending Concept of Inheritance (Tall + Short = Medium))

D. The blending theory did not account for variation, does not explain species diversity.

Diagram illustrating Mendel's pea plant experiment, showing the inheritance of a trait (Gene A) through generations, resulting in a 3:1 phenotypic ratio in the F2 generation.

II. Mendel's Work

C. Mendel's results were contrary to those predicted by a blending theory of inheritance.

D. He found that the F1 plants resembled only one of the parents.

E. Mendel's Conclusions

1. F1 hybrids contained two factors for each trait
2. One dominant and one recessive factors separated when gametes were formed
3. A gamete carries one copy of each factor
4. Random fusion of all possible gametes occurred upon fertilization.

Character	P Generation	Gametes	F ₁ Generation	Genotype	Phenotype	Ratio
Flower color	Purple × White	P, p	Pp	Pp	Purple	100%
Flower position	Terminal × Axial	T, t	Tt	Tt	Terminal	100%
Seed shape	Round × Wrinkled	R, r	Rr	Rr	Round	100%
Pod shape	Inflated × Constricted	I, i	Ii	Ii	Inflated	100%
Pod color	Green × Yellow	G, g	Gg	Gg	Green	100%
Stem height	Tall × Dwarf	T, t	Tt	Tt	Tall	100%

I. Gregor Mendel

E. Charles Darwin wanted to develop a theory of evolution based on hereditary principles.

F. Particulate theory of inheritance, as proposed by Mendel, can account for presence of differences among members of a population.

G. Mendel's work was unrecognized until 1900; Darwin was never able to use it to support his theory of evolution.

Diagram illustrating Mendel's pea plant experiment, showing the inheritance of a trait (Gene A) through generations, resulting in a 3:1 phenotypic ratio in the F2 generation.

III. Chromosomes and Genes

A. Homologous Chromosomes contain genes (locations) for the same traits

B. Mendel's factors are called alleles

C. Traits are controlled by alleles (alternative forms of a gene).

D. Genotype refers to the alleles an individual receives at fertilization.

E. Phenotype refers to the physical appearance of the individual.

Diagram illustrating chromosomes and genes, showing the structure of chromosomes and the location of genes (Gene Locus) and alleles (Alleles).

Genotype: Rr, RR

IV. Mendel's Principle of Dominance and Recessiveness

A. F₁ hybrids resemble only one of the parents.

B. F₁ hybrids contain two factors for each trait, one dominant and one recessive.

Mom BB **Dad** bb

↓ ↓

B b

↓ ↓

Bb

VII. Monohybrid Crosses

B. Types of Crosses

1. Homozygous x Homozygous
2. Homozygous x Heterozygous
3. Heterozygous x Heterozygous
4. Testcross

V. Mendel's Law of Segregation

A. Organism contains two factors for each trait.

B. Factors segregate during formation of gametes.

C. Each gamete contains one factor for each trait.

VIII. Dihybrid Cross

Feather color = **ORANGE** or **blue**
CREST or **no crest**

VI. Mendel's Law of Independent Assortment

A. Each trait is independent of another.

B. Members of one pair of factors assort independently of members of another pair.

C. All combinations of factors occur in gametes.

D. Meiosis explains these results of independent assortment.

IX. Going Beyond Mendel

A. Dominance Has Degrees

1. Incomplete dominance
 - a) Offspring intermediate between two parental phenotypes.
 - b) Blending
2. Codominance
 - a) Both alleles of a gene are expressed.
 - b) F₁ hybrid is different from both parents and not a blending of traits.

