11–3 Exploring Mendelian Genetics

What is the principle of independent assortment?

Independent Assortment

Mendel wanted to know if the segregation of one pair of alleles affects the segregation of another pair of alleles.

To answer his question, Mendel performed a two-factor cross. (crossing 2 traits)

The Two-Factor Cross: F_1

Mendel crossed true-breeding plants.

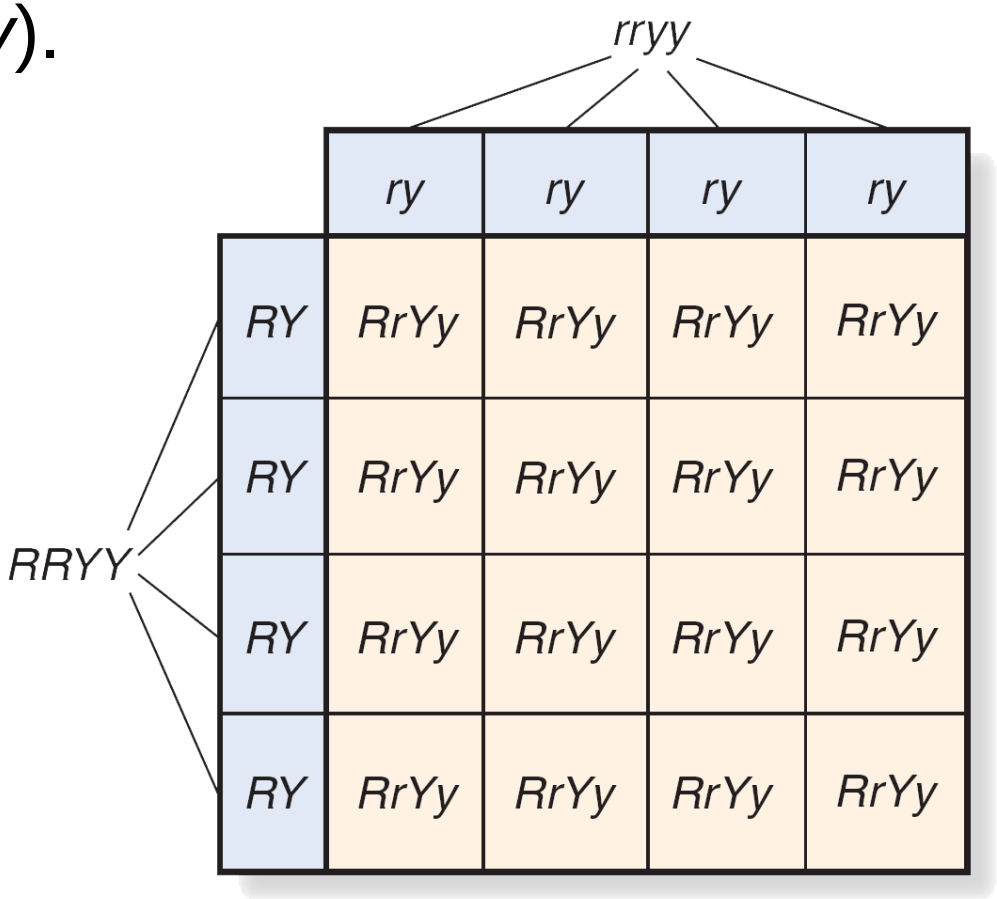
P: Round, Yellow peas X Wrinkled, Green Peas

RRYY X rryy

(homozygous) (homozygous)

F_1 : 100% of offspring RrYy (heterozygous)

The alleles for round (*R*) and yellow (*Y*) are dominant over the alleles for wrinkled (*r*) and green (*y*).

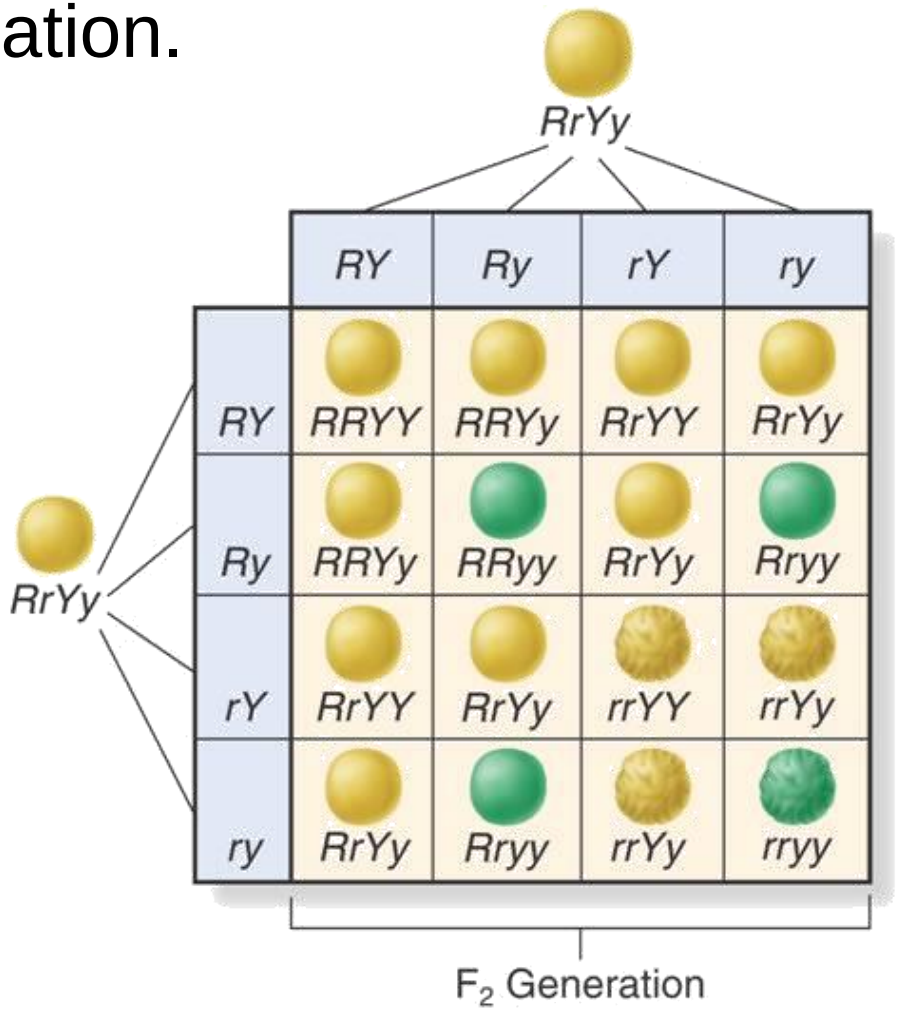


The Two-Factor Cross: F_2

Mendel crossed the heterozygous F_1 plants (*RrYy)* with each other to determine if the alleles would segregate from each other in the F_2 generation.

$$RrYy \times RrYy$$

The Punnett square predicts a 9 : 3 : 3 :1 ratio in the F_2 generation.



In Mendel's experiment, the F_2 generation produced the following:

- some seeds that were round and yellow
- some seeds that were wrinkled and green
- some seeds that were round and green
- some seeds that were wrinkled and yellow

The alleles for seed shape segregated independently of those for seed color.

This principle is known as **independent assortment**.

Genes that segregate independently do not influence each other's inheritance.

Mendel's experimental results were very close to the 9 : 3 : 3 : 1 ratio predicted by the Punnett square.

Mendel had discovered the principle of independent assortment.

The principle of independent assortment states that genes for different traits can segregate independently during the formation of gametes.

Independent assortment helps account for the many genetic variations observed in plants, animals, and other organisms.

A Summary of Mendel's Principles

- Genes are passed from parents to their offspring.
- If two or more forms (alleles) of the gene for a single trait exist, some forms of the gene may be dominant and others may be recessive.

A Summary of Mendel's Principles

- In most sexually reproducing organisms, each adult has two copies of each gene. These genes are segregated from each other when gametes are formed.
- The alleles for different genes usually segregate independently of one another.

What inheritance patterns exist aside from simple dominance?

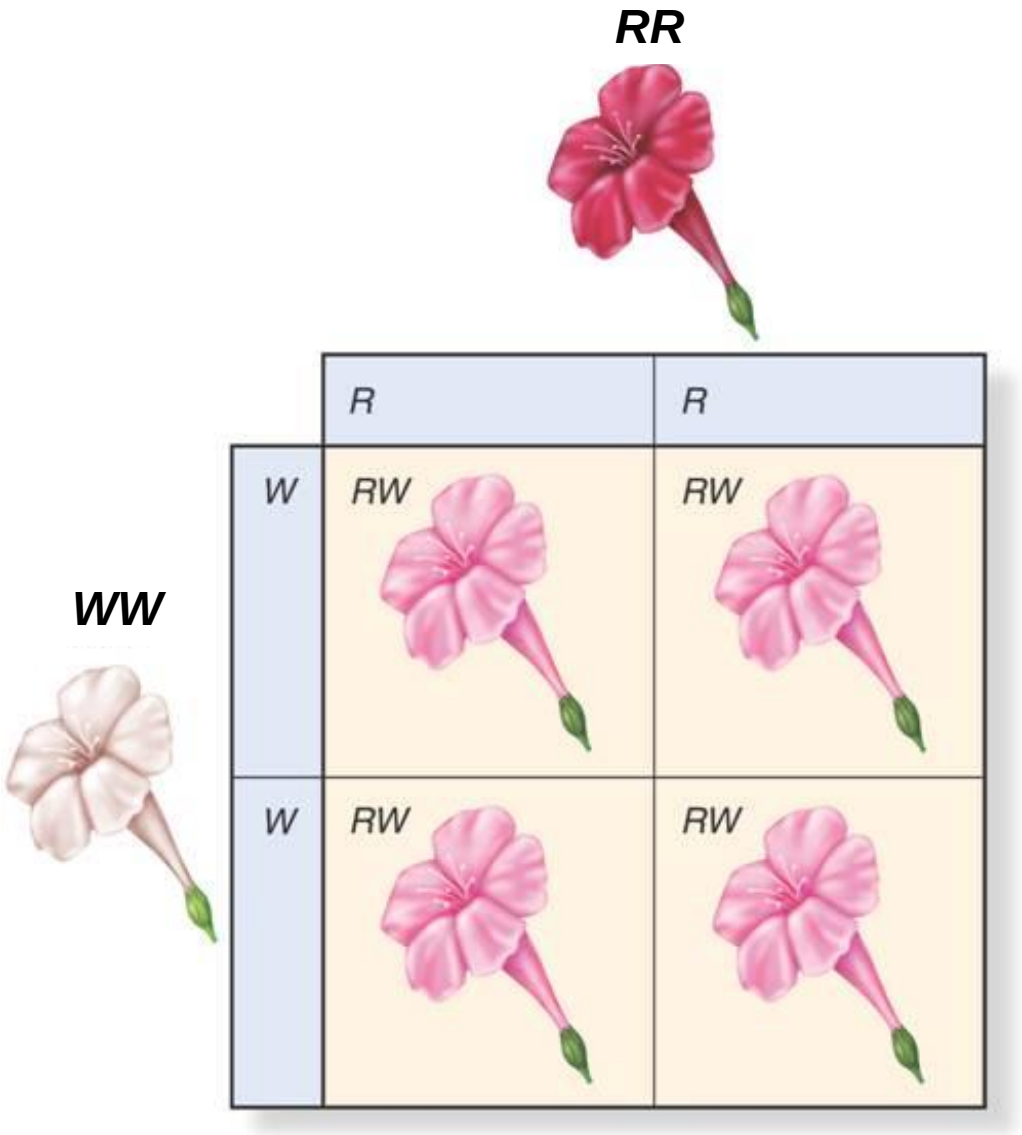
Some alleles are neither dominant nor recessive, and many traits are controlled by multiple alleles or multiple genes.

Incomplete Dominance

When one allele is not completely dominant over another it is called **incomplete dominance**.

In incomplete dominance, the heterozygous phenotype is between the two homozygous phenotypes.

A cross between red (*RR*) and white (*WW*) four o'clock plants produces pink-colored flowers (*RW*).



Codominance

In **codominance**, both alleles contribute to the phenotype.

In certain chicken, the allele for black feathers is codominant with the allele for white feathers.

Heterozygous chickens have both black and white feathers. The black and white colors do not blend.

Multiple Alleles

Genes that are controlled by more than two alleles are said to have **multiple alleles**.

An individual can’t have more than two alleles. However, more than two possible alleles can exist in a population.

A rabbit's coat color is determined by a single gene that has at least four different alleles.

Polygenic Traits

Traits controlled by two or more genes are said to be **polygenic traits.**

Skin color in humans is a polygenic trait controlled by more than four different genes.

Applying Mendel's Principles

Mendel’s principles can be used to study inheritance of human traits and to calculate the probability of certain traits appearing in the next generation.

Genetics and the Environment

Characteristics of any organism are determined by the interaction between genes and the environment.