10.2- Mendelian Genetics

How Genetics Began

genetics, the science of heredity.

heredity (or **inheritance**)- The passing of traits to the next generation

Gregor Mendel (father of genetics) studied inheritance in pea plants:

- Carefully controlled his plants breeding and recorded results
- Discovered patterns and ratios for how traits are passed down.

The Inheritance of Traits

One trait Mendel noticed was seed color – some plants always produced green seeds, others always produced yellow seeds.

Mendel cross-bred the green and yellow seed plants.

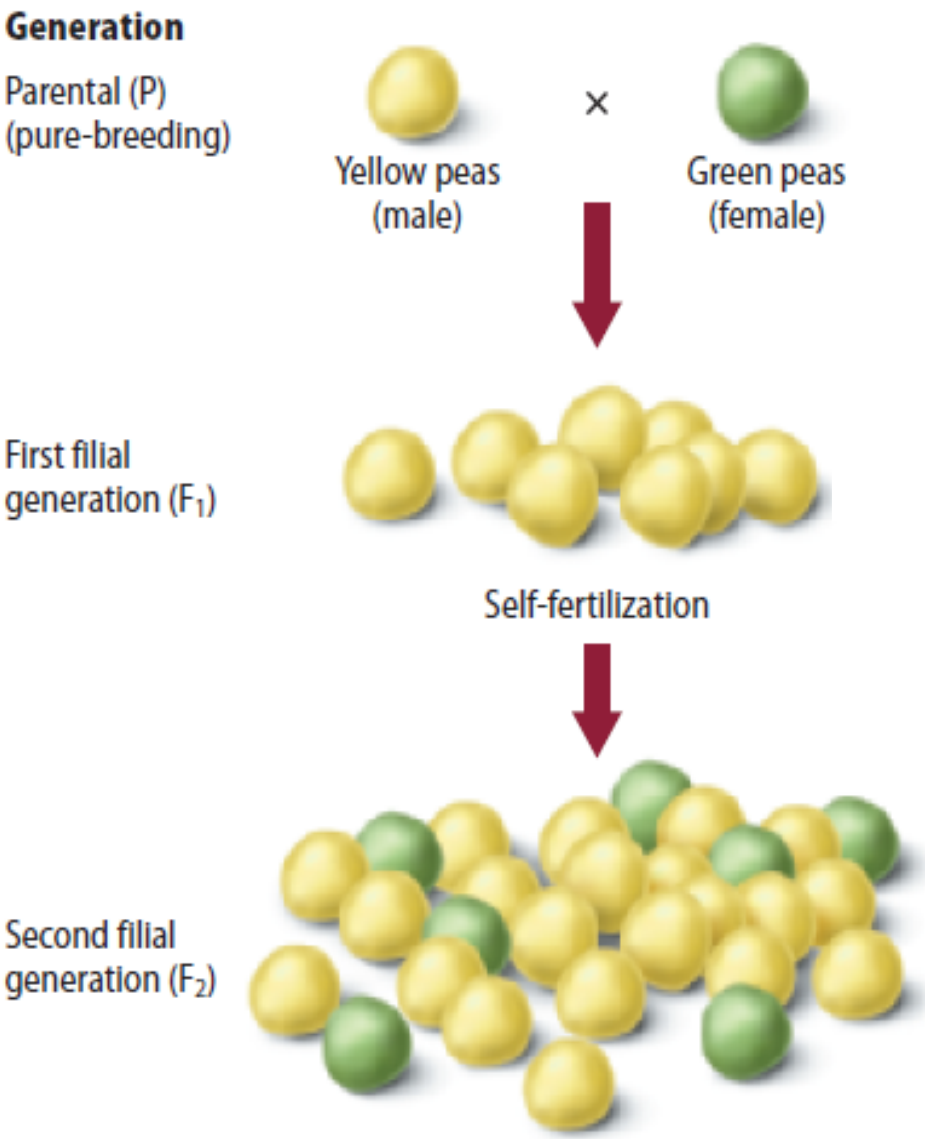
Mendel called the green-seed and yellow-seed plants the **parent (P) generation**.

The offspring of P cross are called the **first filial (F_1) generation.**

The offspring from the F_1 cross are called the **second filial (F_2) generation.**

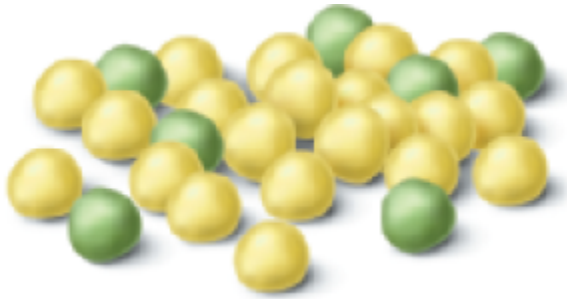
In Mendel's peas, the green-seed trait disappeared in the F_1 generation, but reappeared in the F_2 generation.

The F_2 generation showed a 3:1 ratio of yellow: green seeds



Mendel studied 7 traits for over 8 years recording results from over 30,000 plants.

- Seed or pea color
- Flower color
- Seed pod color
- Seed shape or texture
- Seed pod shape
- Stem length
- Flower position



6022 yellow : 2001 green
3 : 1

In all cases, Mendel found the F_2 generation plants showed a 3:1 ratio of traits.

Mendel's first conclusion-

there must be two forms of each trait in the plants

An **allele** is one of two (or more) different forms of a gene.

The code for yellow seeds and the code for green seeds are different alleles for the same gene.

Mendel's second conclusion-

The **principle of dominance**- some alleles are dominant and others are recessive.

Dominant- always shows up, cannot be hidden, (capital letter)

Recessive- can be hidden (lowercase letter)

Homozygous- means both alleles are the **same**. (ex. TT or tt)

Heterozygous- means the alleles are **different**. (ex. Tt)

called **hybrids**

the dominant trait will hide the recessive trait

The appearance of an organism does not always indicate which pair of alleles it possesses.

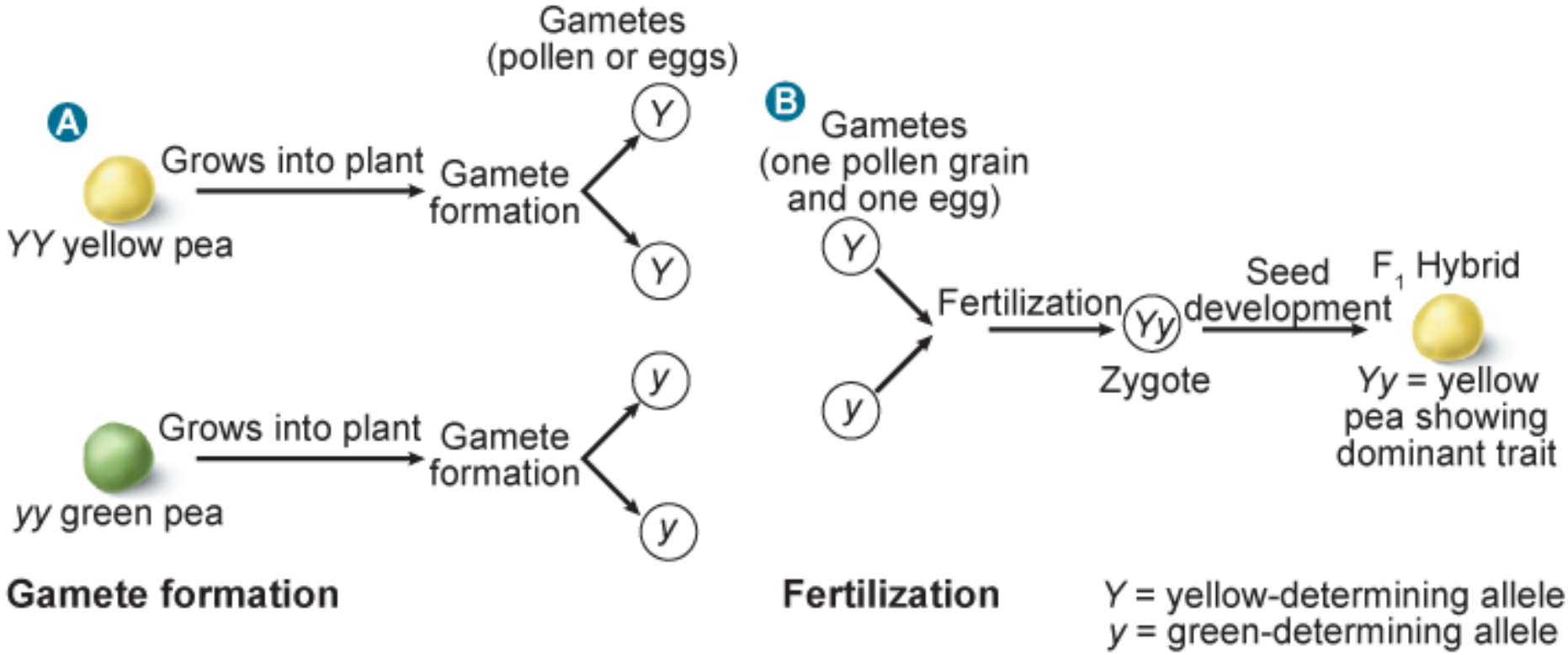
Phenotype- physical characteristics or traits- what you can see (tall, short)

Genotype- genetic makeup, the alleles for the gene (TT, Tt, or tt)

The Inheritance of Traits

Mendel's **law of segregation**- states that the two alleles for each trait separate during meiosis.

Then, during fertilization, the two alleles for that trait unite.


A
Grows into plant
YY yellow pea
Gametes
(pollen or eggs)
Gamete
formation
Y
Y
Grows into plant
yy green pea
Gamete
formation
y
y
Gametes
(one pollen grain
and one egg)
Y
y
Fertilization
Yy
Zygote
Seed
development
F1 Hybrid
Yy = yellow
pea showing
dominant trait
Gamete formation
Fertilization
Y = yellow-determining allele
y = green-determining allele

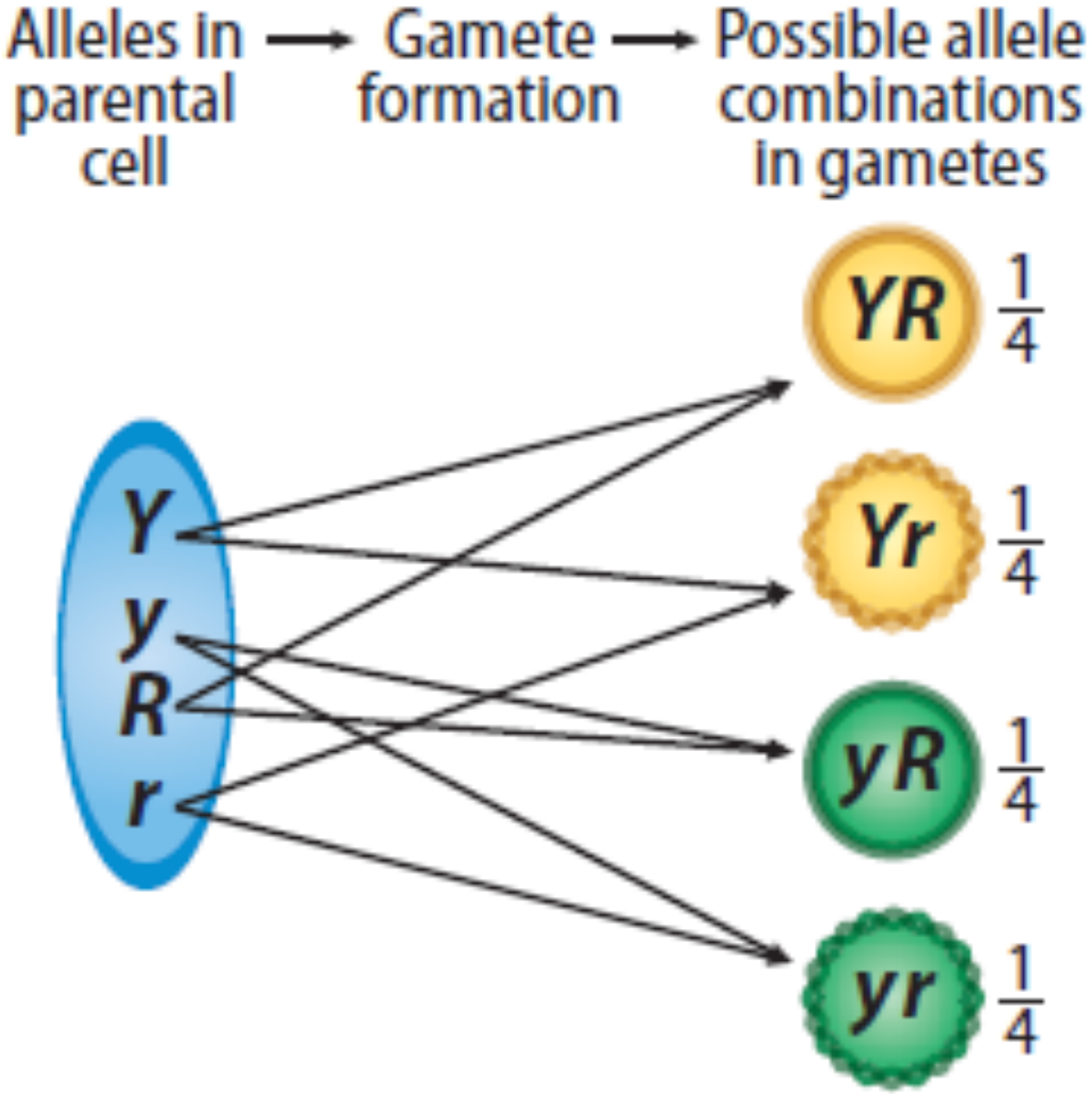
Monohybrid cross- A cross that involves a single gene

Dihybrid cross- a cross that involves two or more genes at once

law of independent assortment- random distribution of alleles occurs during gamete formation

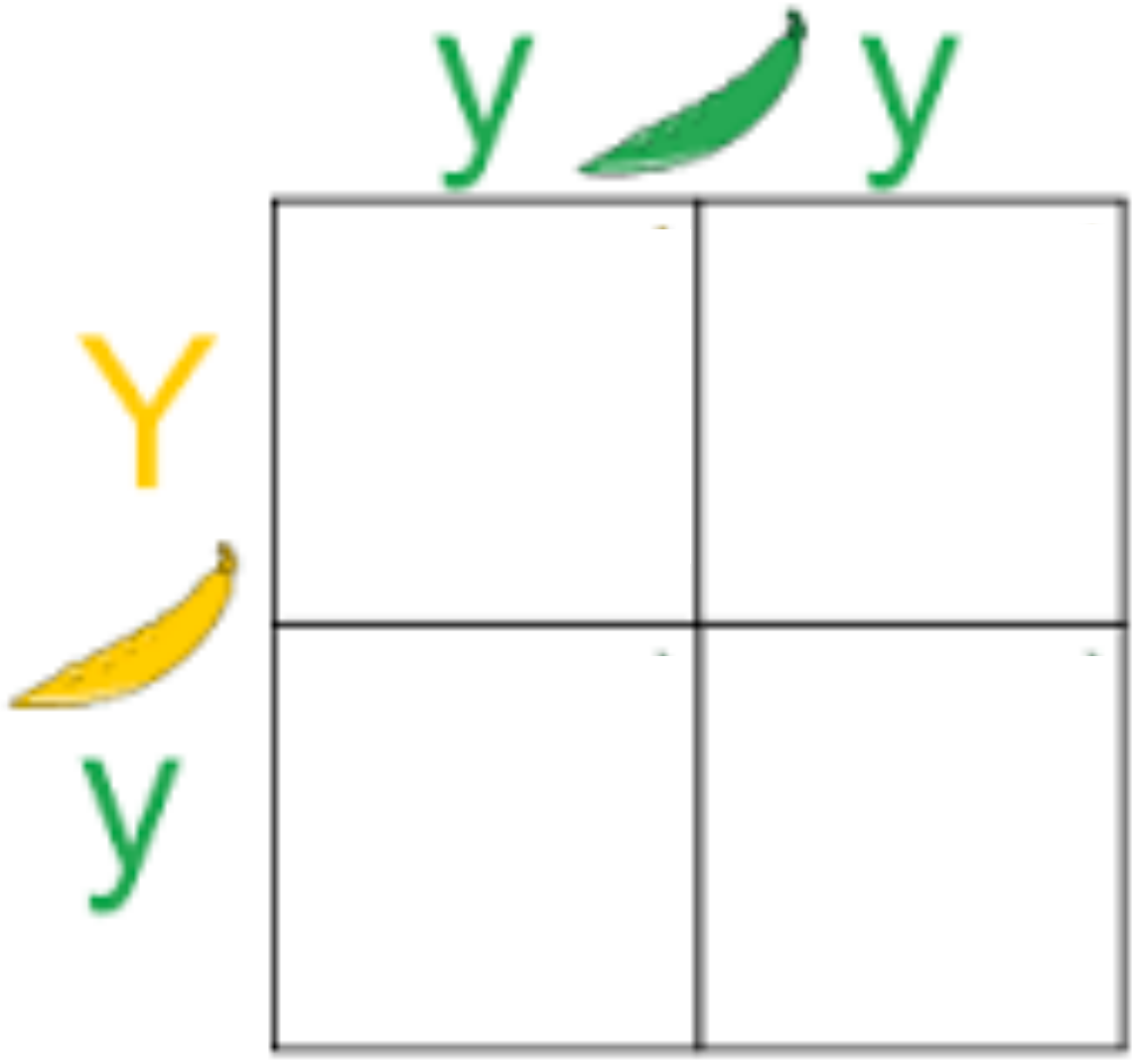
Genes on different chromosomes sort independently.

Each allele combination is equally likely to occur.


Alleles in parental cell
Gamete formation
Possible allele combinations in gametes
Y
y
R
r
YR
1/4
Yr
1/4
yR
1/4
yr
1/4

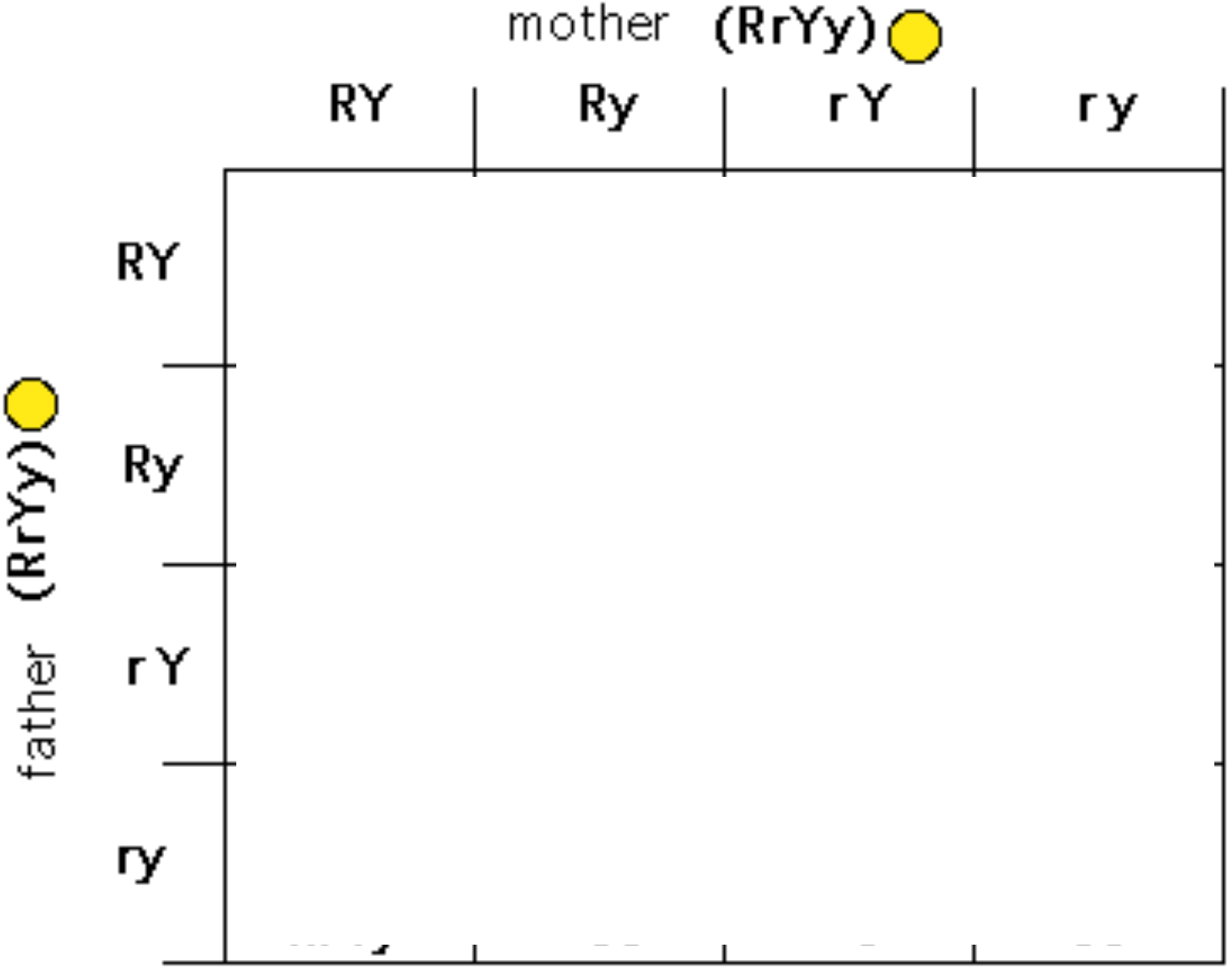
Punnett Squares

- Punnett squares predict the possible offspring of a cross
- The number of squares is determined by the number of alleles from each parent.


y
y
Y
y

dihybrid cross

- Four types of alleles from the male gametes and four types of alleles from the female gametes can be produced.
- The resulting phenotypic ratio is 9:3:3:1.


mother (RrYy)
RY
Ry
rY
ry
father (RrYy)
RY
Ry
rY
ry

Type	Genotype	Phenotype	Number	Phenotypic Ratio
Parental	*Y_R_*	 yellow round	315	9:16
Recombinant	*yyR_*	 green round	108	3:16
Recombinant	*Y_rr*	 yellow wrinkled	101	3:16
Parental	*yyrr*	 green wrinkled	32	1:16

Probability

The inheritance of genes can be compared to the probability of flipping a coin. **The data does not perfectly match, but it averages out to create a pattern.**

Mendel's results were not exactly a 9:3:3:1 ratio, but the larger the number of offspring involved, the more likely it will match the results predicted by Punnett squares.