11-1: Introduction to Genetics

The Work of Gregor Mendel

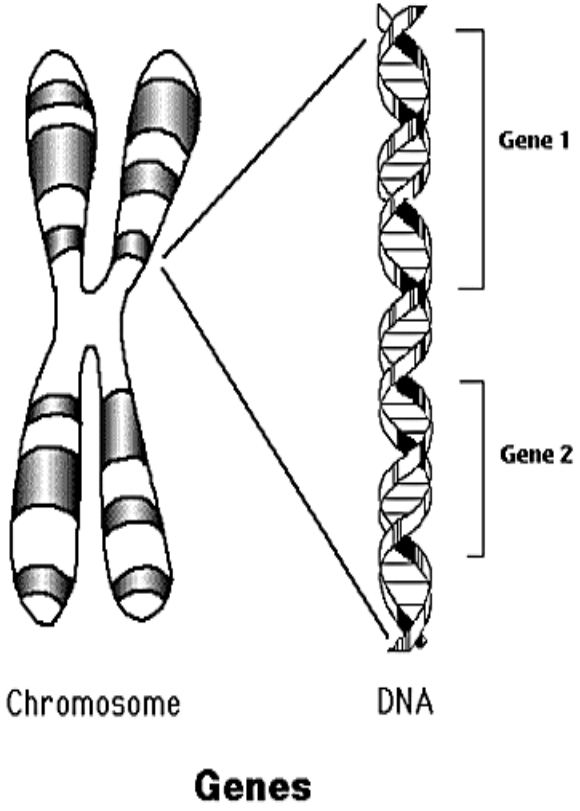
Genetics Vocabulary

- **Genetics**
  - The study of heredity.
- **Heredity**
  - The passing of physical characteristics from parents to offspring

- **Trait**
  - Characteristic that can be passed on to offspring
  - Ex: height, eye color, hair color

Genetics Vocabulary

- **Allele** - the different forms of a trait.
  - Ex: for the "eye color" gene brown and blue are two possible alleles.
- **Gene** - factor that controls a trait; located on your chromosomes.
  - You get your genes from the set of chromosomes you get from mom and the set of chromosomes from dad!

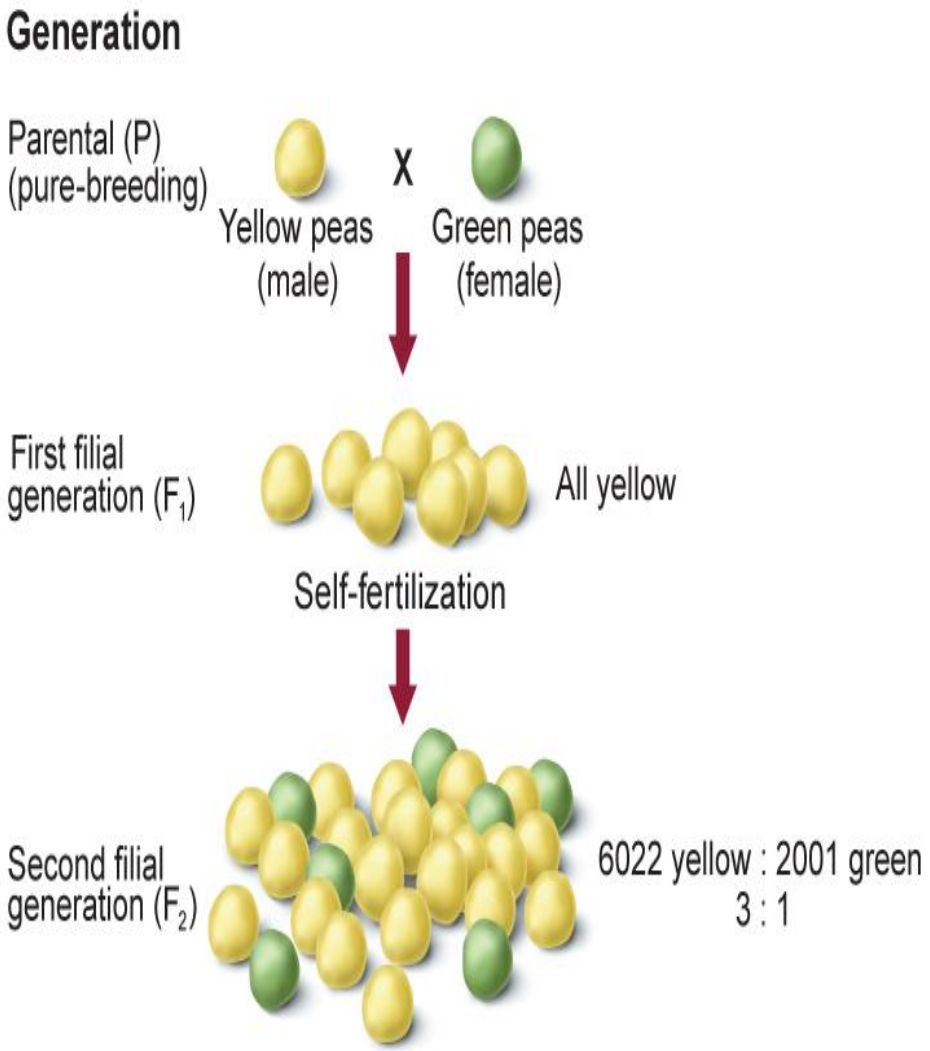


Gregor Mendel

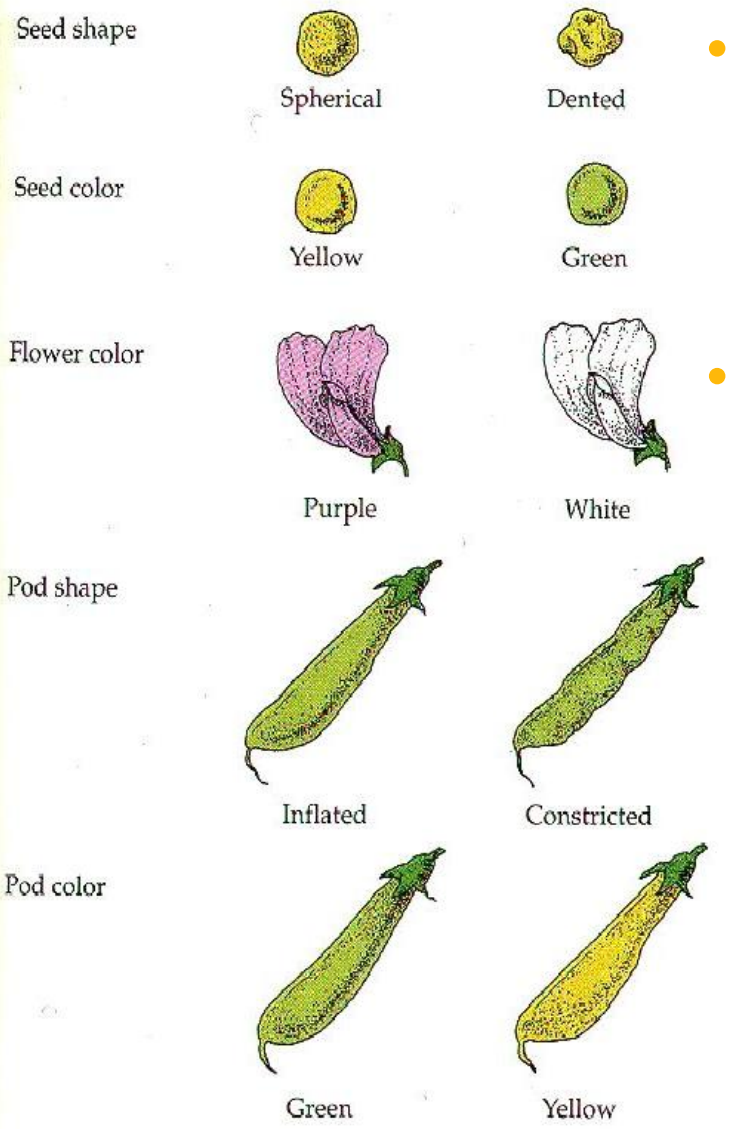
- In the early 1800s, a smart priest named **Gregor Mendel** experimented with **true breeding** (self pollinating) pea plants.
- He wanted to find out how the genetic traits for seed shape and pod color were passed down to new generations of plants.

Mendel's Experiment

- Mendel crossed <u>pure yellow peas</u> with pure green peas
- He noticed that **all the offspring were yellow**
- He then decided to cross these yellow peas with each other
- The offspring of these peas were both yellow and green

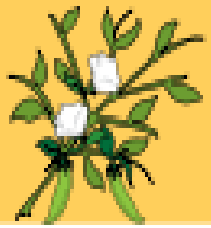


Mendel's Pea Plant Experiment



- Performed experimental crosses with pure bred pea plants.
- Discovered that first generation offspring all showed only one of two alternate traits.
  - Example: pure breeding tall crossed with pure breeding short produced ALL tall.

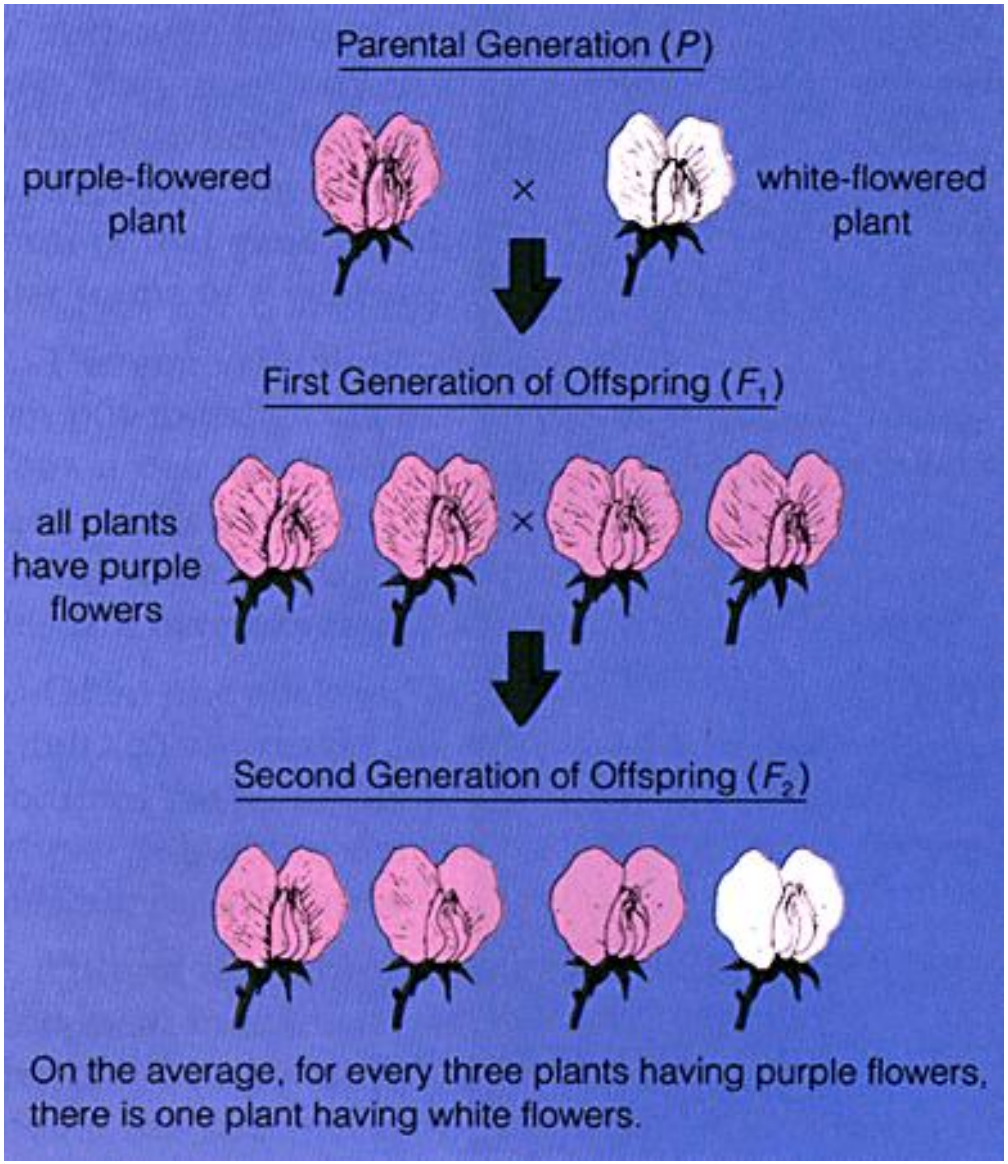
7 Pea Plant Traits

Seed		Flower	Pod		Stem	
Form	Cotyledons	Color	Form	Color	Place	Size
						
Grey & Round	Yellow	White	Full	Yellow	Axial pods, Flowers along	Long (6-7ft)
						
White & Wrinkled	Green	Violet	Constricted	Green	Terminal pods, Flowers top	Short (~1ft)
1	2	3	4	5	6	7

The Contributions of Mendel

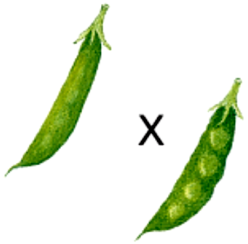
- He demonstrated that inherited characteristics are carried by separate units that are re-assorted in each generation.

Mendel's Pea Plant Experiment



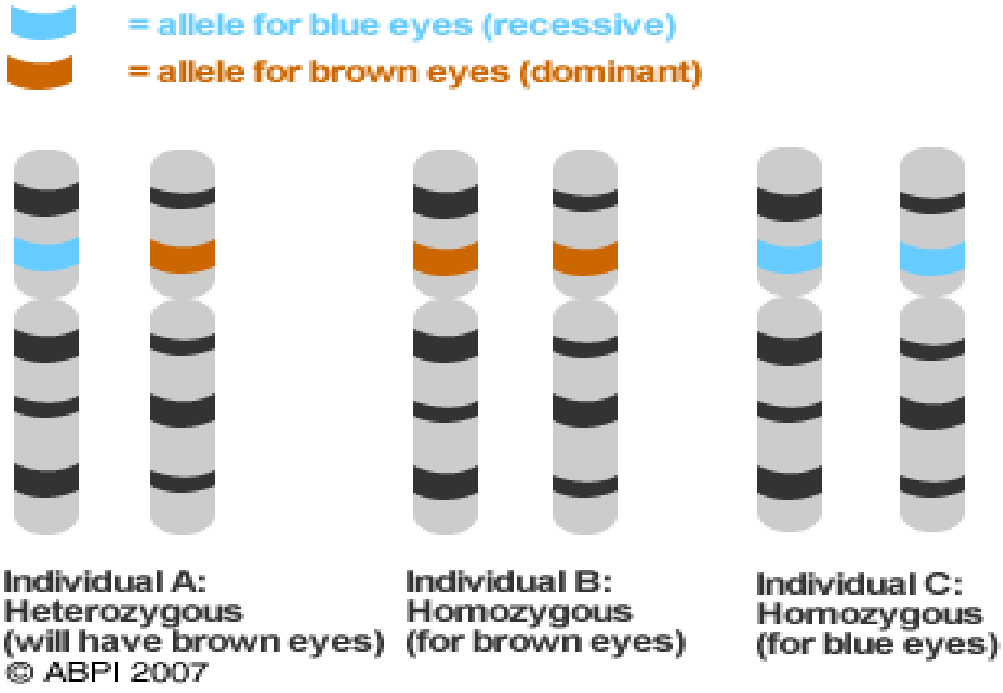
Genes & Dominance

Dominant vs. Recessive

	Seed Shape	Seed Color	Seed Coat Color	Pod Shape
P	Round  Wrinkled	Yellow  Green	Gray  White	Smooth  Constricted
F_1	 Round	 Yellow	 Gray	 Smooth

Principal of Dominance:

- Some **alleles** are *dominant* and others are *recessive*.
- **Dominant** alleles for a trait: will *always* show that form of the trait.
- **Recessive** alleles for a trait: will show that form *only* when the dominant allele is *absent*.



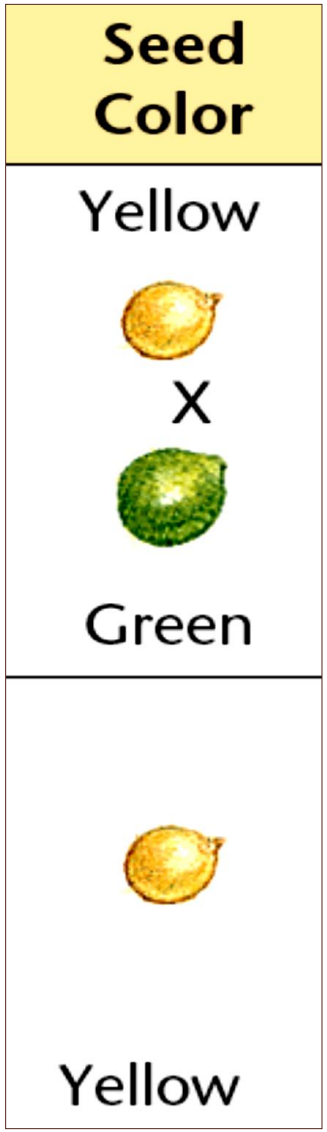
Representing genes:

- For each trait in pea plants, the plant receives one allele from each parent.
  - **Yellow** is dominant for seed color we use the letter **Y**.
  - A capital **Y** represents a gene for a yellow plant.
  - A lowercase **y** represents a gene for a green plant.

Seed Color
Yellow  X  Green
 Yellow

Describing Traits

- There are 2 ways to describe traits:
  1. **Genotype: t**he *genetic* makeup of a trait.
     1. The genotype of the offspring here would be **Yy**.
  2. **Phenotype:** The *physical* characteristic of a trait.
     1. The phenotype of the offspring would be **yellow**.



For Class Credit: On a separate sheet of paper. Please give me the phenotype and genotype of the four offspring below:

	1. Seed Shape	2. Seed Color	3. Seed Coat Color	4. Pod Shape
P	Round  X  Wrinkled	Yellow  X  Green	Gray  X  White	Smooth  X  Constricted
F_1	 Round	 Yellow	 Gray	 Smooth

More Vocab….

Green

Homozygous

yy

Yellow

Heterozygous

Yy

Green

Purebred

yy

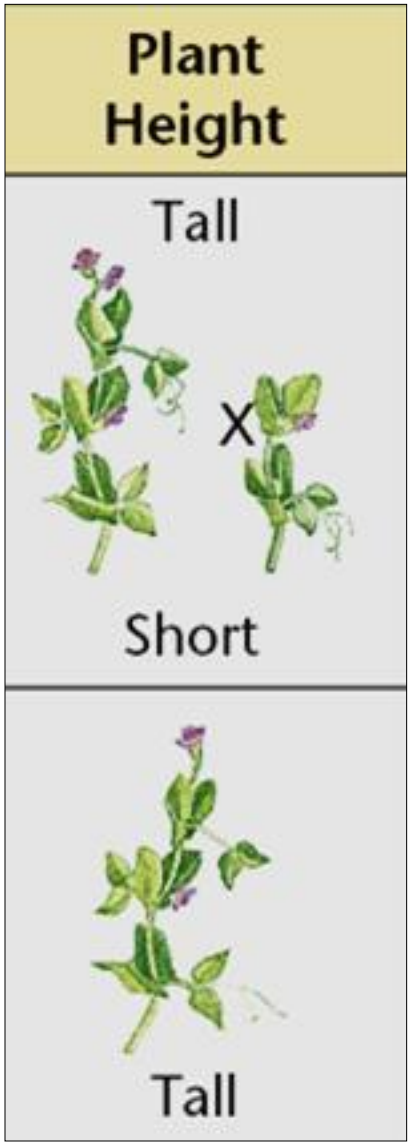
Yellow

Hybrid

Yy

Do Now:

1. Which **trait** is being crossed between these two parents?
2. What are the two **alleles** for this trait?
3. What is a **genotype**?
4. What is a **phenotype**?
5. What is the **genotype** and **phenotype** of the offspring?

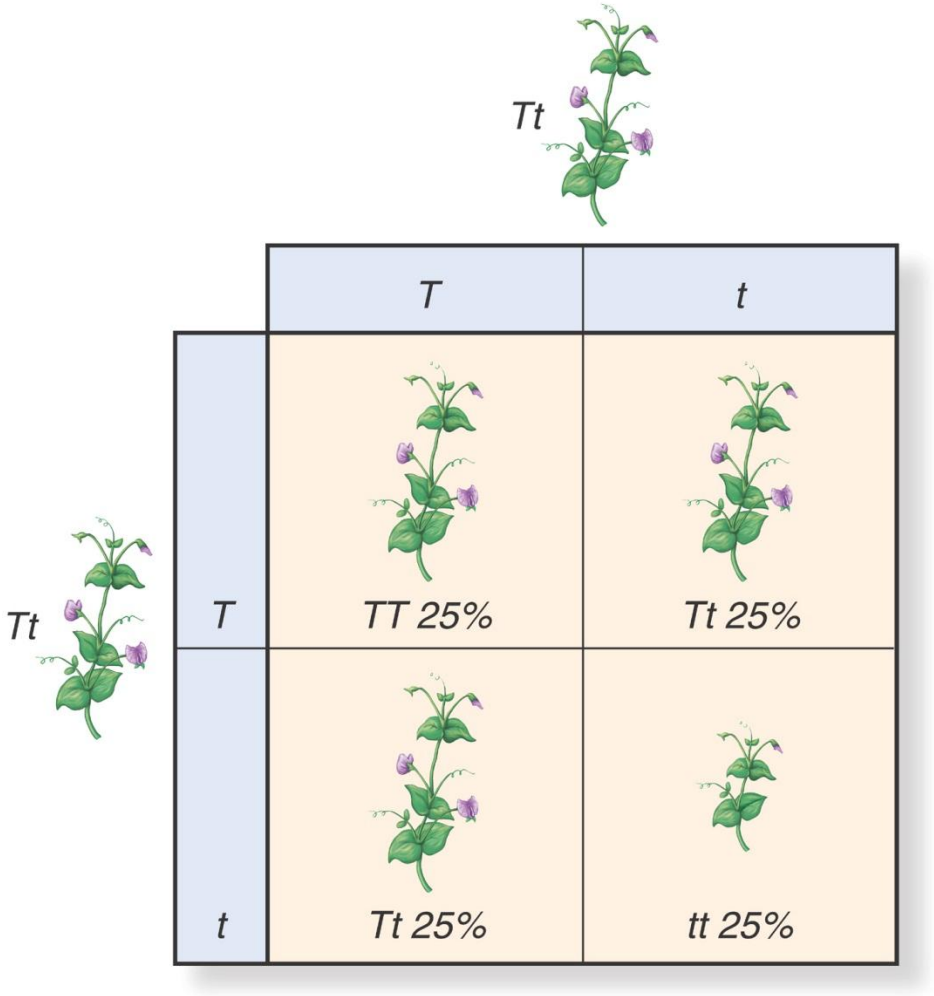


11- 2 Probability & Punnett Squares

Probability can be used to predict genetic outcomes.

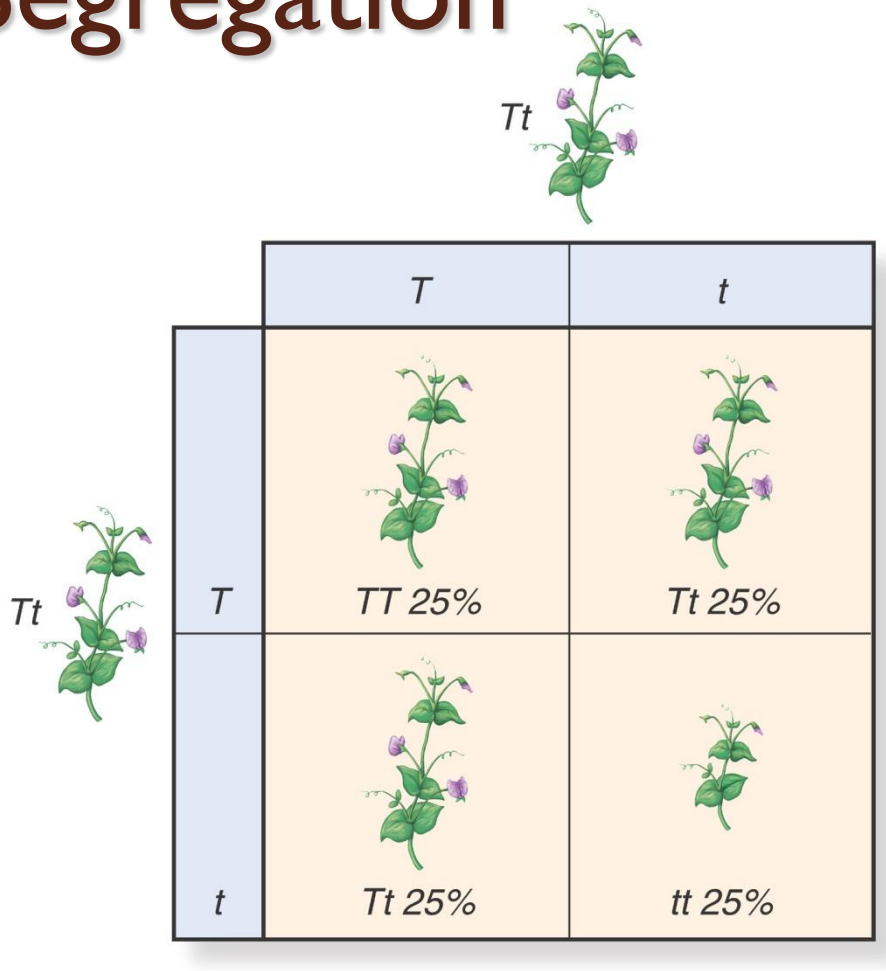
Punnett Squares and Probability

- The likelihood that a particular event will occur is called probability.
- When a gamete is produced there is a 50% chance either gamete will be selected.



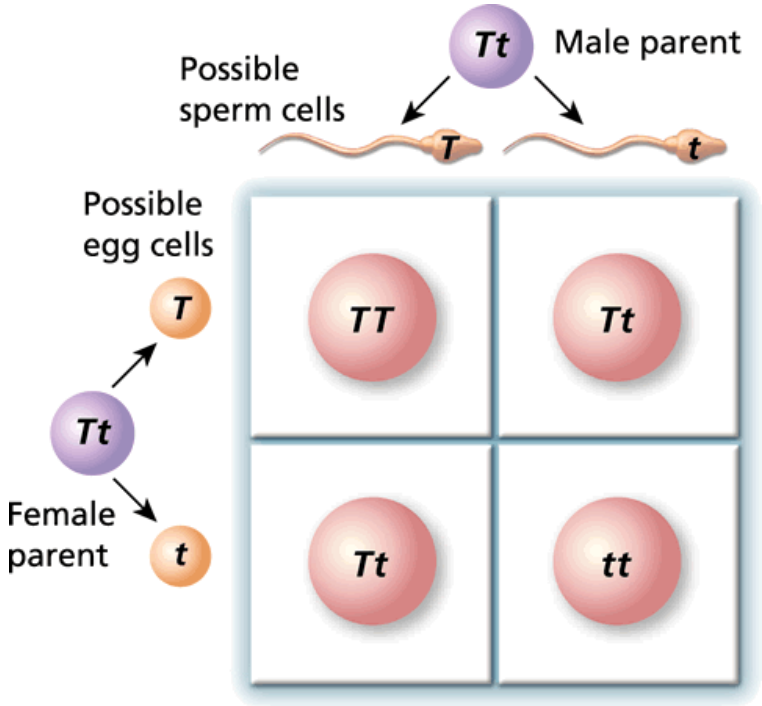
Probability and Segregation

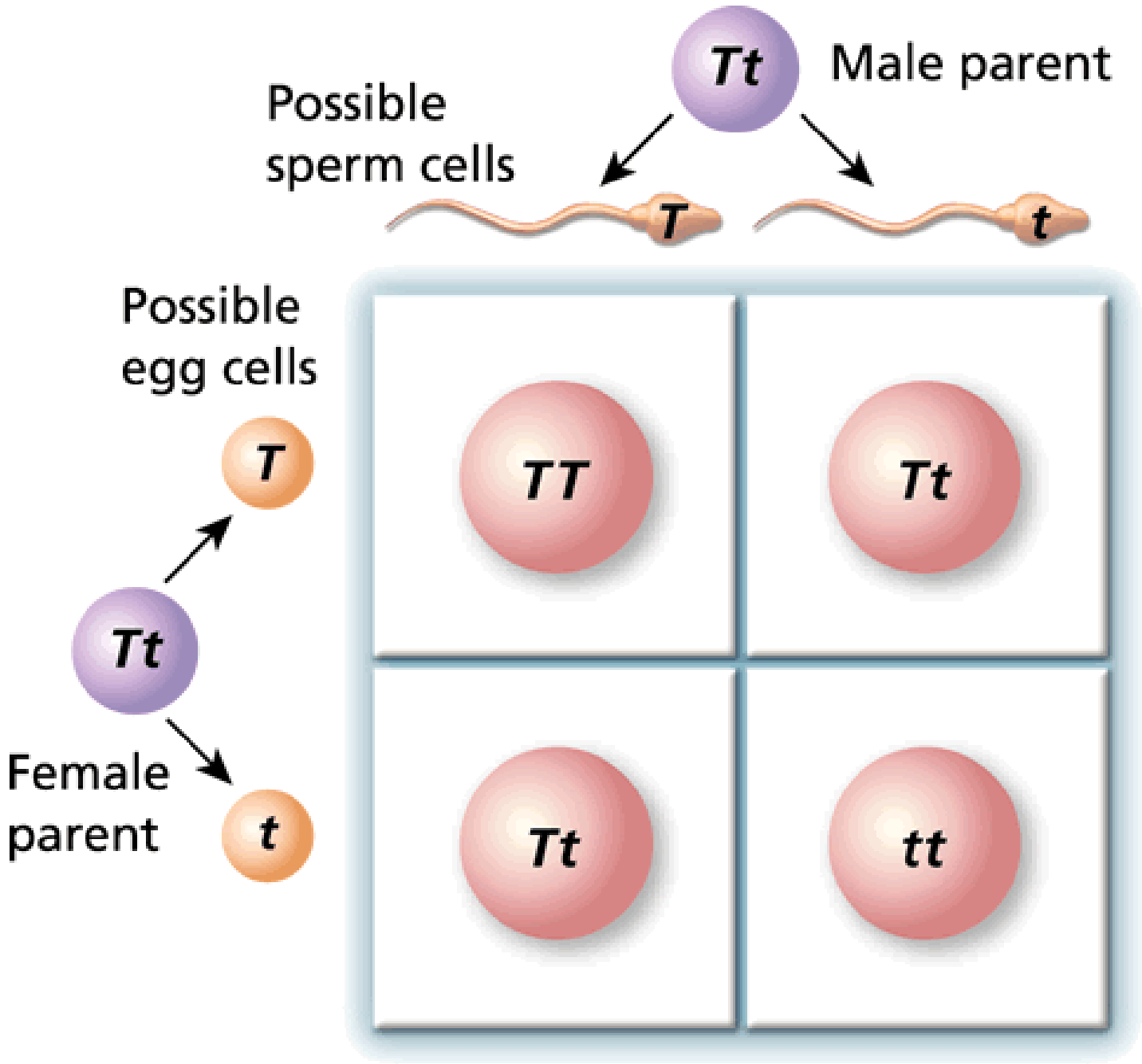
- One fourth (1/4) of the F_2 plants have two alleles for tallness (*TT*).
- 2/4 or 1/2 have one allele for tall (*T*), and one for short (*t*).
- One fourth (1/4) of the F_2 have two alleles for short *(tt)*.



Punnett Squares

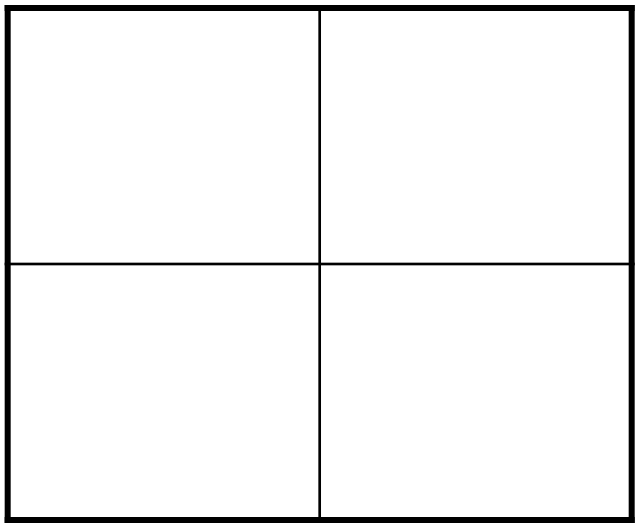
- We show the cross of two parents using a Punnett square.
- **Cross** = a mating between two parents.
- **Punnett square** = a chart that shows all the possible combinations of alleles that can result from a genetic cross.

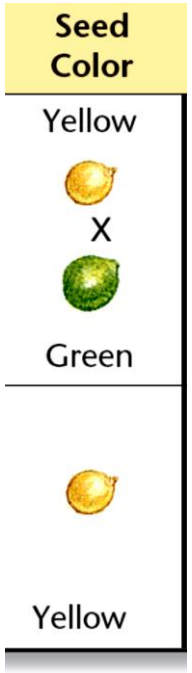



Tt
Male parent
Possible sperm cells
T
t
Possible egg cells
T
Tt
Female parent
t
TT
Tt
Tt
tt

Punnett Squares

- Mendel first did a cross between 2 true-breeding plants. One had yellow seeds, the other had green seeds.





- **Genotype Ratio** of Offspring = _____
- **Phenotype Ratio** of Offspring = _____
- What are the chances of the offspring being **yellow**?
- What are the changes of the offspring being **green**?

Homozygous vs. Heterozygous

- Homozygous: An organism with **two identical alleles** for a trait. **YY or yy.**
- Heterozygous: An organism with **two different alleles** for a trait. **Yy.**

Yellow

YY or Yy

X

yy

Green

Answer this:

- What does it mean to be homozygous dominant?

- What does it mean to be homozygous recessive?

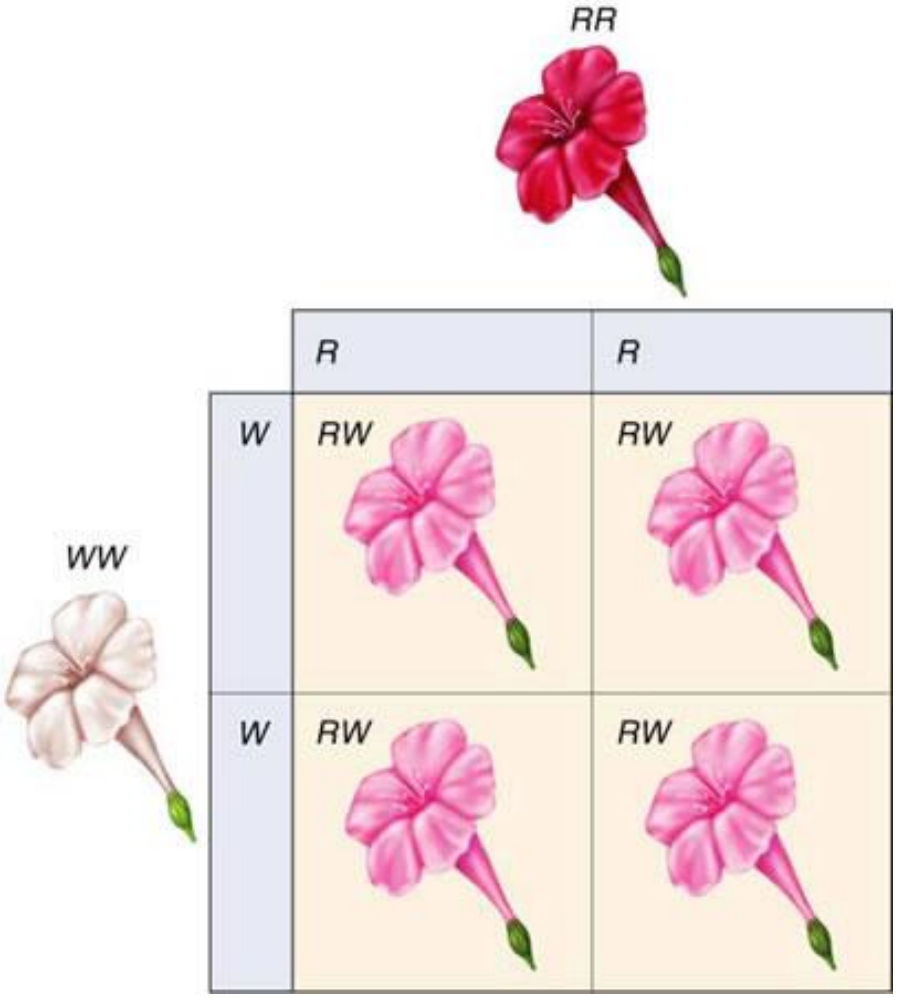
11- 3 Exploring Mendelian Genetics

Patterns of Inheritance

Incomplete Dominance

- The heterozygous phenotype <u>blends together</u>.

Incomplete Dominance



RR = red flower
WW = white flower
RW = pink flower

The heterozygous phenotype <u>blends together</u>.

Codominance:

- The heterozygous phenotype expresses both alleles (just not together).
- In chickens: if they have an allele for white feathers **and** an allele for black feathers the chickens have both black AND white feathers.



Codominance:

	B	W
B	BB	BW
W	BW	WW

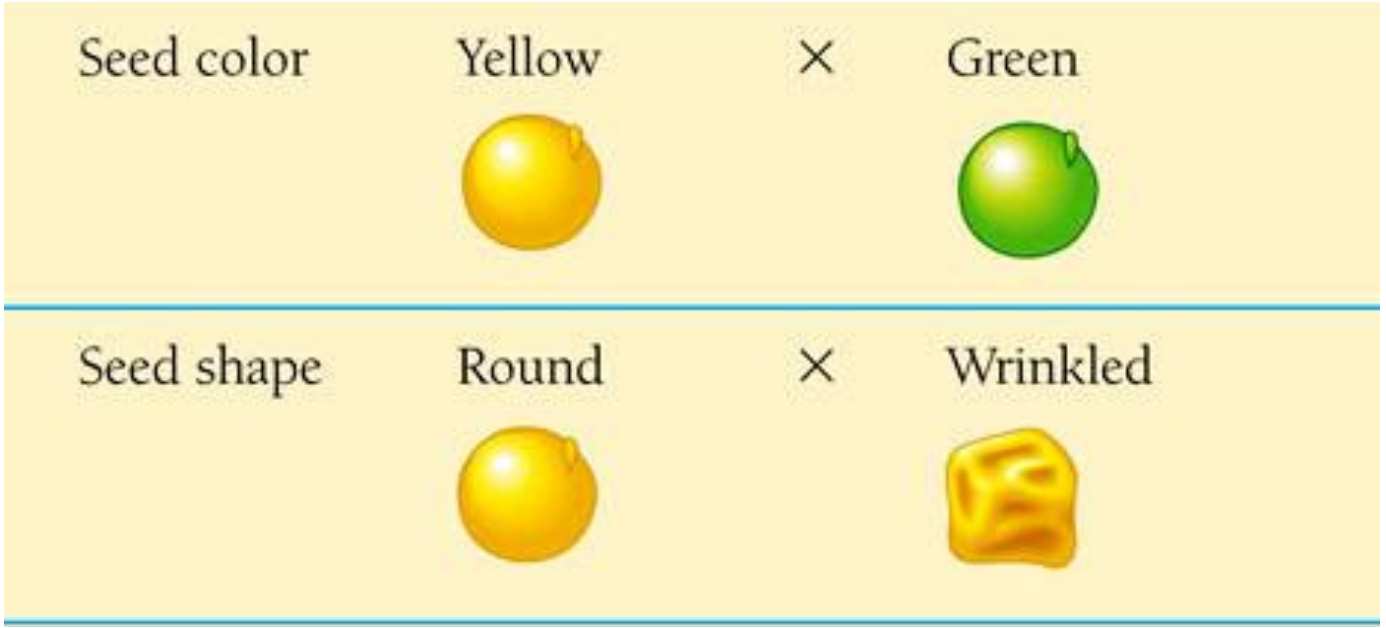
BB = Black feathers
WW = white feathers
BW = black AND white feathers

The heterozygous phenotype <u>shows BOTH alleles</u>.

Do Genes Affect Each Other?

- Mendel wondered if a plant with yellow seeds was more likely to also have round seeds
- He made a cross that **tested for two traits:**

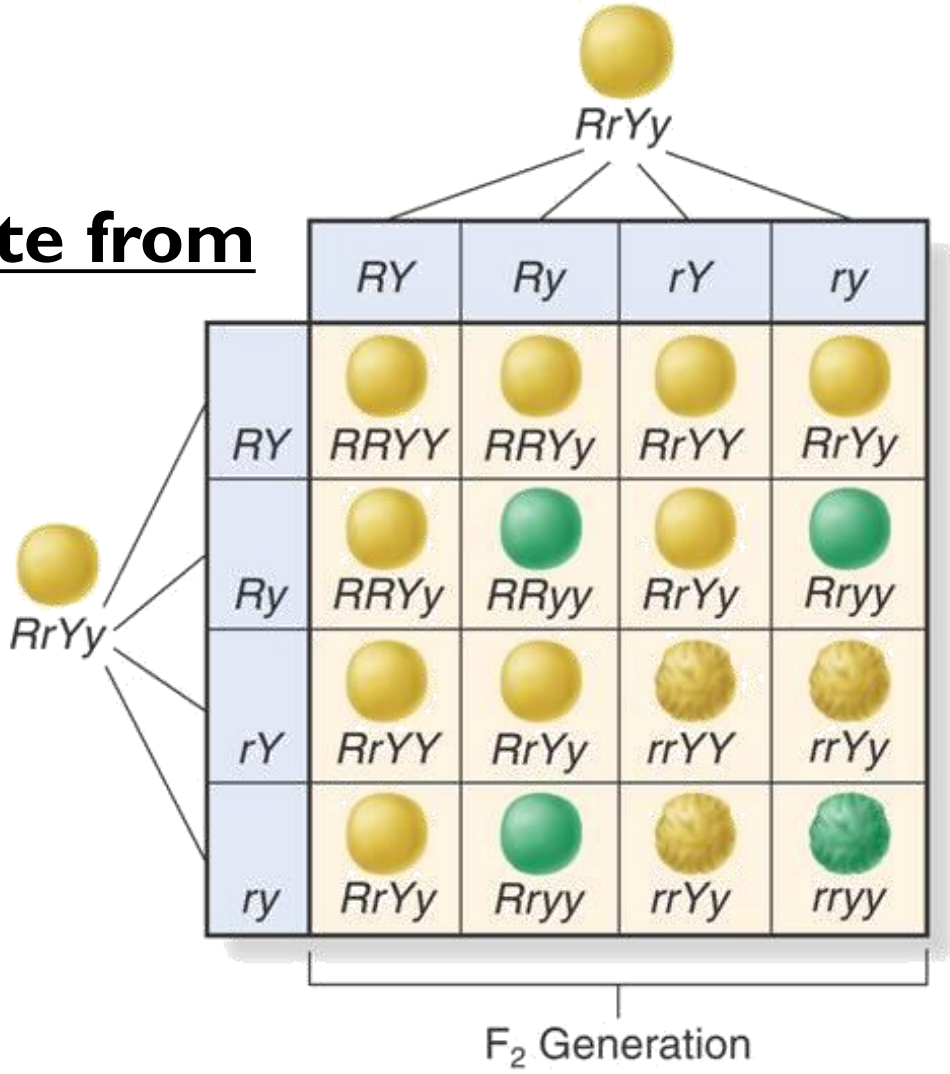
DIHYBRID CROSS



Mendel found that seeds could be:

- **yellow round,**
- **yellow wrinkled,**
- **green round, or**
- **green wrinkled.**

<u>Alleles could separate from each other.</u>

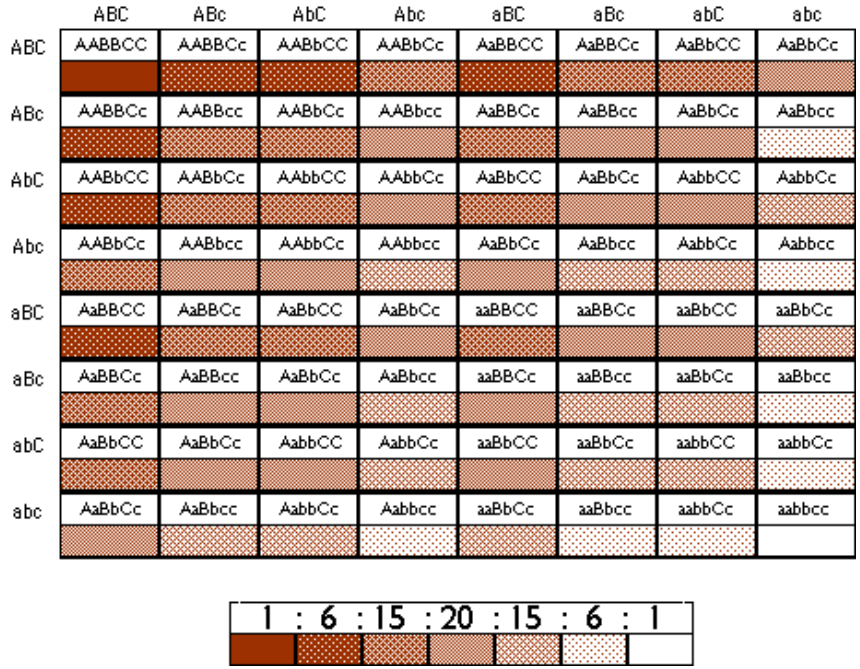


Original Parents:

Yellow Round X Green Wrinkled

Polygenic Traits

- Traits controlled by two or more genes are said to be **polygenic traits.**
- Height, skin color, hair color, eye color in humans are polygenic traits controlled by more than three different genes.



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 but more than two possible alleles can exist in a population.
- For example, there are three different alleles for blood type in humans: A, B, and O.

Blood Types

- Human blood type is determined by codominant alleles.
- There are three different alleles, known as I^A, I^B, and *i*.
- The I^A and I^B alleles are codominant, and the *i* allele is recessive.

Phenotype	Genotype
O	ii
A	I^AI^A or I^Ai
B	I^BI^B or I^Bi
AB	I^AI^B

Blood types need to be matched prior to transfusion. If given the wrong blood type, the body might reject the transfusion.

Rh Factor

- Individuals either have, or do not have, the **Rhesus factor** on the surface of their red blood cells.
- This is usually indicated by:
- Rh^+ (does have the RhD antigen)
- or 'RhD negative' (does not have the antigen)

Rh Factor	Possible Genotypes
RH +	RH+ RH+ RH+ RH-
RH -	RH- RH-