Gregor Mendel
1822-1884

Who was Gregor Mendel?

- Austrian monk who did scientific research in the 1850s
- Father was a farmer
- ★ Bred (crossed) pea plants
- ★ Had no knowledge of DNA, genes, or chromosomes (called them “factors”)
- ★ Described the units of inheritance and how they pass from one generation to the next
- Not recognized during his lifetime

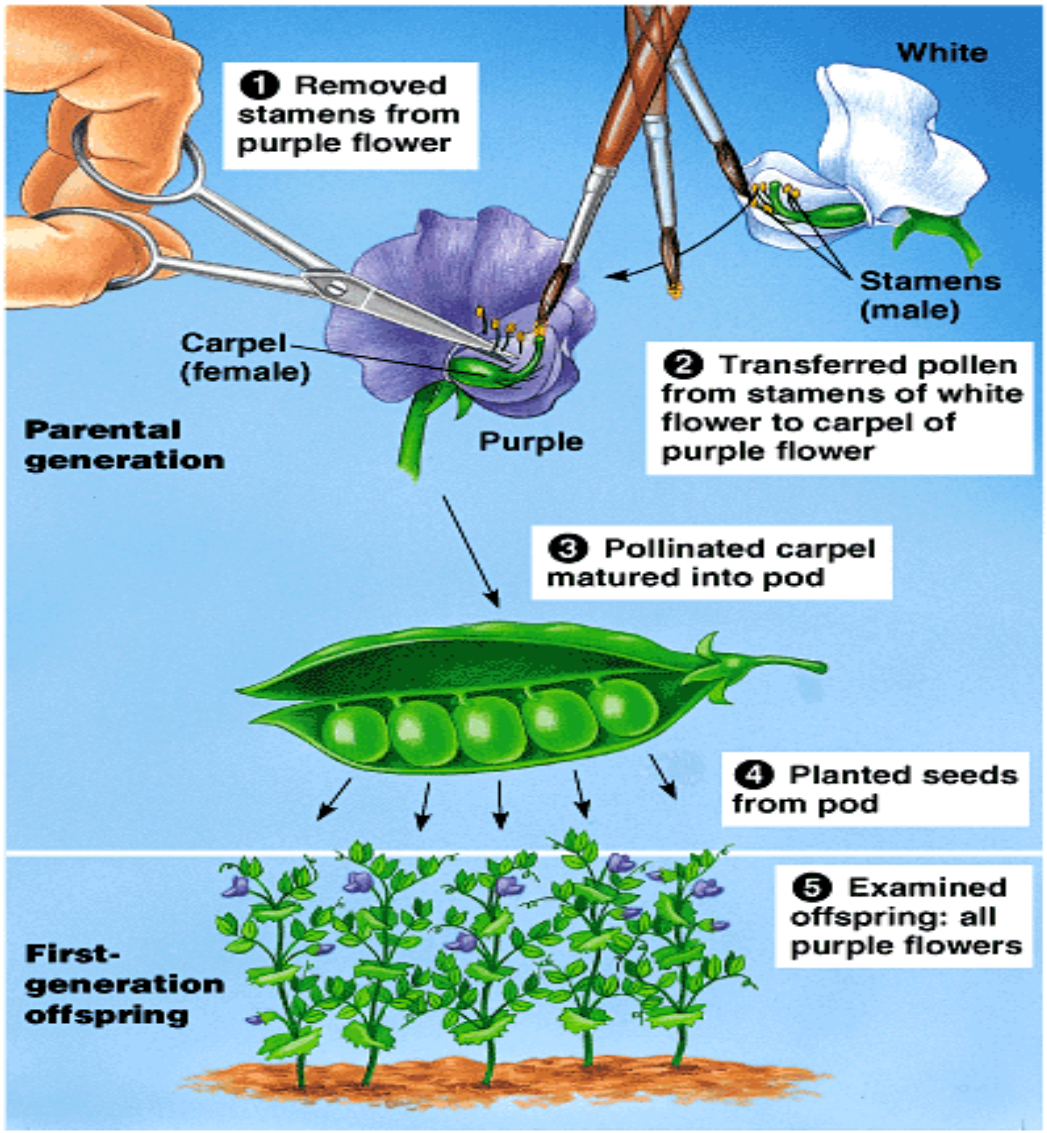
Why Peas?

- Easy to breed
- Grow quickly
- Traits have only two distinguishable forms.
  - Ex- tall or short

	Height	Seed Shape	Seed Color	Seed Coat Color	Pod Shape	Pod Color	Flower Position
Dominant	 Tall	 Round	 Yellow	 Green	 Inflated (full)	 Green	 Axial
Recessive Trait	 Short	 Wrinkled	 Green	 White	 Constricted (flat)	 Yellow	 Terminal

Pea plants can be bred? YES!

- Use flowers to sexually reproduce
- Male part produces pollen (contains sperm)
- Female part produces egg cells called ovules
- When pollen fertilizes an egg, a seed for a new plant is formed.



- **The original plants crossed are called the *P (parent) generation.***
- **The offspring are called the *F1 (first filial) generation.***
- **The offspring of a cross between F1 plants are the *F2 generation***
  - **Ex: Mendel crossed a tall pea plant with a short pea plant. What do you think the F1 generation looked like?**

Monohybrid Cross

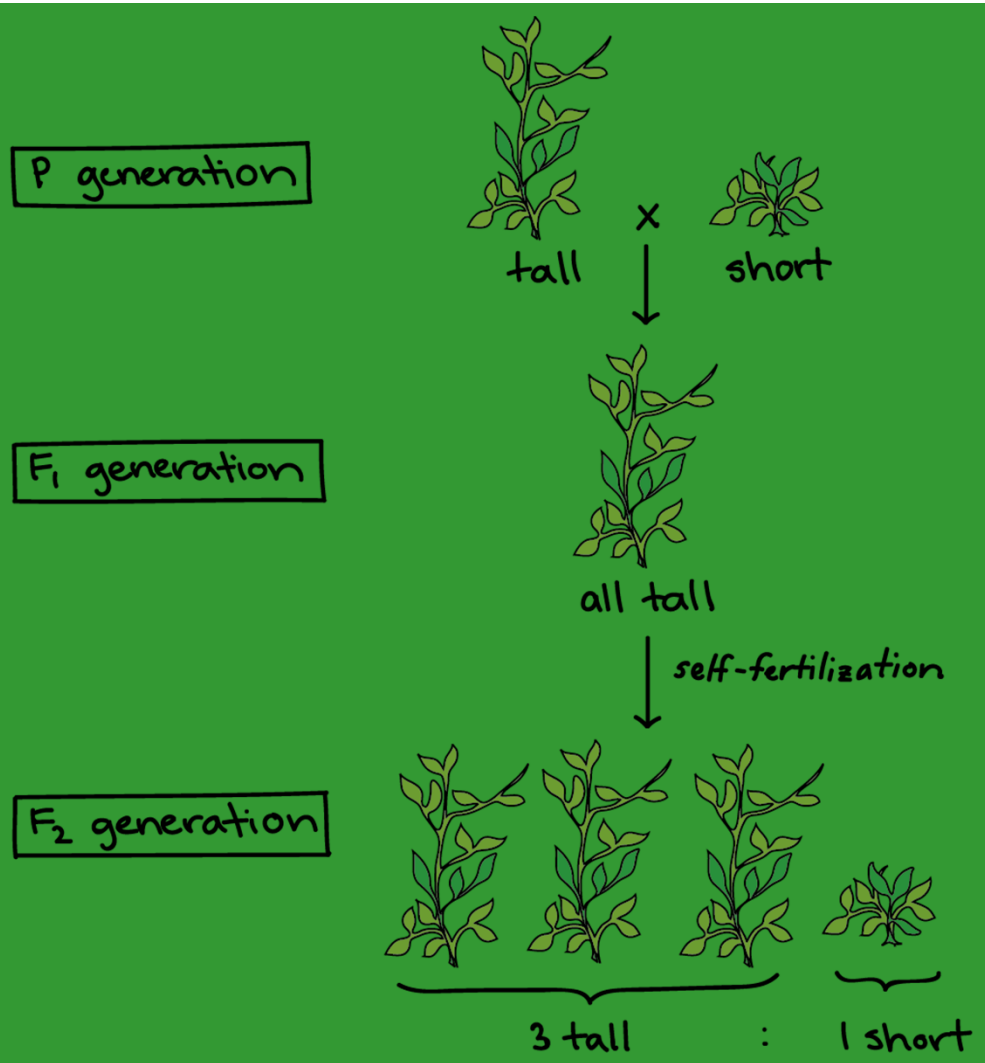
Parental generation (P_1)

Tall x short

F_1

All Tall

- He saw that all of the offspring looked like only one of the parents (all tall). The characteristics of the other parent seemed to disappear!
  - Did it really disappear?
  - No! The short trait was hidden or masked by the tall trait.



Monohybrid Cross (a single trait)

Parental generation (P_1)

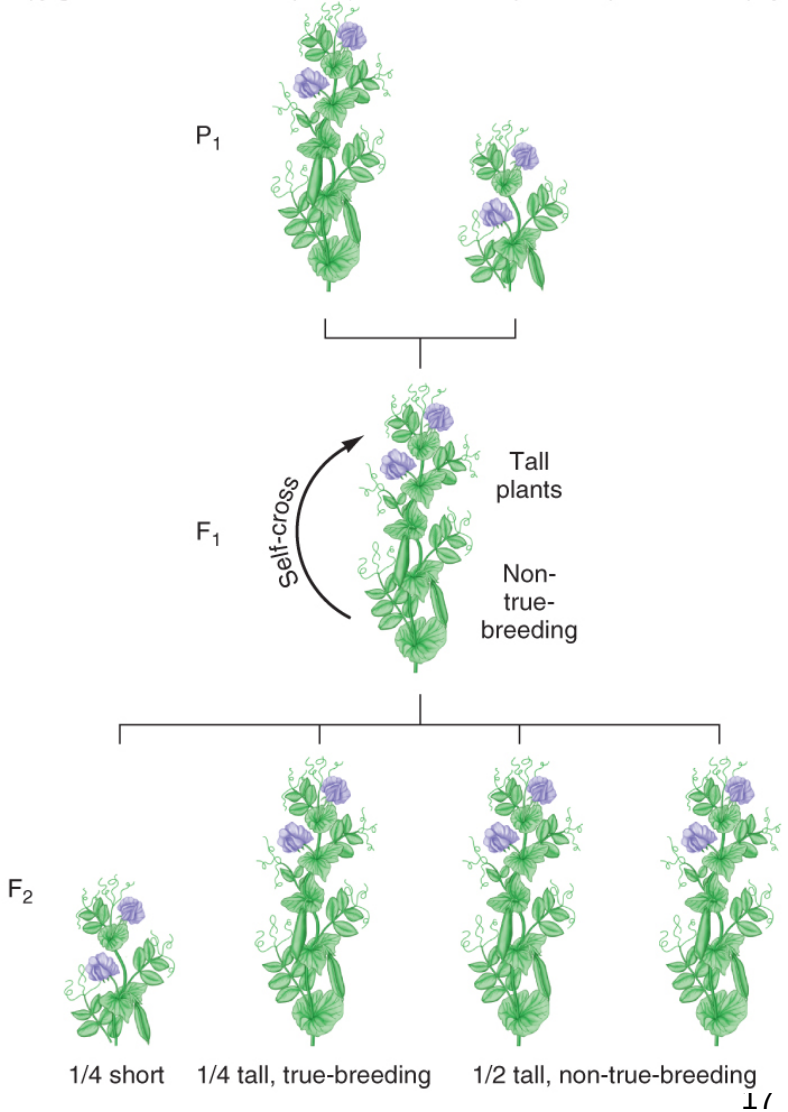
Tall x Short

F_1

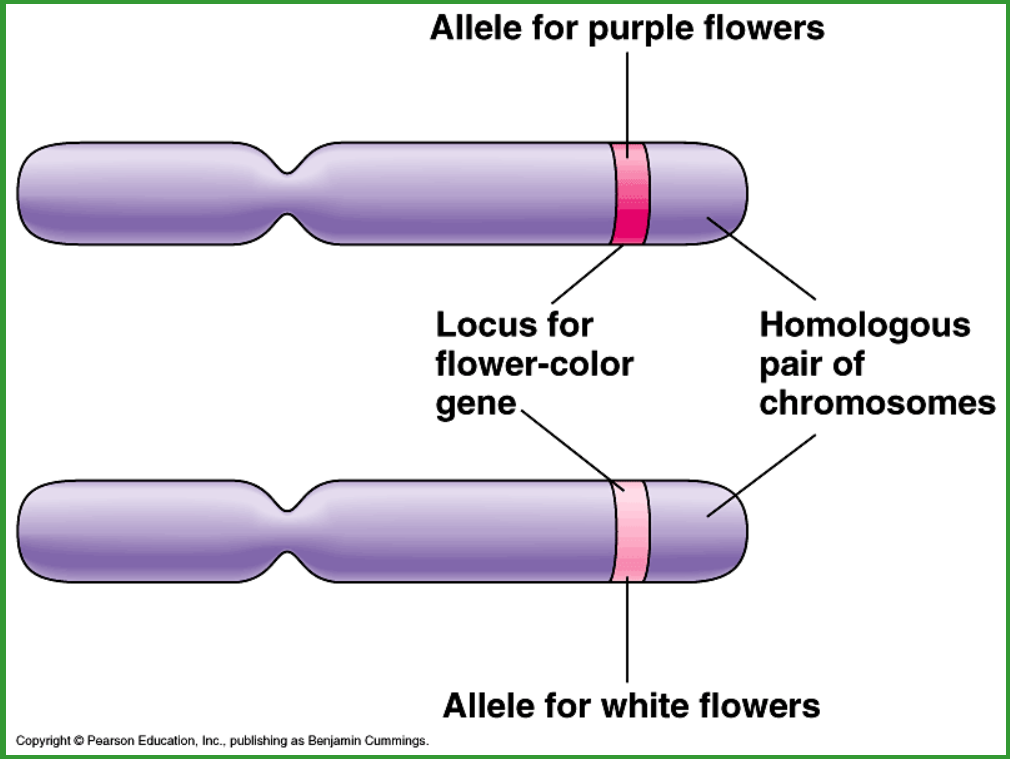
All Tall

F_2

1/4 Short : 3/4 Tall



- **Mendel said some "factor" is passed from parent to offspring.**
- **Scientists now know that these factors are called *genes* found on *chromosomes.***
- **The different forms of a gene are called *alleles*.**



Mendel's Laws

1. Law of Segregation

- Allele pairs separate randomly during gamete production
- Each sperm/egg produced carries only 1 of the 2 alleles for each inherited trait.

2. Law of Independent Assortment

- Each pair of alleles separates independently of the others during gamete formation.

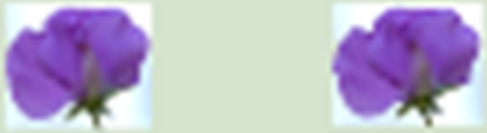
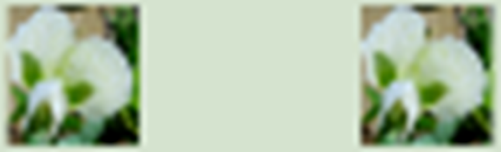
3. Law of Dominance

- Presence of a dominant allele determines the trait that gets expressed

Principle of Dominance

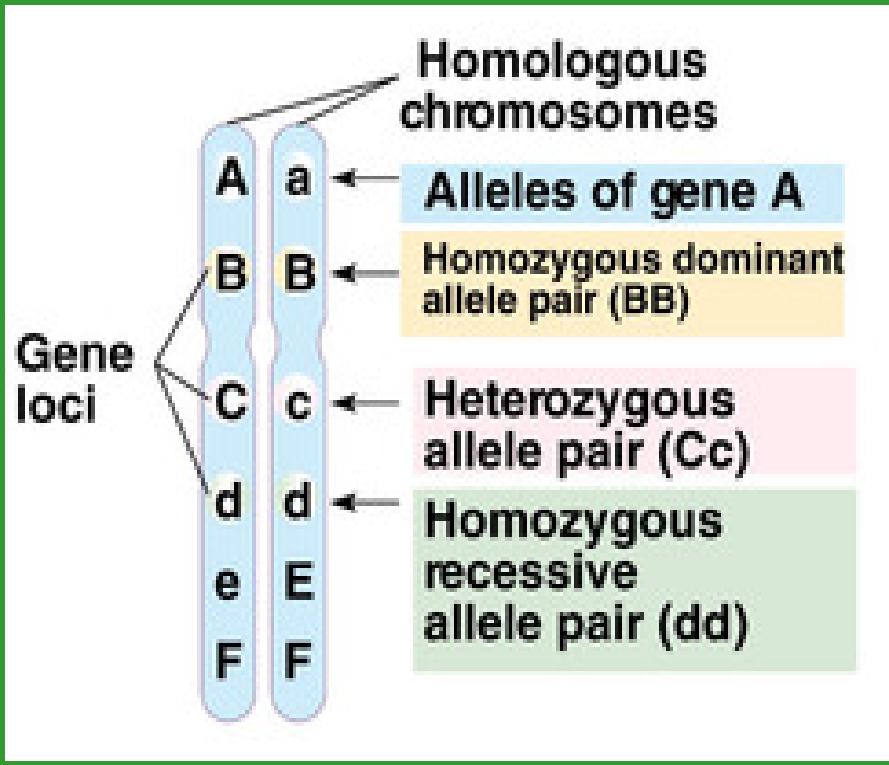
- **Some alleles are dominant, some are recessive.**
  - **An allele is a variant form of a given gene. Organisms have 2 alleles for each gene.**
  - **A *dominant allele* for a certain trait will always be expressed over a recessive allele.**
  - **A *recessive allele* will only be expressed when no dominant allele is present.**

Principle of Dominance

Alleles	Alleles Expressed
Dominant, Dominant 	
Dominant, Recessive 	
Recessive, Recessive 	

Representation of Dominant and Recessive Alleles

- **Use the same letter for both alleles of the same trait (ex. T for Tallness)**
- A ***capital letter*** symbolizes a **dominant allele.**
- The ***lower case*** form of the same letter symbolizes the **recessive allele**.
  - Ex: The allele for tallness (T) is dominant and the allele for shortness (t) is recessive.

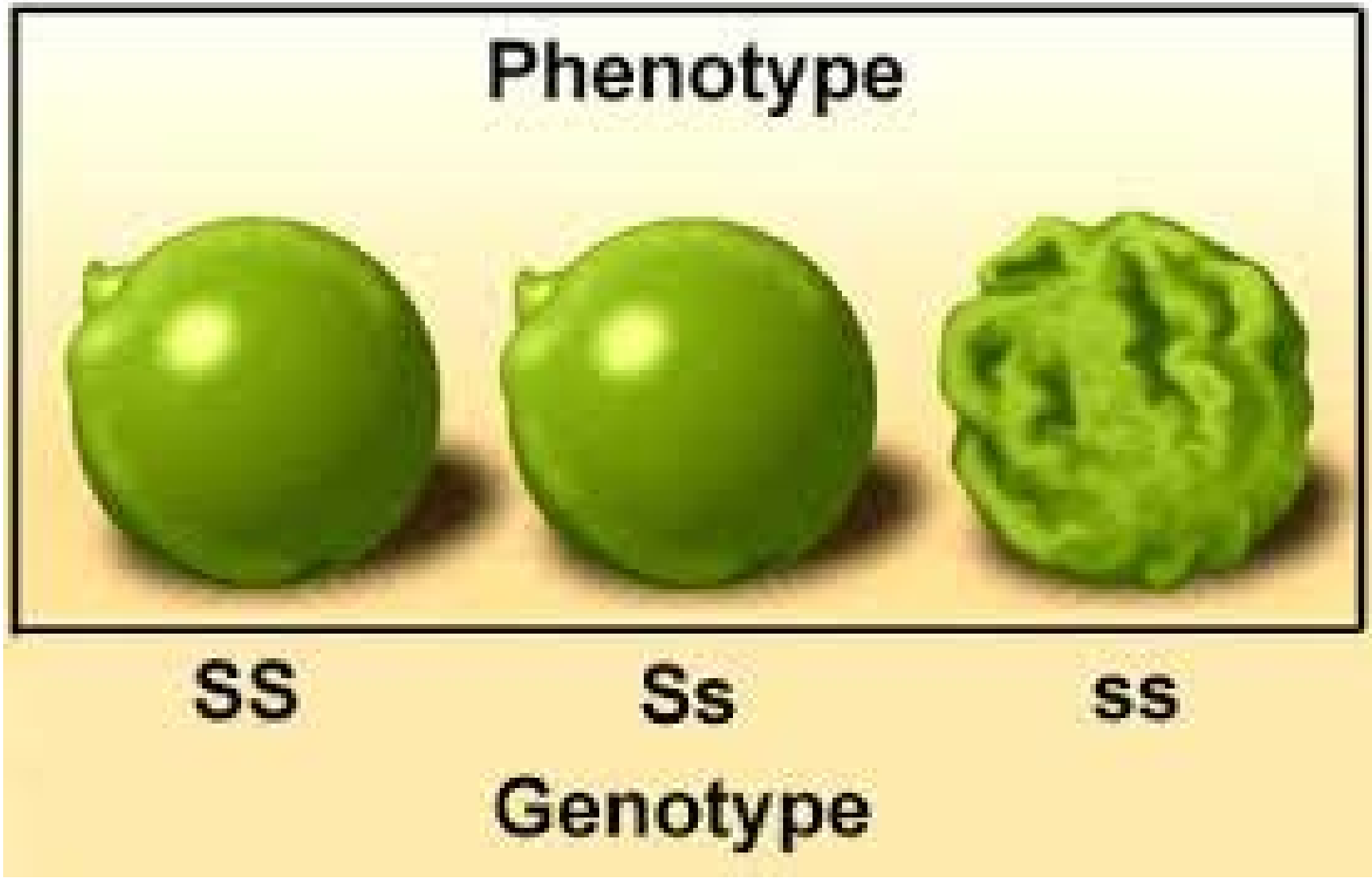


- **Genotype**- genetic makeup of the organism (use letters)

  Homozygous or pure - both alleles acquired by the offspring are the same (ex.- TT or tt)

  Heterozygous or hybrid - both alleles acquired are different (ex.- Tt)

- **Phenotype**- physical expression of an organism trait, determined by the genotype
  - Ex. tall or short


Phenotype
SS
Ss
ss
Genotype

DD

Dd

dd

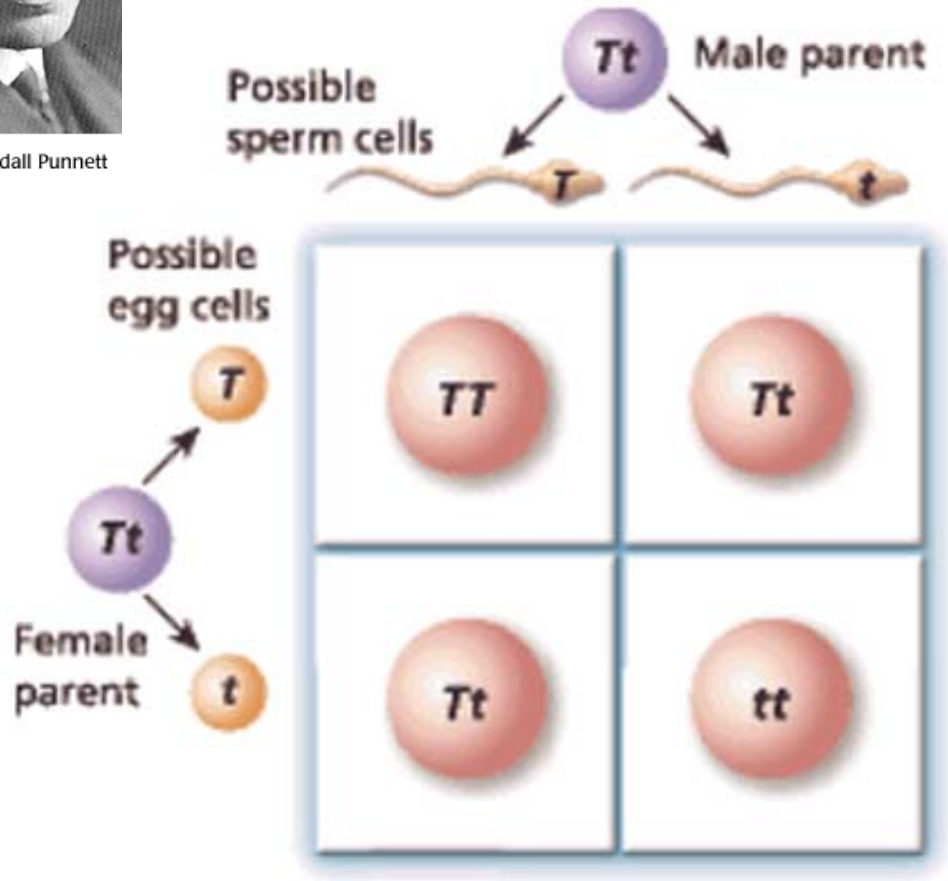
Genotype

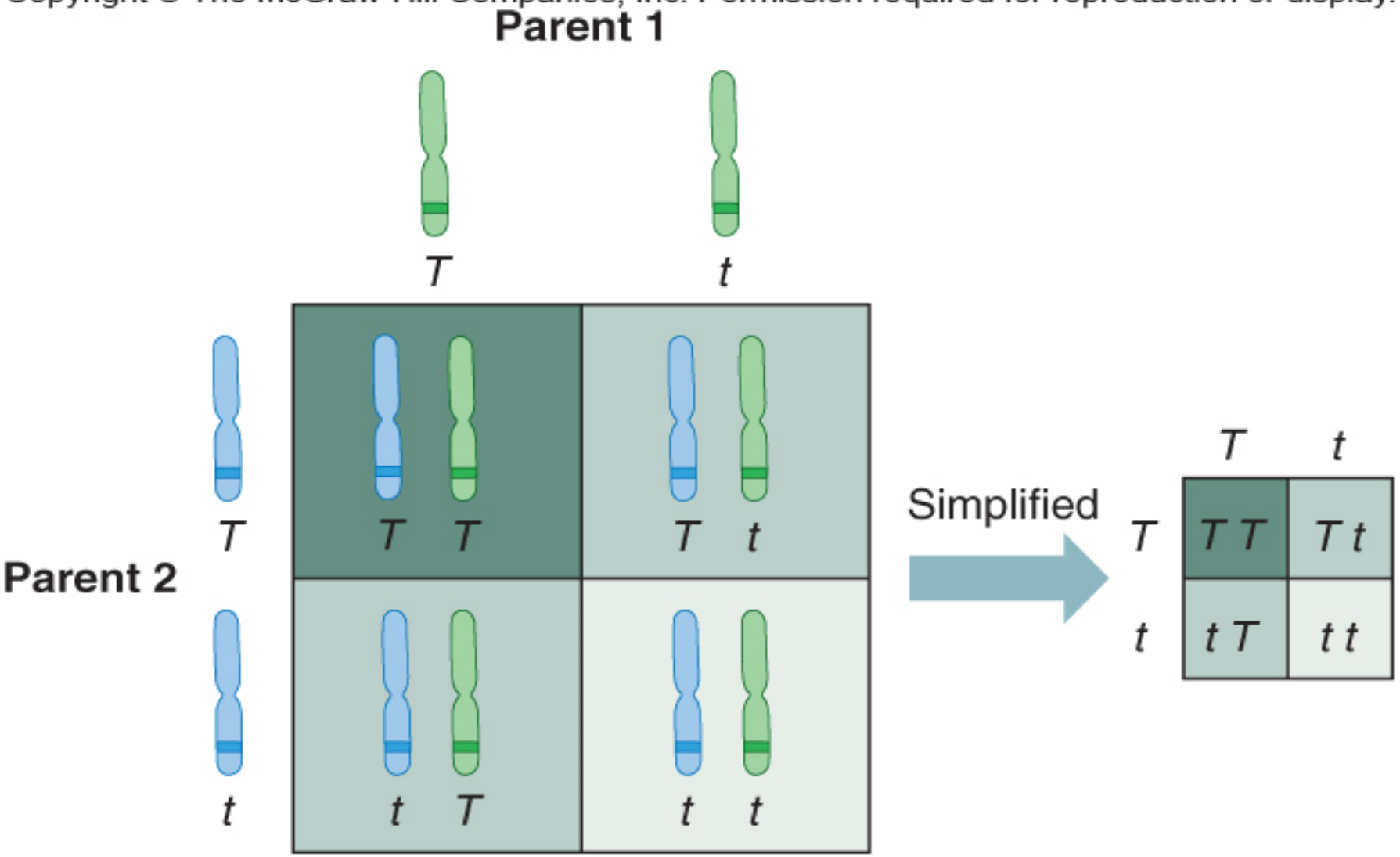
Phenotype

Punnett Square

- Is used to represent <u>possible combinations</u> of genes in gametes and how they may combine in offspring
- Each box = 25% probability

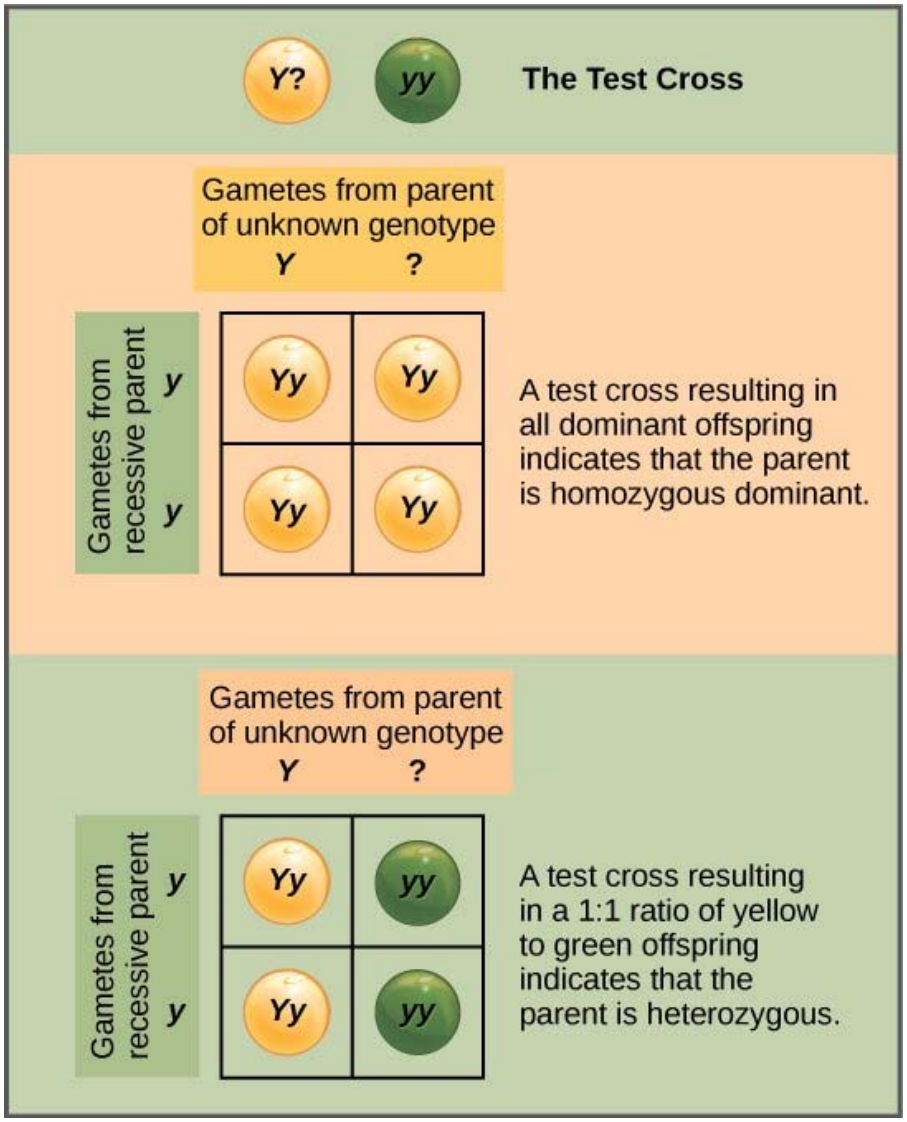
Reginald Crundall Punnett





Test Cross

- Is used to determine an unknown genotype
- Cross the unknown with an organism that is homozygous recessive for the trait.
- If any offspring express the recessive trait, then the unknown must have a heterozygous genotype



In a certain species of animal, black fur (B) is dominant over brown fur (b). Using the following Punnett square, predict the genotypes and phenotypes of the offspring whose parents are both Bb or have heterozygous black fur.

	B	b
B	BB	Bb
b	Bb	bb

Genotypes:

25% % homozygous black fur (BB)

Ratio **50%** % heterozygous black fur (Bb)

1:2:1 **25%** % homozygous brown fur (bb)

Phenotypes:

75% % black fur

Ratio **25%** % brown fur

3:1

Now do the same when one parent is homozygous black and the other is homozygous brown.

	B	B
b	Bb	Bb
b	Bb	Bb

Genotypes: 0% % homozygous black fur (BB)

Ratio 100% % heterozygous black fur (Bb)

0:4:0 0% % homozygous brown fur (bb)

Phenotypes: 100% % black fur

Ratio 0% % brown fur

4:0

Repeat this process again when one parent is heterozygous black and the other is homozygous brown.

	B	b
b	Bb	bb
b	Bb	bb

Genotypes:

Ratio

0:1:1

Reduced from 0:2:2

0% % homozygous black fur (BB)

50% % heterozygous black fur (Bb)

50% % homozygous brown fur (bb)

Phenotypes:

Ratio

1:1

Reduced from 2:2

50% % black fur

50% % brown fur