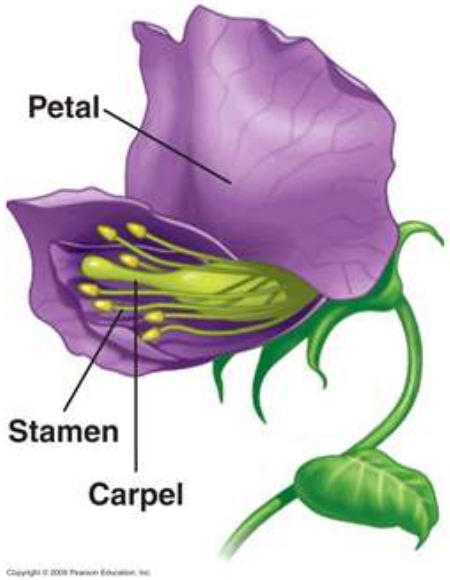
Introduction to Mendelian Genetics

Gregor Mendel was an Austrian Monk who began the science of genetics (the study of heredity) in the 1860's

His success was largely due to that fact that he systematically quantified the results of numerous breeding experiments using pea plants

Why Peas??

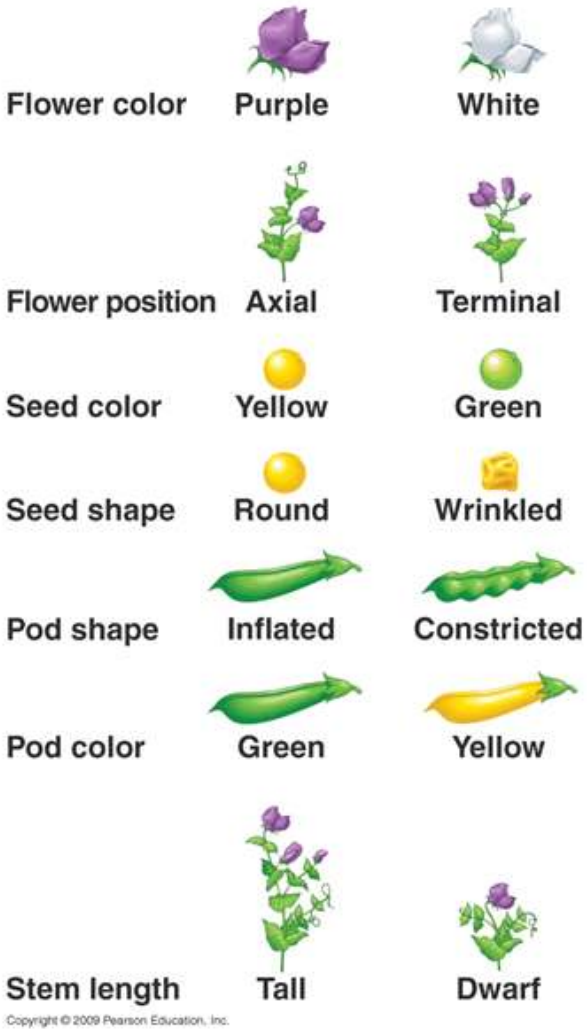
Peas contain male and female reproductive parts on each flower (allows for easy self- or cross-fertilizing in experiments)



Peas exhibit many easily distinguishable characters

Peas are easy to grow and grow fast (allowed for many generations in a short time period - large data set)

Pea Characters Observed by Mendel



Characters are heritable features that vary among individuals (like flower color, seed shape, etc)

Each of the possible variants of a character is called a trait (like purple vs white flowers, round vs. wrinkled seeds)

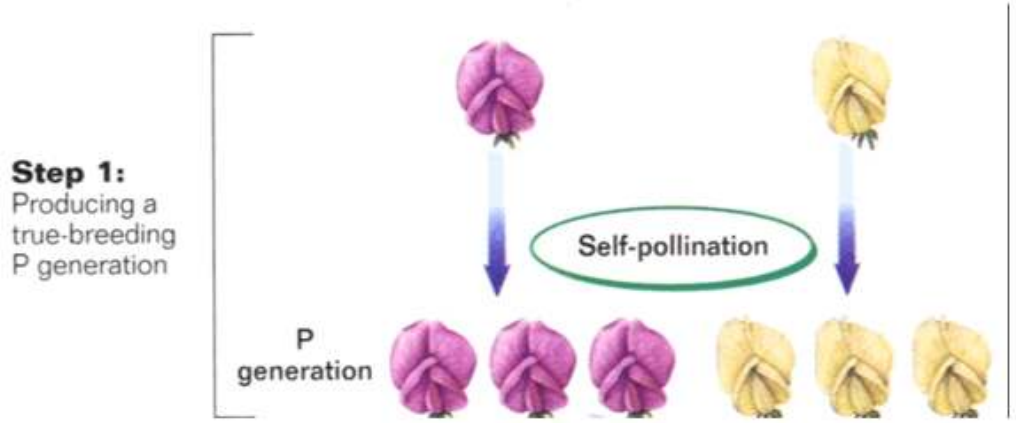
ALL of these traits were *either/or*!!

What Mendel Did...

First he established "true-breeding" lines of plants for each trait

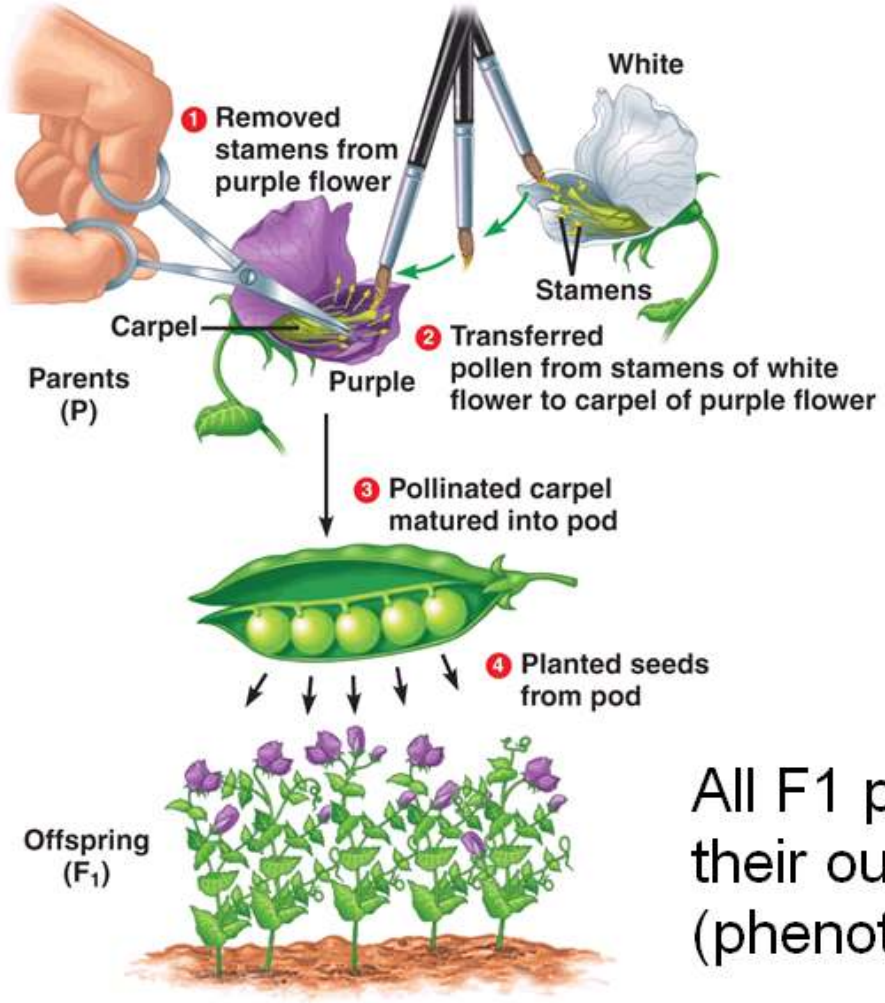
"True-breeding" means that plants exhibit the same (and only the same) trait through repeated generations

He did this by self-fertilizing plants until all variation for a particular character disappeared.



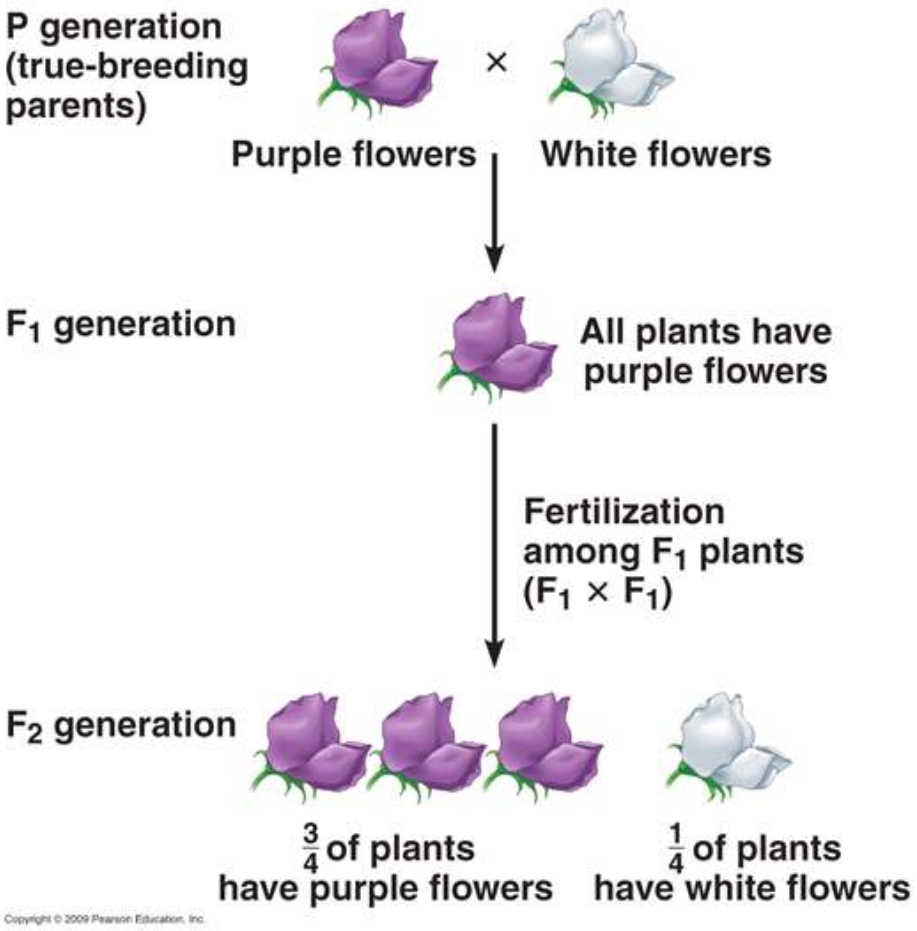
Example: True-breeding lines of purple and white flowering peas…these plants became the P generation for his subsequent experiements

Then he cross fertilized the true-breeding (P) lines for each character to create the F1 generation (1st filial)



All F1 plants were identical in their outward appearance (phenotype)

The F1 generation plants were then self-fertilized to form the F2 generation



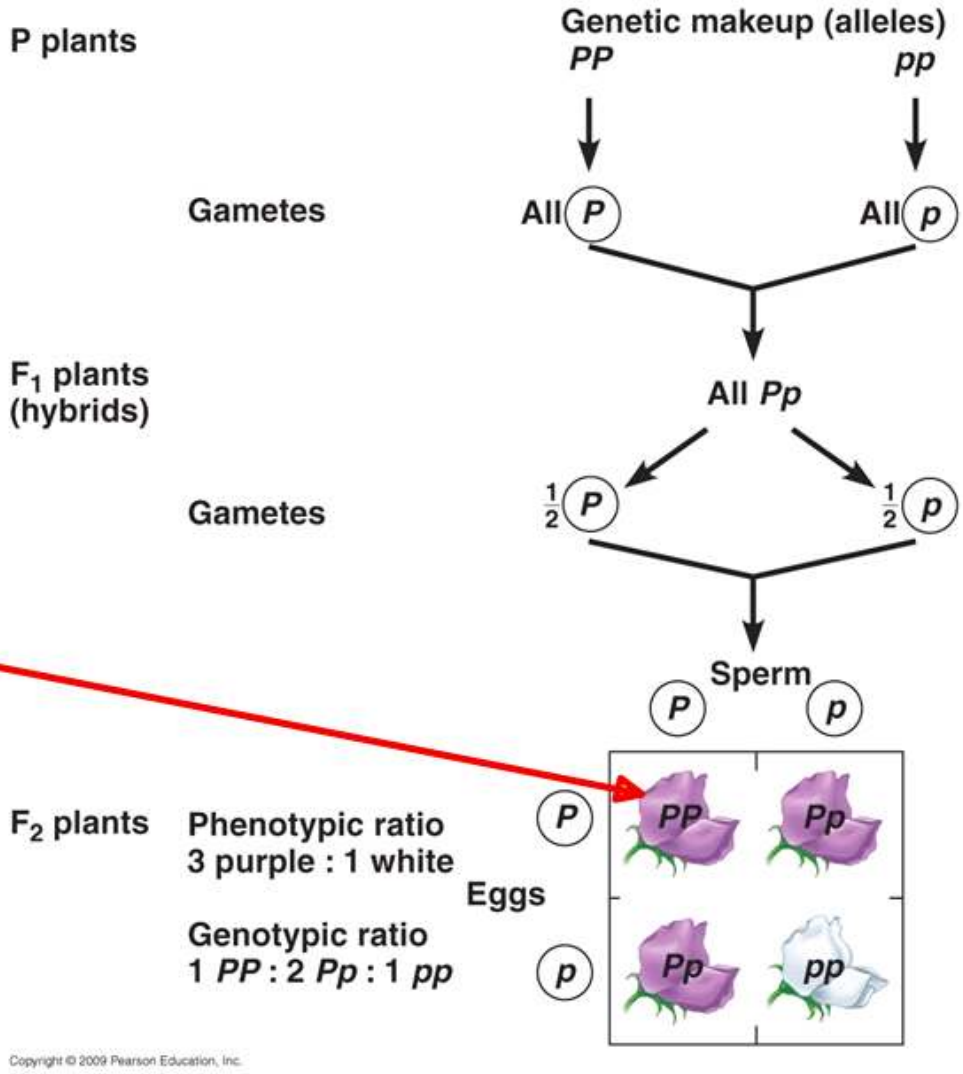
F2 generation shows varied phenotype in 3:1 ratio

WHY?

Each character that Mendel examined was determined by a single pair of alleles - "forms of a gene"

Each pair of alleles has a dominant and a recessive form

Each mature plant grew from a seed (zygote) formed from a combination of a male (pollen) and female (egg) gamete - which each carried a specific allele

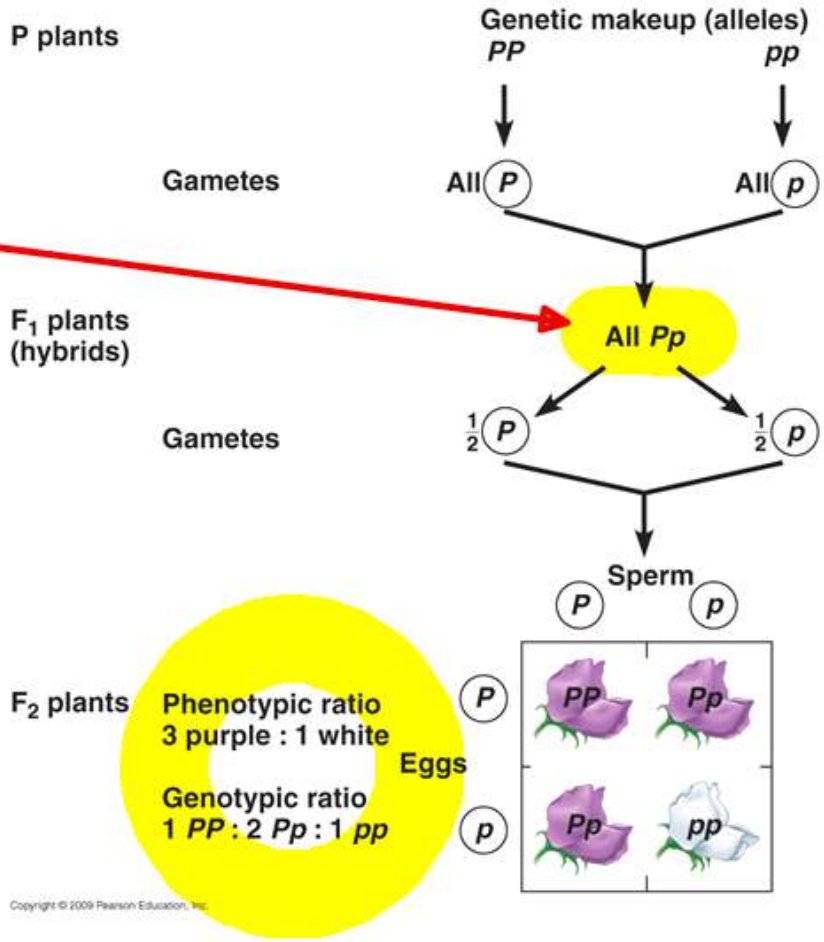


WHY?

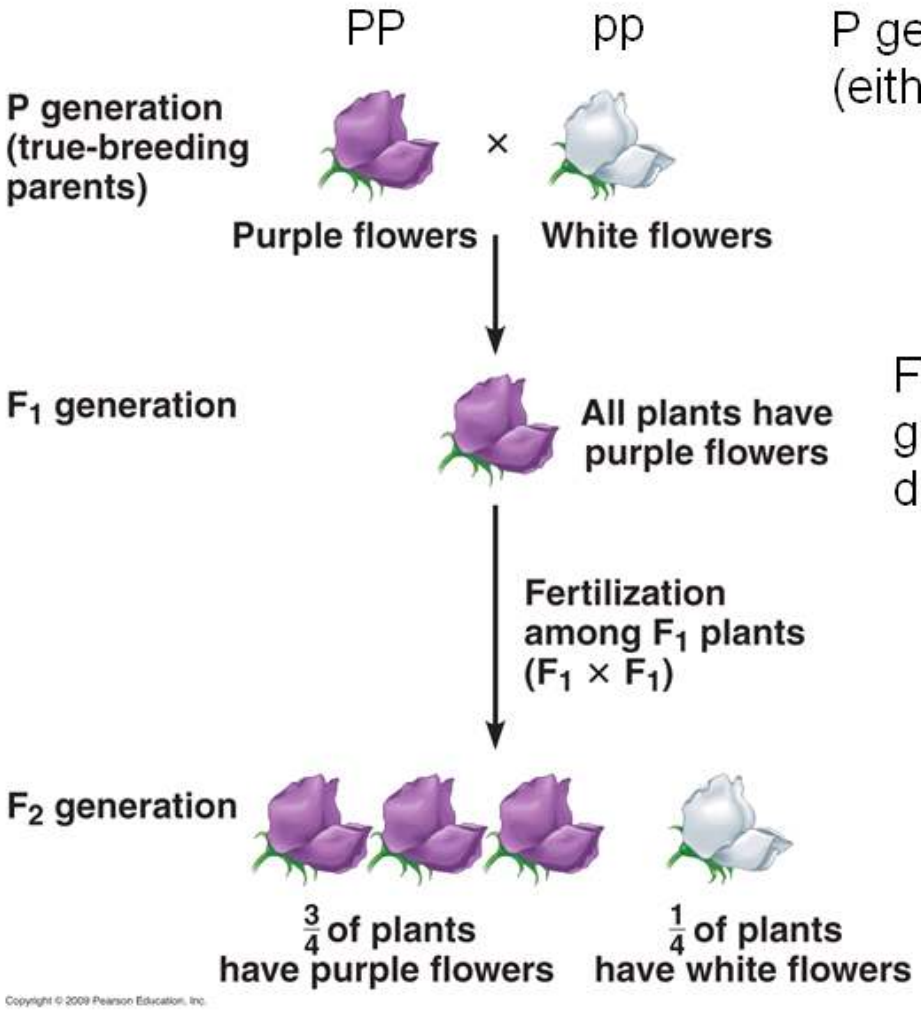
The combination of alleles (received from each parent) makes up an individuals genotype - represented here by PP, Pp, or pp

Within each pair of alleles there is a dominant (P - purple) and a recessive(p - white) form

Dominant alleles will determine the phenotype



It's the genotype that determines the phenotype!



P generation was homozygous! (either dominant or recessive)

F1 was 100% heterozygous (Pp) genotype, and showed the dominant (purple) phenotype

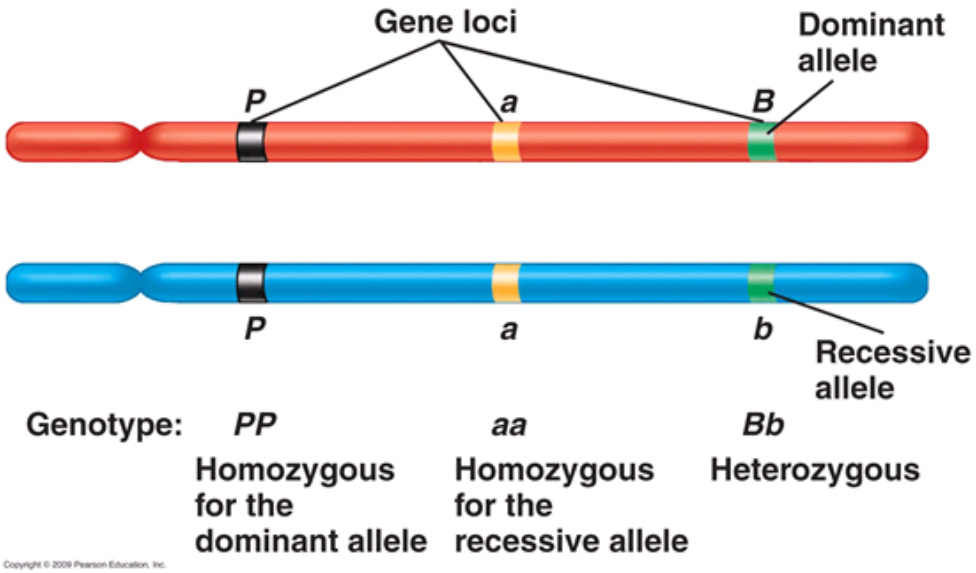
F2 has 1 PP and 2 Pp genotypes that all have purple phenotypes

plus…1 pp that has the white phenotype

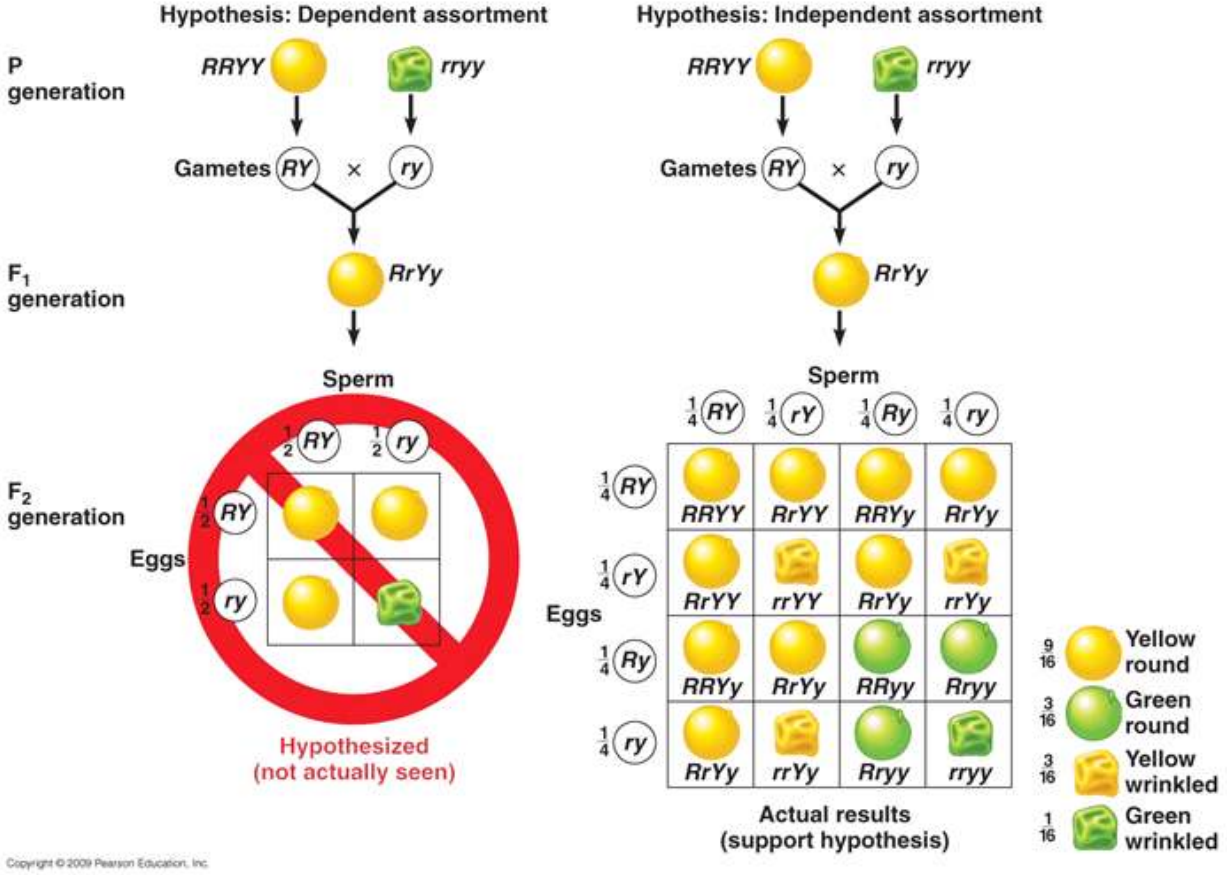
These observations led Mendel to formulate the Law of Segregation:

The male and female gamete carry only 1 allele for each inherited character because the allele pair separate from each other during gamete production

-Think meiosis…separation of homologous chromosomes in anaphase I!



The Law of Independent Assortment (two characters at once)



Allele pairs segregate independently of one another* during gamete formation (independent orientation in metaphase I)

*provided that the allele pairs in question are on non-homologous chromosomes!