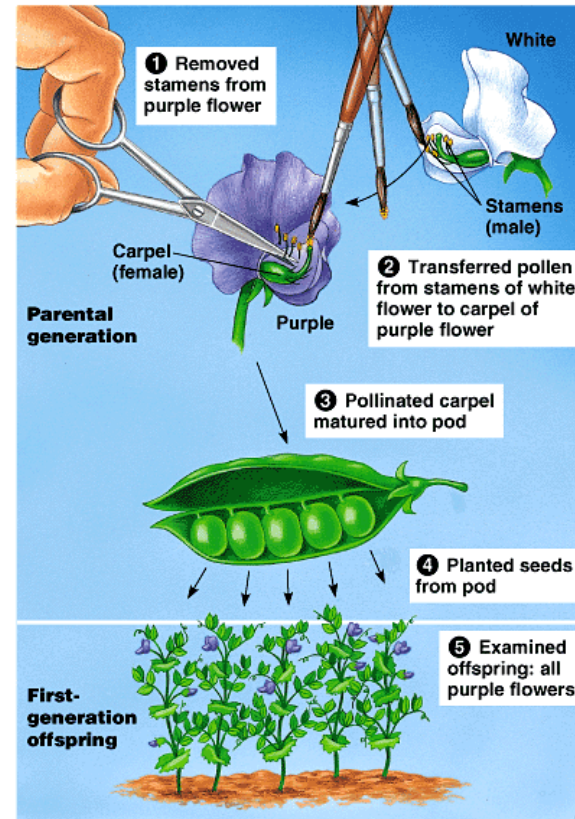


BI107 CHAP 14

Mendel & the Gene Idea

Mendel

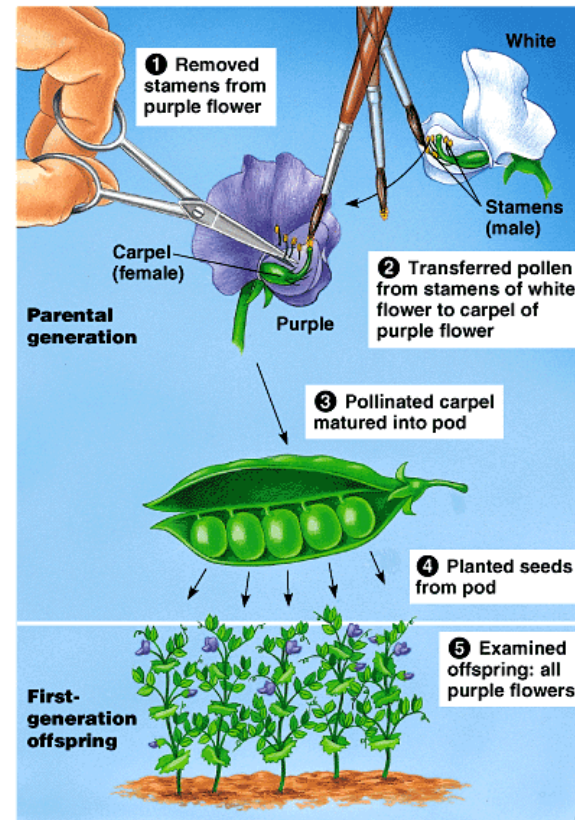
- Term ‘character’ used for heritable feature such as flower color & variation such as red or blue called trait
- Used pea plants so could control matings
- Pea plants have both male (stamen) & female (carpels) sex organs so could self pollinate or cross pollinate



Copyright © Pearson Education, Inc., publishing as Benjamin Cummings.

Mendel cont.

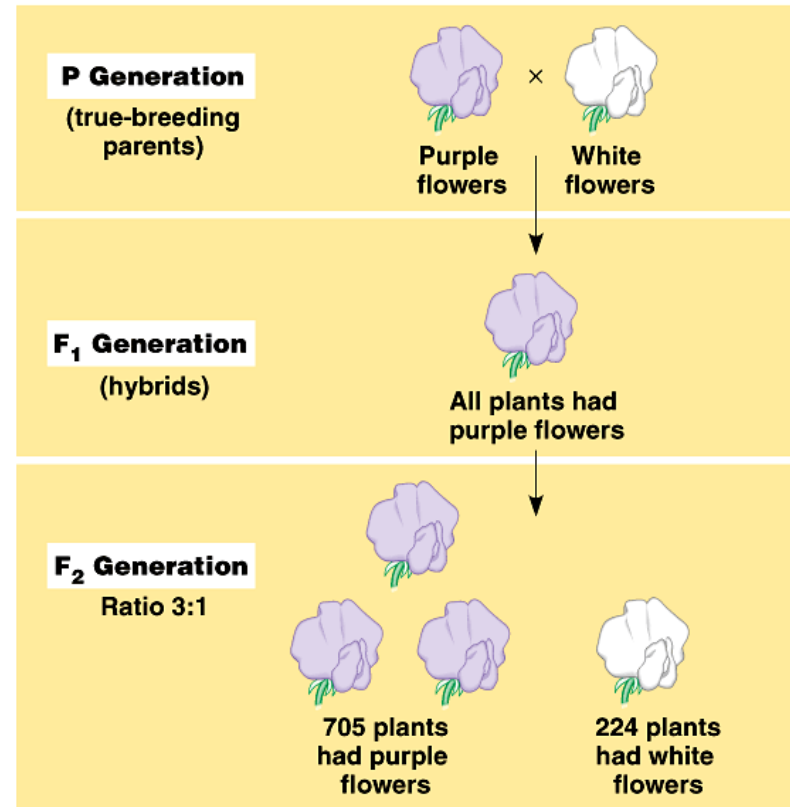
- Mendel chose to study only characters in an either-or design
- Started with true-breeding pea plants – when self-pollinate only get offspring of same variety
- Mating of 2 true-breeding varieties called hybridization & parents are P generation & offspring are F₁ generation



Copyright © Pearson Education, Inc., publishing as Benjamin Cummings.

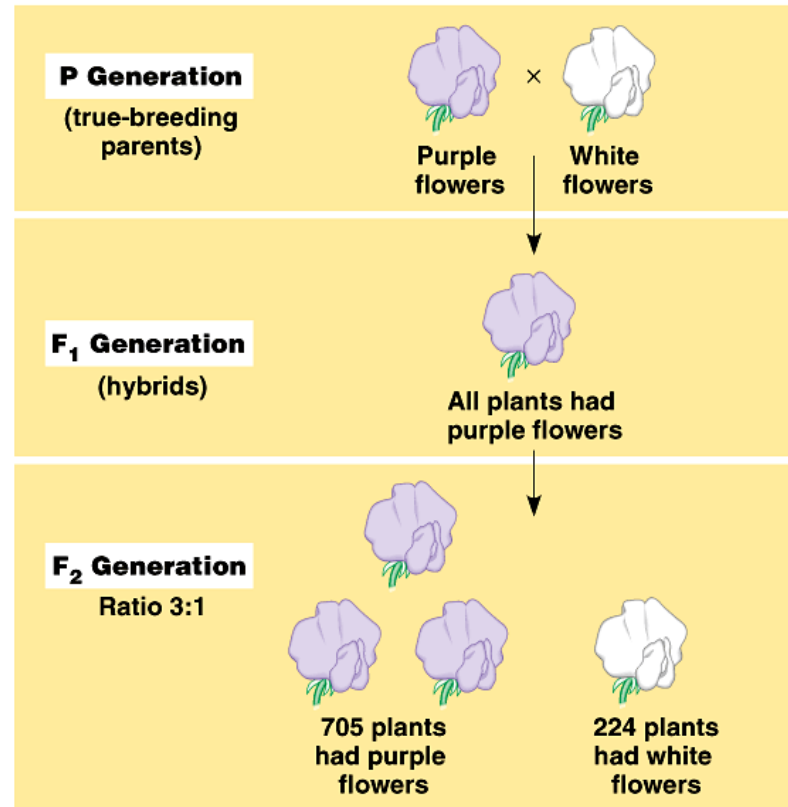
Mendel cont.

- If F_1 generation self-pollinates gives F_2 generation & quantitative analysis of F_2 generation revealed 2 principles of heredity law of segregation & law of independent assortment



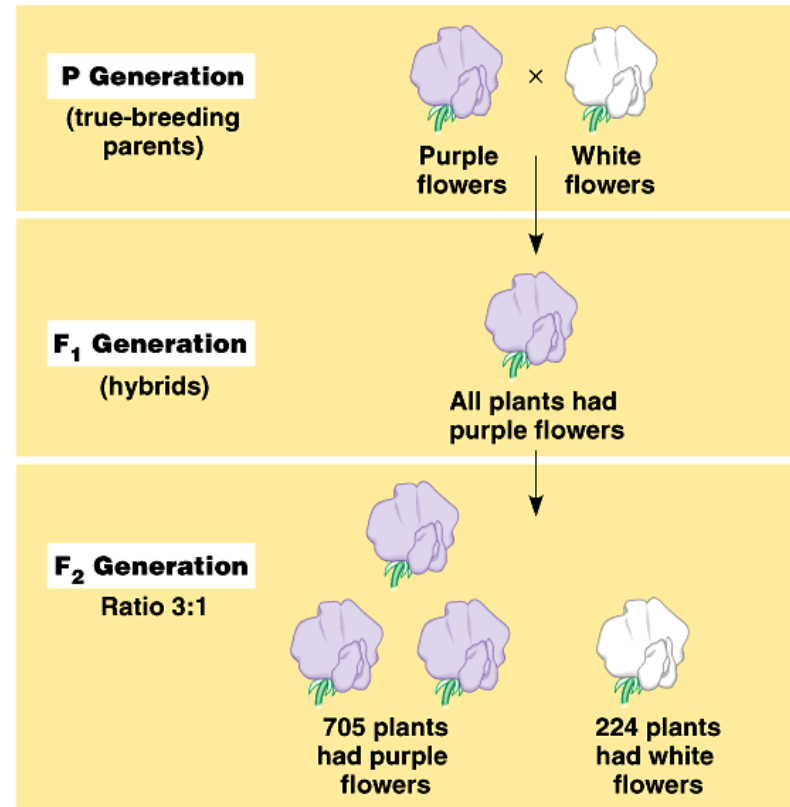
Mendel cont.

- Law of segregation –
in purple flower –
white flower matings
all F₁ flowers were
purple but in F₂
generation white
flowers return in ratio
of 3:1 purple:white



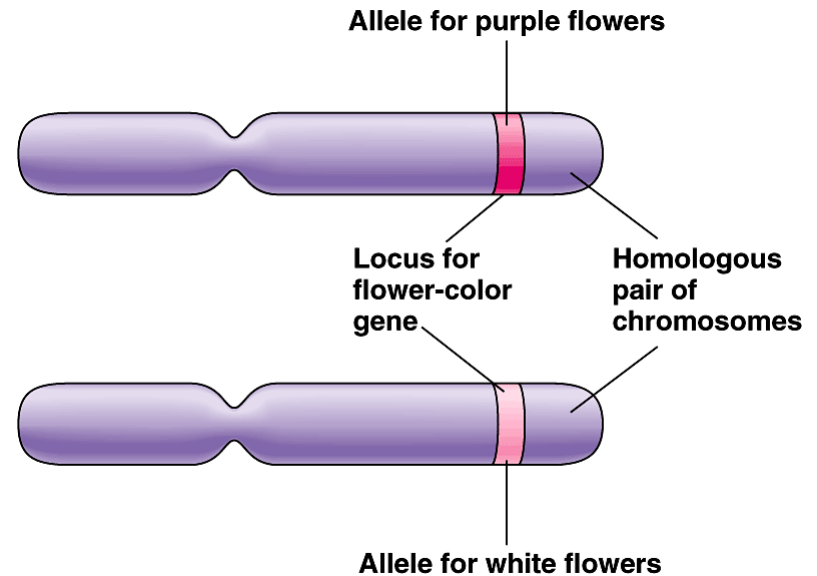
Mendel cont.

- Called purple color dominant over white color (recessive) for flower color
- Saw same pattern for 6 other characters with 2 varieties
- All characters showed 3:1 ratio of variants in F₂ generation



Mendel cont.

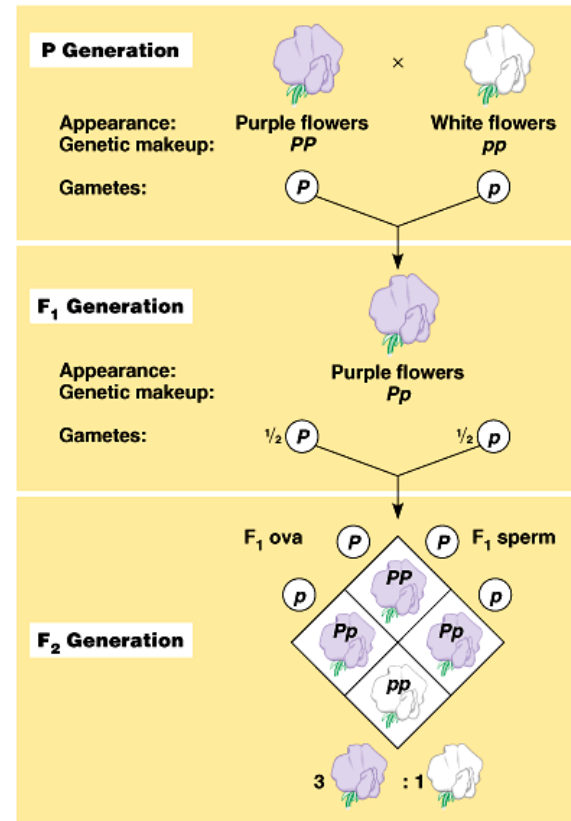
- 4 ideas from Mendel's hypothesis
- Alternate versions of genes (different alleles) account for variations in inherited characters
- For each character an organism inherits 2 alleles one from each parent



Copyright © Pearson Education, Inc., publishing as Benjamin Cummings.

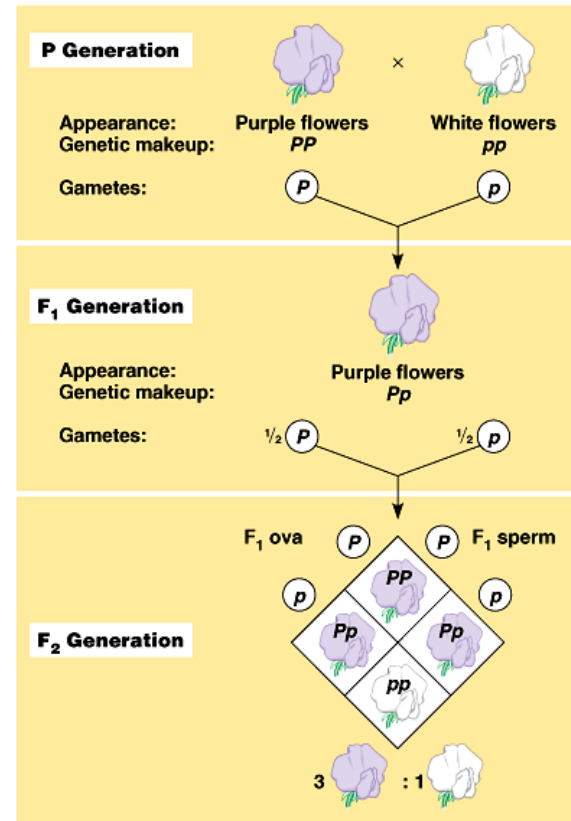
Mendel cont.

- If 2 alleles differ then dominant allele is fully expressed in an organism's appearance but other recessive allele has no noticeable effect on organism's appearance
- 2 alleles for each character segregate or separate during gamete formation



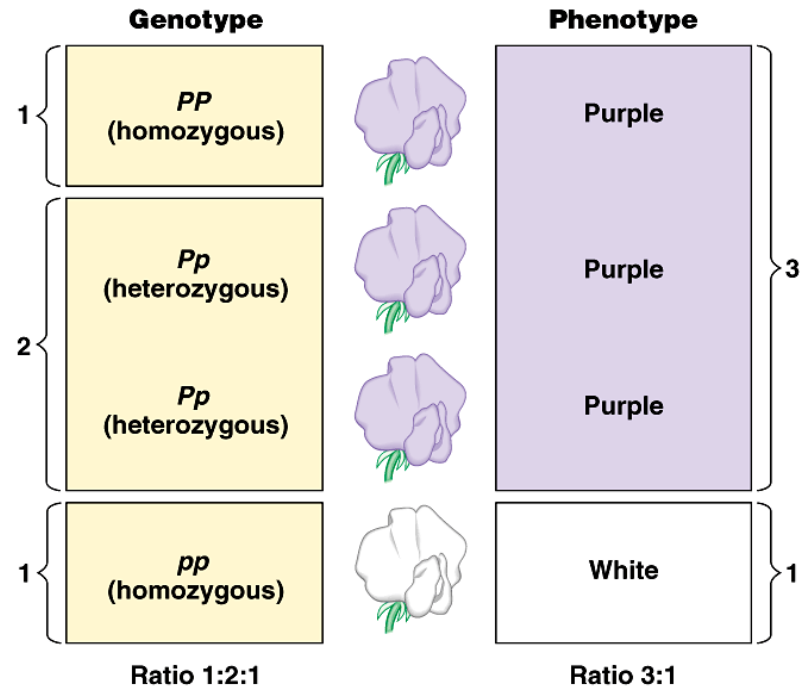
Mendel cont.

- Called law of segregation look at 1 character at a time – monohybrid cross
- Can it account for 3:1 ratio seen in F₂ generation
- F₁ hybrids will produce 2 types of gametes P and p so can have 2 types of eggs & 2 types of sperm
- Can use a Punnett square to determine outcome of self fertilization of F₁



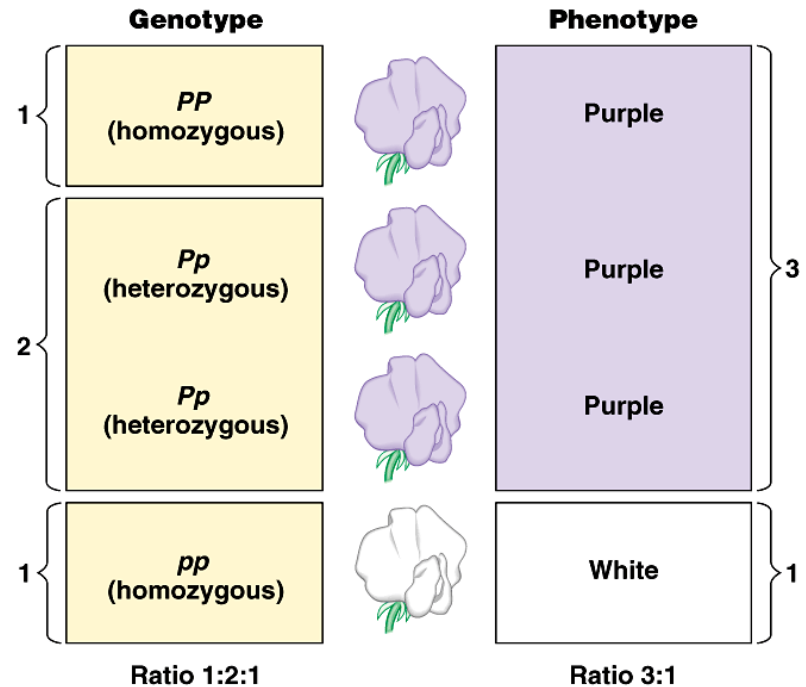
Mendel cont.

- Organism with a pair of identical alleles for a character is homozygous for the gene controlling the character – can be homozygous dominant (PP) or homozygous recessive (pp)



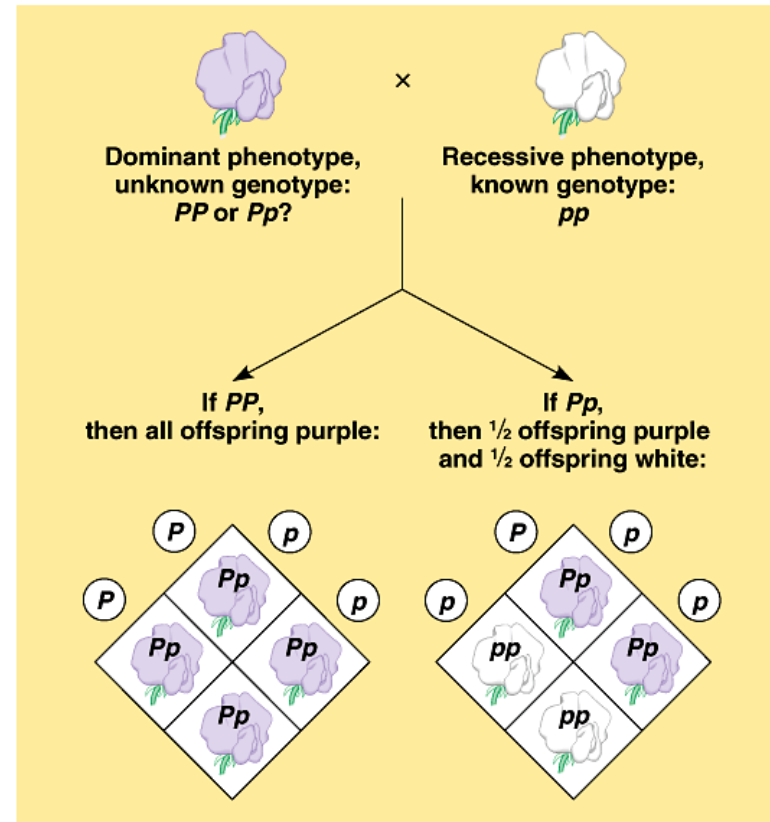
Mendel cont.

- Organism having 2 different alleles for a gene is heterozygous (Pp)
- Can distinguish organism's traits (phenotype) from genetic makeup (genotype)



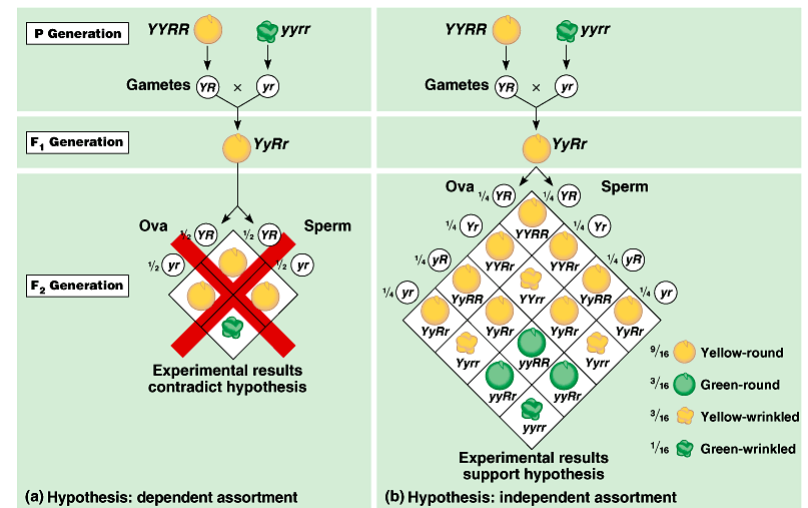
Mendel cont.

- To find out an unknown genotype using known phenotype do a testcross between unknown genotype & known homozygous recessive genotype



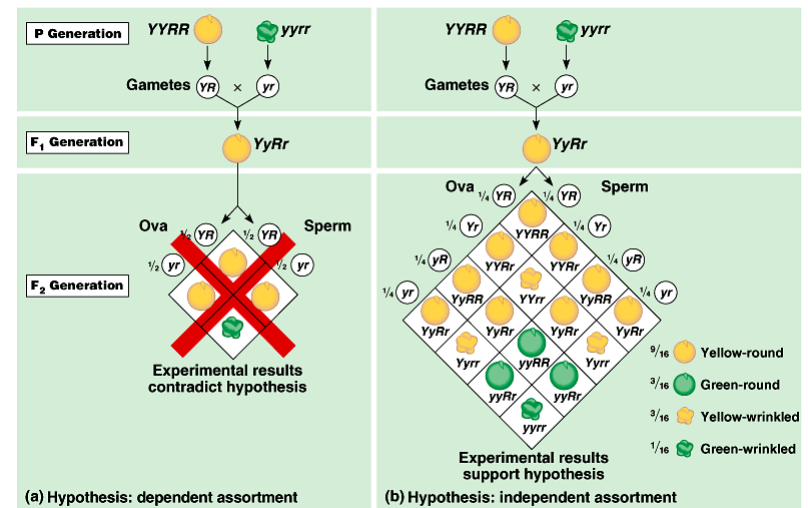
Mendel cont.

- Law of independent assortment – each pair of alleles segregates into gametes independently of other pairs of alleles – must look at 2 or more characters at same time – called dihybrid cross for 2 characters – flower color & pea color or pea shape



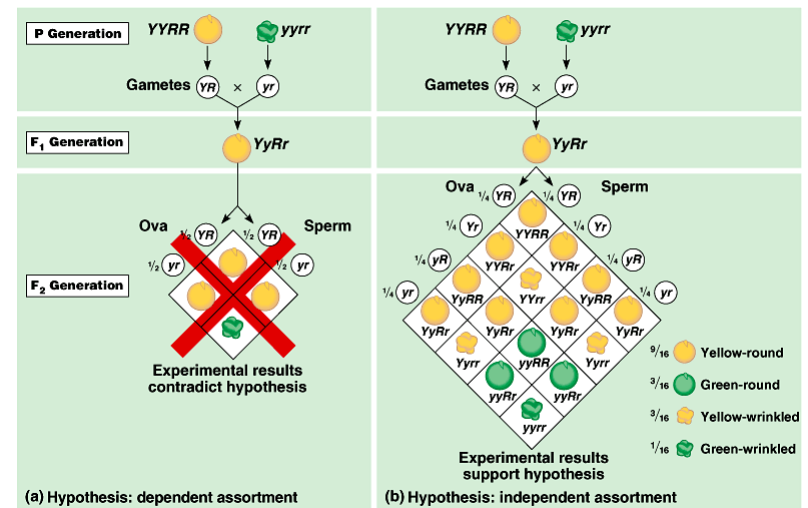
Mendel cont.

- Look at seed color & seed shape
- Yellow dominant over green seeds & smooth dominant over wrinkled seeds
- $YYRR$ & $yyrr$ are true breeding parents which produce gametes having genotype YR for 1 parent & yr for other parent



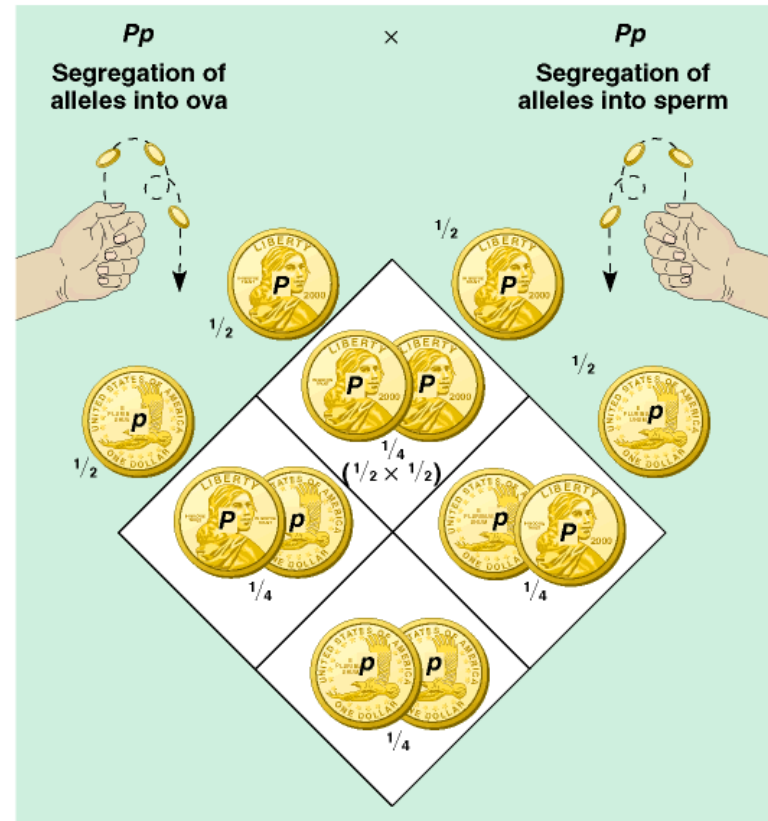
Mendel cont.

- F_1 plants are all $YyRr$ so dominant genotypes expressed in F_1 phenotype – all look yellow & smooth
- Self – fertilizing F_1 gives 9 different genotypes having 4 different phenotypes in ratio 9:3:3:1



Mendel cont.

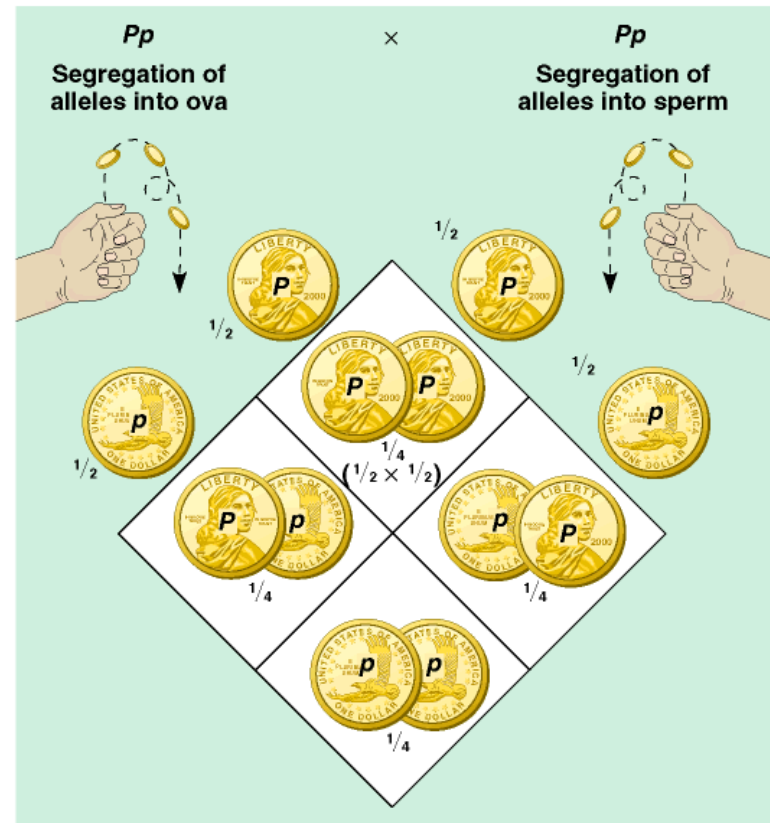
- Laws of segregation & independent assortment reflect rules of probability applied to tossing a coin
- Probability scale 0-1
- Coin has 2 sides so probability of tossing a head is $\frac{1}{2}$ & a tail $\frac{1}{2}$
- Probability of tossing a head on 1 toss is independent of probability of tossing a head on next toss



Copyright © Pearson Education, Inc., publishing as Benjamin Cummings.

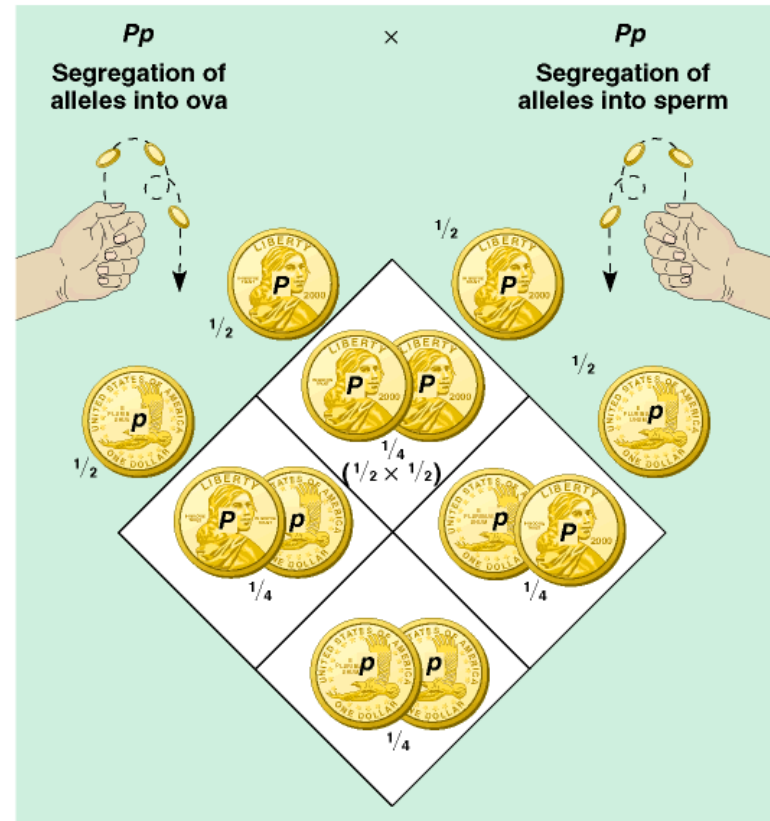
Mendel cont.

- Rule of multiplication
– 2 coins tossed simultaneously
probability of a particular outcome for both is product of probability for each
- Head – $\frac{1}{2}$ head – $\frac{1}{2}$
probability of 2 heads
is $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$



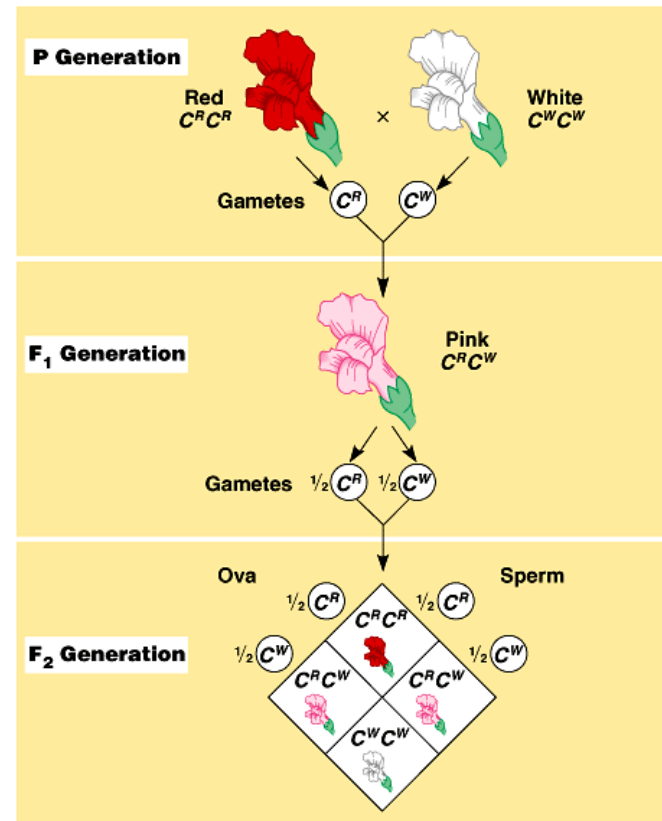
Mendel cont.

- Rule of addition – probability of event that can occur in 2 or more different ways is sum of separate probabilities $\frac{1}{4} + \frac{1}{4} = \frac{1}{2}$



















Beyond Mendel

- Incomplete dominance – F1 have appearance between parent phenotypes – snapdragons – 2 alleles are separate as get white in F2



Beyond Mendel cont.

- Codominance – 2 alleles affect phenotype in separate distinguishable ways
- M & N blood groups in humans – some homozygous for M others for N others heterozygous MN

(a) Phenotype (blood group)	(b) Genotypes (see p.258)	(c) Antibodies present in blood serum	(d) Results from adding red blood cells from groups below to serum from groups at left			
			A	B	AB	O
A	$I^A I^A$ or $I^A i$	Anti-B				
B	$I^B I^B$ or $I^B i$	Anti-A				
AB	$I^A I^B$	—				
O	ii	Anti-A Anti-B				

Copyright © Pearson Education, Inc., publishing as Benjamin Cummings.

Beyond Mendel cont.

- Multiple alleles – ABO blood group in humans has multiple alleles of a single gene
- A – $I^A I^A$ or $I^A i$
- B – $I^B I^B$ or $I^B i$
- AB – $I^A I^B$
- O - ii

(a) Phenotype (blood group)	(b) Genotypes (see p.258)	(c) Antibodies present in blood serum	(d) Results from adding red blood cells from groups below to serum from groups at left			
			A	B	AB	O
A	$I^A I^A$ or $I^A i$	Anti-B				
B	$I^B I^B$ or $I^B i$	Anti-A				
AB	$I^A I^B$	—				
O	ii	Anti-A Anti-B				

Copyright © Pearson Education, Inc., publishing as Benjamin Cummings.

Beyond Mendel cont.

- Pleiotropy – single gene affects organism in many ways
- Epistasis – gene at 1 locus alters phenotypic expression of a gene at 2nd locus
- Polygenic inheritance – phenotype results from expression of several genes – height or skin color

