




Genetics & The Work of Mendel

Gregor Mendel

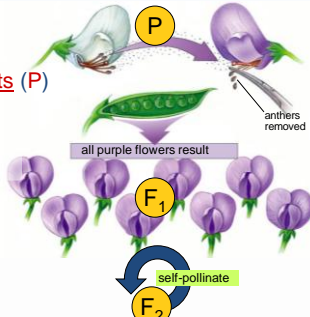
- Modern genetics began in the mid-1800s in an abbey garden, where a monk named Gregor Mendel documented inheritance in peas
- used experimental method
- used quantitative analysis
 - collected data & counted them
- excellent example of scientific method



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Mendel's work

- Bred pea plants
 - cross-pollinate **true breeding parents (P)**
 - P = parental**
 - raised seed & then observed traits (**F₁**)
 - F = filial**
 - allowed offspring to **self-pollinate** & observed next generation (**F₂**)



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Mendel collected data for 7 pea traits

Character		F ₁ Generation	
Dominant Form	Recessive Form	Dominant/Recessive	Ratio
Purple flowers	White flowers	705/224	3.15:1
Yellow seeds	Green seeds	6022/2001	3.01:1
Round seeds	Wrinkled seeds	5474/1800	3.04:1
Green pods	Yellow pods	428/152	2.82:1
Inflated pods	Constricted pods	882/299	2.95:1
Axial flowers	Terminal flowers	651/207	3.14:1
Tall plants	Dwarf plants	787/277	2.84:1

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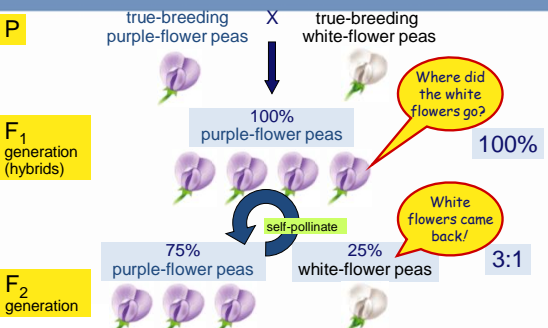
Looking closer at Mendel's work

P generation: true-breeding purple-flower peas × true-breeding white-flower peas

F₁ generation (hybrids): 100% purple-flower peas

F₂ generation: 75% purple-flower peas, 25% white-flower peas (3:1 ratio)

Where did the white flowers go? → White flowers came back!



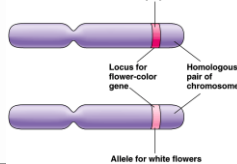
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What did Mendel's findings mean?

- Traits come in alternative versions
 - purple vs. white flower color
 - alleles**
 - different alleles vary in the sequence of **nucleotides** at the specific **locus** of a gene
 - some difference in sequence of A, T, C, G

purple-flower allele & white-flower allele are two DNA variations at flower-color locus

different versions of gene at same location on homologous chromosomes



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Traits are inherited as discrete units

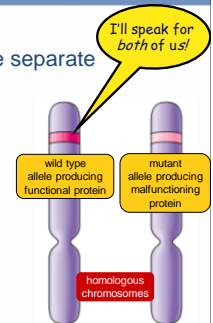
- For each characteristic, an organism inherits 2 alleles, 1 from each parent
 - diploid** organism
 - inherits 2 sets of chromosomes, 1 from each parent
 - homologous chromosomes

What are the advantages of being diploid?

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What did Mendel's findings mean?

- Some traits mask others
 - purple** & **white** flower colors are separate traits that do not blend
 - purple x white \neq light purple
 - purple **masked** white
 - dominant allele**
 - functional protein
 - recessive allele**

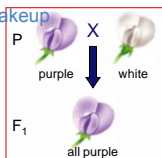


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Genotype vs. phenotype

- Difference between how an organism "looks" & its genetics
 - phenotype**
 - description of an organism's trait
 - the "physical"
 - genotype**
 - description of an organism's genetic makeup

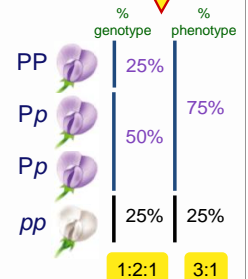
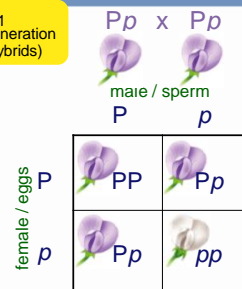
Explain Mendel's results using ... **dominant** & **recessive** ... **phenotype** & **genotype**



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Punnett squares

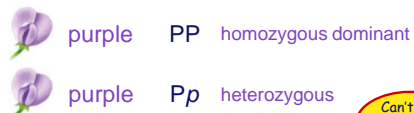
F₁ generation (hybrids)



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Phenotype vs. genotype

- 2 organisms can have the same phenotype but have different genotypes



Can't tell by lookin' at ya!

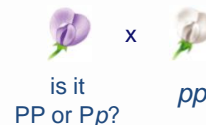
How do you determine the genotype of an individual with a dominant phenotype?



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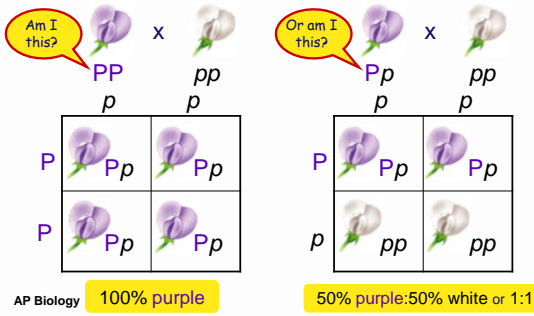
Test cross

- Breed the dominant phenotype — the unknown genotype — with a **homozygous recessive** (pp) to determine the identity of the unknown allele

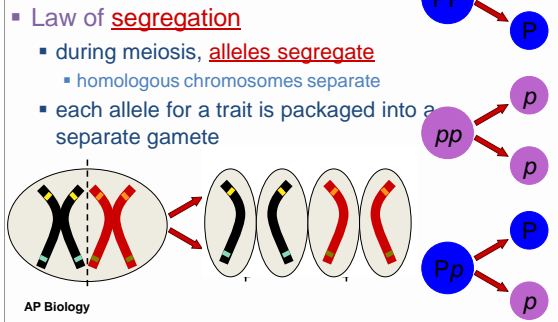


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How does a Test cross work?



Mendel's 1st law of heredity

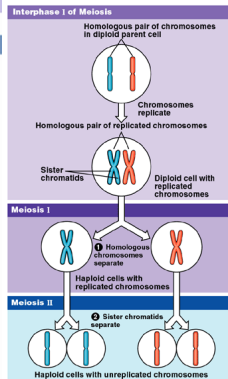


Law of Segregation

- Which stage of meiosis creates the law of segregation?

Metaphase 1

Whoa!
And Mendel didn't even know DNA or genes existed!



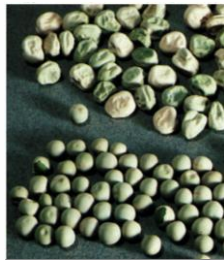
Monohybrid cross

- Some of Mendel's experiments followed the inheritance of single characters
 - flower color
 - seed color
 - monohybrid** crosses

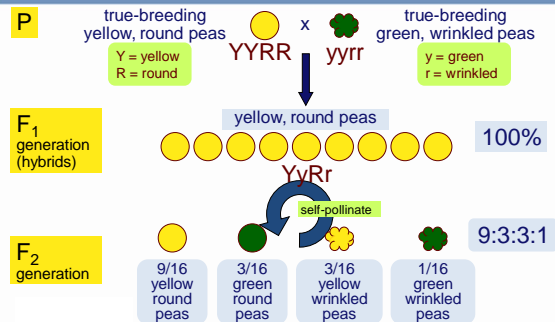


Dihybrid cross

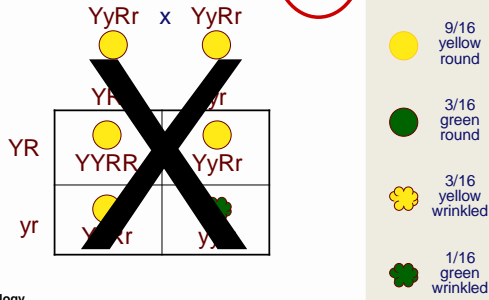
- Other of Mendel's experiments followed the inheritance of 2 different characters
 - seed color **and** seed shape
 - dihybrid** crosses



Dihybrid cross

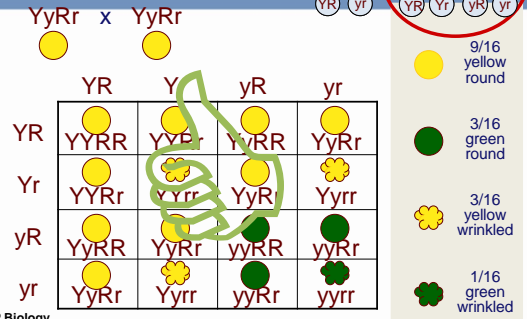


Is this the way it works?



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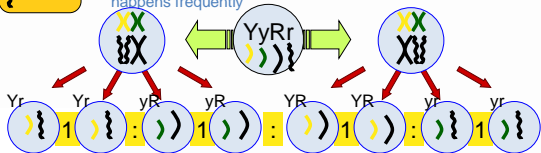
Dihybrid cross



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Mendel's 2nd law of heredity

- Law of **independent assortment**
 - different **loci** (genes) separate into gametes independently
 - non-homologous chromosomes align independently
 - classes of gametes produced in equal amounts
 - $YR = Yr = yR = yr$
 - only true for genes on separate chromosomes or on same chromosome but so far apart that crossing over happens frequently



Law of Independent Assortment

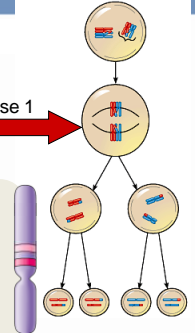
- Which stage of meiosis creates the law of independent assortment?

Remember Mendel didn't even know DNA — or genes — existed!

Metaphase 1

EXCEPTION

- If genes are on same chromosome & close together
 - will usually be inherited together
 - rarely crossover separately
 - "linked"



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