

## Patterns of Inheritance

- DNA is passed on to the next generation
- In sexual species, the DNA will be a mix of both parents
- There are ways to predict how this new DNA will behave and be expressed
  - Genotype and Phenotype

## Transmission Genetics: Inheritance According to Mendel

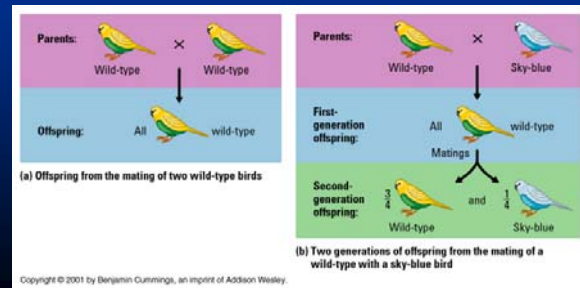


- Gregor Mendel in the 1860s
- Botanical Crosses
- Monohybrid Crosses
- Mendel's Principles of Inheritance
  - #1 - Genes exist in pairs
  - #2 - Dominant vs. recessive alleles
  - #3 - Law of Segregation: Homologous chromosomes segregate randomly
  - #4 - Law of Independent Assortment: Different traits segregate randomly

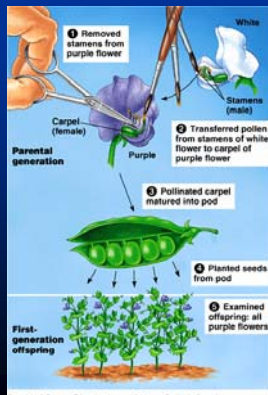
## Vocabulary

- Wild type
- P, F<sub>1</sub>, F<sub>2</sub>
- Monohybrid Cross
- Dihybrid Cross
- "Self" Cross
- Dominant/Recessive
- Gene
- Allele
- Genotype
- Phenotype
- Heterozygous
- Homozygous
- Loci
- Punnett Square

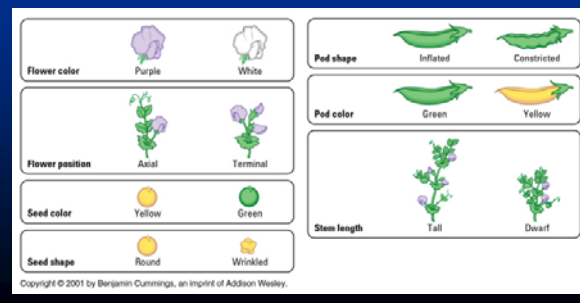
## Patterns of Inheritance



## Mendel's Peas



## Seven Characteristics of Peas

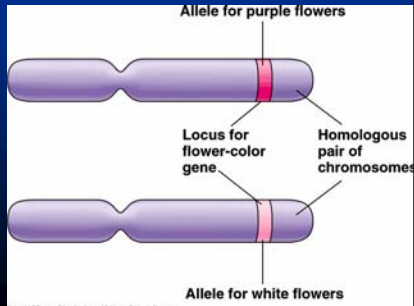


## Loci and Alleles

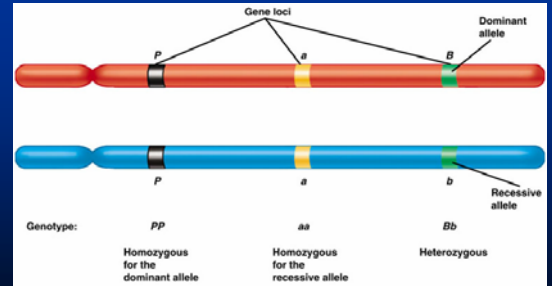
Gene- the unit of inheritance- the coding for a protein

Allele- alternate form of the 'same' gene.

Loci- location of that allele



## Loci and Alleles



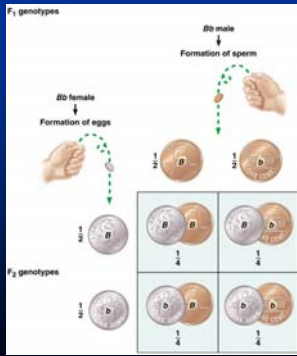
Homozygous- same alleles

Heterozygous- different alleles

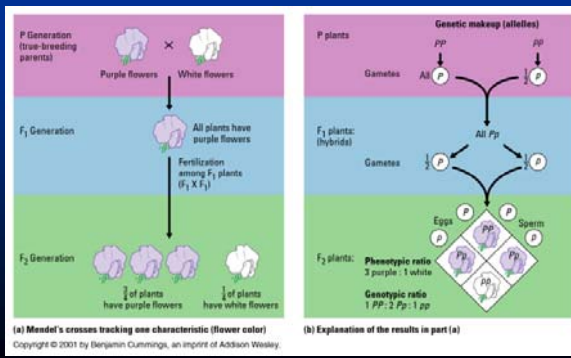
## Coin Crossing

- Alleles- heads or tails
- Probability of getting one or the other = 50%, or  $\frac{1}{2}$
- So, on average, you'll get all possibilities in equal ratios
- But what if a "heads" was all that mattered?
- Dominant vs. Recessive

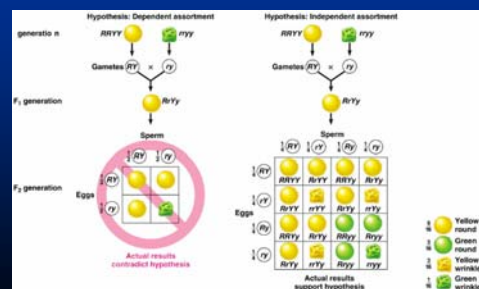
Punnett Square- diagram the possible combinations



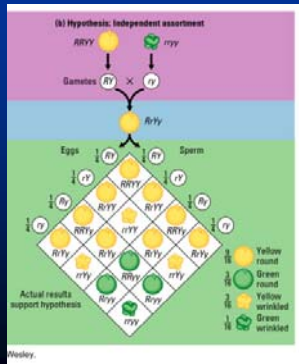
## A Monohybrid Cross: one trait



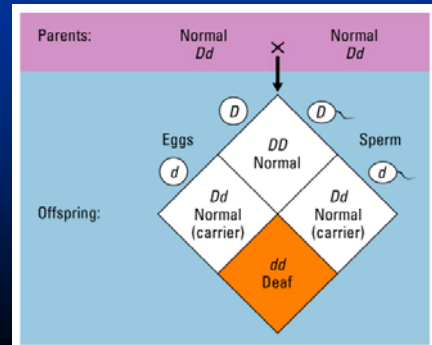
## Monohybrid and Dihybrid crosses



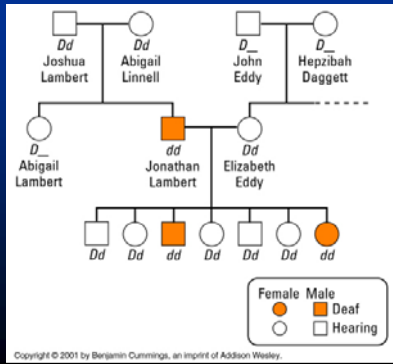
## Dihybrid Cross: two traits



## Recessive Disorders



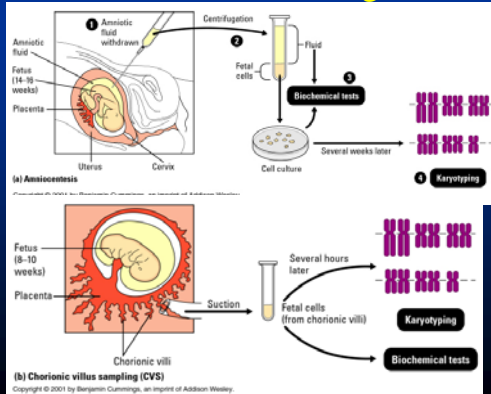
## Family History- Pedigree



## Genetic disorders

Disorder	Major Symptoms	Incidence	Comments
<b>Recessive disorders</b>			
Albinism	Lack of pigment in skin, hair, and eyes	1/22,000	Prone to skin cancer
Cystic fibrosis	Excess mucus in lungs, digestive tract, liver; increased susceptibility to infections; death in early childhood unless treated	1/2,500 Caucasians	See Modules 9.9 and 12.11
Galactosemia	Accumulation of galactose in tissues; mental retardation; eye and liver damage	1/100,000	Treated by eliminating galactose from diet
Phenylketonuria (PKU)	Accumulation of phenylalanine in blood; lack of normal skin pigment; mental retardation	1/10,000 in U.S. and Europe	See Module 9.10
Sickle-cell disease (homozygous)	Sickled red blood cells; damage to many tissues	1/400 African-Americans	Alleles are codominant; see Modules 9.13 and 9.14
Tay-Sachs disease	Lipid accumulation in brain cells; mental deficiency; blindness; death in childhood	1/3,000 Jews from central Europe	See Module 4.11
<b>Dominant disorders</b>			
Achondroplasia	Dwarfism	1/25,000	See Module 9.9
Alzheimer's disease (one type)	Mental deterioration; usually strikes late in life	Not known	
Huntington's disease	Mental deterioration and uncontrollable movements; strikes in middle age	1/25,000	See Modules 9.9 and 12.11
Hypercholesterolemia	Excess cholesterol in blood; heart disease	1/300 are heterozygous	Incomplete dominance; see Module 9.12

## Fetal Testing



## Transmission Genetics: Inheritance According to Mendel

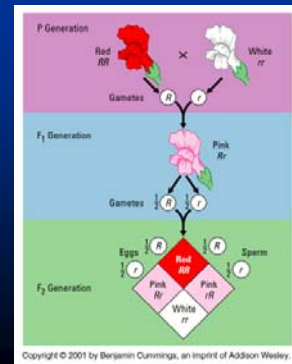


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## Non-Mendelian Inheritance

- Summary: What defines a Mendelian trait?
- How alleles interact w/ each other:
  - What does dominant or recessive really mean?
- Incomplete or partial dominance
- Codominance
- Multiple alleles
- Lethal Alleles: Good genes and bad genes
- Sex (X) -Linked Traits
- Polygenic Traits

## Incomplete Dominance

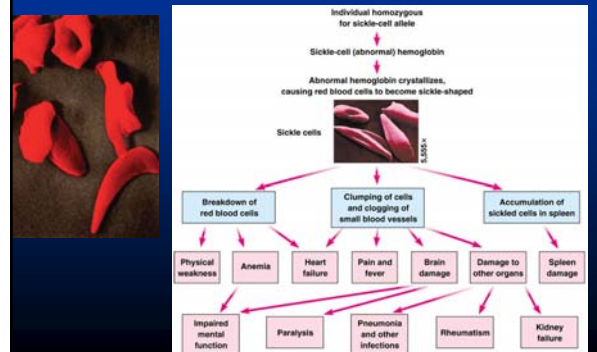


## Multiple Alleles- Codominance

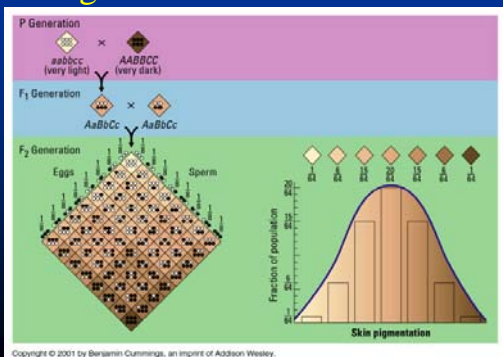
Blood Group (Phenotype)	Genotypes	Antibodies Present in Blood	Reaction When Blood from Groups Below Is Mixed with Antibodies from Groups at Left			
			O	A	B	AB
O	ii	Anti-A Anti-B	•••••	•••••	•••••	•••••
A	$i^A i^A$ or $i^A i$	Anti-B	•••••	•••••	•••••	•••••
B	$i^B i^B$ or $i^B i$	Anti-A	•••••	•••••	•••••	•••••
AB	$i^A i^B$	—	•••••	•••••	•••••	•••••

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## Multiple Effects of One Gene- Pleiotropy

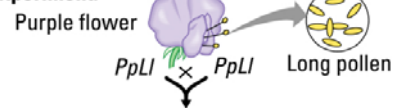


## Polygenic Inheritance- Many genes can affect one trait



## Linked Genes- sometimes they DONT assort independently

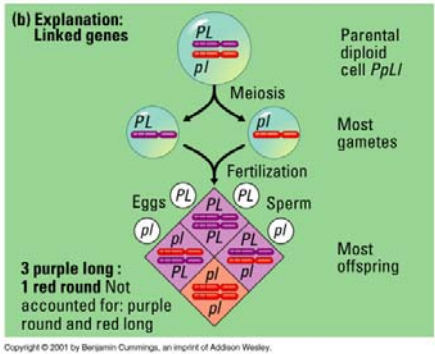
(a) Experiment:



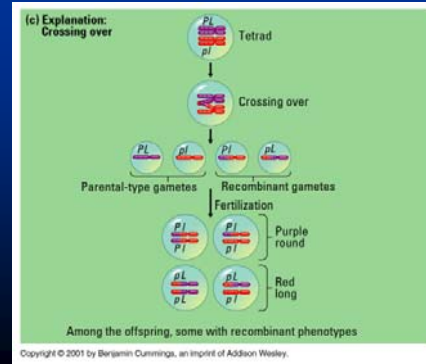
Phenotypes	Observed offspring	Prediction (9:3:3:1)
Purple long	284	215
Purple round	21	71
Red long	21	71
Red round	55	24

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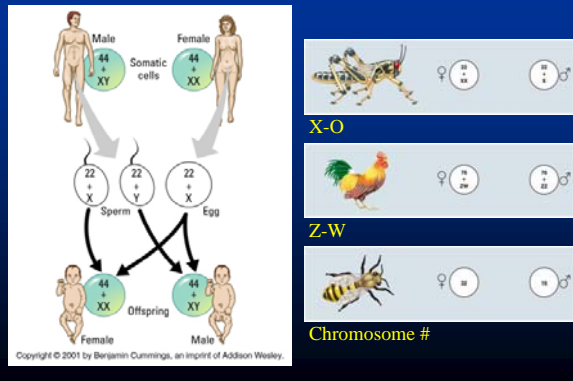
## Link genes



## Crossing over and Linkage

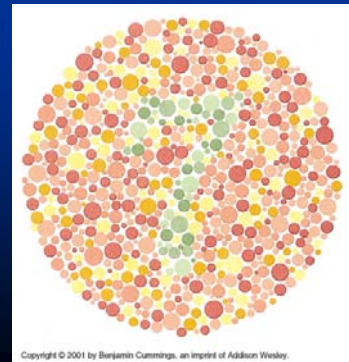


## Sex-linked traits



## Color Blindness

Red-green color blindness  
Caused by several X-linked genes  
More common in males than females... why?



## Hemophilia

Sex-linked trait  
Lack one or more proteins needed to clot the blood.

