Biology 112
Unit 7

Chapter Nine
Patterns of Inheritance

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I. Mendelian Genetics

- Gregor Mendel – monk who worked with pea plants
  - Strong training in the sciences and mathematics
  - Good experimental design and meticulous records
- Published paper in 1866
  - Said parents pass on discrete heritable factors

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Opposed Two Theories of the Time

1) Pangenesis
   - Hippocrates theory
   - Acquired traits of the adult migrate to gametes
2) Blending Hypothesis
   - Early 19th century
   - Heritable traits from each parent blend in young

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Why peas?

- You can easily trace 7 traits with 2 distinct forms each
- Can easily do both self-fertilization and cross-fertilization
  - Allowed him to keep track of parentage
- Kept going until he had true-breeding varieties
  - All identical to the parent plant (homozygous dominant/recessive)

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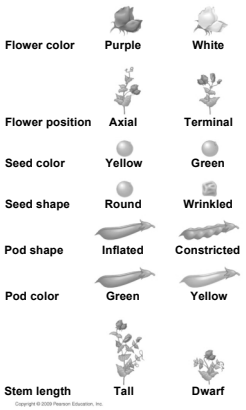

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II. Monohybrid Crosses

- Track inheritance of a single trait
- Four Mendelian Hypotheses
  1) Different forms of a gene exist (allele)
  2) Each organism carries two copies (diploid)

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3) Gametes only carry one copy (haploid) due to Principle (or Law) of Segregation

Combining gametes (Offspring):

Homozygous – carry SAME form of the gene

Heterozygous – carry DIFFERENT forms of the gene

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4) Forms may differ in expression:

Dominant – Homozygous and Heterozygous

Recessive – Homozygous only

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Solving Mendelian Inheritance

P generation X P generation

F_1 generation X F_1 generation

F_2 generation

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Describe the organism two ways

1) Phenotype
   - What you look like
2) Genotype
   - your genetic makeup

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Punnett Square

- Visually shows principle of Independent Assortment
- Steps in Solving

1) Determine P generation genotypes (Diploid)
2) Determine Gametes (Haploid)

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3) Cross gametes in square to yield offspring (Diploid)
4) Summarize

Example

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Rules of Probability

- Rule of Multiplication
  - Product of each event ½ x ½ = ¼

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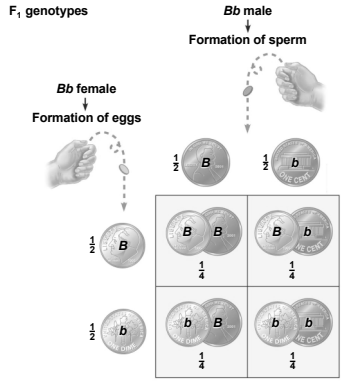

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Testcross

- Used to determine unknown genotypes by crossing with homozygous recessive individual

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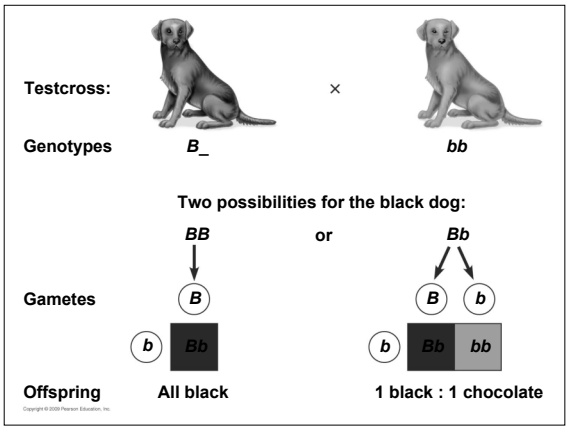

III. Dihybrid Cross

- Track the inheritance of two traits
- Steps to solving:

1) Determine P generation (diploid)
2) Determine gametes (haploid)
3) Cross gametes in square to yield offspring (diploid)
   - FOIL
4) Summarize

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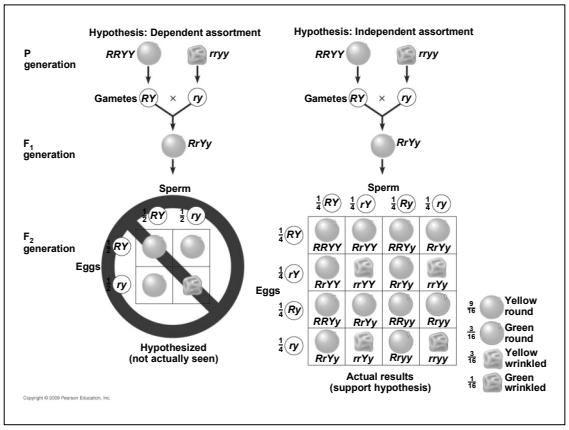

IV. Pedigrees

- Family genetic history illustrated
- Allows one to deduce pattern of inheritance
- Also to determine carriers – those that have the gene but are not affected by it

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	Female	Male
Normal	○	□
Affected	●	■

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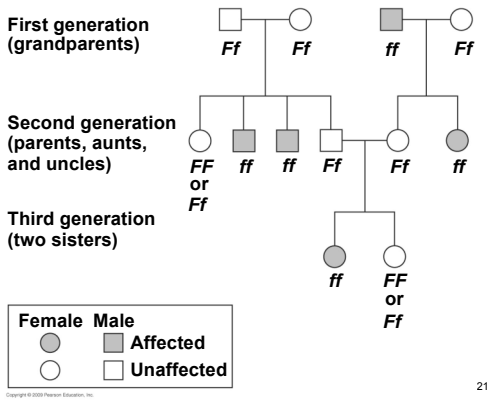

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Patterns of Inheritance

Autosomal

1. Simple Dominant / Recessive

Autosomal Recessive

Albinism, deafness, unattached earlobes, Cystic Fibrosis inflicts 1/1800 caucasian, 1/25 are carriers

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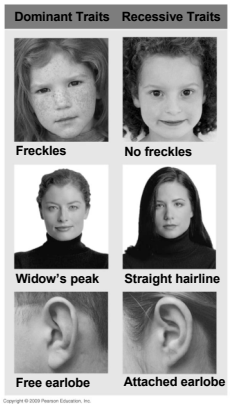

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Autosomal Dominant

Extra digits, webbed digits, tongue rolling, dimples, achondroplasia (one form of dwarfism), Alzheimer's and Huntington's

Dominant doesn't necessarily mean most prevalent

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2) Incomplete dominance
   - Intermediate phenotypes
   - Red x White = Pink
   - coat color (cats, cows), hypercholesterolemia, flower colors

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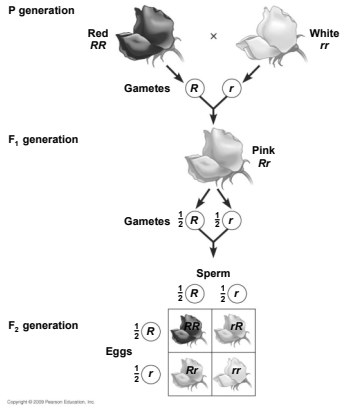

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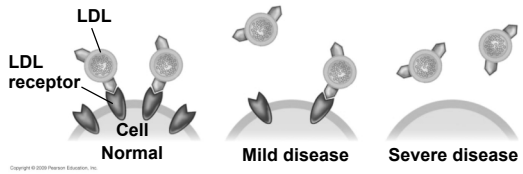
Genotypes:

HH
Homozygous for ability to make LDL receptors

Hh
Heterozygous

hh
Homozygous for inability to make LDL receptors

Phenotypes:



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3) Multiple Alleles:
   - more than two alleles in the population
   - Example – ABO Blood Type of Humans (codominance)

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Blood Type

Phenotype	Genotype
A	AA, AO
B	BB, BO
AB	AB
O	O

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Blood Group (Phenotype)	Genotypes	Red Blood Cells
O	ii	
A	I^AI^A or I^Ai	Carbohydrate A
B	I^BI^B or I^Bi	Carbohydrate B
AB	I^AI^B	

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4) Pleiotropy
   - one trait affects more than one character
   - PKU and Sickle cell

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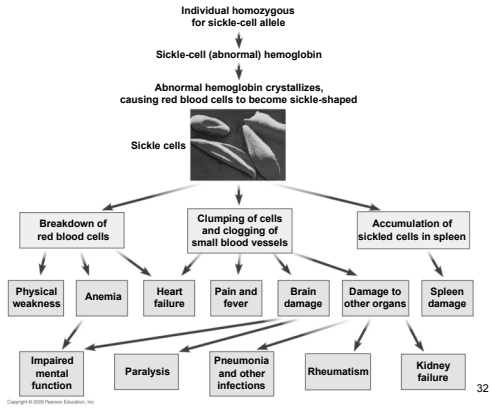

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5) Polygenic:
   - additive effect of 2 or more genes on a single trait
   - skin / hair/ eye colors and height in humans

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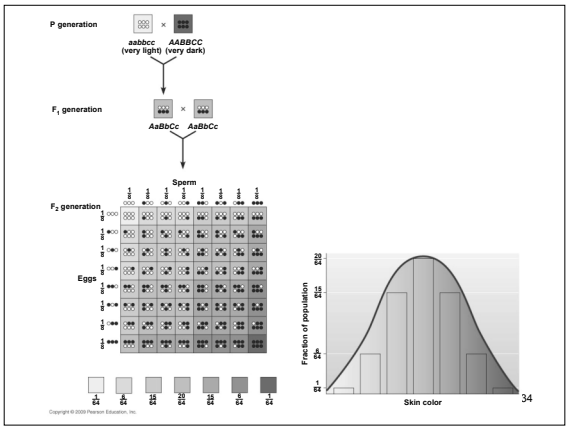

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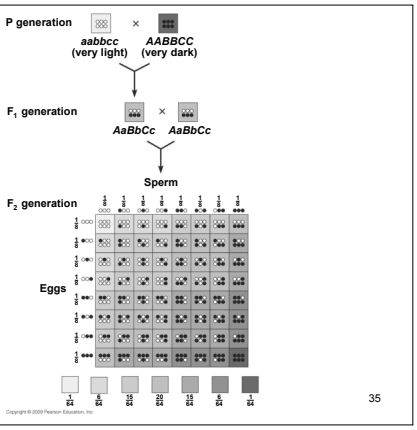

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Sex Chromosomes

6) Sex-linked:

X-linked = colorblindness, hemophilia, heart-valve defect, MS, Fragile X syndrome, hypertrichosis

Y-linked = SRY gene (absence results in a female XY)

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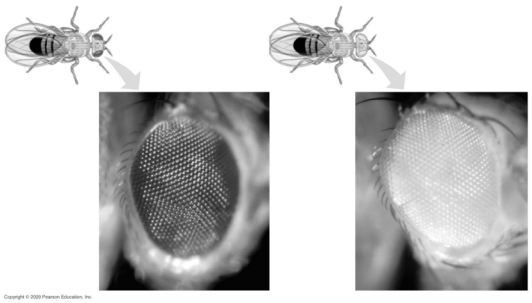

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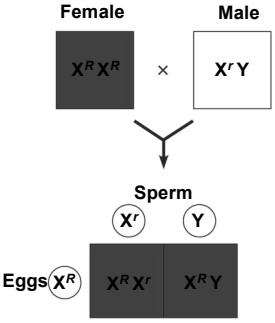

***R* = red-eye allele**
***r* = white-eye allele**

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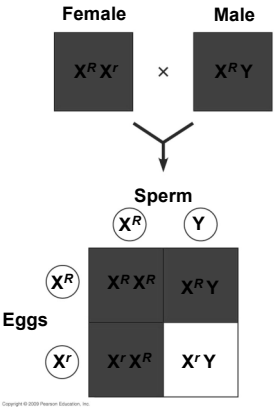

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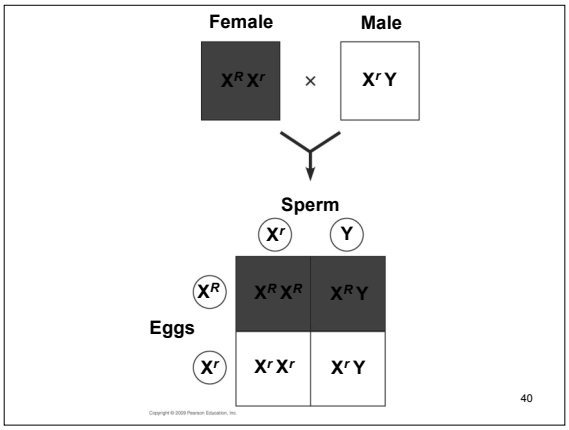
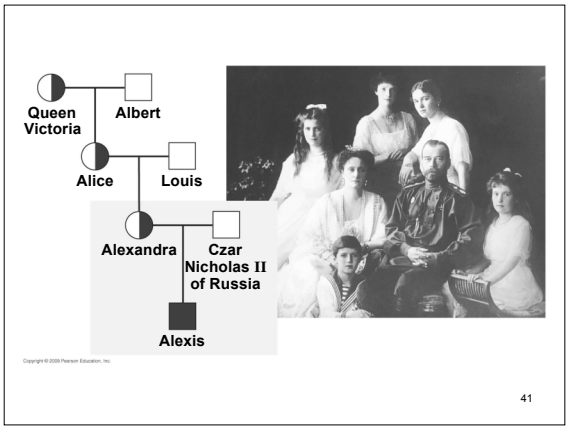

Female
Male
$X^R X^r$
×
$X^r Y$
Sperm
X^r
Y
X^R
Eggs
X^r
$X^R X^R$
$X^R Y$
$X^r X^r$
$X^r Y$
40


Queen Victoria
Albert
Alice
Louis
Alexandra
Czar Nicholas II of Russia
Alexis
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