Important Word Roots

Homozygous	Heterozygous	Dominant	Recessive
• 1 + Form *BB or bb* *True Breeding*	• 2/Mix + Form *Bb*	• Master/ Control *Expressed if present*	• To recess/ hide behind *Only expressed if no dominant*

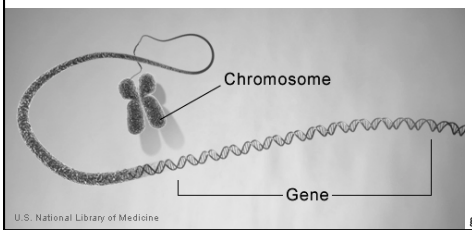
Genes	Phenotype	Genotype
1911; < German Gen: apparently abstracted from *What is inherited*	• Phyical + Form *Blonde*	• Genetic Form *bb*

Key Words

Genetics	The scientific study heredity.
Heredity	Passing of characteristics from parents to offspring.
Character	Heritable feature that varies among individuals. (i.e. eye color)
Trait	The variant of a character. (i.e. different amounts of pigmentation)
Allele	Alternative versions of traits. (i.e. blue or non-blue eyes)
Phenotype	Physical description of alleles. (Outward expression, chemical makeup or behavior.)
Genotype	The genetic makeup – the listing of the alleles.
F1 & F2 generations	The first and second generations, respectively. (Parental generation is labeled P.)
Dominant	The allele that is expressed – written as a capitalized letter.
Recessive	The allele that is masked (by the dominant) – written as a lowercase letter.
Homozygous	An organism with two identical alleles for a trait.
Heterozygous	An organism with two different alleles for a trait.
Punnett Square	A diagram to show the genotypes of possible offspring.
Carriers	An organism that has one recessive allele for a disorder, but doesn't have disorder.
Incomplete Dominance	Phenotype of a heterozygote is intermediate between phenotypes of 2 homozygotes.
Codominance	Heterozygote displays characteristics of both homozygotes. Neither allele masks the other.
Sex-linked Traits	Traits controlled by genes on sex chromosomes
Mendel	Mendel's laws: 1.Law of dominance: When an organism has two different alleles for a given trait (is heterozygous), the allele that is expressed is said to be dominant. The allele whose expression is overshadowed is said to be recessive. 2.Law of segregation: When gametes are formed (via meiosis), the alleles that control the same trait separate from one another into different gametes. (Into different egg or sperm cells.) This process is random. 3.Law of independent assortment: Members of one gene pair separate from each other independently from members of other gene pairs. This process is random.

Genetics = study of heredity

Genes: A chunk of DNA, carried on a chromosome, that produces a protein and ultimately a characteristic.

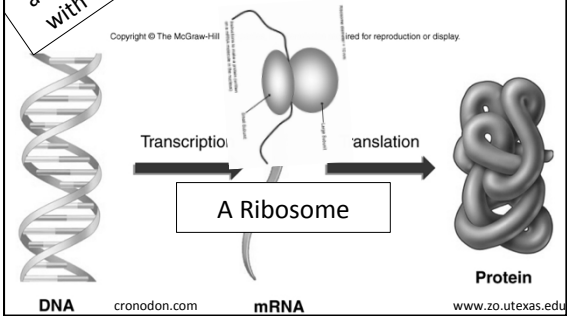


ghr.nlm.nih.gov

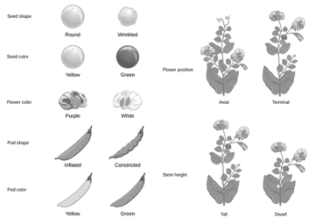
The direction we are going with this

How do we turn DNA into a Protein?

Who reads RNA into the protein?



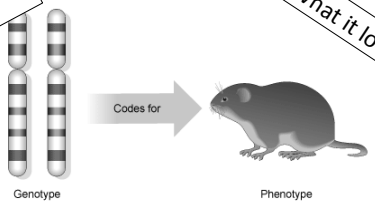
Father of Genetics – Mendel



Genotype Vs Phenotype

Its Genes "alleles" B, b

What it looks like



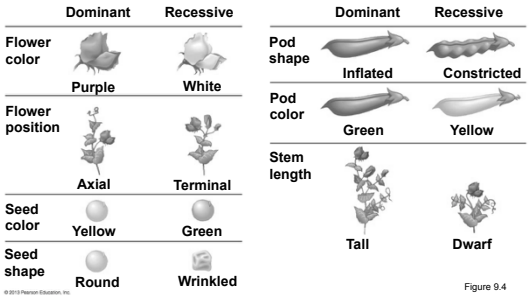
- Phenotypes are physical expressions of traits that are transmitted by alleles.
  a) CAPITAL letters represent **dominant** alleles
  b) lowercase letters represent **recessive** alleles.

Mendelian Vocab:

- A **character** is a heritable feature that varies among individuals. Ex: Hair Color, Eye Color, Freckles
- A **trait** is a variant of a character. Ex: Blonde/Red/Brown/Black, Blue/Brown/Hazel, Present/Absent

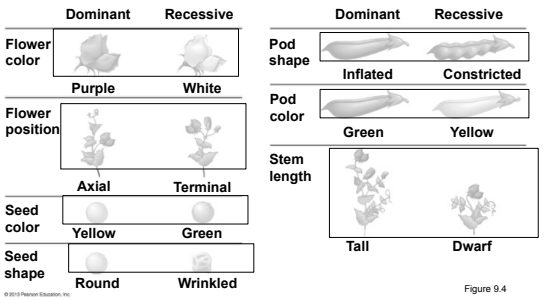
Mendel's Law of Segregation

- He tracked the inheritance of characters that occur as two alternative traits.



Mendel's Law of Segregation

Which characters are paired?

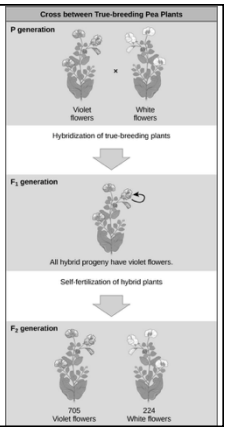


openstax COLLEGE

Figure 8.3

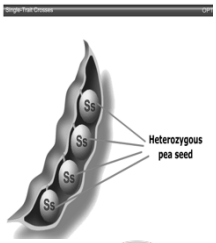
Hybrids

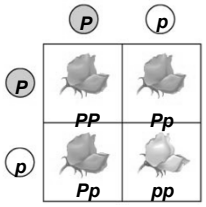
- **Hybrids** are the offspring of two different purebred varieties.
  - The parental plants are the **P generation**.
  - Their hybrid offspring are the **F_1 generation**.
  - A cross of the F_1 plants forms the **F_2 generation**.



Monohybrid Crosses

– A **monohybrid cross** is a cross between purebred parent plants that differ in only one character.



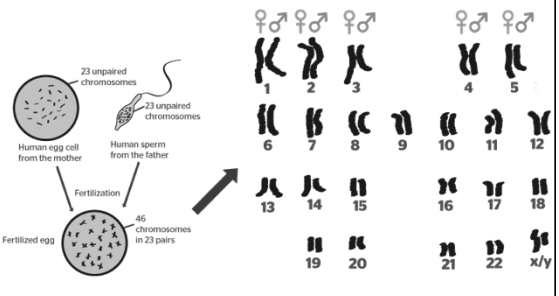


PLAY Blast Animation: Single-Trait Crosses

Karyotype for human being

-1 Chromosome form mom

-1 Chromosome from dad



b4fa.org

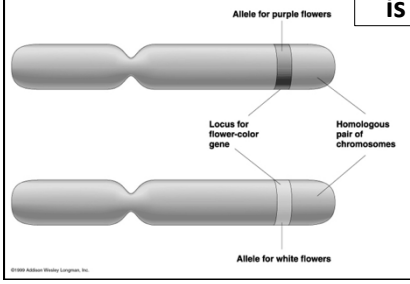
Allele =

-1 Chromosome form mom

-1 Chromosome from dad

Will the flower be purple or pink?

Depends which is dominant



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Monohybrid Crosses

- Mendel developed four hypotheses from the monohybrid cross, listed here using modern terminology (including "gene" instead of "heritable factor").

1. The alternative versions of genes are called **alleles.**
2. For each inherited character, an organism inherits two alleles, one from each parent.
   - An organism is **homozygous** for that gene if both alleles are identical.
   - An organism is **heterozygous** for that gene if the alleles are different.
3. If two alleles of an inherited pair differ,
   - Then one determines the organism's appearance and is called the **dominant allele** and
   - The other has no noticeable effect on the organism's appearance and is called the **recessive allele**.
4. Gametes carry only one allele for each inherited character.
   - The two alleles for a character segregate (separate) from each other during the production of gametes.
   - This statement is called the **law of segregation**.

Genotype Vs Phenotype

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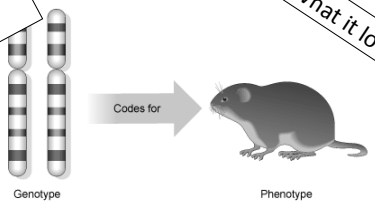
Its Genes "alleles" B, b

What it looks like



- Phenotypes are physical expressions of traits that are transmitted by alleles.
  a) CAPITAL letters represent **dominant** alleles
  b) lowercase letters represent **recessive** alleles.

Monohybrid Crosses

Figure 9.6

- Do Mendel's hypotheses account for the 3:1 ratio he observed in the F_2 generation?
- A **Punnett square** highlights
  - The four possible combinations of gametes and
  - The four possible offspring in the F_2 generation.

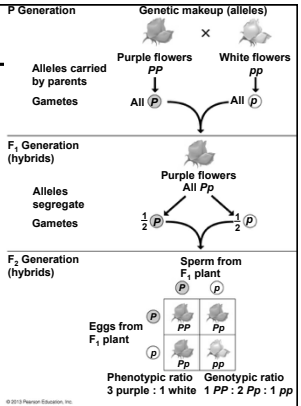
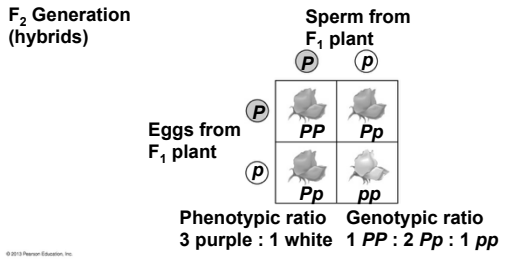
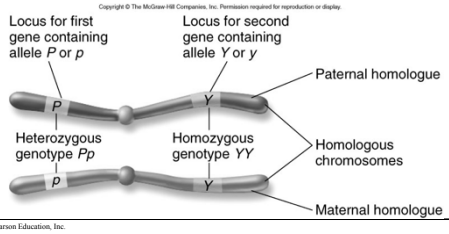


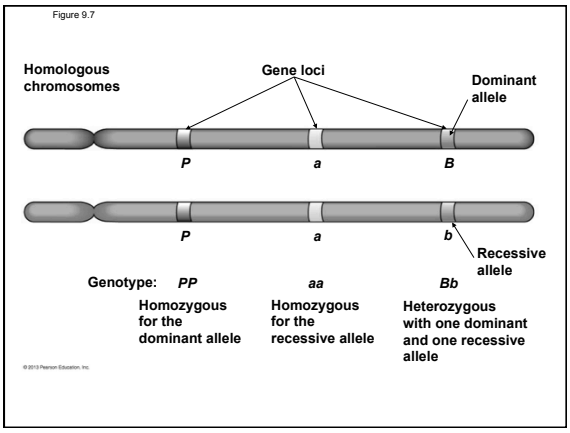
Figure 9.6c



Genetic Alleles and Homologous Chromosomes

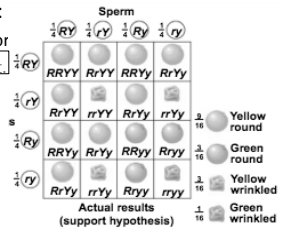
- A gene **locus** is a specific location of a gene along a chromosome.
- Homologous chromosomes have alleles (alternate versions) of a gene at the same locus.





Mendel's Law of Independent Assortment

- A **dihybrid cross** is the mating of parental varieties differing in two characters.
- What would result from a dihybrid cross? Two hypotheses are possible:
  1. Dependent assortment or
  2. Independent assortment.



PLAY Blast Animation: Two-Trait Crosses

Dihybrid Cross

Traits: Seed shape & Seed color

Alleles:

R round
r wrinkled
Y yellow
y green

FOIL

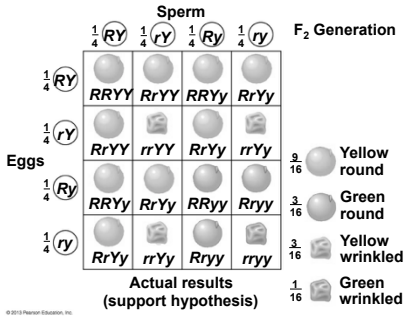
RrYy x RrYy

RY Ry rY ry

RY Ry rY ry

All possible gamete combinations

Figure 9.8b



Mendel's Law of Independent Assortment

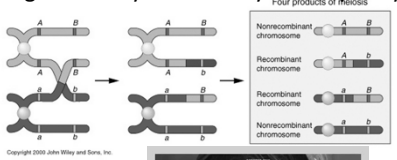
- Mendel's **law of independent assortment:** The inheritance of one character has no effect on the inheritance of another.
  - Independent assortment is also seen in two hereditary characters in Labrador retrievers.

***Basically**: A pea being green does not affect if it is round or wrinkled*

- traits are separate

Reminder: Crossing Over

Our exception to the rule: When genes are close together they are unlikely to be split by crossing over



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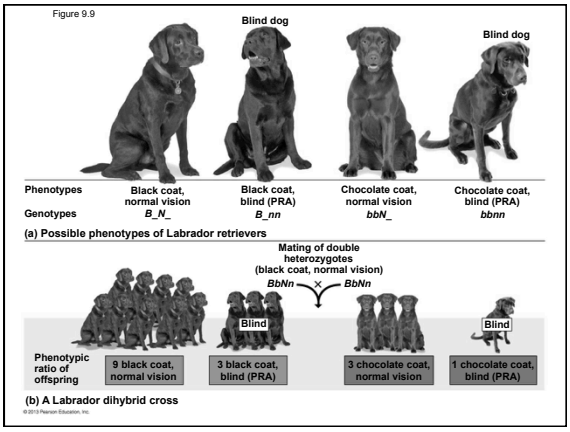
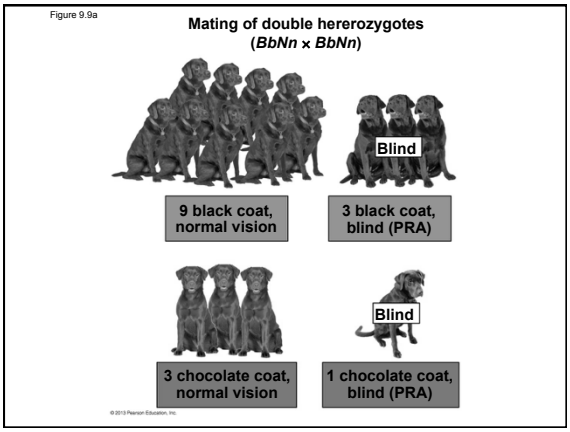
Red Hair and No freckles





Using a Testcross to Determine an Unknown Genotype

- A **testcross** is a mating between
  - an individual of dominant phenotype (but unknown genotype) and
  - a homozygous recessive individual.

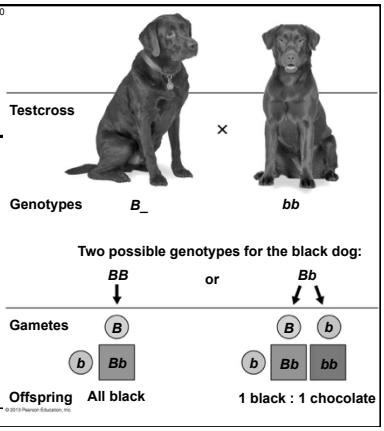
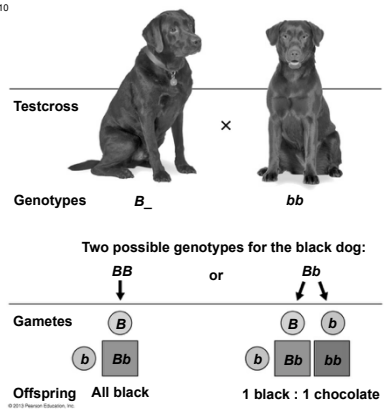


Figure 9.10



Recessive Disorders

- Most human genetic disorders are recessive.
- Individuals who have the recessive allele but appear normal are **carriers** of the disorder.

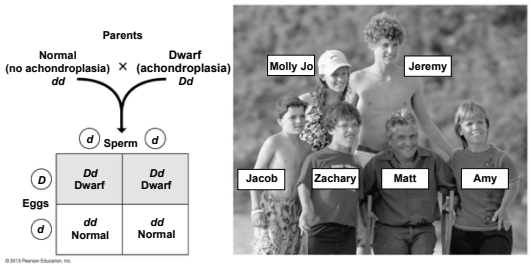
Table 9.1 Some Autosomal Disorders in People

Disorder	Major Symptoms	Incidence
Recessive Disorders		
Albinism	Lack of pigment in skin, hair, and eyes	$\frac{1}{27,000}$
Cystic fibrosis	Excess mucus in lungs, digestive tract, liver; increased susceptibility to infections; death in early childhood unless treated	$\frac{1}{1,800}$ European Americans
Phenylketonuria (PKU)	Accumulation of phenylalanine in blood; lack of normal skin pigment; mental retardation unless treated	$\frac{1}{100,000}$ in U.S. and Europe
Sickle-cell disease	Sickled red blood cells; damage to many tissues	$\frac{1}{500}$ African Americans
Tay Sachs disease	Lipid accumulation in brain cells; mental deficiency; blindness; death in childhood	$\frac{1}{3,600}$ European Jews
Dominant Disorders		
Achondroplasia	Dwarfism	$\frac{1}{25,000}$
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	$\frac{1}{25,000}$
Hypercholesterolemia	Excess cholesterol in blood; heart disease	$\frac{1}{500}$

Dominant Disorders

- Some human genetic disorders are dominant.
  - **Achondroplasia** is a form of dwarfism.
    - The homozygous dominant genotype causes death of the embryo.
    - Thus, only heterozygotes have this disorder.
  - **Huntington's disease**, which leads to degeneration of the nervous system, does not usually begin until middle age.

Figure 9.16



Types of Dominance (other than complete)

Dominant Recessive

Codominant Incomplete Dominance

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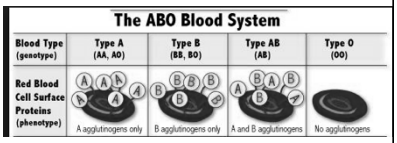
Types of Dominance (other than complete)

1. Incomplete Dominance **2. Co-Dominance**

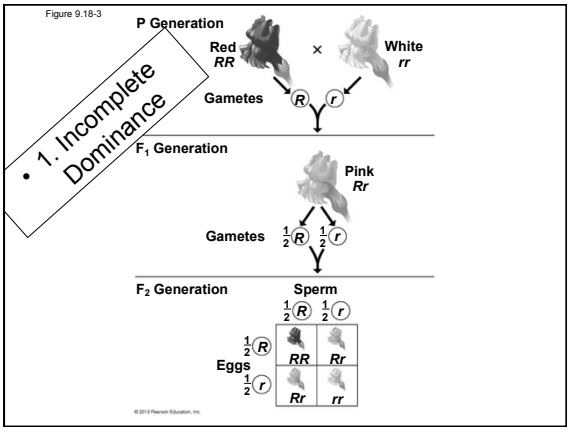


www.superteachertools.us

Incomplete dominance describes situations in which the heterozygote exhibits a phenotype that is intermediate between the homozygous phenotypes.

B=Red, b=White, Bb=Pink

Codominance describes the simultaneous expression of both of the alleles in the heterozygote.



Calico Cat

Calico is a coat color found in cats, which is caused by a SEX-LINKED, CODOMINANT allele.

B = Black
R = oRange
BR = calico

The following genotypes are possible;

Female cats can be black X^BX^B, orange X^RX^R, or calico X^BX^R
Male cats can be black X^BY or orange X^RY

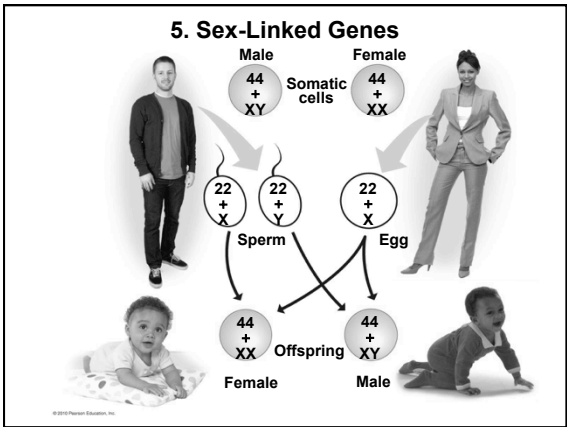
Can there be calico male?

Yes, But very rare

XXY male

http://www.biologycorner.com/worksheets/genetics_calico.html

5. Sex-Linked Genes



Who decides the babies sex?

Mom can give X

Dad can give X or y

	X	X
X	X X	X X
y	X y	X y

Dads determine sex of babies.

If dad gives X with mom's X = girl

If dad give y with mom's X = boy district.goshenschools.org

SEX CHROMOSOMES CAN CARRY OTHER GENES TOO

= SEX LINKED TRAITS

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Sex chromosomes can carry other genes

Y-LINKED GENES:
Genes carried on Y chromosome

EX:
Hairy pinna

Y linked genes only show up in males.

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Make a cross with a y-linked gene

	X	X
X	X X	X X
y^H	X y^H	X y^H

ALL GIRLS = Normal ears

ALL BOYS = Hairy ears

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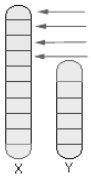
Sex chromosomes can carry other genes

X-LINKED GENES: Genes carried on the X chromosome



EX: Hemophilia
Colorblindness
Duchenne Muscular Dystrophy

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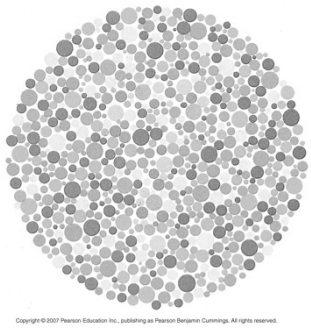

Color blindness is sex linked

	X^b	y
X^B	X^BX^b	X^By
X^B	X^BX^b	X^By

Parents:
- **HOMOZYGOUS Normal Mom**
  X
- **Colorblind dad**

GIRLS = **100% carriers**

BOYS = **100% normal**

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Y linked genes __ONLY__ show up in males.

X linked recessive genes appear __more often__ in males than females.

Females can be __CARRIERS__ for X linked recessive traits.

Males can __NEVER BE__ carriers for X linked recessive genes. The either have trait OR are normal.

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