Genetics Notes

These notes go along with the following lecture videos: *Genes, Alleles, and Genotypes, Punnett Squares with Genetics Practice Questions, and Non-Mendelian Genetics.* Fill them in as you move through the videos and answer questions.

VIDEO FOR THIS SECTION: *Genes, Alleles, and Genotypes, Punnett Squares with Genetics Practice Questions*

What is *Genetics*?

- The science that deal with heredity and variation.
- Heredity: the_____ from parents to offspring
- Variation: similarities and differences

What is a Gene?

➔ Gene = segment of DNA on a chromosome that controls a _____

- ◆ Genes are made up of DNA and act as_____
- ◆ Genes are _____-onto offspring
- ◆ Every person has two copies of each gene, one inherited_____

➔ Trait: a quality of characteristic

➔ Different forms of each gene are called_____.

- ◆ You inherit one from each parent.

➔ Letters represent Alleles

- ◆ Allele H = black hair
- ◆ Allele h = brown hair

➔ Capital letters = dominant alleles

➔ Lowercase letters = recessive alleles

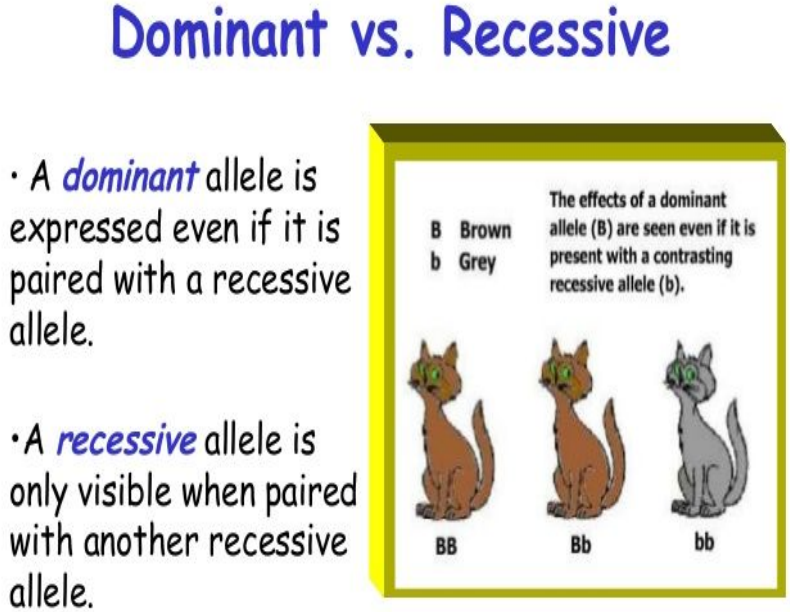
Dominant alleles are notated with **capital** letters

Ex: B= Brown

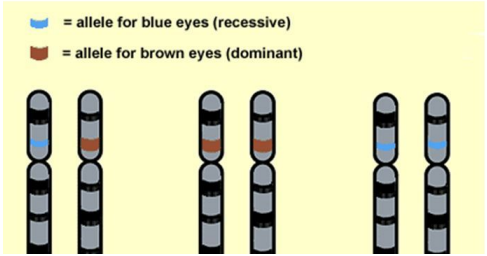
Recessive alleles are notated with **lower case** letters

Ex: b=Grey

****Remember, individuals get ONE allele from EACH PARENT**



Dominant Allele vs Recessive Allele

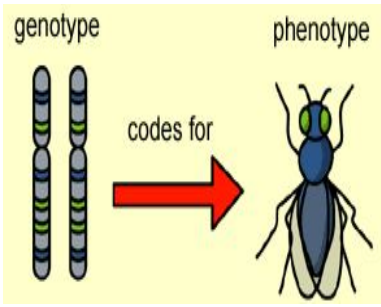


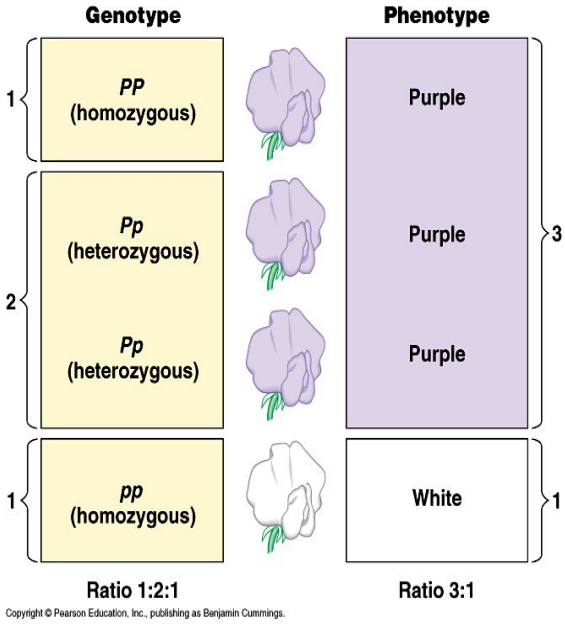
Individual C is the only one who will have blue eyes (recessive allele)

Because the allele for brown eyes is present, individual B and

Homozygous vs. Heterozygous

- _____ = both alleles of a pair are alike for that characteristic
  - ☐ PP – homozygous dominant
  - ☐ pp – homozygous recessive
- _____ = two alleles are different for that characteristic
  - ☐ Pp





P= Purple
p= White

Trait

➔ _____of an organism

The genetic contribution to a trait is called the _____-- ex:tt

The genotype is the DNA or the genetic makeup

The outward expression of the genotype is called the _____

Phenotype= what you actually see

→ genotype codes for phenotype

VIDEO FOR THIS SECTION: *Punnett Squares with Genetics Practice Questions*

Monohybrid Punnett Squares

- Letters outside Punnett = possible gametes (egg/sperm) formed from meiosis
- Letters inside Punnett = possible offspring

Practice: Red is dominant over white. Two heterozygous flowers are crossed. Use a Punnett square to determine the probability of one of their offspring having a red color.
R=red r=white

	R	r
R		
r		

- ☐ Predicted outcome of Punnett:
- ☐ **Genotypic ratio of offspring**:
- ☐ **Phenotypic ratio of offspring**:
- ☐ Answer:

Practice: H = brown hair h = black hair. Determine the possible genotypes for each cross below:

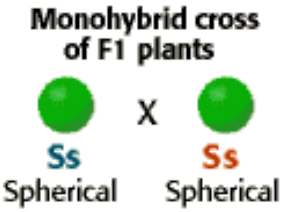
1. Mom is Hh and Dad is hh

2. Mom is hh and Dad is HH

3. Mom is Hh and Dad is Hh

Practice Monohybrid Cross

In pea plants, spherical seeds (S) are dominant to dented seeds (s). In a genetic cross of two plants that are heterozygous for the seed shape trait, what fraction of the offspring should have spherical seeds? Draw the Punnett Square.



Recessive Inheritance

Deafness is a recessive disorder.

D=normal

d=deaf

If we cross heterozygous parents with normal hearing, what will the Punnett Square look like? Draw a Punnett square.

Practice Questions: *Draw Punnett squares to answer the questions.*

1. In mussels, brown (**B**) coloring is dominant, and blue (**b**) coloring is recessive. If a blue mussel has two brown parents, what percentages of the total offspring of these brown parents are expected to be blue?

a. 100% b. 75% c. 50% d. 25%

2. In cats, the allele for short hair (**H**) is dominant to the allele for long hair (**h**). If a heterozygous short-hair cat is crossed with a long-hair cat, what percentage of the offspring is expected to be heterozygous for hair length?

a. 0 % b. 25 % c. 50 % d. 75 %

3. In pigeons, the allele **B** produces ash-red feathers. The allele **b** produces blue feathers. The **B** allele is dominant to the **b** allele. A pigeon with genotype **Bb** is crossed with a pigeon with the genotype **bb.** What percent of the offspring are expected to have ash-red feathers?

a. 0 % b. 25 % c. 50 % d. 100 %

Draw Punnett squares to answer the questions.

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   a. 0 % b. 25 % c. 50 % d. 75 %

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   a. 0 % b. 25 % c. 50 % d. 100 %

VIDEO FOR THIS SECTION: *Non-Mendelian Genetics*

Non – Mendelian Genetics aka Complex Genetics

Different types of Inheritance Patterns

Types of Inheritance:

1. Dominant/Recessive aka complete dominance
2.
3.
4.
5.

Incomplete dominance

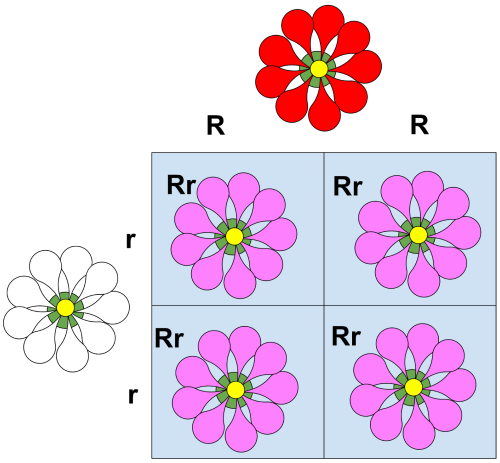
a. results in intermediate (_____) phenotypes
b. Neither allele is dominant over the other
c. Both alleles are present in heterozygotes
d. often described as _____
e. No dominant allele

Examples of incomplete dominance

Human Hair: If a straight-haired person and a curly haired person have a child, the child will likely have wavy hair

Flowers:

Crossing homozygous red flowers with homozygous white flowers produces heterozygotes that pink (blend of white and red)



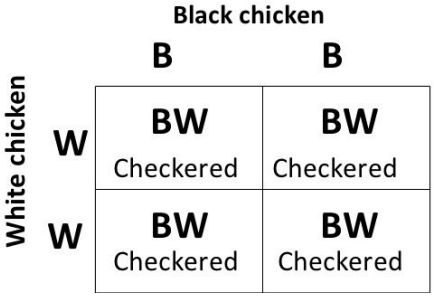
Codominance

- Many genes have more than two alleles in the population

  _____

- Expression of both alleles is observed as a distinct phenotype in the heterozygous individual

Often results in a spotting pattern



Sample Questions 1 and 2:

Cow traits:

BB = black BW = black and white WW = white

1) Is this an example of incomplete dominance or codominance?
2) Two black and white cows are crossed. What are possible phenotypes, and their %'s, for the offspring? (Draw a Punnet Square.)

Sample Questions 3 and 4:

Cow traits:

BB = black BW = grey WW = white

3) Is this an example of incomplete dominance or codominance?
4) A black cow and a grey cow are crossed. What are possible phenotypes, and their %'s, for the offspring? (Draw a Punnet Square.)

Multiple alleles

- _____alleles in the population
- individuals can carry any_____of these alleles
- The_____blood group has three alleles:
  - leading to four phenotypes: type A, type B, type AB, and type O blood

ABO Blood Type

- blood type gene is found on the 9th_____
- blood type results from_____ (A, B, or O) from each parent. 2 alleles total.
- Types A and B are dominant. Type O is recessive.

father \ mother	A	B	O
A	AA	AB	AO
B	BA	BB	BO
O	OA	OB	OO

alleles	blood type
A+A	A
A+O	A
A+B	AB
B+B	B
B+O	B
O+O	O

- Possible outcomes:
- AO genotype will have an A phenotype
- BO genotype will have an B phenotype
- OO genotype will have an O phenotype
- AB genotype will have an AB phenotype

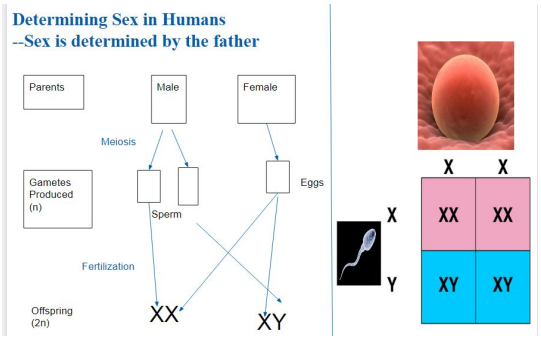
Blood Type Practice

The police have rounded up the usual suspects in the latest rash of bookstore robberies. The thief got a nasty paper cut at the scene of the crime. The suspects are of blood types O, A, B and AB. The blood at the crime scene contained O alleles. Which suspect therefore **cannot** have been involved? Explain.

SEX CHROMOSOMES AND SEX-LINKED GENES

Determining Sex in Humans

--Sex is determined by the father



Sex-linked genes exhibit a unique pattern of inheritance

- Sex-linked genes are located on either of the sex chromosomes
  - X-linked genes are _____and mother to daughter
  - X-linked genes are_____
  - Y-linked genes are _____

Sex-linked (x) disorders affect mostly males

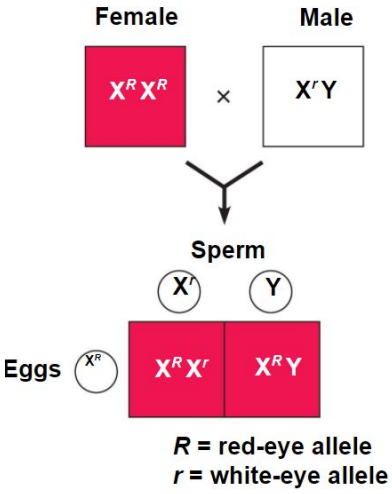
If a **male** inherits only one sex linked allele from his mother the allele will be expressed -----> **X^rY**

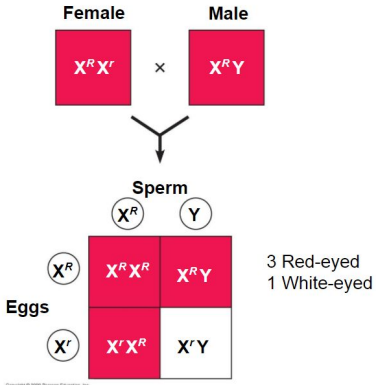
A **woman** must inherit_____ (one from each parent) and therefore 2 alleles ----->X^RX^r or X^rX^r or X^RX^R

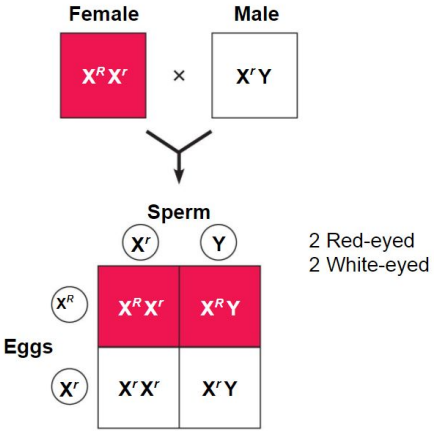
Example of a sex-linked gene (x-linked gene)

Because the alleles are found on X chromosomes, we show them as a _____

Remember that **females** can only produce gametes with a_____ chromosome and **males** can produce gamete with _____ chromosome.







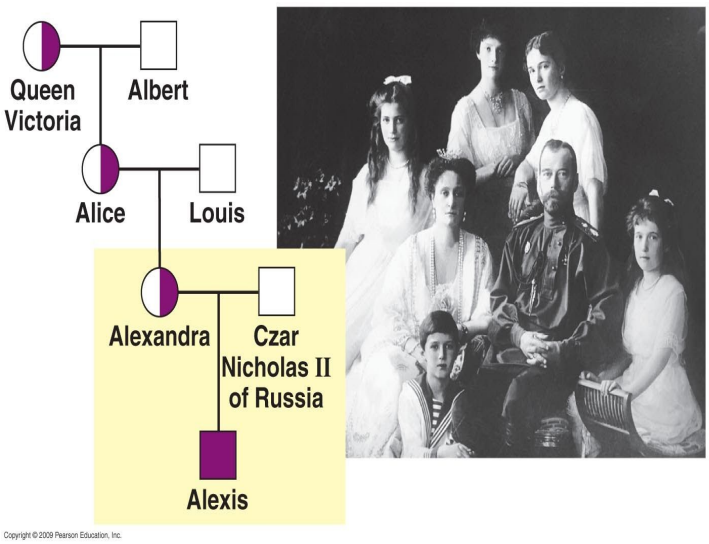
Hemophilia is a sex-linked (x) trait

A high incidence of hemophilia plagued royal families of Europe.

-Queen Victoria of England carried the hemophilia allele X^RX^r

- She passed it onto one of her sons and two of her daughters (only her daughter Alice is shown)

-Via marriage, her grand daughters introduced the gene to royal families of Spain and Russia.



- Thus the age-old practice of using marriage to strengthen international alliances effectively spread hemophilia to several nations.

Hemophilia in the royal families of England and Russia. **Half filled shapes represent unaffected heterozygous carriers.**

More examples of sex-linked disorders

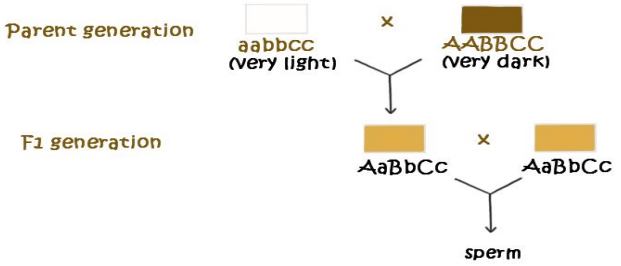
1. _____
2. Duchenne muscular dystrophy

Sex-linked genes Practice Problem

Neither Tom nor Sue has hemophilia, but their first son does. If the couple has a second child, what is the probability that this child will also have the disease? Draw a Punnett square as evidence for your response. Remember that x-linked alleles are notated with superscripts about the X.

Polygenic inheritance

- **A single characteristic may be influenced by_____**
- Many genes influence one trait
- Skin color is affected by _____



F2 generation

Gametes	ABC	ABc	AbC	Abc	aBC	aBc	abC	abc
ABC	6	5	5	4	5	4	4	3
ABc	5	4	4	3	4	3	3	2
AbC	5	4	4	3	4	3	3	2
Abc	4	3	3	2	3	2	2	1
aBC	5	4	4	3	4	3	3	2
aBc	4	3	3	2	3	2	2	1
abC	4	3	3	2	3	2	2	1
abc	3	2	2	1	2	1	1	0

eggs