CONCEPT: MENDEL'S LAWS

●Through his research with pea plants, Gregor Mendel proposed 2 fundamental laws of genetics:

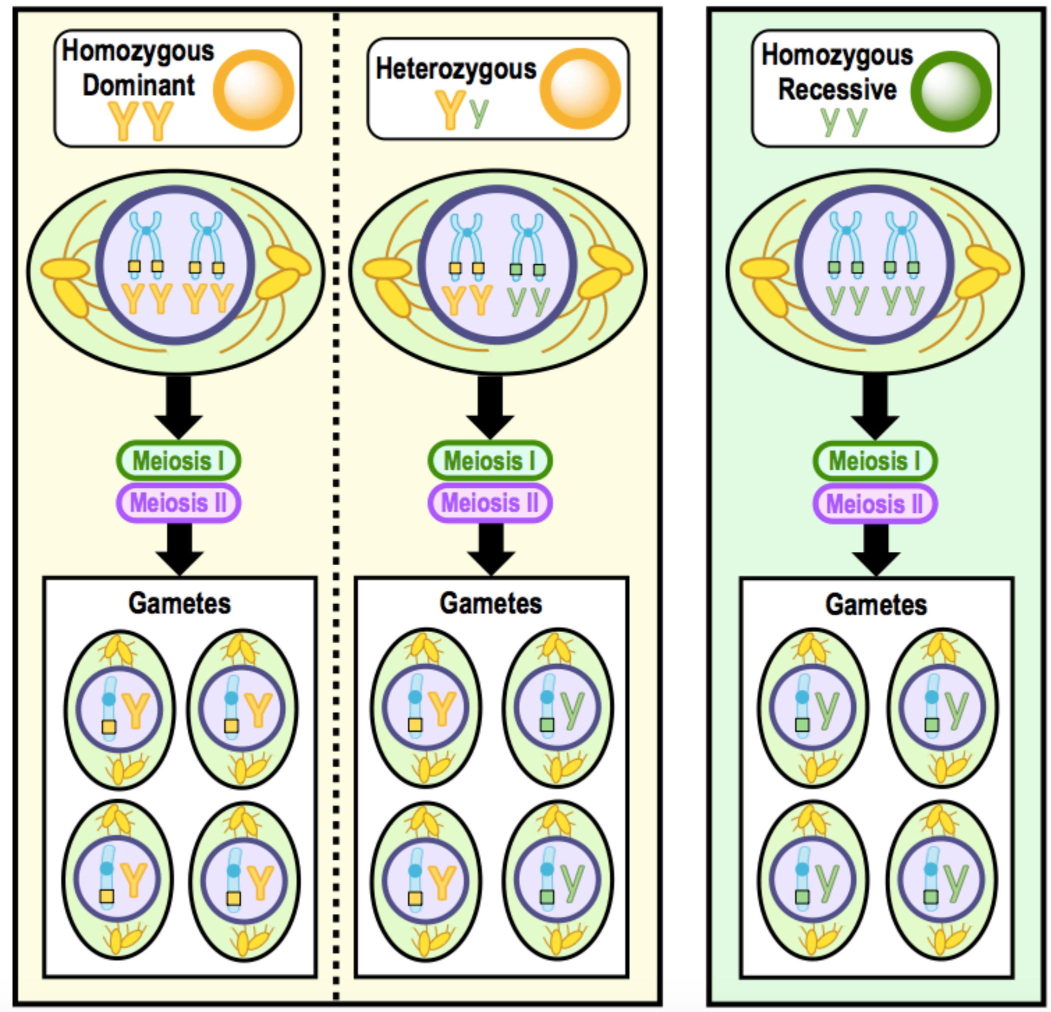
1) Law of ______________________ & 2) Law of ____________________ *Assortment*

1) Law of Segregation

●During gamete formation, 2 alleles of the same gene _________________ & end up in __________________ *gametes*.

□ In other words, *gametes* are _______________ & only receive _________ copy of a gene/allele.

EXAMPLE: Law of Segregation.



PRACTICE: According to Mendel's Law of Segregation, which of the following is a true statement?

a) Each gamete receives both of the parent's alleles for each gene.

b) Dominant alleles segregate into gametes more frequently than recessive alleles.

c) Alleles segregate into different gametes with equal frequency.

d) Recessive alleles segregate into gametes more frequently than dominant alleles.

<u>CONCEPT:</u> <u>MENDEL'S LAWS</u>

PRACTICE: Mendel's observation of the segregation of alleles in gamete formation has its basis in which of the following phases of cell division?

a) Prophase I of meiosis.

b) Metaphase II of meiosis.

c) Anaphase II of meiosis.

d) Anaphase I of meiosis.

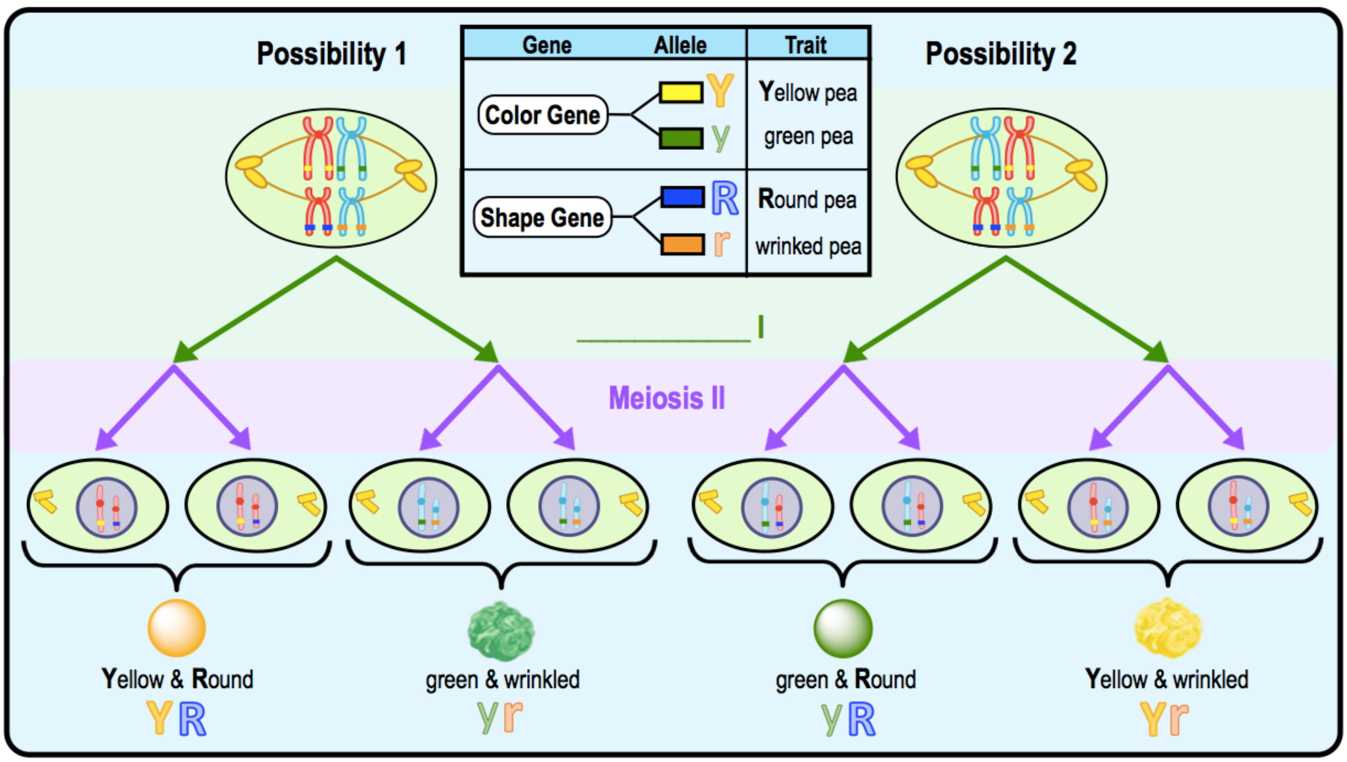
<u>2) Law of Independent Assortment</u>

●*Recall: Independent assortment*, homologous chromosomes *randomly* align on the metaphase I plate during meiosis I.

●**Law of Independent Assortment**: allele segregation of one gene does ________ affect the segregation of another gene.

- □ Allows for gametes with _________ *combinations* of alleles from different genes.
- □ Mendel monitored the inheritance of *multiple* genes to make this discovery using __________________ *crosses*.

EXAMPLE: Independent Assortment During Metaphase I of Meiosis I.



PRACTICE: Mendel's law of independent assortment has its basis in which of the following events of meiosis I?

a) Synapsis of homologous chromosomes.

b) Crossing over of homologous pairs of chromosomes.

c) Alignment of pairs of homologous chromosomes along the middle of the cell.

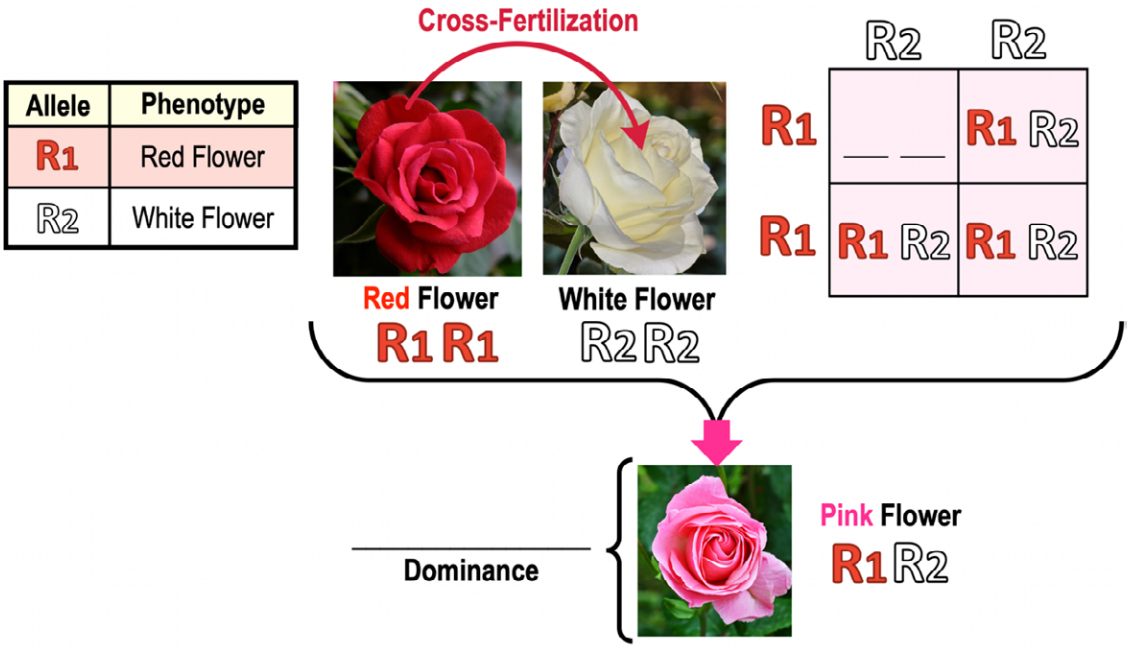
d) The division of cells during cytokinesis.

CONCEPT: INCOMPLETE DOMINANCE VS. CODOMINANCE

Incomplete Dominance

●Heterozygotes show a _________________ phenotype that is an *intermediate* of the phenotypes from the two alleles.

EXAMPLE: Incomplete Dominance in Red & White Flower Cross Makes Pink "Baby" Flowers.

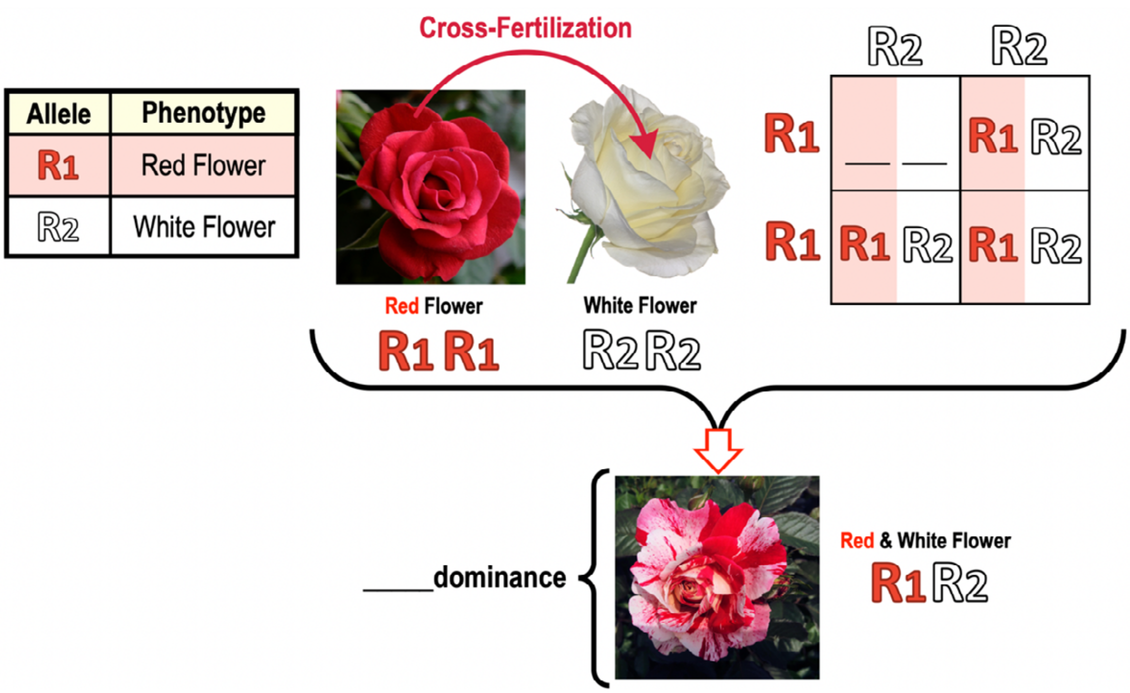


Codominance

●Heterozygotes _________________ express both phenotypes from each allele in "patches".

□ 2 different alleles "dominate" ______________________ (one allele does _______ mask expression of the other).

EXAMPLE: Codominance in Red & White Flowers.



<u>CONCEPT:</u> <u>INCOMPLETE DOMINANCE VS. CODOMINANCE</u>

PRACTICE: You cross two true breeding lines of petunia. One produces red flowers and the other white flowers. The F1 offspring all show pink flowers. You conclude from this that:

a) Red is dominant.
b) White is dominant.
c) Red is incompletely dominant.
d) Red is incompletely recessive.
e) None of the answers listed above are correct.

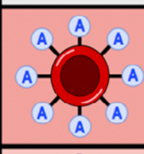
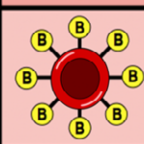
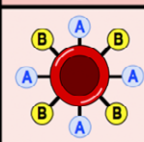
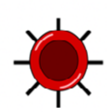
<u>Codominance & Blood Type</u>

●Blood-type in humans is a common example of ______*dominance*.

□ Blood type is determined by combinations of _____ possible alleles: I^A, I^B, or *i*.

□ I^A & I^B alleles are ______________________, whereas the *i* allele is ____________________.

EXAMPLE: ABO Blood Types.

Genotype	Surface Molecules	Phenotype
I^AI^A or I^Ai	A Only	 Type-____ blood
I^BI^B or I^Bi	B Only	 Type-____ blood
I^AI^B	A and B	 Type-_____ blood
i i	NONE	 Type-____ blood

PRACTICE: If you look at a blood sample from a person who is heterozygous at the sickle cell locus you will see both normal circular red blood cells and sickle-shaped red blood cells. This is an example of

a) multi-locus inheritance.
b) complete dominance.
c) incomplete dominance.
d) codominance.
e) linked genes.

CONCEPT: INCOMPLETE DOMINANCE VS. CODOMINANCE

PRACTICE: A gene for the MN blood group has codominant alleles M and N. If both children in a family are of blood type M, which of the following situations is possible?

a) Each parent is either M or MN.
b) Each parent must be type M.
c) Both children are heterozygous for this gene.
d) Neither parent can have the N allele.

PRACTICE: The number of different alleles for ABO blood types is _____ resulting in _____ different blood types.

a) 3; 3.
b) 4; 3.
c) 6; 3.
d) 3; 4.
e) 2; 4.

CONCEPT: EPISTASIS

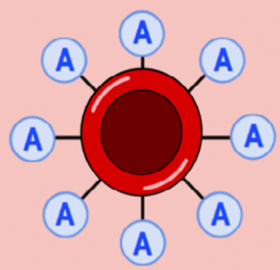
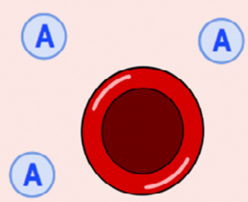
●**Epistasis**: inheritance pattern where _______ gene's product _____________ the phenotype of _______________ gene.

Epistasis in Blood Type

●*H* protein serves as a "__________________" molecule attaching A & B molecules to the surfaces of blood cells.

- □ The recessive allele (*h*) encodes an _______________ form that does _______ connect A or B to blood cells.
- □ Even if a person has alleles I^A or I^B , they will have type ____ blood if they are *homozygous recessive (hh).*
- □ In other words, *one gene* (_____) affects the expression of *another gene* (I^A or I^B).

EXAMPLE: Epistasis causes inconsistencies in inheritance of blood-types.

Genotype	Phenotype
I^A_ & *H*_	 _______________ H protein Type-____ blood
I^A_ & *h h*	 _______________ H protein Type-____ blood ***Epistasis: **one gene** (H gene) affects expression of **another gene** (I^A gene).*

PRACTICE: Which of the following statements best describes epistasis?

a) An allele that changes the genotype of another allele.

b) A gene that changes the genotype of another gene.

c) A gene that controls or masks the expression of another gene.

d) A gene that changes the genotype of the organism.

e) None of the above.

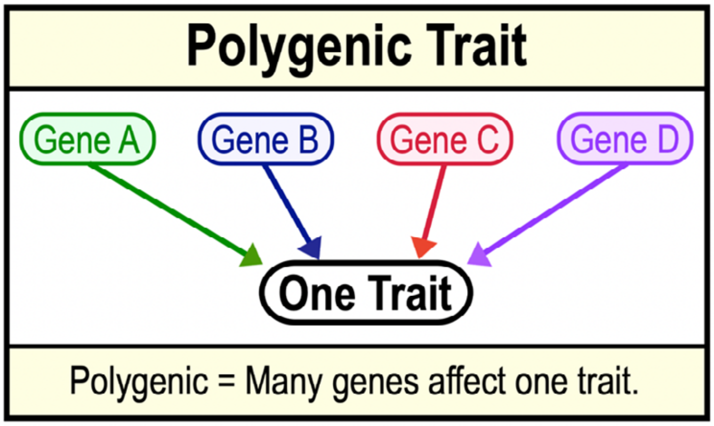
CONCEPT: NON-MENDELIAN GENETICS

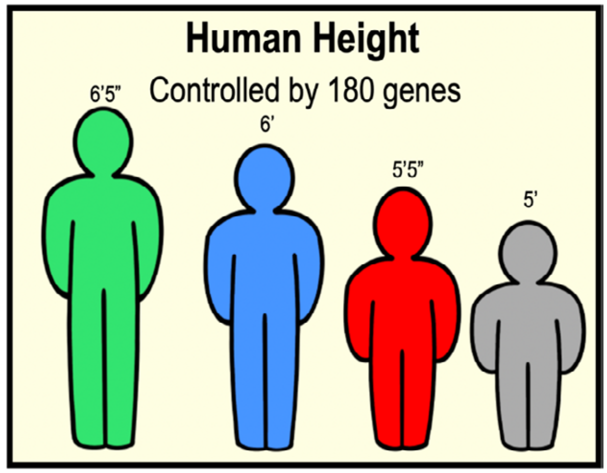
Polygenic Inheritance

●*Most* inherited traits are ________________.

□ ***Polygenic Trait***: a *single* phenotypic trait affected by _______________ *genes*.

EXAMPLE: Polygenic Inheritance.





PRACTICE: Which of the following phenotypes is an example of polygenic inheritance?

a) White or purple flower color in pea plants.

b) Yellow or green pea color in pea plants.

c) The ABO blood groups in humans.

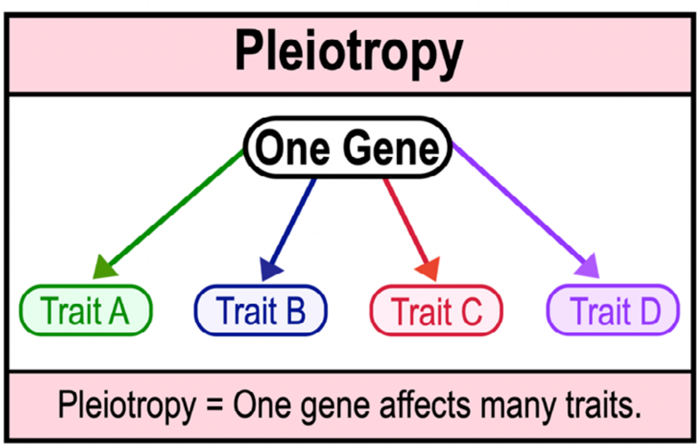
d) Skin pigmentation in humans.

Pleiotropy

●Pleiotropy is practically the ______________________ of polygenic.

□ **Pleiotropy**: a *single* ___________ has effects on _________________ phenotypic traits.

EXAMPLE: Marfan Syndrome.



Marfan Syndrome

Mutation of the ***FBN1*** *gene*

Limits the body's ability to build connective tissue.

Marfan Syndrome Phenotypes:

Tall and slender body.

Long arms, legs, & fingers.

Curved spine.

Crooked or crowded teeth.

Heart disease & heart mumurs.

Eye conditions (Ex. Vision Loss).

CONCEPT: NON-MENDELIAN GENETICS

PRACTICE: A pleiotropic genetic disorder typically has what characteristics?

a) A single gene is mutated resulting in the change of one phenotypic trait.

b) A single gene is mutated resulting in the change of many phenotypic traits.

c) Many genes are mutated resulting in the change of one phenotypic trait.

d) Many genes are mutated resulting in the change of many phenotypic traits.

CONCEPT: PEDIGREES

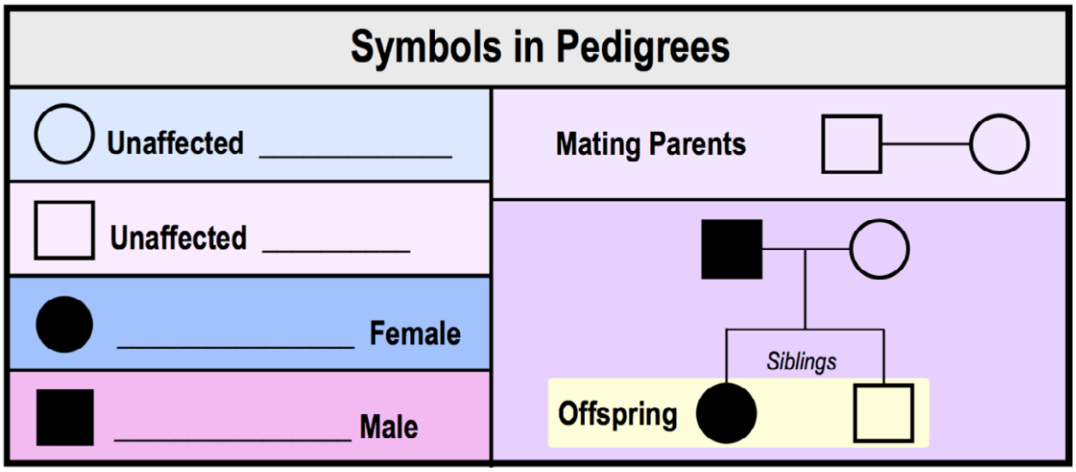
●**Pedigree**: a chart or "family tree" depicting family ___________________ & *tracking a phenotype* over many generations.

□ Circles (◯) = ______________.   □ Squares (□) = ___________.

□ Shaded/colored shapes = _________________ individuals with the phenotype.

□ ___________________ lines connect two mating parents & ______________ lines connect parents to offspring.

EXAMPLE: Symbols & Connections on a Pedigree.

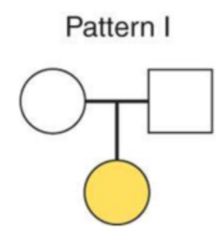


CONCEPT: AUTOSOMAL INHERITANCE

●A specific family trait/disorder can be tracked over multiple generations to identify the ____________________ *pattern*.

□ *Inheritance patterns* can either be _________________ or __________-linked.

PRACTICE: The pedigree chart shown depicts the inheritance pattern of __________.



a) An autosomal recessive characteristic with both parents being heterozygous.

b) An autosomal dominant characteristic with both parents being homozygous dominant.

c) An autosomal recessive characteristic with both parents being homozygous recessive.

d) None.

PRACTICE: Determine the likely pattern of inheritance in the following pedigree. List the genotypes of the numbered individuals in this order: #1, #2, and #3.

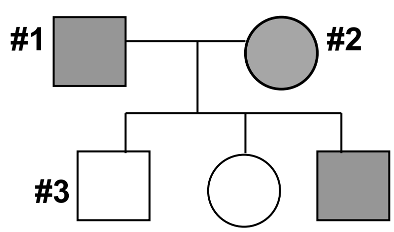
a) aa, aa, aa.

b) Aa, Aa, Aa.

c) Aa, Aa, aa.

d) AA, Aa, aa.

e) None of the above.



CONCEPT: SEX-LINKED INHERITANCE

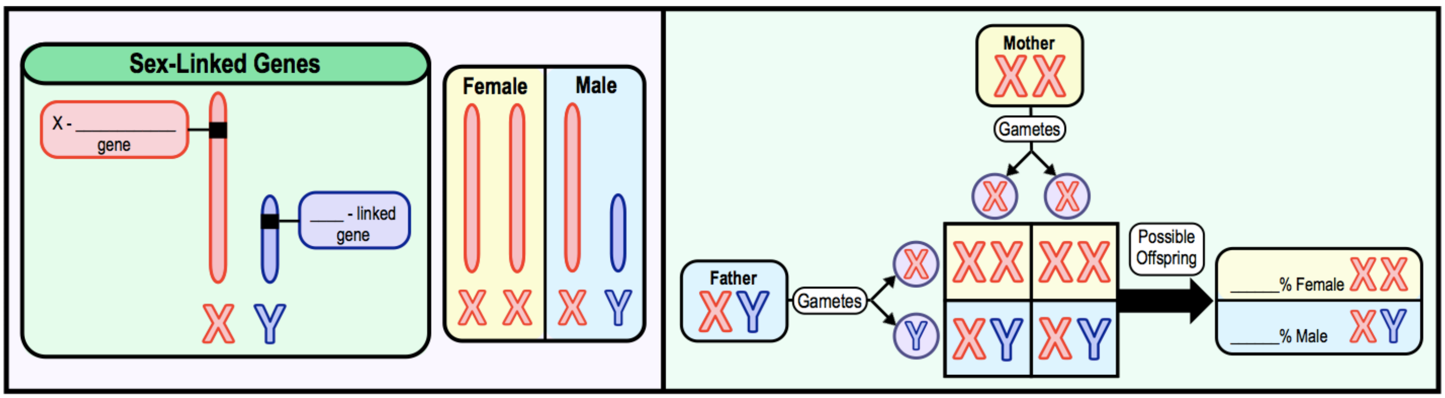
●Recall: *sex chromosomes* (X or Y) determine the ________ of an organism.

□ Female (♀): X ______ □ Male (♂): X ______

●________**-Linked Genes**: genes found on *either* sex chromosome (X or Y).

□ X-chromosome contains ~1,100 ____**-linked genes**. □ Y-chromosome contains ~100 ____**-linked genes**.

□ With each fertilization, there is a ______% chance of having a female.



X-Linked Inheritance

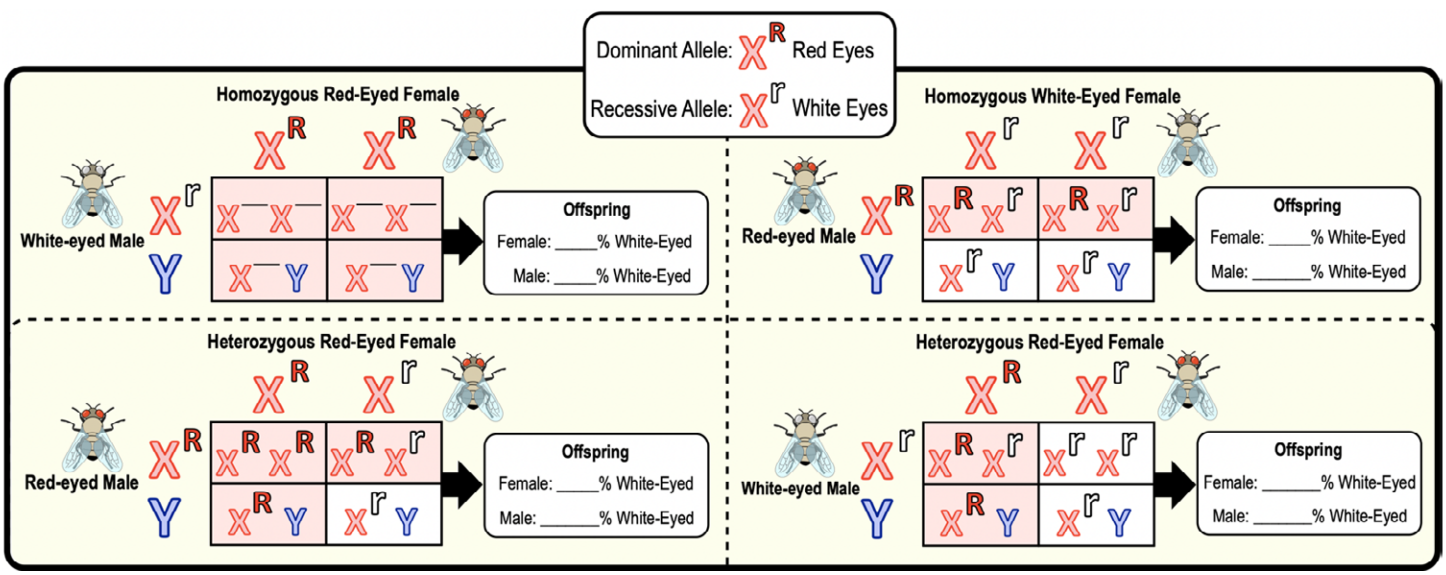
●Females have ______ alleles for each X-linked gene (one allele inherited from ____________ parent).

□ Therefore, females can be ________*zygous* dominant/recessive or __________*zygous* for X-linked genes.

●Males have ______ allele for each X-linked gene (_____ inherited from *mother*; _____ inherited from *father*).

□ Therefore, ____________ express whatever X-linked allele is on their *single* X-chromosome.

EXAMPLE: Experiment Tracking Eye Color in Fruit Flies Revealed X-Linked Inheritance Pattern.



CONCEPT: X-INACTIVATION

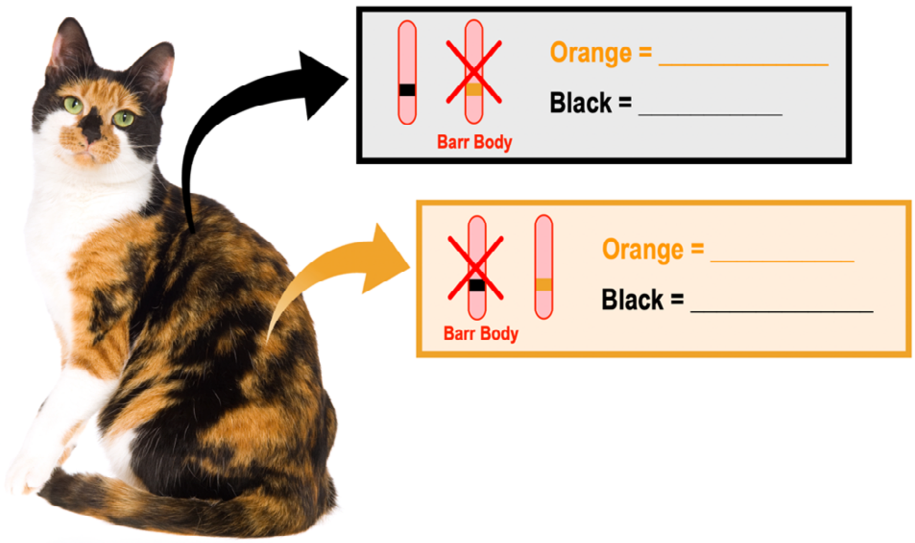
●Females (XX) inherit "*double*" the number of X-linked genes, but do ________ have double expression of those genes.

□ Female cells *randomly* turn ________ (or *inactivate*) one of their X-chromosomes during early development.

□ **Barr Body**: the highly condensed, _________________ X-chromosome in female cells.

□ Random X-inactivation can result in a female expressing different alleles of an X-linked gene in different cells.

EXAMPLE: Calico Cats Have Color Patches Due to X-Inactivation.



PRACTICE: A Barr body is:

a) An inactive Y chromosome.

b) An active X chromosome.

c) An inactive X chromosome.

d) An active Y chromosome.