Introduction to Mendelian Genetics

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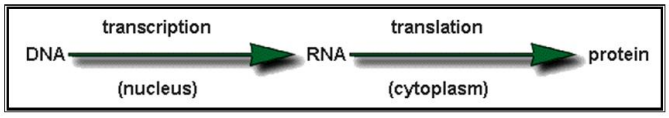
As we have learned, many genes code for _____. These proteins may be _____ (keratin in hair), _____, _____ proteins, _____ etc.



Some genes code for proteins that produce _____ in an organism.

These visible characteristics are called _____.

Traits:

eg. skin colour is determined by a group of genes that control how much _____ (a brown coloured _____) is produced in the skin

eg. People with dark eyes (black or brown) have genes for different _____ than people with light-coloured eyes (blue or green)

The _____ (visible characteristics) that we see are caused by our _____.

In genetics, the visible (_____) traits are called the "_____".

The _____ that are responsible for producing the visible traits are called the "_____".

Genotypes and Phenotypes

People usually have _____ copies of each _____, and therefore _____ copies of each _____, one from each _____. This is their _____.

The genes for each trait _____ to produce the _____ (visible characteristics) that we see.

The connections between the genotype and phenotype are not always obvious.

Genotypes and Phenotypes

eg. brown eyed parents may have _____ children

eg. brown skinned parents can have _____ children

eg. brown haired parents can produce _____ children

eg. parents with achondroplasia _____ may have children with _____ height

Mendelian Inheritance

Up until the late _____, it was believed that the characteristics of the parents were _____ in their offspring.

eg. If one parent was _____ and one parent was _____, the children would be _____ height

But in the mid 1800s, an Austrian monk named _____ performed some very careful experiments and came up with another idea.

Mendelian Inheritance

Mendel studied the common _____ _____. He noticed that pea plants had either:

- Green or yellow _____
- Green or yellow _____
- Tall or short _____
- White or purple _____
- Smooth or wrinkled _____
- Smooth or wrinkled _____

In his first experiment, Mendel took _____ (_____) plants for one trait:

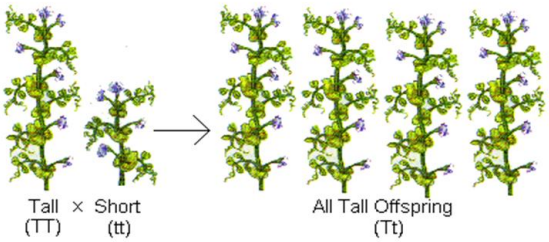
eg. _____ plants that always produced _____ plants
eg. _____ plants that always produced _____ plants

Mendel _____ (_____) the _____ plant flowers with _____ from _____ plant flowers, and visa versa

He called this the _____ generation (___).

It was believed that this cross would produce a _____ of traits, so the offspring would all be _____ height. But, Mendel always obtained the same results:

All the pea plants were _____ (100% tall)!!!



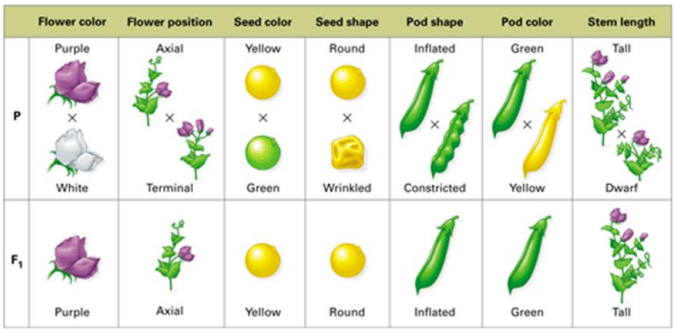
When he crossed purebred _____-flowered pea plants with purebred _____ -flowered pea plants, the offspring were:

All _____-flowered!!

When he crossed purebred _____-pod pea plants with purebred _____-pod pea plants, the offspring were:

All _____-podded!!

Mendel's First Experiment



There was no _____ of traits!!

Mendel called these peas the first _____ (____) generation.

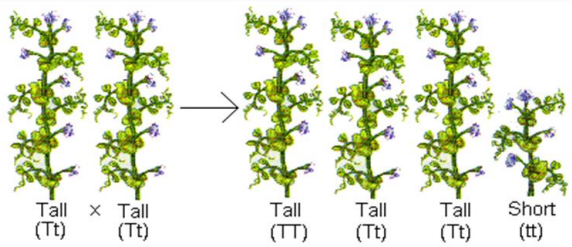
He called the F1 plants _____.

The experiment was called a "_____ _____" because only _____ trait was different between the plants.

Mendel concluded that some traits are stronger or "_____" over other traits, and the dominant traits would _____ be seen. He called this the _____.

Then Mendel did a second experiment:

Mendel allowed the _____ (____) plants to _____. He collected the seeds and grew the plants to see what the ____ generation looked like. He saw:



Mendel kept very careful _____ of the _____ of each type of plant.

- Again, there was no _____ of traits.
- Even though the ____ plants were all _____, there were some _____ offspring in the _____ generation
- The short plants had "_____" a generation.
- There were: 787 tall and 277 short
  (% or) (% or)

- Mendel repeated this experiment to see the _____ generation of other traits
- The ratio of approximately ___ to ___ was repeated for each of the traits he studied.
- Mendel interpreted the results to indicate that each plant has two "_____" that determine _____. One factor is _____ over the other.
- Mendel's factors were later identified as '_____'

Mendels' Law of Segregation

- Mendel suggested that the offspring get one _____ (_____) from each _____
- The factors (genes) for each _____ are passed _____ of the other traits
- This was later explained by the process of _____, when the _____ and sister _____ go _____ to either side of the _____ during _____ and _____

Terminology

Genes can exist in different _____.

These different forms of the same gene are called _____.

Every organism inherits one _____ from each _____.

_____: both alleles are the _____ (eg. _____)

_____: both alleles are _____ (eg. _____)

Dominant and Recessive Genes

If a _____ allele (version of the gene) is present, it is always "_____" or _____ as a _____ in the organism

eg. pea plants with T T (tall – tall) genotype are _____ (have the tall trait or _____)

eg. pea plants with T t (tall – short) genotype are _____ (have the tall trait or _____)

Dominant and Recessive Genes

If a _____ allele (version of the gene) is present, it is only "_____" or _____ if there is _____ gene to over-shadow it

eg. pea plants with T t (tall – short) genotype are _____ (have the tall trait or _____)

eg. pea plants with t t (short – short) genotype are _____ (have the short trait or _____)

The _____ of an individual is the _____ makeup (which _____ it has).

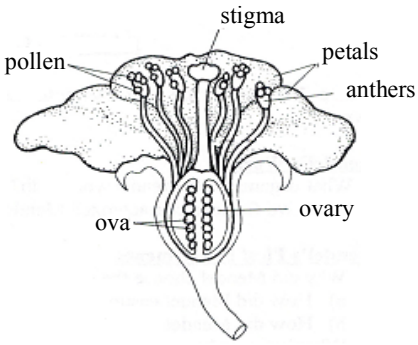
The _____ of an individual is the _____ appearance (its _____).

eg. TT – the genotype is _____
_____
– the phenotype (trait) will be _____

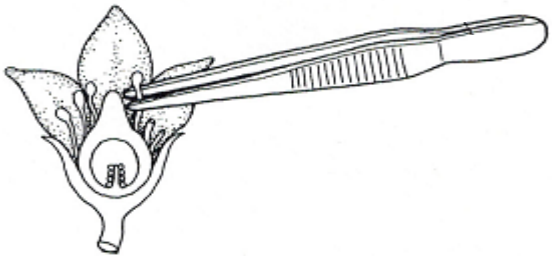
eg. Tt – the genotype is _____
– the phenotype (trait) will be _____

eg. t t – the genotype is _____
_____
– the phenotype (trait) will be _____

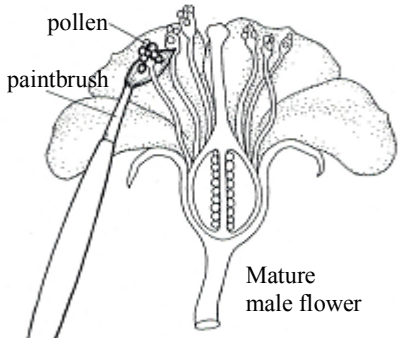
Summary of Mendel's First Experiment



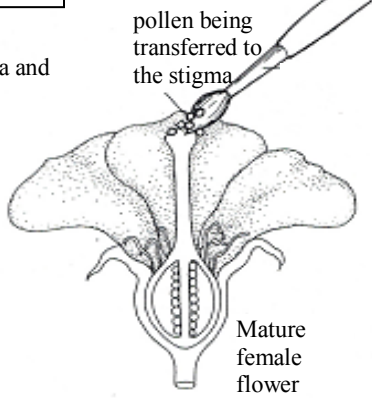
A mature pea flower has both male and female parts enclosed within the flower. Normally they self-pollinate when pollen from the anthers attaches to the stigma. In Mendel's second experiment, he allowed flowers to self-pollinate.



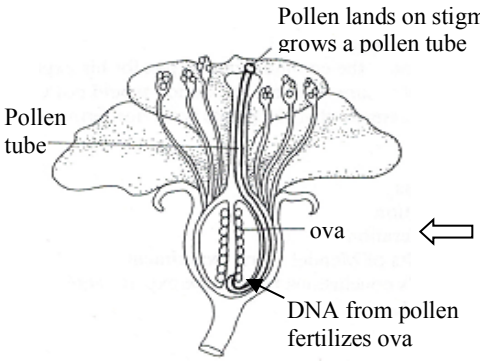
In Mendel's first experiment, he prevented self-pollination by removing the anthers (which make the pollen) from the some of the immature flowers, then covering the pea flowers with a bag while they matured.



Mendel used a paint brush to collect pollen from mature flowers of one of his purebred (true-breeding) parent plants.



He transferred pollen from the second flower to the stigma of a flower which had had its anthers removed. These flowers were from purebred plants with opposite traits (eg. tall & short stems).



The pollen grew a pollen tube which allowed the DNA to reach and fertilize the ova. The fertilized ova (zygote) developed into a seed, which Mendel harvested and grew to observe the phenotype (physical traits) of the F1 plants.

Homework Questions: (Reference: pages 118-129 of the textbook)

1. Define: cross pollination, P generation, F1 generation, hybrid, monohybrid cross, dominant trait, recessive trait, gene, allele, homozygous, heterozygous, genotype and phenotype
2. List 4 reasons why the common pea plant was such a good choice for Mendel's research.
3. Refer to the above diagram which summarizes Mendel's first experiment. Summarize the ***results*** of this experiment and state Mendel's principle of dominance.
4. Regarding the F2 generation:
   a) Explain what is meant by the F2 generation and describe how it is obtained.
   b) Summarize the results of Mendel's second experiment and the traits of the F2 plants.
   c) What is the Mendelian ratio?
5. Summarize Mendel's conclusions from these experiments.
6. State the Law of Segregation.

Name: _____

Inherited Human Characteristics Lab: Results and Analysis

	Personal Data		Classroom Data		
Human trait	**Your phenotype**	**Your possible genotype(s)**	**Number in Class** Dominant	Recessive	**Percentage Ratio (% : %)** Dominant Recessive
Tongue Rolling (alleles R or r)					
Bitter Taster (alleles T or t)					
Hand Clasping (alleles C or c)					
Straight or Bent Thumb (alleles S or s)					
Straight or Bent Little Finger (alleles B or b)					
Widow's peak (alleles W or w)					
Earlobe Attachment (alleles E or e)					
Eye Pigmentation (D or d alleles)					
Mid digit hairs (alleles H or h)					
Wrist cords (alleles C or c)					
Freckles (alleles F or f)					
Dimples (alleles A or a)					

To simplify analysis, we will concentrate on just five (5) human characteristics. In the chart below, enter your personal phenotypes and genotypes for each of the traits:

	Tongue Rolling	Hand Clasping	Straight or Bent Thumb	Earlobe Attachment	Eye Pigmentation
Phenotype					
Genotype					

Using the information in the above chart and the Phenotype Numbers for Five Characteristics chart, determine your phenotype number: _____

Summary of class results for phenotype numbers:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32

Questions:

1. Explain why it is impossible to know the exact genotype of a person with a dominant trait.

2. Would it be helpful to know your parents' phenotypes in determining your genotype? Explain.

3. Phenotype numbers:

a) How many students are in the class? _____

b) How many different phenotype numbers are represented in the class? _____

c) How many phenotype numbers were duplicated (had more than one student listed)? _____

d) If the phenotype number chart was expanded to include all 12 of the human characteristics studied in this lab, how many students would you expect to have exactly the same phenotype number? _____

4. What is the phenotype of a person with the genotype:

a) EE Tt _____

b) dd AA _____

c) Rr Ww _____

5. Predict the genotype and phenotype for people who have the following:

a) homozygous recessive for tongue rolling and heterozygous for Straight or Bent thumb?

Genotype: _____ Phenotype: _____

b) heterozygous for both Mid-digit hair and wrist cords

Genotype: _____ Phenotype: _____

c) homozygous dominant for freckles and homozygous recessive for the ability to taste bitter

Genotype: _____ Phenotype: _____

6. For the traits observed, did you find that the dominant allele is the most common allele? Give an example from the class results to support your answer.

_____

7. Did you observe the typical Mendelian 3:1 pattern (75% dominant; 25% recessive) for the examined dominant and recessive phenotypes in the classroom? _____

If no, suggest a reason why not:

Genetics Problems #1: Solving Monohybrid Crosses

Genetics is the study of the _____ of characteristics (traits) from _____ to their _____.

In the Inherited Human Characteristics activity, we observed your phenotype (_____ characteristics) in an attempt to determine your _____ (types of _____) for several inherited traits.

If the genotypes of two organisms are known, they can be used to predict the _____ (chances) of some traits appearing in their _____.

When only _____ trait (one _____) is studied, it is called a _____ cross.

Steps in solving monohybrid cross genetics problems using _____ :

1. Write a "_____" statement to define the alleles. Use a _____ letter to represent the _____ allele and the lower case of the _____ letter for the _____ allele.
2. Determine the _____ of the parents. For animals, specify which is _____ and _____. For _____, choose one plant as the male and the other as the female.

   Note: there are several "code words" that may be used to indicate the genotypes. For example, write the genotypes for the following pea plants using Mendel's tall (T) and dwarf (t) genes:

• homozygous tall plant _____	• homozygous dwarf plant _____
• purebred tall plant _____	• purebred dwarf plant _____
• heterozygous plant _____	• a dwarf plant _____
• a hybrid plant _____	• a 'carrier' _____

3. For both the male and female, determine the possible _____ by segregating (_____) the alleles.
4. Write the possible gametes for the males (_____ or _____) across the _____ of a Punnett square and the possible gametes for the female (_____) down the _____.
5. Fill in the Punnett square to show all possible _____ of gametes.
6. State the possible _____ and _____ of the offspring. This is just the _____ (chances) of each combination, not necessarily the reality.

eg. A homozygous dominant pea plant with yellow seeds is crossed with a homozygous recessive pea plant with green seeds. What are the possible genotypes and phenotypes of the offspring?

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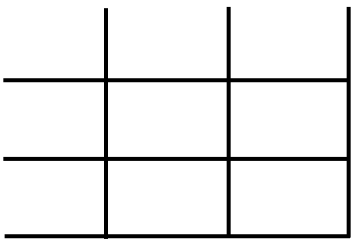

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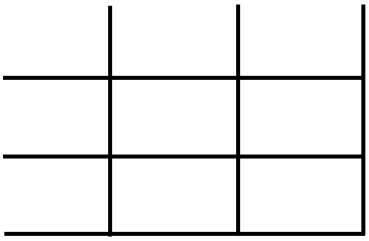
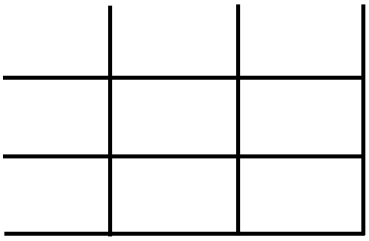
eg. A man who is heterozygous for the allele for a widow's peak marries a woman with a straight hairline. As we saw in the human characteristics lab, the dominant allele is_____. What are the possible genotypes and phenotypes of their children?



eg. A man and a woman are both heterozygous for freckles. As we saw in the human traits lab, the dominant allele is _____. What are the chances of their children having freckles?



eg. Mendel crossed a purebred smooth pod pea plant with a purebred pea plant with wrinkled pods. All of the offspring had smooth pods. Determine the genotypes and phenotypes of the F_1 and F_2 generations.

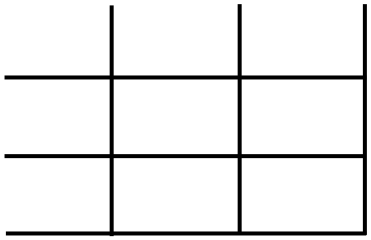
Monohybrid Crosses: Pedigrees and Test Crosses

Single gene inheritance refers to traits (characteristics) that are determined by _____ gene.

- breeding between individuals that differ in a single gene are called _____
- different versions of a gene are called _____
- some alleles are _____ over others
- a dominant gene will always be _____ (_____) in the phenotype of an organism

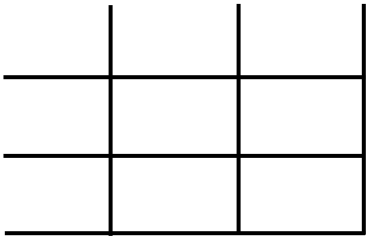
In monohybrid crosses, there are _____ general combinations of alleles. Let's use Mendel's tall (_____ or _____) and short (_____) pea plants as an example:

Homozygous vs. Homozygous



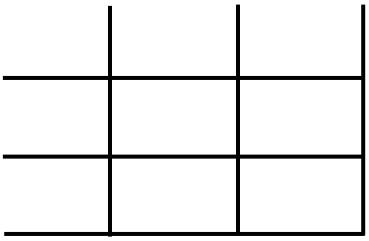
Genoytpes: _____
Phenotypes: _____

Homozygous vs. Heterozygous



Genoytpes: _____
Phenotypes: _____

Heterozygous vs. Heterozygous



Genoytpes: _____
Phenotypes: _____

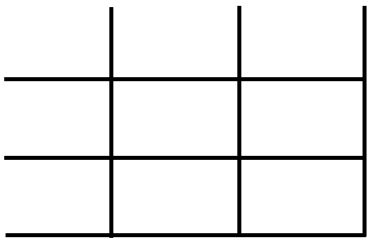
If a plant is short, we know that it must be _____(____)
If a plant is tall, it can be either _____ (____) or _____ (____)

Mendel devised a very clever technique to determine the _____ of plants with _____ phenotypes. He bred (crossed) these plants with a _____ _____ plant. He called it a "_____".

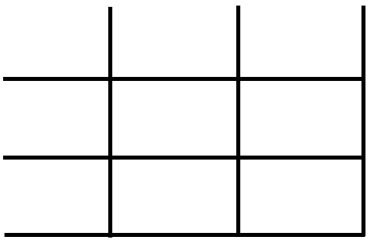
If the parent plant exhibiting the dominant trait was:

- homozygous for the dominant allele (eg. TT), then the phenotypes of the offspring would be _____
- heterozygous for the dominant allele (eg. Tt), then the phenotypes of the offspring would be _____ and _____

eg. Pea plants can have either purple or white flowers. Purple is dominant. The genotype of a purple-flowered plant could be PP or Pp. How could you determine the genotype of a purple-flowered plant?



Genoytpes: _____
Phenotypes: _____



Genoytpes: _____
Phenotypes: _____

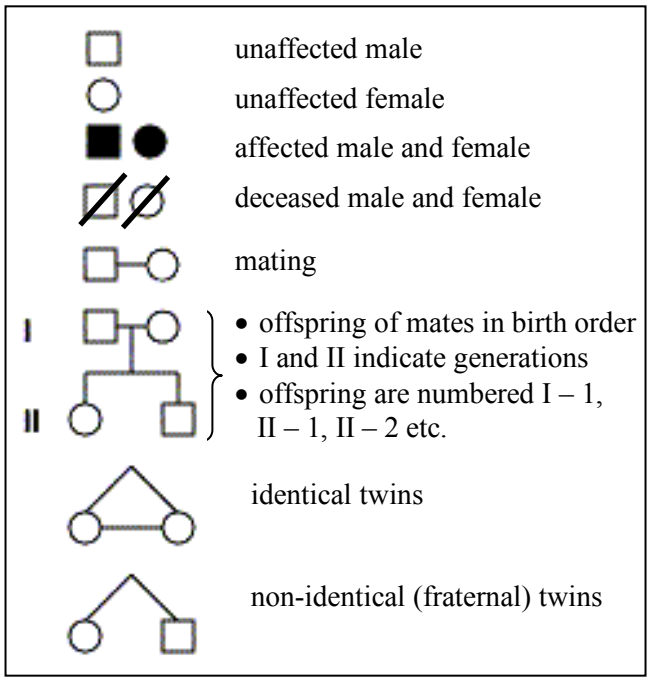
If a person exhibits a _____ trait, it wouldn't be ethical or practical to do breeding experiments to find out if they are homozygous or heterozygous for the _____. Instead, they may get some information about their genetics by looking at the _____ of other members of their _____. This is called a _____.

A pedigree is a type of _____ (diagram) that uses _____ to show the inheritance pattern of a trait in a _____ over several _____.

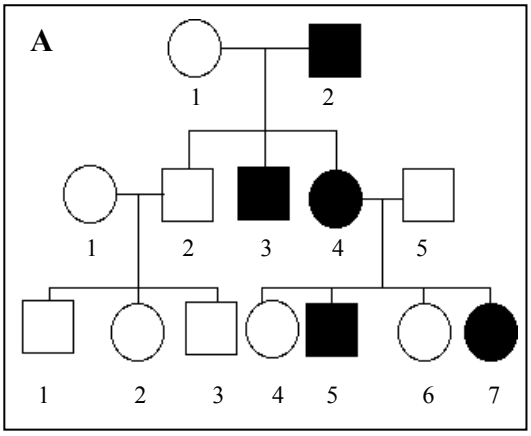
By studying the _____ of inheritance of a trait, geneticists may be able to determine if a trait is due to a _____ or _____ allele. They may also be able to determine the _____ of the individual.

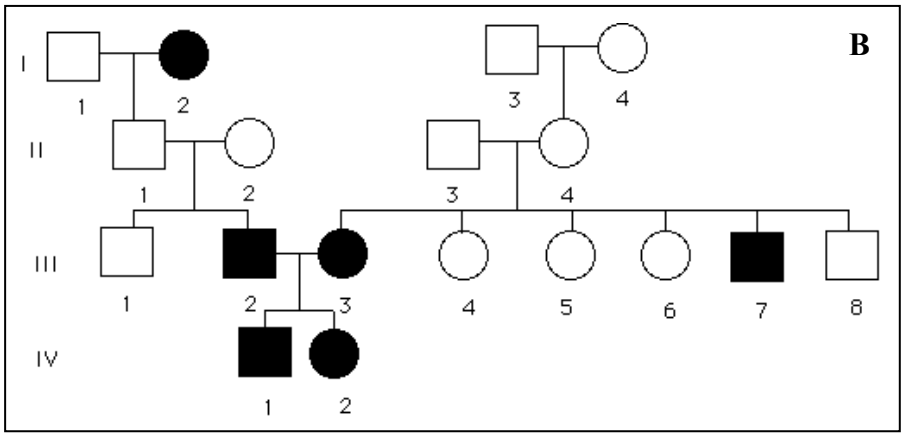
For example, if a trait:

a) appears in _____ generation, it is probably caused by a _____ allele
b) appears in an _____ but not in either _____ (ie. if it '_____' a generation), it is probably caused by a _____ allele



Examples:





Questions:

1. Does pedigree A show the inheritance of a dominant or recessive allele? _____. How do you know?

2. Does pedigree B show the inheritance of a dominant or recessive allele? _____. How do you know?

3. Label the genotypes of as many individuals in the pedigrees as possible. Use 'A/a' for the alleles in the first pedigree and 'B/b' for the alleles in the second pedigree.

Monohybrid Cross Variations: Incomplete Dominance and Co-Dominance

So far, we have discussed single gene traits which show _____. If the dominant allele is present, it completely _____ the presence of a recessive allele

ex.

But there are several variations:

1) **Incomplete Dominance**
   The dominant gene does _____ completely mask the presence of the recessive allele. A _____ individual shows a _____ of the traits part way between the dominant and recessive alleles. (For example, a red flower & white flower may produce a pink flower)

   Both alleles are _____, so we can't say that one is completely dominant over the other and use a normal upper-case and lower-case letter. Instead we use a capital letter for the _____ allele (ex. _____) and the same capital letter plus a "prime" symbol (') for the _____ allele (ex. _____)

Ex. When a homozygous red flowered snapdragon plant is crossed with a homozygous white flowered snapdragon, predict the genotypes and phenotypes of the F_1 and F_2 generation. (a heterozygous plant will have pink flowers)

2) **<u>Co-dominance</u>**

There are two _____ alleles and both are expressed. A heterozygous individual clearly shows _____ traits at the same time. (For example, a red flower & white flower may produce a red/white striped flower)

Since both alleles are equally dominant, each trait gets a _____ capital letter.

Ex. A homozygous red tulip is crossed with a homozygous white tulip. Predict the genotypes and phenotypes of the F_1 and F_2 generations. The red and white alleles are co-dominant.

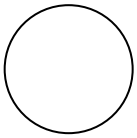
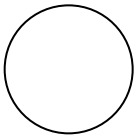
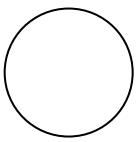
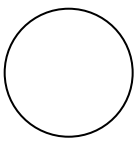
Blood Types: Multiple Alleles and Co-Dominance

So far, we have seen genes with ____ alleles. These alleles can be: _____ dominant or recessive (Bb), _____ (BW), or _____ dominant (B B').

However, some genes can have _____ (_____ than two) alleles. For example, there are _____ main phenotypes (types) of blood: _____, _____, _____, and _____. Blood type is determined by the _____ or _____ of certain _____ (proteins) on the surface of the _____ (_____). There are _____ alleles that determine blood type. These alleles are:

- a _____ allele called _____ which codes for immunoglobulin ____ on the surface of the RBC
- a _____ allele called _____ which codes for immunoglobulin ____ on the surface of the RBC
- a _____ allele called _____ which codes for _____ immunoglobulins on the surface of the RBC

There are _____ possible alleles for the blood type (immunoglobulin) gene, but you still only get _____, one from each _____. The possible phenotypes and genotypes are:

BLOOD TYPE	Immunoglobulins (Proteins) on the RBCs	Will make Antibodies to:	What type(s) of blood can they give and get?
Blood Type A (Phenotype A) Genotype(s):			Can give to: Can get from:
Blood Type B (Phenotype B) Genotype(s):			Can give to: Can get from:
Blood Type AB (Phenotype AB) Genotype(s):			Can give to: Can get from:
Blood Type O (Phenotype O) Genotype(s):			Can give to: Can get from:

People with A type blood (RBCs with _____) can be given blood from another person with type _____ blood (either _____ or _____) because their body will not recognize any _____ between the _____ blood and their _____ blood. They can also receive type _____ blood (_____) because ____ blood has _____ immunoglobulins for the body to recognize as _____ (_____).

However, if a person with A type blood is given type _____ or _____ blood, the person's immune system will recognize that the _____ immunoglobulin is "_____". Their immune system will make _____ to the _____ immunoglobulins. Antibodies work by _____ to _____ proteins from _____, _____, _____ or _____. The antibodies make these foreign materials _____ together (_____). This makes it easier for the _____ (_____) to recognize the foreign material and _____ it.

So, if a person with type _____ blood is given type ____ blood, the antibodies stick to the ____ _____ and cause the _____ to _____ together. If the person has been given a fairly large amount of blood, there are so many _____ (clumped together) type ____ red blood cells that they will _____ the person's _____ _____, and the person will _____.

Similarly, people with type ____ blood have immunoglobulin ____ on their _____

- type ____ immunoglobulin is _____, so they make _____
- they can be given type ____ (either _____ or _____) or type O (i^Oi^O, has no ___ or ___)
- can give (_____) their blood to people with ___ or _____ blood

A person with type _____ type blood has _____ and ____ immunoglobulins on their _____

- there are _____ foreign immunoglobulins, so they _____ form any _____
- they can be given (receive) _____ of blood
- they can only give (_____) their blood to other people with type _____

A person with type ____ blood (_____) has _____ immunoglobulins on their RBCs

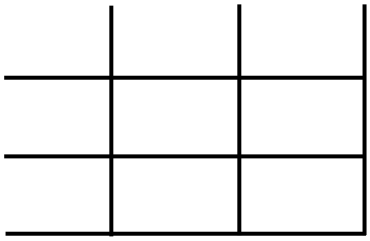
- all immunoglobulins with be _____, so they form antibodies to both ___ and ___
- they can be given (receive) type ____ blood because it has _____ immunoglobulins
- can give (_____) their blood to _____

The Rh Factor

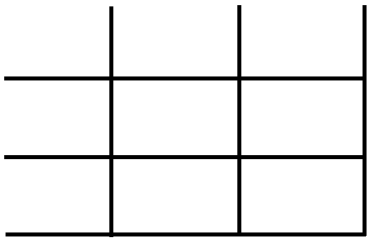
Another aspect of blood type is the _____ or _____ of the _____. If you have the Rh factor (_____) on your _____, you are _____. Most people (_____) have the Rh factor. If you _____ have the Rh factor (protein) on your RBCs, you are _____. Only _____ of people do not have the Rh factor. So, a person's _____ blood type includes their blood _____ and their _____ status, eg. _____

Examples of a genetics problem involving multiple alleles:

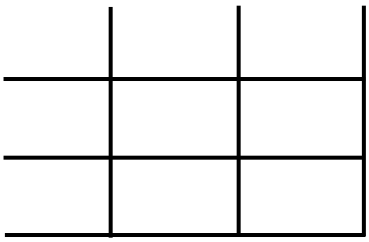
1. A woman who is homozygous for blood type B marries a man that is heterozygous for blood type A. State the possible genotypes and phenotypes of their offspring.

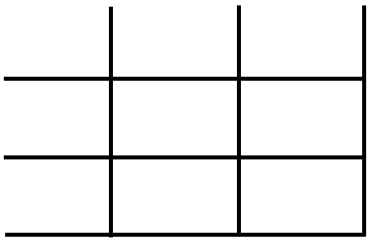


2. A man with blood type O marries a woman with blood type AB. State the possible genotypes and pheontypes of their children.



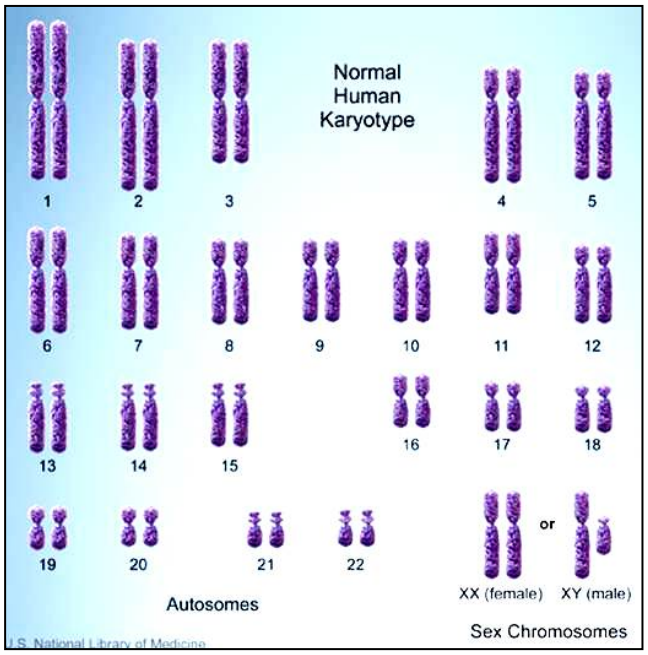
3. A woman whose blood type is B (heterozygous) gives birth to a child whose blood type is O. The woman claims that there are two possible fathers: one with blood type AB and the other with blood type A (heterozygous). Showing all work, determine which man <u>cannot</u> be the father.





Monohybrid Crosses: Sex-Linked Traits

Recall: people have _____ pairs of _____



Chromosomes 1 to 22 are called _____

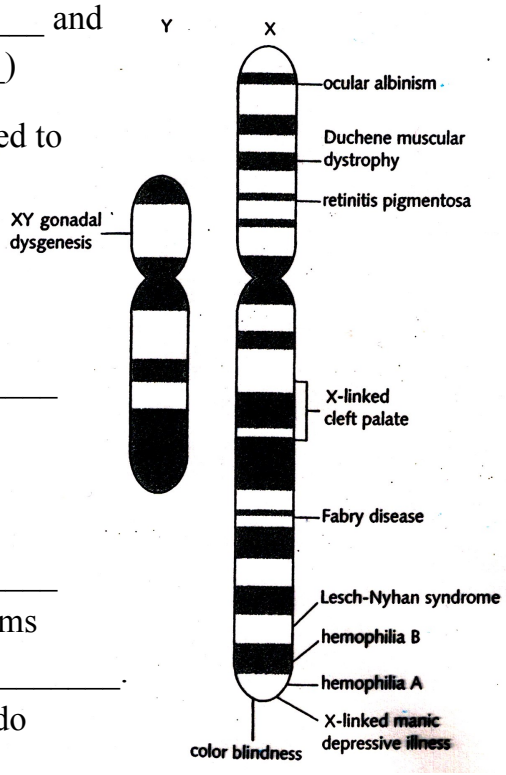
- if a gene is found on chromosomes 1 to 22, it is an _____
- if a gene on chromosomes 1 to 22 is responsible for a disorder or disease, it is called an _____
- if the gene is dominant, then it is called an _____ disorder, eg. _____
- if the gene is recessive, then it is called an _____ disorder, eg. _____

Chromosome pair _____ is the _____ chromosomes

- females have _____ chromosomes, one from each parent (_____)
- males have _____ chromosome from their _____ and _____ chromosome from their _____ (_____)

The Y chromosome carries only _____, most are related to _____ and _____ production:

- these are called _____ traits
- if a gene for testosterone production is _____ or _____ on the Y chromosome, an XY embryo will not make _____ so his _____ will not develop into _____ and he will have _____
- if one of the 9 genes for _____ production is missing or mutated, the male will make _____ sperm. This is the cause of about _____ of infertility problems
- another gene carried on the Y chromosome is for _____. Because females do not have a _____ chromosome, women do not get _____.



The X chromosome carries _____ genes for all kinds of traits

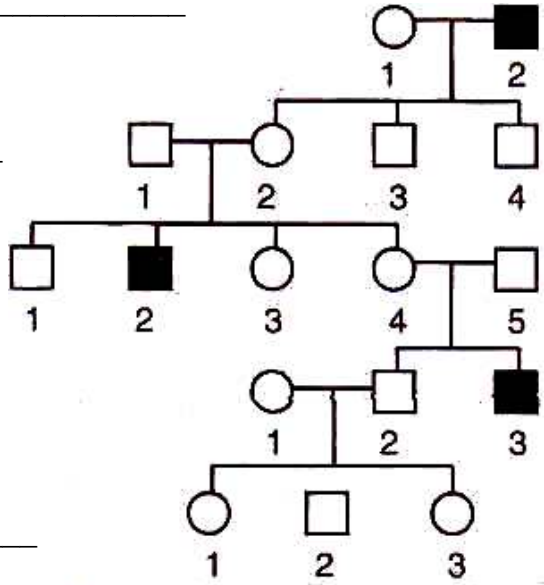
- genes on the X chromosome are called _____ genes
- these genes can be _____ or _____

a) **Dominant X-linked genes** affect males and females _____, because both males and females have an _____ chromosome

- _____ of a _____ gene is enough to cause the trait or disorder
- one of the very few conditions that are caused by _____ inheritance is _____
- Rett syndrome causes _____ and _____ disability in _____. Male fetuses with this gene are _____

b) **Recessive X-linked genes** affect _____ much more often than _____

- females have _____ chromosomes, so they get a "_____" copy of the genes on the X chromosome. A female will only develop a recessive X-linked trait if she has _____ _____ of the recessive gene, one from _____ and this is very _____
- a girl who is heterozygous for the recessive allele _____ have the disorder, but she will be a _____
- males are much _____ to exhibit X-linked disorders because they have _____ chromosome. If their X chromosome carries the gene for a genetic disorder, they do not have a second X chromosome to provide a "_____" copy so they _____ the disorder.
- examples of X-linked recessive genes include Duchenne's _____, _____, red-green _____ _____ and male-pattern _____

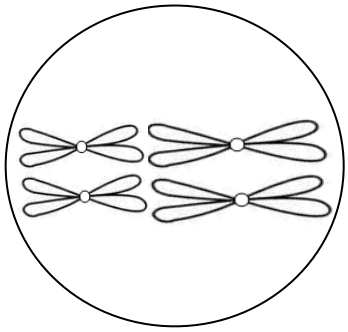


eg. Hemophilia is an X-linked recessive trait. A female carrier marries a normal male.

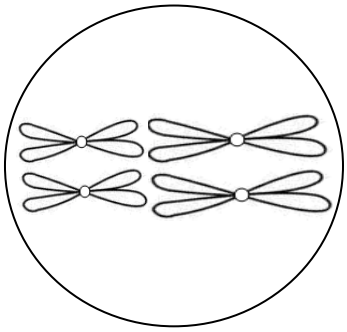
a) If the couple has a son, what are the chances that he will have hemophilia?
b) What are the chances that their children will be carriers of the hemophilia gene?

Review of Meiosis as an Introduction to Dihybrid Crosses

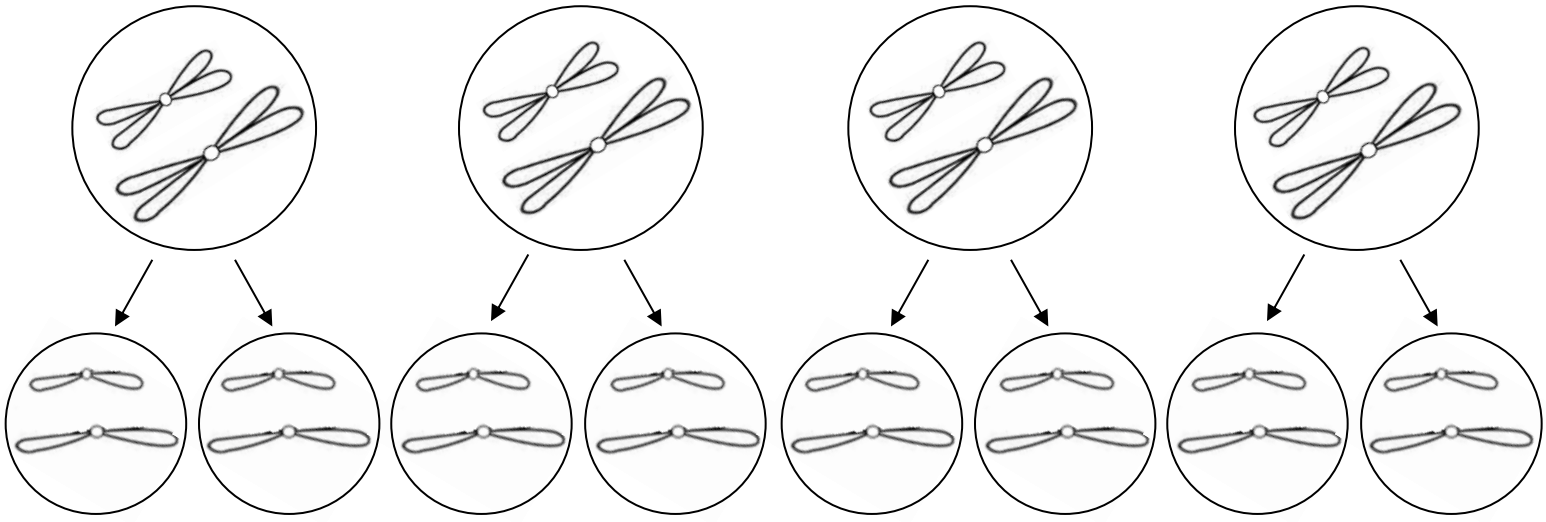
During metaphase I of meiosis, homologous pairs of duplicated chromosomes (_____) line up along the equator with the _____ and _____ chromosomes _____ on either side of the equator. This is called _____ (Random) _____. For example, if we consider a diploid cell with two chromosomes in metaphase I, the tetrads could be arranged _____ ways (for simplicity, we will ignore the results of _____):



OR



Then during metaphase II and anaphase II, the _____ are separated to form four haploid _____. Each gamete gets _____ for each trait in _____ combinations:



The probability (chance) of each combination of alleles is equal: a _____ chance of each.

The discovery that offspring get _____ for each trait from each parent was made by _____ during his _____ cross experiments with garden peas. He called the division of maternal and paternal _____ (alleles) into separate gametes the "Principle of _____".

Then Mendel asked another question: was there a relationship between the inheritance of certain _____? Did tall plants always have purple flowers and yellow seeds (all _____ traits)? Did short plants always have white flowers and green seeds (all _____ traits)? Did the _____ or _____ traits tend to be inherited together?

To answer this question, Mendel did a second set of experiments called '_____ in which he studied _____ at the same time. Mendel bred plants that were '_____' (purebred or _____) for two traits.

eg. tall plants (TT) which always had purple flowers (PP), so the plant was _____
short plants (tt) which always had white flowers (pp), so the plant was _____

He _____-pollinated the purebred plants to produce the _____ generation. All of the plants were _____ with _____ flowers. Then Mendel allowed the F_1 plants to _____-pollinate to produce the _____ generation. He observed the ratio:

- _____ tall plants with purple flowers
- _____ tall plants with white flowers
- _____ short plants with purple flowers
- _____ short plant with white flowers

Mendel repeated the dihybrid cross experiments with other combinations of traits and always got the _____ in the F_2 generation: _____

From his dihybrid experiments, Mendel discovered the Principle of _____ _____. Very simply, it states that different _____ are inherited _____ of one another. We now know that this is because of _____-_____ and _____ of maternal and paternal chromosomes during _____ and the independent (_____) assortment of chromosomes in _____ in meiosis. The inheritance of one _____ (one _____) does _____ influence the inheritance of other _____ (_____).

F_1:

TT PP  X  tt pp

Solving Dihybrid Crosses: Two Traits at the Same Time

eg. A homozygous dominant pea plant with tall stem and yellow seeds is crossed with a homozygous recessive pea plant with a dwarf stem and green seeds. Predict the possible genotypes and phenotypes of the F_1 and F_2 generation plants.

Step 1: Define the alleles.

Step 2: Determine the genotypes of the parents from the information you are given. Write the male's genotype above the Punnett Square and the female's genotype along the side**.**

Step 3: Set up a Punnett square. Use "FOIL" rule to get all the possible combinations of gametes. This is the F_1 cross.

Step 4: Determine the genotype(s) of the F_1 individuals and write them across the top and down the side a second Punnett Square.

Step 5: Set up a Punnett square. Use "FOIL" rule to get all the possible combinations of gametes. This is the F_2 cross.

Step 6:
List the ratios of the phenotypes of the F_2 generation. Make a concluding statement to answer the original question.

eg. In mice, long whiskers are dominant over short whiskers, and brown fur is dominant over white fur. A male mouse that is heterozygous for both traits is crossed with a female mouse that is homozygous recessive for whisker length and heterozygous for fur colour. Predict the possible phenotypes of their offspring.

Step 1: Define the alleles.

Step 2: Determine the genotypes of the parents from the information you are given. Write the male's genotype above the Punnett Square and the female's genotype along the side**.**

Step 3: Set up a Punnett square.
Use "FOIL" rule to get all the possible combinations of gametes.

Step 4: Summarize the phenotypes of the offspring and answer the question (if necessary).

eg. In a certain type of plant, smooth leaves are dominant over hairy leaves and red leaves are dominant over green leaves. If a plant that is homozygous for smooth leaves and heterozygous for leaf colour is crossed with a hairy plant with green leaves, predict the possible appearance of the offspring.

Using Genetics: Treating Genetic Disorders

Gene Therapy:

All traits (including " _____") are expressed through the production of _____. A _____ means that the person is unable to produce the _____ protein(s) for that trait (either no protein is made, or the protein that is made is _____.

In a procedure known as _____, basically, the defective gene (recessive allele) is _____ with a "non-defective" gene (dominant allele)

Steps involved:

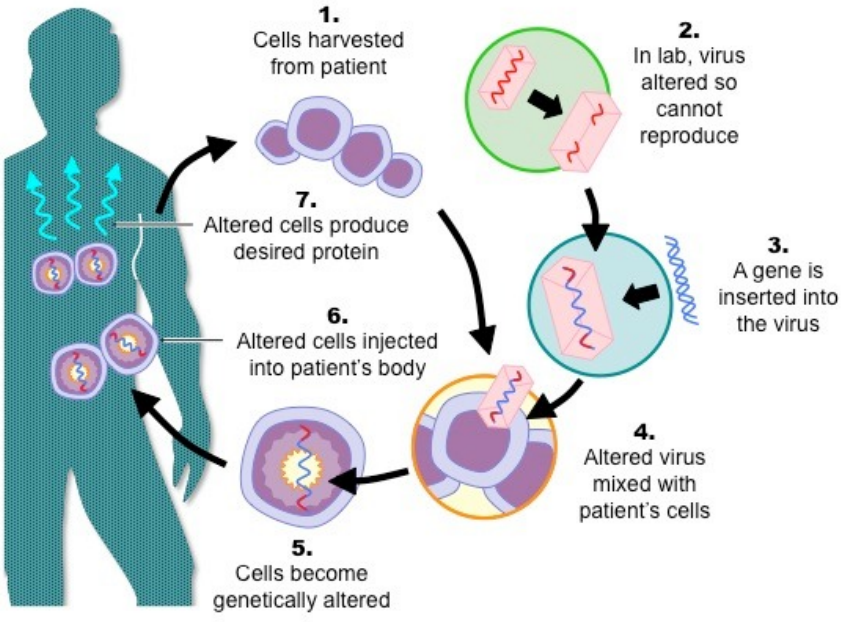
1) The _____ cells are removed from the body and grown in a _____.

2) Meanwhile, the "_____" gene is isolated from normal donor cells (or created _____)

3) The normal gene is then _____ (inserted) into the DNA of a harmless or _____virus. DNA that has been created from two or more sources is called _____.

4) The genetically engineered viruses (GEV's) then "_____" the affected cells in the petri dish by _____. The cells now have a "_____" gene (dominant allele) for the trait and begin to produce the _____.

5) These "_____" cells (repaired cells) are re-introduced into the person's body. Any _____ cells produced by mitosis from these repaired cells will have the ability to produce the _____ (since they now have the "normal" gene as part of their DNA)



Final Thoughts: Gene Frequency, Dominance and Penetrance

The frequency of certain genes in a population is very _____ over generations. Genes have higher _____ (are more _____) in certain populations if they give the individual some kind of _____.

eg. populations who live close to the _____ have a higher frequency of genes for _____ in their skin because this protects them from _____ and _____

eg. populations who live in areas where there is _____ have a higher frequency of genes for _____. People with _____ recessive allele for sickle hemoglobin are more resistant to _____

Dominant genes are not necessarily more _____ or _____ in a population. Dominant genes will not "_____". For example:

- the gene for _____ (extra fingers & toes) is dominant, but quite _____
- the blood type _____ is the most _____, but also the most _____

The _____ of an individual (its _____) is the result of the _____ between its _____ (_____) and the _____ in which it lives (_____).

While many individuals have the _____ for certain traits, the genes are not necessarily _____ in the _____. A new field called _____ ("epi" means "_____" or "_____") is the study of how genes are _____ (turned _____ or _____) by different factors in the _____.

In genetics, _____ is defined as the proportion of individuals who have a certain _____ for a _____ in their _____ compared to the number of individuals who actually show (_____) the _____ for that _____.

In medicine, some genetic disorders are highly _____ and _____ individuals with the allele develop the disease. Alleles for other genetic disorders are _____ penetrant.

For example, the BRCA1 and BRCA2 alleles for _____ cancer are about _____ penetrant. This means that _____ of people who carry these alleles _____ breast cancer in their lifetime. However, _____ and this is influenced by environmental factors such as _____ (_____, _____ and _____ levels), _____ history (hormone levels), _____, _____ consumption and other factors.