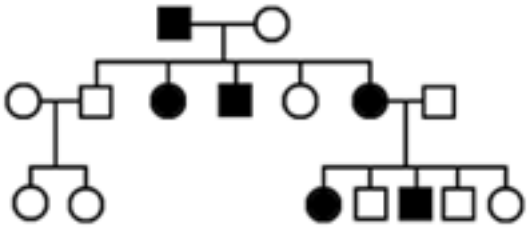
Modes of Inheritance

USE THE PROCESS OF ELIMINATION TO FIGURE OUT INHERITANCE!

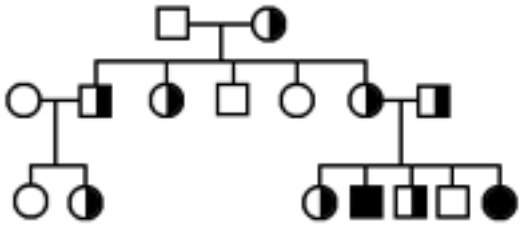
Autosomal Dominant

Dominant conditions are expressed in individuals who have just one copy of the mutant allele. The pedigree on the right illustrates the transmission of an autosomal dominant trait. Affected males and females have an equal probability of passing on the trait to offspring. Affected individuals have one normal copy of the gene and one mutant copy of the gene, thus each offspring has a 50% chance on inheriting the mutant allele. As shown in this pedigree, approximately half of the children of affected parents inherit the condition and half do not.



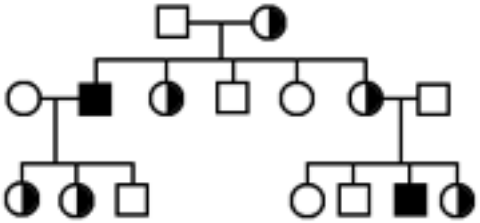
Autosomal Recessive

Recessive conditions are clinically manifest only when an individual has two copies of the mutant allele. When just one copy of the mutant allele is present, an individual is a carrier of the mutation, but does not develop the condition. Females and males are affected equally by traits transmitted by autosomal recessive inheritance. When two carriers mate, each child has a 25% chance of being homozygous wild-type (unaffected); a 25% chance of being homozygous mutant (affected); or a 50% chance of being heterozygous (unaffected carrier). Every parent of an affected individual must have at least one affected allele.



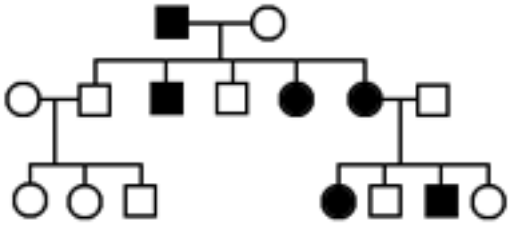
X-linked Recessive

X-linked recessive traits are not clinically manifest when there is a normal copy of the gene. All X-linked recessive traits are fully evident in males because they only have one copy of the X chromosome, thus do not have a normal copy of the gene to compensate for the mutant copy. For that same reason, women are rarely affected by X-linked recessive diseases, however they are affected when they have two copies of the mutant allele. Because the gene is on the X chromosome there is no father to son transmission, but there is father to daughter and mother to daughter and son transmission. If a man is affected with an X-linked recessive condition, all his daughter will inherit one copy of the mutant allele from him.



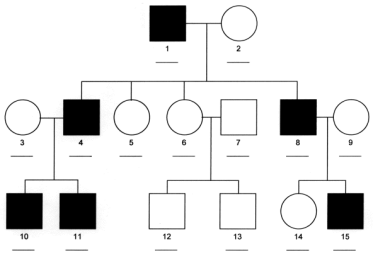
X-linked Dominant

Because the gene is located on the X chromosome, there is no transmission from father to son, but there can be transmission from father to daughter (all daughters of an affected male will be affected since the father has only one X chromosome to transmit). Children of an affected woman have a 50% chance of inheriting the X chromosome with the mutant allele. X-linked dominant disorders are clinically manifest when only one copy of the mutant allele is present.



Holandric (Y-linked)

This is very easy to spot. Because the gene is located on the Y chromosome, it can only be passed from a man to his son. He cannot pass it to his daughters, and every single son will get it.



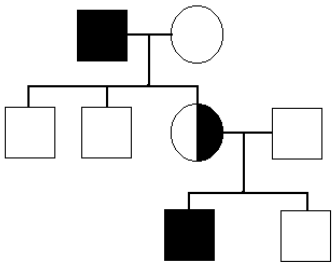
Sporadic

A sporadic disease is a non-hereditary version of a disease that can also be genetic. For example, Amyotrophic Lateral Sclerosis (ALS), also known as Lou Gehrig's Disease, a disease marked by severe muscle loss due to the deterioration of motor neurons, has a familial (genetic) variant and a sporadic variant. Some people will get it because it is in their family's gene pool. Other people will get it randomly. Those who get it randomly without a family history are called sporadic.

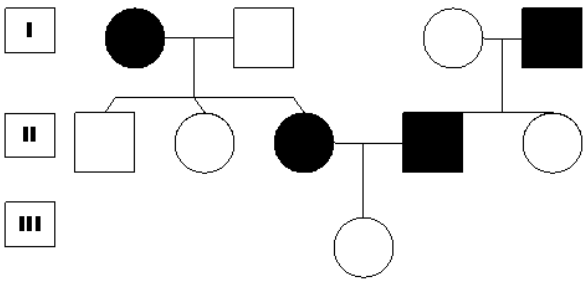
<u>Pedigree Problems</u>

1. Determine the genotype of all people in the X-linked recessive pedigree on the right. The allele for colourblindness is X^b and normal vision is X^B.

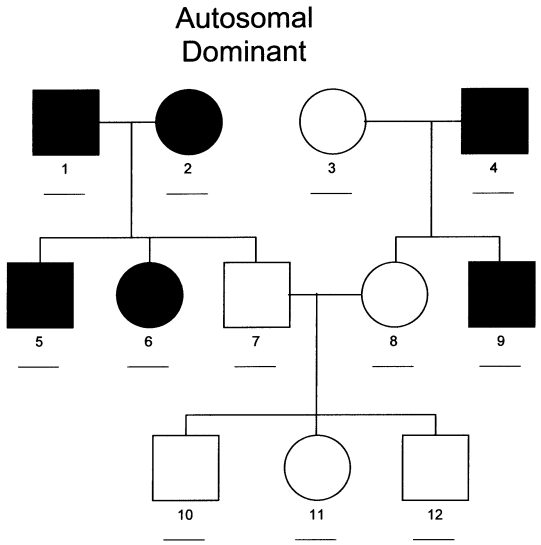
2. How can you immediately spot holandric (Y-linked) inheritance?



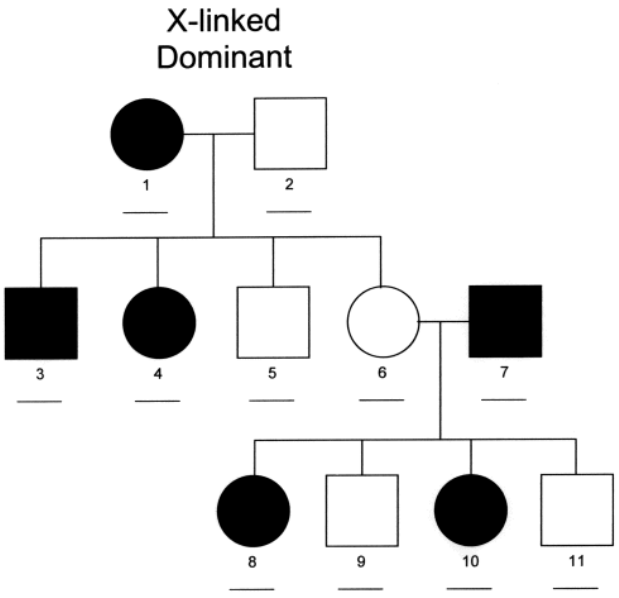
3. What type of inheritance is shown here? How can you tell?



4. Determine the genotype of all the individuals in the following pedigree assuming the disease is transmitted in an autosomal dominant pattern.



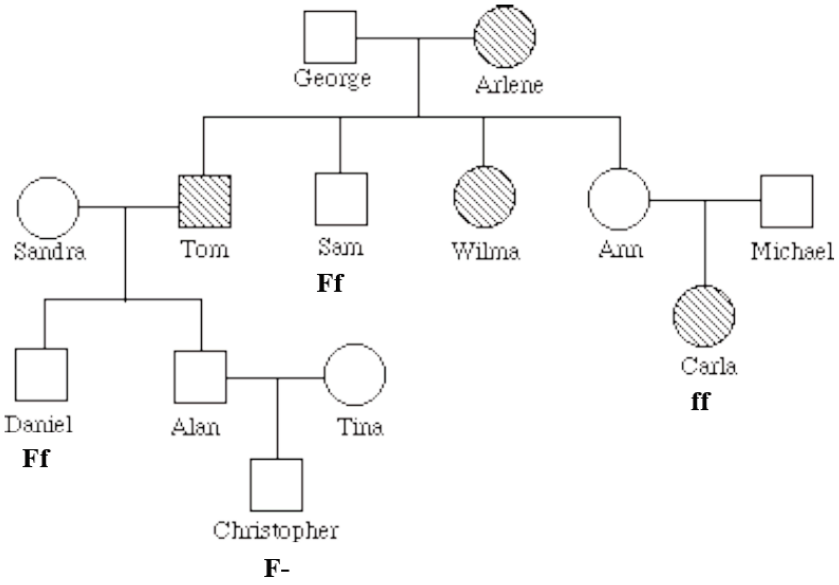
5. Write the genotypes for all individuals in the cross assuming X-linked dominant inheritance. Use X^D for a mutant allele and X^d for a normal allele.



6. Draw a proper pedigree of the following: A man and a woman have normal vision. They have three offspring, all of whom marry people with normal vision. The three offspring and their children are as follows:
    i. A colourblind son who has a daughter with normal vision.
    ii. A daughter who has three sons with normal vision.
    iii. A daughter who has one colourblind son and one son with normal vision

7.

A **typical pedigree** for a family that carries Falconi anemia. Note that carriers are **not** indicated with half-colored shapes in this chart.



Analysis Questions.

To answer questions #1-5, use the letter "f" to indicate the recessive Falconi anemia allele, and the letter "F" for the normal allele.

1. What is Arlene's genotype?_____

2. What is George's genotype?_____

3. What are Ann & Michael's genotypes?_____

4. Most likely, Sandra's genotype is _____.

5. List three people from the chart (other than George) who are most likely *carriers* of Falconi anemia.

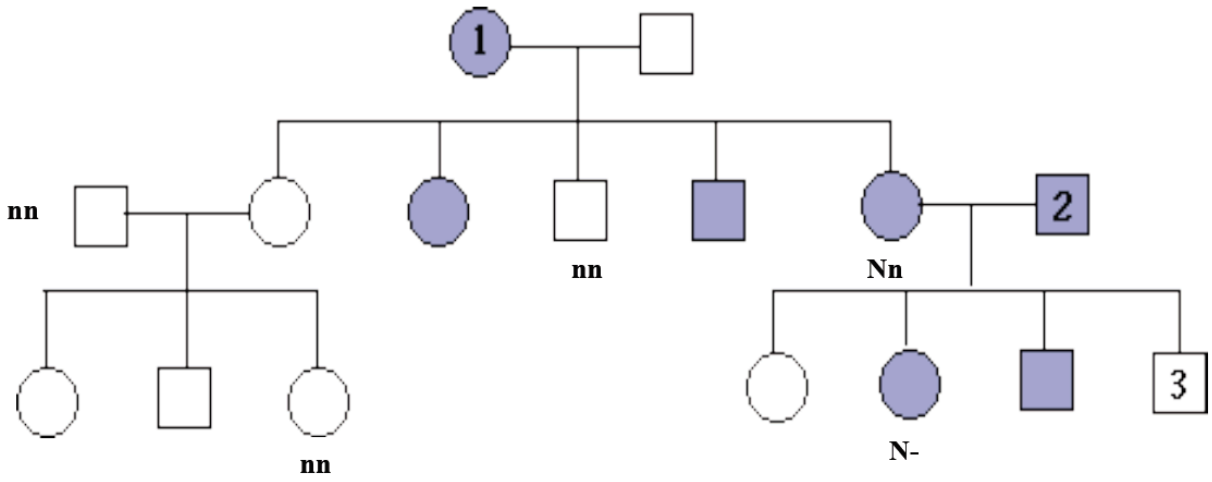
_____

8.

Trait: Neurofibromatosis
Forms of the trait:

- The **dominant** form is neurofibromatosis, caused by the production of an abnormal form of the protein neurofibromin. Affected individuals show spots of abnormal skin pigmentation and non-cancerous tumors that can interfere with the nervous system and cause blindness. Some tumors can convert to a cancerous form.
- The **recessive** form is a normal protein - in other words, no neurofibromatosis.

A **typical pedigree** for a family that carries neurofibromatosis is shown below. Note that carriers are **not** indicated with half-colored shapes in this chart. Use the letter "N" to indicate the dominant neurofibromatosis allele, and the letter "n" for the normal allele.



Analysis Questions:

1. Is individual #1 most likely homozygous dominant or heterozygous? Explain how you can tell._____

_____

_____

_____

2. What is the genotype of individual #3?_____

3. Can you be sure of the genotypes of the affected siblings of individual #3? Explain.

_____

_____

_____

Challenge:

9. Geneticists often use pedigrees to determine the inheritance of a disease and to tell people their susceptibility to a disease. A woman goes to her geneticist to find out if her young child has lactose intolerance This disease is characterized by an inability to break down the sugar lactose, often found in milk products. It often leads to gastrointestinal problems. It can usually be managed by avoiding foods with lactose or by taking specific pills. Not all versions of lactose intolerance are genetic. Her geneticist asks her to fill out a family history
    a. Her mother had lactose intolerance Her father did not.
    b. Her husband did not have lactose intolerance, neither did his older brother or his parents. His younger sister had lactose intolerance.
    c. Their other daughter has lactose intolerance. Their other son does not.
    d. The woman's mother did not have lactose intolerance, but her father did. Neither of her two brothers had lactose intolerance.
    e. We know nothing about lactose intolerance in the great-grandparents of either the man or the woman.

a) Draw a pedigree of the family. Include genotypes of all individuals. Be sure to mark carriers if they exist.
b) How is this condition passed on?
c) What is the probability that their young child will have lactose intolerance.