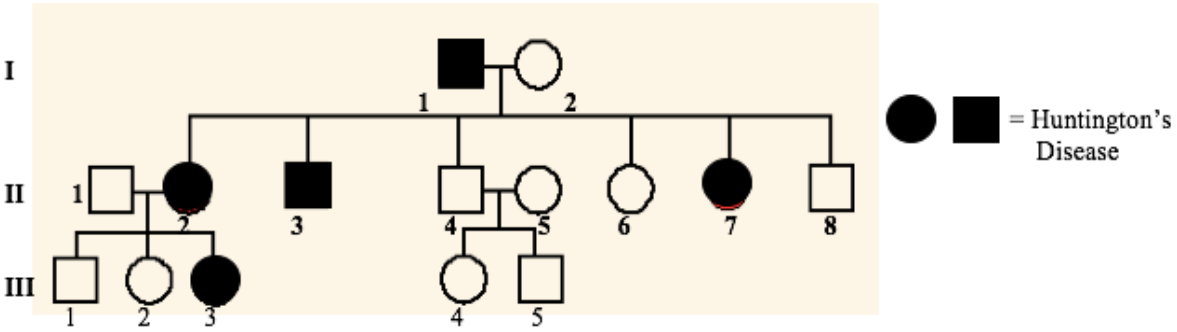
GROUP A

1. _____ _____



a. Which members of the family above are afflicted with Huntington's disease?
_____

b. There are no carriers (heterozygotes) for Huntington's Disease – you either have it or you don't. with this in mind, is Huntington's disease caused by a dominant or recessive trait? Why?
_____

c. How many children did individuals I-1 and I-2 have? _____

d. How many girls did II-1 and II-2 have?_____ How many of these daughters have Huntington's Disease?_____

e. How are individuals III-2 and II-4 related? _____ I-2 and III-5?_____

2. Hemophilia A is a recessive sex-linked genetic disorder that prevents the blood from clotting.
   a. The effects of this X chromosome disorder develops almost entirely in males even though the gene is inherited from one of the mother's X chromosomes. Why is this the case?_____
   _____
   _____
   b. Fill in the Punnett square and determine the expected genotypes and phenotypes from crossing a male with hemophilia A (X^HY) and a female who is a carrier for hemophilia (X^HX^h).

Genotypes of offspring (w/ percentages): _____

What are all the possible phenotypes? Be sure to differentiate male and female offspring. _____
_____
(match genotypes and phenotypes)

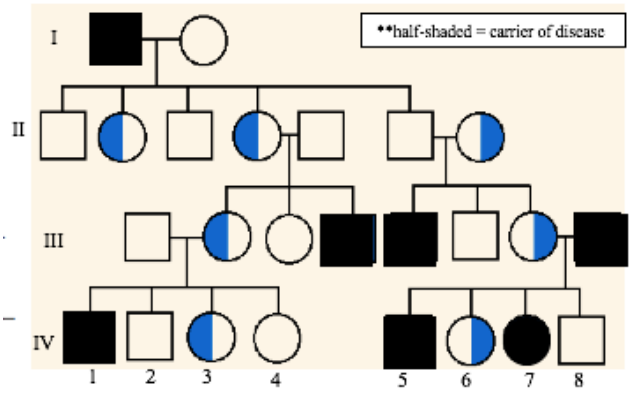
   c. Fill in the Punnett square and determine the expected genotypes and phenotypes from crossing a male without hemophilia A and a female who is has hemophilia A.

Parent genotypes: _____

Genotypes and percentages: _____

All possible phenotypes (include sex): _____
_____

GROUP B

1. 

   a. The pedigree shows a family's pedigree for colorblindness. Which sex can be carriers of colorblindness and not have it? _____ Which sex is more commonly affected by the disease? _____

   b. With this in mind, what kind of trait is colorblindness (what is its pattern of inheritance)? How is it passed on from parent to offspring?_____

   c. Name 2 generation IV colorblind males. _____

   d. Why does individual IV-7 have colorblindness? _____

   e. Why do all the daughters in generation II carry the colorblind allele?
   _____

2. In chestnut horse, their coat (hair) color can be reddish brown (AA), light red/pink (Aa), and creamy white (aa).
   a. Fill in the Punnett square and determine the expected genotypes and phenotypes from crossing two heterozygous parents.

Parent genotypes and phenotypes: _____

Possible genotypes and phenotypes of offspring (with percentages): _____
_____

Is this an example of incomplete or codominance? How do you know? What would the traits be if it were the other type of inheritance?

   b. Fill in the Punnett square and determine the expected genotypes and phenotypes from crossing a heterozygous parent and a homozygous recessive parent.

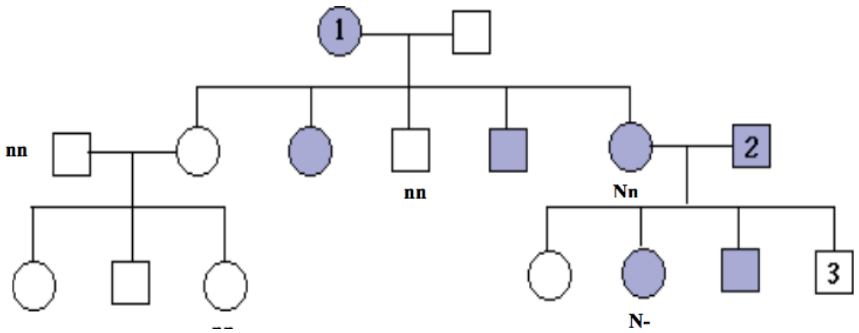
Parent genotypes and phenotypes: _____

Genotypes of offspring (w/ percentages): _____

Phenotypes of offspring (w/ percentages): _____

GROUP C

1. Individuals with Neurofibromatosis show spots of abnormal skin pigmentation and non-cancerous tumors that can interfere with the nervous system and cause blindness. This is an autosomal dominant disease and is caused by the production of an abnormal form of the protein neurofibromin. The recessive form is a normal protein – no neurofibromatosis. A typical pedigree for a family that carries neurofibromatosis is shown below. Carriers are not indicated. Use "N" to indicate the dominant allele and "n" for the normal allele.



a. Is individual #1 most likely homozygous dominant or heterozygous? How do you know?_____
_____

b. What is the genotype of individual #3?_____ What trait do they show?_____

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

2. Humans can be one of the four possible blood types. Alleles A (I^A) and B (I^B) are dominant over allele O (I^O or i). These alleles code for proteins found on the outside of red blood cells. Type A individuals produce protein A, type B produces protein B, type AB produces both A and B protein, and type O produces no protein.
    a. Fill in the Punnett square and determine the expected genotypes and phenotypes from crossing a person who was homozygous type A and a person with type AB.

Parent genotypes: _____

Genotypes of offspring (w/ percentages): _____

Phenotypes (w/ percentages): _____

When looking at alleles I^A and I^B, do they display incomplete or codominance? How do you know?

    b. Fill in the Punnett square and determine the expected genotypes and phenotypes from crossing a person who is heterozygous type B (I^Bi) and a person who is heterozygous type A (I^Ai).

Parent genotypes: _____

Genotypes of offspring (w/ percentages): _____

Phenotypes (w/ percentages): _____

What patterns of inheritance are displayed in this cross? (complete dominance, codominance, incomplete dominance, sex-linked, polygenic, etc.). There may be more than one! Give examples of your choice(s).

    c. Fill in the Punnett square and determine the expected genotypes and phenotypes from crossing a person who has type AB and a person who has type O.

Parent genotypes: _____

Genotypes and percentage: _____

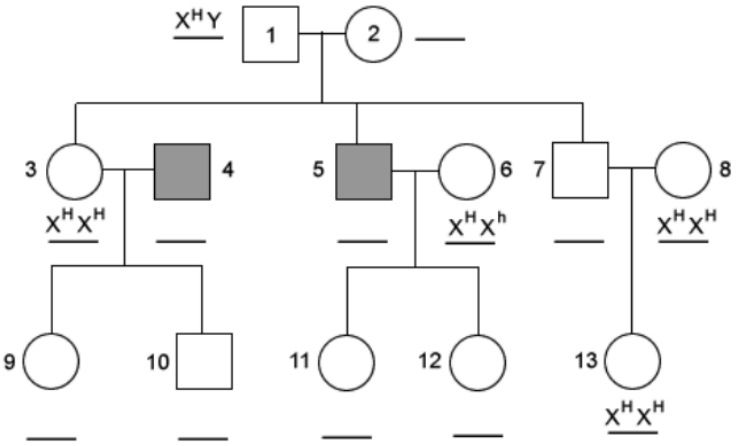
Phenotypes and percentage: _____

What type of inheritance is displayed in this cross? Explain.

    d. Based on your answers to a-c, what patterns of inheritance are displayed in blood type? Give examples.

GROUP D

1. Hemophilia is a recessive sex-linked disorder located on the X-chromosome where a person's body cannot control blood clotting or coagulation. Write in the genotypes on the line next to/below each individual.



   a. Identify the phenotypes of individuals 2, 4, 5, 7, 9, 10, 11, 12. (label on pedigree or make list if there isn't enough room). Add genotypes also if you want a challenge!
   b. What do you notice about which gender is more commonly affected? _____ Is it possible for the other gender to have the disease?_____ What would the genotypes of the parents have to be in order for that to happen? _____

3. Cystic fibrosis is an autosomal recessive disease which causes chronic lung infections and limits an individual's ability to breathe over time. A defective gene causes a thick, sticky buildup of mucus in the lungs, pancreas, and other organs. The mucus clogs airways and traps bacteria.
   a. Fill in the Punnett square and determine the expected genotypic ratios from crossing a homozygous dominant and a heterozygous individual.

Parent genotypes and phenotypes: _____

Circle the possible offspring phenotypes:
normal, carrier, has cystic fibrosis

% of kids with disorder:_____ % carriers of the disorder:_____

   b. Fill in the Punnett square and determine the expected genotypic ratios from crossing parents who are both carriers.

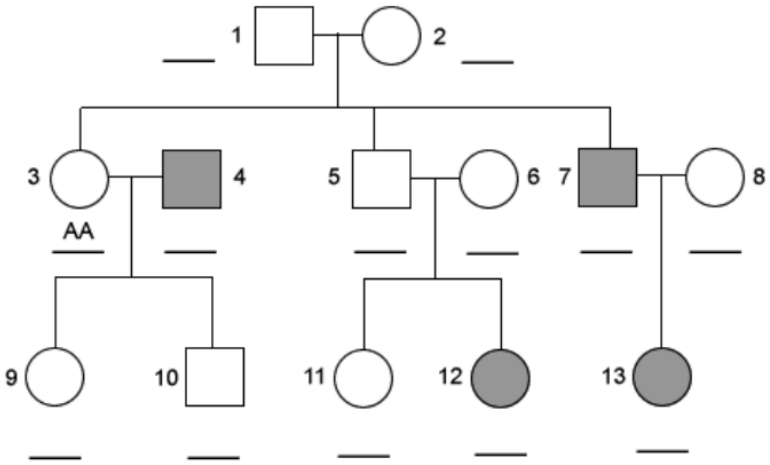
Parent genotypes and phenotypes: _____

Circle the possible offspring phenotypes:
Normal, carrier, has cystic fibrosis

% of kids with disorder:_____ % carriers of the disorder:_____

GROUP E

1. Sickle-cell anemia is an autosomal recessive (aa) genetic disorder that causes red blood cells to change shape, which can cause the red blood cells to become stuck in blood vessels. Write in the genotypes on the line next to/below each individual.



   a. Sickle-cell trait is caused when an individual is a carrier for the disease. What is the genotype of a carrier? _____
   b. An individual with sickle cell trait has some normal shaped red blood cells and some crescent shaped red blood cells. What type of inheritance does sickle cell display? _____ How do you know?_____

2. When a green betta fish (BB) is crossed with a steel blue betta fish (bb), the offspring will have a genotype of _____ and display a royal blue color that results from the phenotypes of both alleles.
   a. What is this pattern of inheritance called? _____
   b. Why did you choose this pattern? _____
   c. Fill out a Punnett square for a cross between a green betta fish and a royal blue betta fish.

Parent genotypes: _____

Genotypes of offspring (w/ percentages): _____

Phenotypes (w/ percentages): _____

   d. Fill out a Punnett square for a cross between a royal blue betta fish and a steal blue fish.

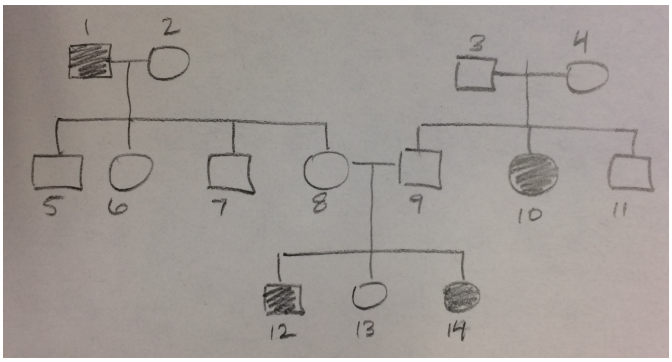
Parent genotypes: _____

Genotypes of offspring (w/ percentages): _____

Phenotypes (w/ percentages): _____

GROUP F

1. Use the pedigree chart below to answer the following questions about dimples. The dimple gene controls whether a person has dimples or doesn't have dimples. Dimples (D) is dominant to no dimples (d). Place the genotypes of each individual below its symbol.



   a. How many family members have dimples? _____
   b. What is the genotype of individual #3 and #4? _____
      i. How do you know? _____
   c. Can either individual #8 or #9 be homozygous? _____
      i. How do you know? _____
   d. Explain the family relationship that #12 has with #2. _____

2. Albinism is an autosomal recessive genetic disorder that causes deficiency of pigmentation in skin, hair, and eyes. When a single gene affects many traits, like albinism, it is called pleiotropy.
   a. Fill in the Punnett square and determine the expected genotypic and phenotypic ratios from crossing homozygous recessive and heterozygous parents.

Parent genotypes and phenotypes: _____

Expected offspring genotypes and percentages:_____

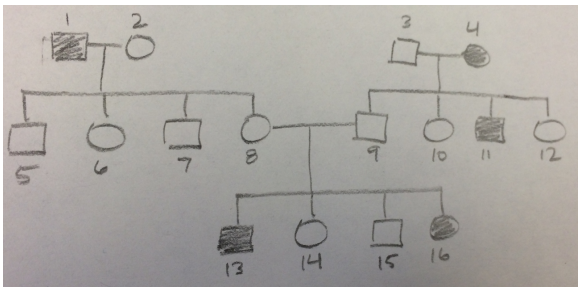
Circle all possible phenotypes: normal, carrier, has albinism

% of kids with disorder:_____ % carriers of the disorder:_____

   b. In the last unit, we also learned that the MC1R protein is important for skin color – if tyrosinase is functional, individuals will produce pheomelanin (pinkish pigment). If that person has a functional MC1R protein, they can produce eumelanin (black/brown pigment).
      i. If an individual has a heterozygous gene for albinism, and a function MC1R, what melanin can they produce? _____ why?
      _____
      ii. If an individual has a homozygous recessive gene for albinism and a functional MC1R, what trait will they display? _____ why?_____
      iii. If an individual has a homozygous dominant gene for albinism and a functional MC1R, what trait will they display? _____ why? _____
      iv. What would the genotype of a person who can only produce pheomelanin be? _____
      How do you know? _____

GROUP G

1. Use the below pedigree chart to answer the following questions about unibrows. A person can either have two eyebrows or one fused eyebrow called a unibrow. The eyebrow gene codes for which type of eyebrows a person will have. The eyebrow gene (E) is dominant over the unibrow gene (e).



   a. How many family members have unibrows? _____
   b. What is the genotype of individual #4? _____
   c. Are individuals #8 and #9 homozygous or heterozygous? _____
      i. How do you know? _____
   d. What is the genotype of individual #2? _____

4. Camellia plants can show three different phenotypes for flower petal colors. When a red camellia (RR) is crossed with a white camellia (rr) the resulting offspring have petals that are red and white (Rr) [see picture below].
   a. Does this inheritance display incomplete or codominance?_____
   b. Explain your choice. _____
   c. What would the heterozygous trait look like if it were the other type of inheritance from what you chose for (a)?_____
   d. Fill out a Punnett square and answer the questions if you cross a red camellia with a white camellia.

Genotypes w/ percentages: _____

Phenotypes w/ percentages: _____

   e. Fill out a Punnett square if you cross a red AND white camellia with a white camellia.

Genotypes w/ percentages: _____

Phenotypes w/ percentages: _____

   f. Bonus question: looking at your results from the cross in (e), is it possible to cross that F1 population to reproduce only red flowers?

CLASS QUESTION

In the middle of the 1800s, Gregor Mendel was trying to determine how traits were passed on from parents to offspring. He recognized that traits are inherited as discrete units from the parent generation and each organism inherits two copies of each discrete unit (which we call?!). Mendel studied plant variation in pea plants. He chose seven traits to follow: pea shape, pea color, pod shape, pod color, plant height, flower color, and flower position. All of these traits are "either-or" characteristics; they are extremes and don't show intermediate phenotypes.

a. Fill out a Punnett square for a cross between a homozygous dominant round pea to a homozygous recessive wrinkled pea.

What ratio of the F1 (offspring) are going to be round? _____

What ratio of the F1 are going to be wrinkled? _____

b. Fill out a Punnett square if you cross an F1 plant with another F1 plant.

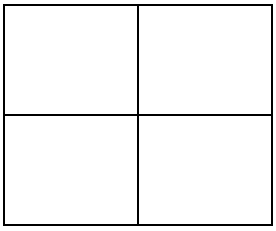
What genotypes can the F2 plant be (include percentages)? _____
_____

What phenotypes could the F2 plants be (include percentages) _____
_____

c. What do you notice about the phenotypes of the parental, F1, and F2 offspring?

BONUS PROBLEMS

1. A man with a widow's peak (homozygous dominant) marries a woman with a continuous hairline (homozygous recessive).
    a. What kind of hairline will their children have?

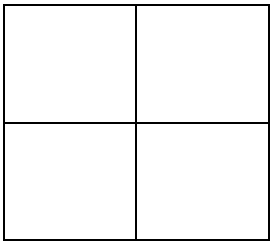


Genotypes of parents: _____

Genotypes of offspring (w/ percentages): _____

Phenotypes of offspring (w/ percentages): _____

    b. If their child marries someone who is a carrier for the widow's peak trait, what kind of hairline might their children have?

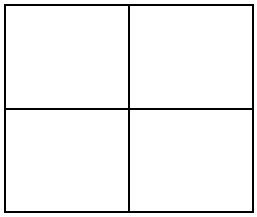


Parent genotypes: _____

Genotypes of offspring (w/ percentages): _____

Phenotypes of offspring (w/ percentages): _____

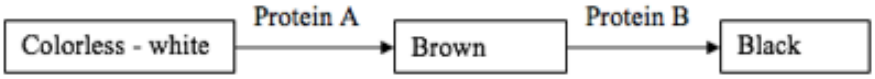
2. Sally and Jake are expecting a baby and know that they are both carriers of PKU. PKU is an autosomal recessive disease. PKU is a buildup of phenylalanine in the body. Untreated PKU can lead to intellectual disability, seizures, behavioral problems, and metal disorders.
    a. Fill out the Punnett square and answer the questions below.



        i. _____% disease free; genotype = _____
        ii. _____% PKU carrier; genotype = _____
        iii. _____% PKU; genotype = _____
    b. If Sally and Jake's baby (Larry) is also a PKU carrier, what is the probability that if Larry has a baby with someone who has PKU, his baby will have PKU? _____
    c. What if Larry has a baby with someone who is disease free? What is the probability that his offspring will have PKU? _____
    d. Still assuming Larry is a PKU carrier, what are the two possible gametes he can produce? In regards to the PKU trait. _____

CHALLENGE PROBLEM

15. Proteins often work together like workers in an assembly line to carry out the processes that make our bodies function. The instructions for building proteins are found in genes. Differences in genes, which pass from parent to child, lead to differences in proteins. Epistasis describes a certain relationship between genes, where one allele of a gene hides or masks the visible output, or phenotype, of another gene. One example of epistasis is feather color in pigeons. Making and distributing feather pigments is a complex, multi-step process involving many proteins. Variations in these proteins generate a lot of diverse feather colors and patterns (this should sound familiar to you!!)



a. Imagine that feather color in pigeons is determined by 2 proteins (A and B). Protein A is coded with dominant allele "A" and recessive allele "a". Protein B is coded with dominant allele "B" and recessive allele "b". Functionality is autosomal dominant.
   i. Fill out a Punnett square crossing an individual who is AaBb to an individual who is AaBb.

   ii. In your Punnett square, circle the genotypes which will result in white birds.
   iii. _____% offspring with brown feathers; genotypes _____
   iv. _____% offspring with black feathers; genotypes _____

REMEMBER, YOU NEED BROWN TO MAKE BLACK!