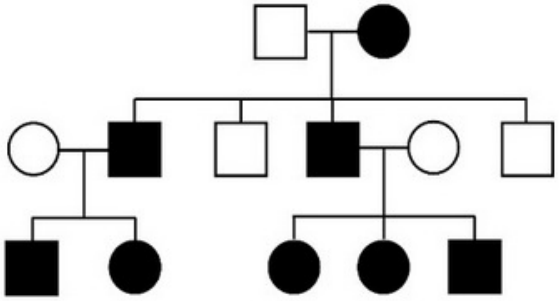
Lesson 8 Simple Genetics Traits

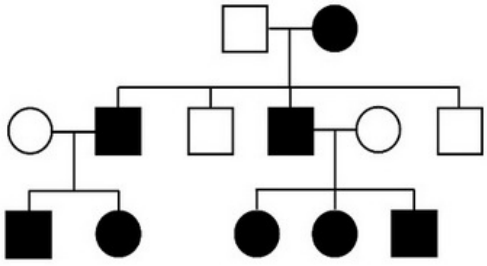
1. Although a mutation that causes a premature stop codon will shorten the overall length of a protein, a cell has a way of recognizing when premature stop codons exist in some mRNA transcripts and clearing them from the cell in a process called Nonsense Mediated Decay, or NMD. Considering only the effects of NMD, would you expect a nonsense mutation that results in the NMD pathway to be a:
   A. Loss-of-function allele
   B. Gain-of-function allele
   Why?

2. Without knowing anything about the actual disease that is traced in this partial pedigree, does this disease show an inheritance pattern likely be autosomal, sex-linked, or maternal/mitochondrial, and how do you know?



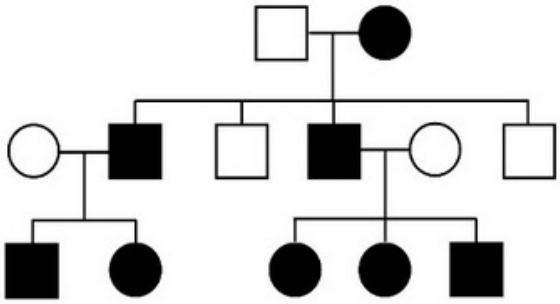
   A. Autosomal
   B. Sex-linked
   C. Maternal/Mitochondrial
   Why?

3. Does this disease appear to be dominant or recessive? Why?



   A. Dominant
   B. Recessive

4. The pedigree shown is from an American family afflicted with Huntington's Disease. It is caused by an expanded trinucleotide repeat (CAG) encoding glutamine in the gene encoding huntingtin, HTT, on chromosome 4. The typical number of CAG repeats in an unaffected person is 18-19, and the average number in Huntington's patients is about 47. Which mutation best describes this trinucleotide repeat expansion?



A. Silent mutation
B. Missense mutation
C. Nonsense mutation
D. Frameshift mutation
E. Insertion mutation

5. Huntington's Disease (HD) is a lethal condition that is inherited in a dominant fashion, i.e. only one copy of the mutated allele is required for the onset of disease. The average age of onset can be quite varied, but typically it is between the ages of 30 and 50. Which of the following two statements must be true? Select any and all that apply.
   A. All carriers of the HD mutation ultimately die of the disease
   B. The HD mutation persists in the gene pool because reproduction can happen before the onset of symptoms
   C. Natural selection prevents the HD mutation from spreading

6. There is currently no cure for Huntington's Disease. If you knew that the disease was prevalent in your extended family, would you want to be screened for the disease-causing mutation? Why or why not?

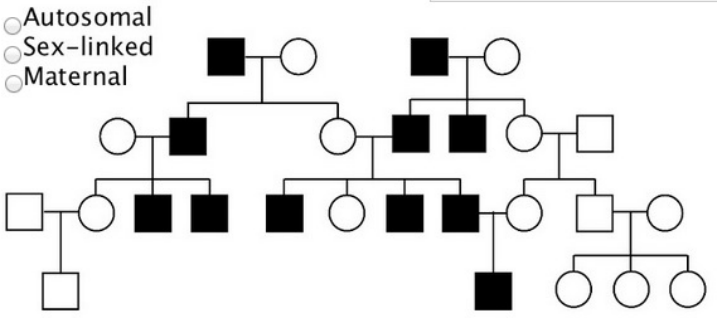
7. After receiving your personal genetics results you become particularly interested in a genetic disorder that your grandmother had: Autosomal Recessive Polycystic Kidney Disease. Knowing just the name alone, how many copies of a mutation would be needed to cause the disease?

8. If two parents each carry one copy of a mutation in the PKHD1 gene that causes Autosomal Recessive Polycystic Kidney Disease, what is the probability that a child of theirs would: be affected? be a carrier? be unaffected? be unaffected and not a carrier?

	Affected	A carrier	Unaffected	Unaffected (but not a carrier)
A.	100%	100%	100%	100%
B.	75%	75%	75%	75%
C.	50%	50%	50%	50%
D.	25%	25%	25%	25%
E.	0%	0%	0%	0%

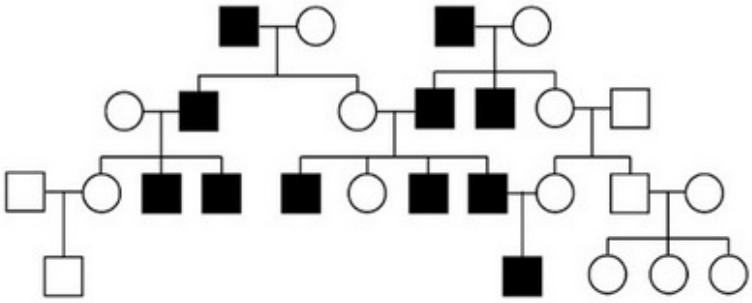
9. A dominant negative mutation indicates a mutant gene product that adversely affects the normal gene product within the same cell, usually by combining with it. Although the dominant negative has lost a certain part of its function (loss-of-function), it out-competes the normal protein, making the mutant effects dominant. This is true for the collagen (COL1A1) mutation in osteogenesis imperfecta. Based on this, which do you think would have a more detrimental effect? Why?
   A. One copy of a silent collagen (COL1A1) mutation
   B. One copy of a dominant negative collagen (COL1A1) mutation
   C. One copy of a complete collagen (COL1A1) deletion mutation

10. Observe the following pedigree for the inheritance of a particular trait:



Is the this an example of a dominant or recessive trait? Is it autosomal, sex-linked, or maternal inheritance pattern? Why?

11. This pedigree is an example of a Y-linked gene. Which of the following statements must be true? Select any and all that apply.

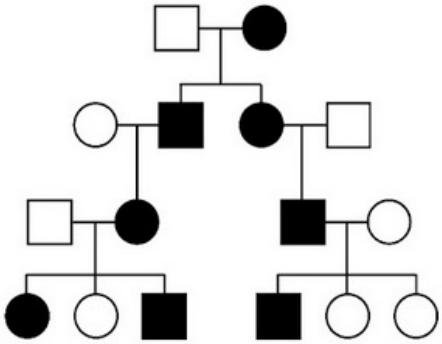


A. Affected fathers always produce affected sons
B. Unaffected sons always have unaffected fathers
C. Affected individuals are homozygous
D. Affected fathers have a 25% probability of having an affected child
E. Daughters can be affected if they are homozygous

12. Match the trait number with the given category of trait:

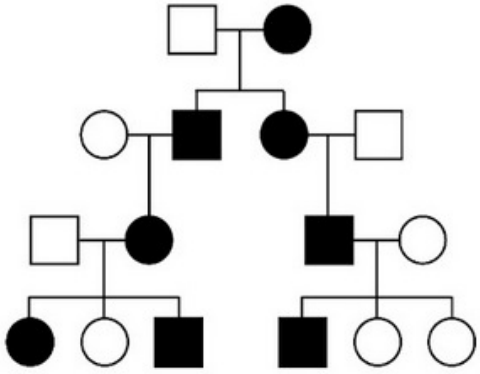
1. Red-Green Color Blindness	___ dominant and loss-of-function
2. Osteogenesis Imperfecta	___ dominant and gain-of-function
3. Achondroplasia	___ recessive and loss-of-function
4. Sickle Cell Anemia	___ recessive and gain-of-function

13. Fatal familial insomnia is a very genetic disorder. It typically presents later in life and results in increasing bouts of insomnia that lead to panic attacks, hallucinations, eventual inability to sleep, significant weight loss, dementia, and ultimately death. Based on the pedigree for this trait, determine the dominance and inheritance pattern.



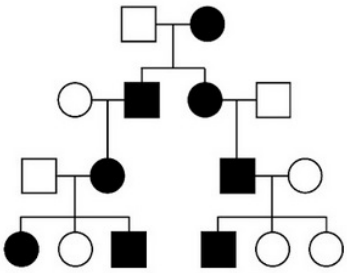
Dominant or Recessive
Autosomal or Sex-linked or Maternal

14. For this pedigree of fatal familial insomnia, which of the following must be true? Select any and all that apply.

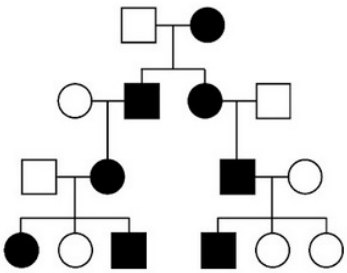


A. This is an example of heterozygote advantage
B. There is not strong selection against this trait because the onset of symptoms are typically after reproductive age
C. The heterozygous condition is lethal
D. The homozygous recessive condition is lethal

15. True or False. In the case of fatal familial insomnia, a heterozygous affected individual who mates with an unaffected individual has a 50% chance of having an unaffected child. Why?



16. True or False. A heterozygous affected individual who mate with another heterozygous person has a 50% chance of having an affected child. Why?



17. Fill in the blank to make the statement true.
    An affected _____ with one copy of an autosomal _____ allele has a bigger chance of having an affected offspring than an affected _____ with one copy of an X-linked _____ allele if both individuals mate with an unaffected partner.
    [Word bank: dominant, recessive, male, female]

18. Select the underlined word in the following paragraph that is incorrect. Then write the correct word that should replace it.
    The recessive sickle cell allele has not been eliminated from the gene pool because it exhibits a homozygote advantage with the dominant allele in areas with a high prevalence of Malaria.

19. Which of the following statements is true? Select any and all that apply. (think hard about this one!) Why?
    A. Silent mutations always result in loss-of-function alleles
    B. Missense mutations always result in loss-of-function alleles
    C. Nonsense mutations always result in loss-of-function alleles
    D. Frameshift mutations always result in loss-of-function alleles

20. Two of the following three statements are true. Identify the false statement and explain why.
    A. Monogenic traits are caused by variations in single genes.
    B. A dominant allele can also be recessive depending on the trait perspective.
    C. Loss-of-function mutations are always recessive.