Pedigrees
Differentiated Lesson B

Background Information: Why was Secretariat a winning horse? Why are spaniels born with a skull too small for their brain? Will my child be at risk for a genetic disorder? These are some of the questions that can be answered by analyzing a pedigree. A pedigree is a diagram that shows the family relationships of individuals and traces specific traits to better inform us.

Learning Targets:

K: Know that a pedigree is a diagram of family relationships that uses symbols to represent people and lines to represent genetic relationships.

U: Understand that pedigrees are used to trace patterns of inheritance through a family. Patterns of inheritance include autosomal recessive, autosomal dominant, sex-linked recessive, and sex-linked dominant.

D: Use a pedigree to identify patterns of inheritance in order to inform patients and families of the risk of inheriting certain traits or disorders.

Directions: Analyze the following pedigrees and answer the questions below. You will need to use Punnett squares during your analysis to determine the pattern of inheritance.

Human Genetics Counseling Aptitude Test

You have sought a job at a human genetic counseling clinic. They gave you an aptitude test shown below. Answer the yes/no questions concerning each of the four pedigrees. Assume that none of these traits is the result of a spontaneous mutation. Assume 100% penetrance for all pedigree problems in this problem set (meaning dominant alleles will always be expressed).

Pedigree A

Could this trait be inherited as a simple...

If "YES", then suggest a genotype for father and mother.
(example genotypes: TT, tt, Tt, T'T', X'T', X'TY', XY')

A. autosomal recessive?

B. autosomal dominant?

C. X-linked recessive?

D. X-linked dominant?

E. Y-linked trait?
Could this trait be inherited as a simple...

If "YES", then suggested genotypes of:
(example genotypes: TT, tt, TT, X\(^Y\)X\(^Y\); X\(^Y\)Y, XY\(^Y\))

**Pedigree B**

A. autosomal recessive? YES NO
B. autosomal dominant? YES NO
C. X-linked recessive? YES NO
D. X-linked dominant? YES NO
E. Y-linked trait?

**FATHER**  x  **MOTHER**

Tt  x  Tt

**Pedigree C**

Could this trait be inherited as a simple...

If "YES", then suggested genotypes of:
(example genotypes: TT, tt, TT, X\(^Y\)X\(^Y\); X\(^Y\)Y, XY\(^Y\))

**FATHER**  x  **MOTHER**

Tt  x  Tt

A. autosomal recessive? YES NO
B. autosomal dominant? YES NO
C. X-linked recessive? YES NO
D. X-linked dominant? YES NO
E. Y-linked trait? YES NO
Could this trait be inherited as a simple...

If "YES", then suggested genotypes of:
(example genotypes: TT, tt, TT, X^YX^, X^Y, XY^)

A. autosomal recessive?  YES  NO  t\text{t} \times \text{t}\text{t}
B. autosomal dominant?  YES  NO  T\text{t} \times \text{tt}
C. X-linked recessive?   YES  NO  X^\text{t}Y \times X^\text{t}X^\text{t}
D. X-linked dominant?   YES  NO  X^\text{t}Y \times X^\text{t}X^\text{t}
E. Y-linked trait?      YES  NO

On the job:
On your first day interning in the office of a human geneticist, a man with purple ears walks in. You questioned the man and wrote down the following family history.
The man's mother and one of his sisters also had purple ears, but his father, his brother, and two other sisters had normal ears. The man and his normal-eared wife had seven children, including four boys and three girls. Two girls and two boys had purple ears.
Draw the family pedigree.

What pattern of inheritance does the purple-ear trait most likely follow? autosomal dominant
2. Achondroplasia is a common form of hereditary dwarfism that causes very short limbs, stubby hands, and an enlarged forehead. Below are three pedigrees depicting families with this specific type of dwarfism.
   A. What is the most likely pattern of inheritance? **Autosomal dominant**
   B. Explain your reasoning.
   "The trait is found in each generation. Males pass the trait to sons." 

   [Pedigrees are shown on the page]

3. Caleb has a double row of eyelashes, which he inherited from his mother as a dominant trait. His maternal grandfather is the only other relative to have the trait. Veronica, a woman with normal eyelashes, falls madly in love with Caleb, and they marry. Their first child, Polly, has normal eyelashes. Now Veronica is pregnant again and hopes they will have a child who has double eyelashes.
   A. What chance does a child of Veronica and Caleb have of inheriting double eyelashes? **50%**
   B. Draw a pedigree of this family. Assign genotypes to each individual.

4. On the soap opera "The Young and the Restless", several individuals suffer from a rapid aging syndrome in which a young child is sent off to boarding school and returns three months later an angry teenager. Victims have been known to age up to two decades. In the Newman family, siblings Nicholas and Victoria aged from ages six and eight to sixteen and eighteen within a few months. Their parents, Victor and Nikki, are not affected; in fact, they never seem to age at all.
   A. What is the pattern of inheritance of the rapid aging disorder affecting Nicholas and Victoria? **Autosomal recessive**
   B. How do you know the pattern of inheritance?
   "The parents do not have the trait. They are carriers."
   C. Draw a pedigree to depict this portion of the Newman family.
5. Jack and Jill get married. As Jill falls down the hill, she cuts herself and bleeds profusely. She goes to the doctor and realizes that she has hemophilia, an X-linked blood disorder. They have 5 children, 3 boys and 2 girls, all of which get tested for hemophilia. They discover that all the boys have hemophilia and one of the daughters is a carrier. The oldest son marries a healthy woman with no family history of hemophilia and they have twin babies who are carriers.

A. Draw the pedigree indicating all individual who have the trait and those who are carriers appropriately. Assign each individual a genotype.

B. What is the sex of these carrier children? Explain you answer.

Female - females can be carriers for sex-linked traits, males cannot because they have only one X.

6. Analyze the following pedigree.

A. Circle the pattern of inheritance.

autosomal recessive  autosomal dominant  sex-linked recessive  sex-linked dominant  y-linked

B. Provide an explanation for the determined pattern of inheritance.

An affected father passes the trait to all his daughters.