Name _____ Date _____

CHAPTER 26

ENRICHMENT ACTIVITY

Genetics Problem Solving

Sex-Linked Traits

Sex-linked traits are those whose genes are found on the X chromosome but not on the Y chromosome. In humans the X chromosome is much larger than the Y chromosome and contains thousands of genes more than the Y chromosome. For each of the genes that are exclusively on the X chromosome, females, who are XX, would obviously have two alleles. Males, who are XY, would have only one allele. Thus, females with one recessive allele and one dominant allele for a gene that is unique to the X chromosome will display the dominant phenotype. However, a male with a recessive allele for a gene unique to the X chromosome will always exhibit that recessive trait because there is no other corresponding allele on the Y chromosome.

In humans, each of three different sex-linked genes has a defective recessive allele that causes a disease. The diseases are hemophilia, color-blindness, and Duchenne's muscular dystrophy, a condition wherein muscles begin to degenerate in childhood. In hemophilia, the defective allele prevents the synthesis of a factor needed for blood clotting. In the example below, hemophilia is used to illustrate how sex-linked traits are designated.

X^H X chromosome with normal dominant allele (nonhemophilia)
X^h X chromosome with recessive hemophilia allele
Y Y chromosome (does not contain comparable gene)

SAMPLE PROBLEM

A man with hemophilia marries a homozygous normal woman. Predict the genotypes and phenotypes of their children.

Step 1 Determine the genotypes of the parents.
hemophiliac male X^hY, normal female X^HX^H
$X^hY \times X^HX^H$

Step 2 Determine the gamete genotypes produced by each parent.
$X^hY \rightarrow X^h, Y$; $X^HX^H \rightarrow X^H$

Step 3 Set up a Punnett square using the gamete genotypes.

	X^h	Y
X^H		

Step 4 Combine the gamete genotypes of one parent with those of the other parent to show all possible offspring genotypes.

	X^h	Y
X^H	X^HX^h	X^HY

Step 5 State the genotype and phenotype ratios of the offspring.
1 X^HX^h: 1 X^HY = ½X^HX^h, ½ X^HY
1 normal female: 1 normal male = ½ normal females, ½ normal males

EXERCISES

For each exercise write out the Punnett square where appropriate, and answer the questions in the spaces provided.

1. A woman who is heterozygous for hemophilia marries a normal man. What will be the possible phenotype ratio of their children?

_____

2. A woman who is a carrier for hemophilia marries a hemophiliac man. What will be their childrens' possible phenotypes?

_____

_____

3. A hemophiliac woman has a phenotypically normal mother. What are the genotypes of her mother and father?

_____

_____

4. A phenotypically normal woman has phenotypically normal parents. However, she has a hemophiliac brother. (a) What are her chances of being a carrier for hemophilia? (b) If she is a carrier and marries a normal male, what is the chance of a child being a hemophiliac?

a. _____

b. _____

5. A phenotypically normal man who has a hemophiliac brother marries a homozygous normal woman. What is the probability that any of their children will be hemophiliac?

_____

6. If a normal-sighted woman whose father was color-blind marries a color-blind man, what is the probability that they will have a son who is color-blind? What is the probability that they will have a color-blind daughter?

_____

7. What is the probability that a color-blind woman who marries a man with normal vision will have a color-blind child?

_____

8. In fruit flies, white eyes is a sex-linked recessive trait. Normal eye color is red. If a white-eyed male is crossed with a heterozygous female, what proportion of the offspring will have red eyes?

_____