

Sex-linked traits

Background Information:

Sex-linked traits are those whose genes are found on the X chromosome but not on the Y chromosome. In humans the X chromosomes are much larger than the Y chromosome and contain thousands of more genes than the Y chromosome. For each of the genes that are exclusively on the X chromosomes, 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 always 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 two different sex-linked genes has a defective recessive allele that causes a disease. The diseases are hemophilia and colorblindness. In hemophilia, the defective allele prevents the synthesis of a factor needed for blood clotting. In colorblindness, the defective allele prevents a person from seeing certain colors.

Use the information below to answer the following questions.

X^H - X chromosome with normal dominant allele (no hemophilia)

X^h - X chromosome with recessive hemophilia allele

Y - Y chromosome (does not contain comparable gene)

X^B - X chromosome with normal dominant allele (not colorblind)

X^b - X chromosome with recessive colorblind allele

Y - Y chromosome (does not contain comparable gene)

1. Write the genotypes for the following phenotypes of red-green color blindness.

a. normal male _____

b. normal female carrying no colorblind alleles (Homozygous) _____

c. colorblind male _____

d. normal female carrying the colorblind allele (Heterozygous) _____

e. colorblind female _____

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2. $X^B X^B \times X^b Y$

a. What proportion/percent of the male children are colorblind? _____

b. What proportion/percent of the female children are colorblind? _____

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3. $X^B X^b \times X^B Y$

a. What proportion of the male children are colorblind? _____

b. What proportion of the female children are colorblind? _____

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4. What is the probability that a colorblind woman who marries a man with normal vision will have a colorblind child? _____

_____ X _____

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5. A normal-sighted woman (whose father was colorblind) marries a colorblind man. _____ X _____

a. What is the probability that they will have a **son** who is colorblind? _____

b. What is the probability that they will have a colorblind **daughter**? _____

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For the following sex-linked punnett squares:

H= normal blood clotting

h=hemophilia

6. $X^H X^h$ x $X^H Y$

- a. What is the probability that any of their offspring will have hemophilia? _____

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7. A woman who is a carrier for hemophilia marries a hemophiliac man.

- a. What proportion of the male children are hemophiliacs? _____
- b. What proportion of the female children are hemophiliacs? _____

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8. A phenotypically normal man marries a homozygous normal woman.

_____ X _____

- a. What is the probability that any of their children will be hemophiliacs? _____

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9. A phenotypically normal woman has phenotypically normal parents. However, she has a hemophiliac brother.

(Mom is carrier)

(Dad)

Brother

a. What are her chances of being a carrier for hemophilia? _____

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ANSWER THE FOLLOWING QUESTIONS USING YOUR KNOWLEDGE OF SEX-LINKED TRAITS, THE BACKGROUND INFORMATION AND YOUR NOTES.

10. What is a sex-linked trait?

11. Why must males inherit colorblindness or hemophilia from their mothers?

12. Why is colorblindness or hemophilia more common in males than in females?