

Practice with Sex Linkage and Other Cool Stuff

1. In fruit flies, eye color is sex-linked. What are the expected sexes and eye colors from the following crosses?

- red-eyed (homozygous) female x white-eyed male
- carrier female x white-eyed male
- white-eyed female x red-eyed male
- female carrier x red-eye male

2. A recessive sex-linked gene (h) located on the X chromosome increases blood-clotting time. This causes the genetic disease, hemophilia.

- Explain how a hemophilic offspring can be born to two normal parents.
- Would any of the female offspring have hemophilia?

3. A mutant sex-linked trait called "notched" (N) is deadly in *Drosophila* when homozygous in females. Males who have a single N allele will also die. The heterozygous condition (Nn) causes small notches on the wing. The normal condition in both male and females is represented by the allele n.

- Indicate the phenotypes of the F₁ generation from the following cross: $X^N X^n \times X^n Y$
- Explain why dead females are never found in the F₁ generation no matter which parents are crossed.
- Explain why the mating of female $X^N X^n$ and a male $X^N y$ is unlikely.

4. In *Drosophila*, eye color is determined by two different genes located on different chromosomes. A recessive gene b, found on chromosome 2 (an autosome), produces brown eye color. A recessive sex-linked gene v causes vermilion eye color to be produced. The presence of the dominant genes b⁺ and v⁺ results in a wild-type color. The presence of both the brown and vermilion allele, in the homozygous condition result in an individual with white eyes. Indicate the genotypes and phenotypes produced from the following crosses:

- $b^+ b^+ X^v X^v$ (wild-type female) x $bb X^v y$ (white-eyed male)
- $b^+ b X^v X^v$ (wild-type female) x $b^+ b X^v y$ (wild-type male)
- $bb X^v X^v$ (brown-eyed female) x $b^+ b X^v y$ (vermilion-eyed male)

5. Larry has hemophilia (a recessive, X-linked condition) but his daughter, Lauren, has a normal phenotype. She marries Jake who is normal for the trait.

- What is the probability that Lauren and Jake have a daughter with hemophilia?
- What are the chances of having a son with the disorder?
- What are the chances of their daughters being a carrier?
- If the couple has four sons, what is the probability that all four will be hemophiliac?
- In a different family, Jill's father had hemophilia. What are the chances that she is normal for the trait? Explain.
- If we learn that her mother was a carrier, what are the chances that she is normal? A carrier?

6. Red-green colorblindness is caused by a sex-linked recessive allele. A color blind man marries a woman with normal vision whose father was color blind. What is the probability that they will have a color blind daughter? What is the probability that their first son will be color blind? (Notice that these questions are worded slightly differently)

7. Paul is colorblind and he marries Linda, whose father was colorblind.

- a) What are the chances they have a normal boy?
- b) What are the chances that their sons will be colorblind?
- c) What are their chances of having a normal girl?
- d) What are the chances that their daughters will be carriers?

8. The coat color in cats is determined by several genes. One of those genes is sex-linked and has two codominant alleles – one for orange fur and one for black fur. The heterozygous condition produces a pattern called calico (or tortoiseshell, depending on the presence of other alleles).

- a) What types of kittens could result from a cross between a black female and a orange male.
- b) If one kitten were later crossed with the male parent, what offspring would result?
- c) If a calico cat were mated to a black cat, what are the chances of them producing calico females?
- d) If a calico cat were mated to a black cat, what are the chances of them producing calico males?

9. A coloboma is a defect of the eye which results in a hole in one of the structures of the eyes, such as the iris, retina or optic nerve. A man and woman are divorced and the man is refusing to pay child support on the grounds that the child is the product of his wife's infidelity. Both he and his wife have normal eyes, but their first daughter has a coloboma of the iris. The particular trait is known to display sex-linked recessive inheritance. Imagine that you are a genetic counselor and the man's lawyer has come to you for your expert opinion. What would you say about the man's claim regarding the paternity of the child?