SEX - LINKED Practice Problems

A female has the chromosomes XX, while a male has the chromosomes XY. In sex-linked inheritance the genes are carried on the X chromosome as a rule and are usually recessive. For example: A woman with a normal gene on one X chromosome will not be colorblind, but is called a carrier for colorblindness. In order to be colorblind, a woman must carry the recessive allele for colorblindness on each of her X chromosomes. A male is either normal or has colorblindness. He cannot be a carrier.

1 The gene for colorblindness is carried on the X chromosome and is recessive. A man, whose father was colorblind, has a colorblind daughter.
   a) Is this man colorblind? How do you know?
   b) Where did he get his gene for colorblindness?
   c) Must the fathers of all colorblind girls be colorblind? Why?

2 A man whose parents were normal with respect for color vision marries a woman of normal vision and similar pedigree. One of their daughters is colorblind. Give the genotypes of this daughter, her parents, and paternal grandparents. Is the girl's father colorblind?

3 Cross a woman carrier for hemophilia to a hemophiliac man.
   a) What fraction of the offspring will be carrier females?
   b) What fraction will be normal males?
   c) What fraction will be normal females--those who do not have the disease?
   d) What fraction will be hemophiliac females?
   e) What is the genotype of the carrier female?
   f) How many different genotypes are possible among the offspring?

4 Brown eyes are dominant over blue eyes. This is NOT a sex-linked trait. Cross a brown-eyed colorblind male (whose mother had blue eyes) with a normal blue-eyed female (whose father was colorblind).
   a) What is the genotype of the male?
   b) What is the genotype of the female?
   c) What is the probability of getting offspring that are blue-eyed carrier females? (Remember that a carrier is a female that carries one copy of the sex-linked allele, but does not have the disease.)
   d) What is the probability of getting offspring that are blue-eyed?
   e) What is the probability of getting offspring that are blue-eyed colorblind males?
   f) What is the probability of getting offspring that are brown-eyed carrier females?
   g) What is the probability of getting offspring that are blue-eyed normal males?
   h) What is the probability of getting offspring that are colorblind?

5 Brown eyes are dominant over blue. This is NOT a sex-linked trait. If a blue-eyed colorblind woman marries a normal visioned man who is homozygous for brown eye color, what kind of children might they expect with respect to these two traits? If one of the sons in turn marries a heterozygous brown-eyed, normal visioned woman, not a carrier, what kinds of children might they expect?

6 A normal woman who is a carrier for colorblindness marries a normal man. What types of offspring would you expect?

7 Hemophilia is inherited exactly like colorblindness. The dominant allele calls for normal clotting time of the blood; the recessive for hemophilia. A normal woman marries a normal man. They have one daughter and 14 sons, all normal. In view of this, what gene combination would this woman most likely have? Why do you say this? What is the probable genotype of the daughter?
8 A man whose father was a hemophiliac, but whose own blood clotting time is normal, marries a normal woman with no record of hemophilia in her ancestry. What is the chance of hemophilia in their children?

9 If a husband and wife have a heterozygous girl for colorblindness, a normal boy, a colorblind girl, and a colorblind boy, what would be the genotypes of the parents?

10 Suppose a young lady comes to you for advice in your capacity as a marriage counselor. She tells you that her brother has hemophilia, but both her parents are normal. She wishes to marry a man who has no history of hemophilia in his family and wants you to tell her the probability of her children having this disease. What would you tell her, and how would you explain your conclusions?

11 A man sues his wife on the grounds of infidelity. Both man and wife have normal vision, but their daughter has coloboma irisis, a fissure in the iris of the eye. This is known to be sex-linked recessive. If you were the man's lawyer, could you use this fact as evidence? If so, how?

12 In man, defective color vision results from a sex linked recessive allele. A man (1) and a woman (2), both of normal vision, have the following three children, all of whom are married to people with normal vision: a colorblind son (3) who has a daughter of normal vision (6); a daughter of normal vision (4) who has one colorblind son (7) and two normal sons (8); and a daughter of normal vision (5) who has six normal sons (9). Give the genotypes of all the individuals in the family (1 to 9).

13 In fruit flies, eye color is carried on the X chromosome. The allele for red eyes is dominant over its recessive allele, white eyes. Cross a homozygous red-eyed female to white-eyed male.
   a) What is the genotype of the male?
   b) What is the genotype of the female?
   c) How many genotypes are possible among the offspring?
   d) How many phenotypes are possible among the offspring?
   e) What is the probability of getting offspring that are red-eyed males?
   f) What is the probability of getting offspring that are white-eyed males?
   g) What is the probability of getting offspring that are red-eyed females?
   h) What is the probability of getting offspring that are white-eyed females?

14 In fruit flies, eye color is carried on the X chromosome. The allele for red eyes is dominant over its recessive allele, white eyes. Two fruit flies are mated; both have red eyes. The female offspring are all red-eyed, but some of the male offspring are white-eyed and some are red-eyed.
   a) What is the genotype of the male parent?
   b) What is the genotype of the female parent?
   c) What is the genotype of the red-eyed female offspring?
   d) What is the genotype of the red-eyed male offspring?
   e) What is the genotype of the white-eyed male offspring?

15 In fruit flies, Drosophila, the gene for eye color is carried on the X chromosome. The allele for red eyes is dominant over its recessive allele, white eyes.
   a) If a white-eyed female is mated with a red-eyed male, what is the appearance of their offspring?
   b) If the daughters from this cross are mated with their father, what types of offspring would be expected and the probability of each?

16 In fruit flies, normal wings (N) are dominant over vestigial wings (n). This is not a sex-linked trait. What offspring would be expected if a heterozygous normal winged white eyed male were mated with a female who has vestigial wings and is heterozygous red-eyed?
In alley cats, the coat color is determined by a gene carried on the X chromosome. At the same time, the alleles are expressed as intermediate (nondominance) inheritance. Genotypes and color are as follows:

- **Females:**
  - $X^bX^b$ = yellow
  - $X^BX^b$ = calico
  - $X^BX^B$ = black

- **Males:**
  - $X^bY$ = yellow
  - $X^BY$ = black

17. A calico cat has a litter of eight kittens: one yellow male, two black males, two yellow females, and three calico females. What is the color of the father of the litter?

18. A black cat has a litter of seven kittens: three black males, one black female, and three calico females. Comment on the probable paternity of this litter and explain.

19. A yellow cat has a litter of four kittens: one yellow, and three calicos. Assuming a single father for the litter, what is the sex of the yellow kitten?
SEX - LINKED Practice Problems

A female has the chromosomes XX, while a male has the chromosomes XY. In sex-linked inheritance the genes are carried on the X chromosome as a rule and are usually recessive. For example: A woman with a normal gene on one X chromosome will not be colorblind, but is called a carrier for colorblindness. In order to be colorblind, a woman must carry the recessive allele for colorblindness on each of her X chromosomes. A male is either normal or has colorblindness. He cannot be a carrier.

1 The gene for colorblindness is carried on the X chromosome and is recessive. A man, whose father was colorblind, has a colorblind daughter.

a) Is this man colorblind? How do you know?

b) Where did he get his gene for colorblindness?

c) Must the fathers of all colorblind girls be colorblind? Why?

2 A man whose parents were normal with respect for color vision marries a woman of normal vision and similar pedigree. One of their daughters is colorblind. Give the genotypes of this daughter, her parents, and paternal grandparents.

_____ Grandmother   _____ Grandfather

_____ Mom            _____ Dad

_____ Daughter

Does the father of the colorblind daughter have to be colorblind? ______________

3 Cross a woman carrier for hemophilia to a hemophiliac man.

<table>
<thead>
<tr>
<th>Genotypes</th>
<th>Phenotypes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

_______(a) What fraction of the offspring will be carrier females?

_______(b) What fraction will be normal males?

_______(c) What fraction will be normal females--those who do not have the disease?

_______(d) What fraction will be hemophiliac females?

_______(e) What is the genotype of the carrier female?

_______(f) How many different genotypes are possible among the offspring?
Brown eyes are dominant over blue eyes. This is NOT a sex-linked trait. Cross a brown-eyed colorblind male (whose mother had blue eyes) with a normal blue-eyed female (whose father was colorblind).

_________ Genotype of the male

_________ Genotype of the female

<table>
<thead>
<tr>
<th>Genotypes</th>
<th>Phenotypes</th>
</tr>
</thead>
</table>

What is the probability of getting offspring that are blue-eyed carrier females? (Remember that a carrier is a female that carries one copy of the sex-linked allele, but does not have the disease.)

What is the probability of getting offspring that are blue-eyed?

What is the probability of getting offspring that are blue-eyed colorblind males?

What is the probability of getting offspring that are brown-eyed carrier females?

What is the probability of getting offspring that are blue-eyed normal males?

What is the probability of getting offspring that are colorblind?

Brown eyes are dominant over blue. This is NOT a sex-linked trait. If a blue-eyed colorblind woman marries a normal visioned man who is homozygous for brown eye color, what kind of children might they expect with respect to these two traits?

_________ Genotype of woman

_________ Genotype of man

What two genotypes are possible in the children?

If one of the sons in turn marries a heterozygous brown-eyed, normal visioned woman, not a carrier, what kinds of children might they expect?
6 A normal woman who is a carrier for colorblindness marries a normal man. What types of offspring would you expect?

________ Genotype of woman          _______ Genotype of man

7 Hemophilia is inherited exactly like colorblindness. The dominant allele calls for normal clotting time of the blood; the recessive for hemophilia. A normal woman marries a normal man. They have one daughter and 14 sons, all normal. In view of this, what gene combination would this woman most likely have? Why do you say this? What is the probable genotype of the daughter?

8 A man whose father was a hemophiliac, but whose own blood clotting time is normal, marries a normal woman with no record of hemophilia in her ancestry. What is the chance of hemophilia in their children?

9 If a husband and wife have a heterozygous girl for colorblindness, a normal boy, a colorblind girl, and a colorblind boy, what would be the genotypes of the parents?
Suppose a young lady comes to you for advice in your capacity as a marriage counselor. She tells you that her brother has hemophilia, but both her parents are normal. She wishes to marry a man who has no history of hemophilia in his family and wants you to tell her the probability of her children having this disease. What would you tell her, and how would you explain your conclusions?

A man sues his wife on the grounds of infidelity. Both man and wife have normal vision, but their daughter has coloboma irisis, a fissure in the iris of the eye. This is known to be sex-linked recessive. If you were the man's lawyer, could you use this fact as evidence? If so, how?

In man, defective color vision results from a sex linked recessive allele. A man (1) and a woman (2), both of normal vision, have the following three children, all of whom are married to people with normal vision: a colorblind son (3) who has a daughter of normal vision (6); a daughter of normal vision (4) who has one colorblind son (7) and two normal sons (8); and a daughter of normal vision (5) who has six normal sons (9). Give the genotypes of all the individuals in the family (1 to 9).
In fruit flies, eye color is carried on the X chromosome. The allele for red eyes is dominant over its recessive allele, white eyes. Cross a homozygous red-eyed female to white-eyed male.

_________ What is the genotype of the male?  
_________ What is the genotype of the female?

<table>
<thead>
<tr>
<th>Genotypes</th>
<th>Phenotypes</th>
</tr>
</thead>
</table>

_________ How many genotypes are possible among the offspring?  
_________ How many phenotypes are possible among the offspring?  
_________ What is the probability of getting offspring that are red-eyed males?  
_________ What is the probability of getting offspring that are white-eyed males?  
_________ What is the probability of getting offspring that are red-eyed females?  
_________ What is the probability of getting offspring that are white-eyed females?

In fruit flies, eye color is carried on the X chromosome. The allele for red eyes is dominant over its recessive allele, white eyes. Two fruit flies are mated; both have red eyes. The female offspring are all red-eyed, but some of the male offspring are white-eyed and some are red-eyed.

_________ What is the genotype of the male parent?  
_________ What is the genotype of the female parent?  
_________ What is the genotype of the red-eyed female offspring?  
_________ What is the genotype of the red-eyed male offspring?  
_________ What is the genotype of the white-eyed male offspring?
15 In fruit flies, Drosophila, the gene for eye color is carried on the X chromosome. The allele for red eyes is dominant over its recessive allele, white eyes.

a) If a white-eyed female is mated with a red-eyed male, what is the appearance of their offspring?

_________ Genotype of white-eyed female

_________ Genotype of red-eyed male

________________________ What are the two possible genotypes in the offspring?

b) If the daughters from this cross are mated with their father, what types of offspring would be expected and the probability of each?

16 In fruit flies, normal wings (N) are dominant over vestigial wings (n). This is not a sex-linked trait. What offspring would be expected if a heterozygous normal winged, white eyed male were mated with a female who has vestigial wings and is heterozygous red-eyed?

_________ Genotype of the male

_________ Genotype of the female
In alley cats, the coat color is determined by a gene carried on the X chromosome. At the same time, the alleles are expressed as intermediate (nondominance) inheritance. Genotypes and color are as follows:

Females: \( X^bX^b = \text{yellow} \)  
\( X^BX^b = \text{calico} \)  
\( X^BX^B = \text{black} \)

Males: \( X^bY = \text{yellow} \)  
\( X^BY = \text{black} \)

17 A calico cat has a litter of eight kittens: one yellow male, two black males, two yellow females, and three calico females. What is the color of the father of the litter?

18 A black cat has a litter of seven kittens: three black males, one black female, and three calico females. Comment on the probable paternity of this litter and explain.

19 A yellow cat has a litter of four kittens: one yellow, and three calicos. Assuming a single father for the litter, what is the sex of the yellow kitten?
SEX - LINKED Practice Problems

A female has the chromosomes XX, while a male has the chromosomes XY. In sex-linked inheritance the genes are carried on the X chromosome as a rule and are usually recessive. For example: A woman with a normal gene on one X chromosome will not be colorblind, but is called a carrier for colorblindness. In order to be colorblind, a woman must carry the recessive allele for colorblindness on each of her X chromosomes. A male is either normal or has colorblindness. He cannot be a carrier.

1. The gene for colorblindness is carried on the X chromosome and is recessive. A man, whose father was colorblind, has a colorblind daughter.
   
a) Is this man colorblind? How do you know? Yes. To have a colorblind daughter, the man would have to have the colorblind allele himself.  
b) Where did he get his gene for colorblindness? Men get their X chromosome from their mother.  
c) Must the fathers of all colorblind girls be colorblind? Why? Yes. A colorblind daughter must receive the colorblind allele from each parent.  

2. A man whose parents were normal with respect for color vision marries a woman of normal vision and similar pedigree. One of their daughters is colorblind. Give the genotypes of this daughter, her parents, and paternal grandparents.  
   
   \[ \begin{array}{c} 
   X^b Y \\
   X^b X^b \\
   X^b Y \\
   \end{array} \] 
   Grandmother  
   \[ \begin{array}{c} 
   X^y Y \\
   X^y Y \\
   \end{array} \] 
   Grandfather  
   \[ \begin{array}{c} 
   X^X \\
   X^X \\
   \end{array} \] 
   Mom  
   \[ \begin{array}{c} 
   X^y Y \\
   \end{array} \] 
   Dad  
   \[ \begin{array}{c} 
   X^X \\
   \end{array} \] 
   Daughter  

   Does the father of the colorblind daughter have to be colorblind? Yes  

3. Cross a woman carrier for hemophilia to a hemophiliac man.  

   \[ \begin{array}{c|c|c|c} 
   X^h & X^h & X^h Y & X^H Y \\
   X^h & X^h & X^h Y & X^H Y \\
   Y & X^h Y & X^h Y & X^H Y \\
   \end{array} \]  

   Genotypes | Phenotypes  
   \[ \begin{array}{c|c|c} 
   \frac{1}{4} X^h X^h & \frac{1}{4} X^h X^h & \frac{1}{4} \text{ female hemophiliac} \\
   \frac{1}{4} X^H X^h & \frac{1}{4} X^H Y & \frac{1}{4} \text{ normal female} \\
   \frac{1}{4} X^h Y & \frac{1}{4} X^h Y & \frac{1}{4} \text{ hemophiliac male} \\
   \frac{1}{4} X^H Y & \frac{1}{4} X^H Y & \frac{1}{4} \text{ normal male} \\
   \end{array} \]  

   \[ \begin{array}{c} 
   X^h X^h \\
   X^h Y \\
   \end{array} \]  

   (a) What fraction of the offspring will be carrier females?  
   \[ \begin{array}{c} 
   \frac{1}{4} \\
   \frac{1}{4} \\
   \end{array} \]  

   (b) What fraction will be normal males?  
   \[ \begin{array}{c} 
   \frac{1}{4} \\
   \end{array} \]  

   (c) What fraction will be normal females--those who do not have the disease?  
   \[ \begin{array}{c} 
   \frac{1}{4} \\
   \end{array} \]  

   (d) What fraction will be hemophiliac females?  
   \[ \begin{array}{c} 
   \frac{1}{4} \\
   \end{array} \]  

   (e) What is the genotype of the carrier female?  
   \[ \begin{array}{c} 
   \frac{1}{4} \\
   \end{array} \]  

   (f) How many different genotypes are possible among the offspring?
Brown eyes are dominant over blue eyes. This is NOT a sex-linked trait. Cross a brown-eyed colorblind male (whose mother had blue eyes) with a normal blue-eyed female (whose father was colorblind).

\[ B b \times y \] Genotype of the male   \[ b b \times X^c X \] Genotype of the female

<table>
<thead>
<tr>
<th>Genotypes</th>
<th>Phenotypes</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \frac{2}{16} ) Bb X^c X^c</td>
<td>( \frac{2}{16} ) Bb X^c X</td>
</tr>
<tr>
<td>( \frac{2}{16} ) Bb X^c Y</td>
<td>( \frac{2}{16} ) Bb X^c X</td>
</tr>
<tr>
<td>( \frac{2}{16} ) Bb X Y</td>
<td>( \frac{2}{16} ) Bb X^c X</td>
</tr>
<tr>
<td>( \frac{2}{16} ) bb X^c X</td>
<td>( \frac{2}{16} ) bb X^c X</td>
</tr>
<tr>
<td>( \frac{2}{16} ) bb X Y</td>
<td>( \frac{2}{16} ) bb X Y</td>
</tr>
<tr>
<td>( \frac{2}{16} ) bb X Y</td>
<td>( \frac{2}{16} ) bb X Y</td>
</tr>
</tbody>
</table>

What is the probability of getting offspring that are blue-eyed carrier females? (Remember that a carrier is a female that carries one copy of the sex-linked allele, but does not have the disease.)

What is the probability of getting offspring that are blue-eyed?

What is the probability of getting offspring that are blue-eyed colorblind males?

What is the probability of getting offspring that are brown-eyed carrier females?

What is the probability of getting offspring that are blue-eyed normal males?

What is the probability of getting offspring that are colorblind?

Brown eyes are dominant over blue. This is NOT a sex-linked trait. If a blue-eyed colorblind woman marries a normal visioned man who is homozygous for brown eye color, what kind of children might they expect with respect to these two traits?

\[ b b \times X^c X \] Genotype of woman   \[ B B \times y \] Genotype of man

\[ B b \times X^c X \] or \[ B b \times X^c Y \] What two genotypes are possible in the children?

If one of the sons in turn marries a heterozygous brown-eyed, normal visioned woman, not a carrier, what kinds of children might they expect? \[ B b \times X^c Y \times B b \times X X \]

<table>
<thead>
<tr>
<th>Genotypes</th>
<th>Phenotypes</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \frac{1}{16} ) BB X^c X^c</td>
<td>( \frac{1}{16} ) BB X^c Y</td>
</tr>
<tr>
<td>( \frac{1}{16} ) BB X X</td>
<td>( \frac{1}{16} ) BB X^c X</td>
</tr>
<tr>
<td>( \frac{1}{16} ) BB X Y</td>
<td>( \frac{1}{16} ) BB X X</td>
</tr>
<tr>
<td>( \frac{1}{16} ) bb X^c X</td>
<td>( \frac{1}{16} ) bb X^c X</td>
</tr>
<tr>
<td>( \frac{1}{16} ) bb X Y</td>
<td>( \frac{1}{16} ) bb X Y</td>
</tr>
<tr>
<td>( \frac{1}{16} ) bb X Y</td>
<td>( \frac{1}{16} ) bb X Y</td>
</tr>
<tr>
<td>( \frac{1}{16} ) bb X Y</td>
<td>( \frac{1}{16} ) bb X Y</td>
</tr>
</tbody>
</table>
6 A normal woman who is a carrier for colorblindness marries a normal man. What types of offspring would you expect?

\[ X^c X \quad \text{Genotype of woman} \quad Xy \quad \text{Genotype of man} \]

<table>
<thead>
<tr>
<th>Genotypes</th>
<th>Phenotypes</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \frac{1}{4} X^c X )</td>
<td>( \frac{3}{4} ) female with normal vision</td>
</tr>
<tr>
<td>( \frac{1}{4} X X )</td>
<td>( \frac{1}{4} ) colorblind male</td>
</tr>
<tr>
<td>( \frac{1}{2} X^c Y )</td>
<td>( \frac{1}{4} ) normal male</td>
</tr>
</tbody>
</table>

7 Hemophilia is inherited exactly like colorblindness. The dominant gene calls for normal clotting time of the blood; the recessive for hemophilia. A normal woman marries a normal man. They have one daughter and 14 sons, all normal. In view of this, what gene combination would this woman most likely have? Why do you say this? What is the probable genotype of the daughter?

The woman is most likely \( X^H X^H \) and is not carrying the recessive allele for colorblindness. If she carried one copy of the recessive allele, it is probable that her sons would have hemophilia.

The daughter is probably \( XX \).

8 A man whose father was a hemophiliac, but whose own blood clotting time is normal, marries a normal woman with no record of hemophilia in her ancestry. What is the chance of hemophilia in their children?

\[ \text{Man} = Xy \]
\[ \text{Woman} = XX \]
No chance in their children.

9 If a husband and wife have a heterozygous girl for colorblindness, a normal boy, a colorblind girl, and a colorblind boy, what would be the genotypes of the parents?

\[ \text{Mom} = X^c X \]
\[ \text{Dad} = X^c Y \]

Children:
- \( X^c X \)
- \( X^c Y \)
- \( X X \)
- \( X Y \)
- \( X^c Y \)
Suppose a young lady comes to you for advice in your capacity as a marriage counselor. She tells you that her brother has hemophilia, but both her parents are normal. She wishes to marry a man who has no history of hemophilia in his family and wants you to tell her the probability of her children having this disease. What would you tell her, and how would you explain your conclusions?

If the brother has hemophilia, their mother was a carrier for the disease. The daughter could then be $X^H X^H$ or $X^h X^h$.

- If she is $X^H X^H$ there is no chance of producing a child with hemophilia.
- If she is $X^H X^h$, she might produce a son (25% chance) who has hemophilia.

A man sues his wife on the grounds of infidelity. Both man and wife have normal vision, but their daughter has coloboma iridis, a fissure in the iris of the eye. This is known to be sex-linked recessive. If you were the man's lawyer, could you use this fact as evidence? If so, how?

- If the man has normal vision, he could not produce a daughter with the disease. He could use this as evidence.
- He is not the child’s father.

In man, defective color vision results from a sex linked recessive gene. A man (1) and a woman (2), both of normal vision, have the following three children, all of whom are married to people with normal vision: a colorblind son (3) who has a daughter of normal vision (6); a daughter of normal vision (4) who has one colorblind son (7) and two normal sons (8); and a daughter of normal vision (5) who has six normal sons (9). Give the genotypes of all the individuals in the family (1 to 9).
In fruit flies, eye color is carried on the X chromosome. The gene for red eyes is dominant over its recessive allele, white eyes. Cross a homozygous red-eyed female to white-eyed male.

\[ X^r Y \] What is the genotype of the male? \[ X^R X^R \] What is the genotype of the female?

<table>
<thead>
<tr>
<th>Genotypes</th>
<th>Phenotypes</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \frac{1}{4} X^R X^r )</td>
<td>( \frac{3}{4} ) red-eyed females</td>
</tr>
<tr>
<td>( \frac{3}{4} X^R Y )</td>
<td>( \frac{1}{4} ) red-eyed male</td>
</tr>
</tbody>
</table>

2 How many genotypes are possible among the offspring?

2 How many phenotypes are possible among the offspring?

\( \frac{3}{4} \) What is the probability of getting offspring that are red-eyed males?

0 What is the probability of getting offspring that are white-eyed males?

\( \frac{3}{4} \) What is the probability of getting offspring that are red-eyed females?

0 What is the probability of getting offspring that are white-eyed females?

In fruit flies, eye color is carried on the X chromosome. The gene for red eyes is dominant over its recessive allele, white eyes. Two fruit flies are mated: both have red eyes. The female offspring are all red-eyed, but some of the male offspring are white-eyed and some are red-eyed.

\[ X^R Y \] What is the genotype of the male parent?

\[ X^R X^r \] What is the genotype of the female parent?

\[ X^R X^r \text{ or } X^r X^r \] What is the genotype of the red-eyed female offspring?

\[ X^R Y \] What is the genotype of the red-eyed male offspring?

\[ X^r Y \] What is the genotype of the white-eyed male offspring?
In fruit flies, Drosophila, the gene for eye color is carried on the X chromosome. The gene for red eyes is dominant over its recessive allele, white eyes.

a) If a white-eyed female is mated with a red-eyed male, what is the appearance of their offspring?

- Genotype of white-eyed female: \( X^r X^r \)
- Genotype of red-eyed male: \( X^R y \)
- \( X^R X^r \) or \( X^r y \) What are the two possible genotypes in the offspring?

b) If the daughters from this cross are mated with their father, what types of offspring would be expected and the probability of each?

\[ \begin{array}{cc}
X^R & X^r \\
X^R & X^R X^R & X^R X^r \\
X^r & X^R X^r & X^r y \\
y & X^r y & X^r y \\
\end{array} \]

<table>
<thead>
<tr>
<th>Genotypes</th>
<th>Phenotypes</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \frac{1}{4} X^R X^R )</td>
<td>( \frac{3}{4} ) red-eyed females</td>
</tr>
<tr>
<td>( \frac{1}{4} X^R X^r )</td>
<td>( \frac{1}{4} ) red-eyed male</td>
</tr>
<tr>
<td>( \frac{1}{4} X^r y )</td>
<td>( \frac{1}{4} ) white-eyed male</td>
</tr>
<tr>
<td>( \frac{1}{4} X^r y )</td>
<td></td>
</tr>
</tbody>
</table>

In fruit flies, normal wings (N) are dominant over vestigial wings (n). This is not a sex-linked trait. What offspring would be expected if a heterozygous normal winged (dominant) white eyed male were mated with a female who has vestigial wings and is heterozygous red-eyed?

- Genotype of the male: \( N n X^r y \)
- Genotype of the female: \( n n X^R y \)

\[ \begin{array}{cccc}
N X^r & N y & n X^r & n y \\
N X^r & N n X^R X^r & N n X^R y & n n X^R X^r & n n X^R y \\
N y & N n X^R y & n n X^R X^r & n n X^R y \\
N X^r & N n X^R X^r & N n X^R y & n n X^R X^r & n n X^R y \\
N X^r & N y & n n X^R X^r & n n X^R y \\
\end{array} \]

<table>
<thead>
<tr>
<th>Genotypes</th>
<th>Phenotypes</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \frac{1}{4} N n X^R X^r )</td>
<td>( \frac{3}{4} ) normal red-eyed</td>
</tr>
<tr>
<td>( \frac{1}{4} N n X^R y )</td>
<td>( \frac{1}{4} ) normal white-eyed</td>
</tr>
<tr>
<td>( \frac{1}{4} N n X^R X^r )</td>
<td>( \frac{3}{4} ) normal red-eyed</td>
</tr>
<tr>
<td>( \frac{1}{4} n n X^R y )</td>
<td>( \frac{1}{4} ) normal white-eyed</td>
</tr>
<tr>
<td>( \frac{1}{4} n n X^R X^r )</td>
<td>( \frac{3}{4} ) normal red-eyed</td>
</tr>
<tr>
<td>( \frac{1}{4} n n X^R y )</td>
<td>( \frac{1}{4} ) normal white-eyed</td>
</tr>
</tbody>
</table>
In alley cats, the coat color is determined by a gene carried on the X chromosome. At the same time, the alleles are expressed as intermediate (nondominance) inheritance. Genotypes and color are as follows:

Females: \( X^bX^b = \text{yellow} \)  
\( X^B^X^b = \text{calico} \)  
\( X^B^X^B = \text{black} \)

Males: \( X^bY = \text{yellow} \)  
\( X^B^Y = \text{black} \)

17. A calico cat has a litter of eight kittens: one yellow male, two black males, two yellow females, and three calico females. What is the color of the father of the litter?

\[ \text{female: } X^B^X^b \]
\[ x \]
\[ 1 \text{ } X^bY \]
\[ 2 \text{ } X^bY \]
\[ 2 \text{ } X^bX^b \]
\[ 3 \text{ } X^bX^b \]

In order to produce yellow females, this father would have to be \( X^bY = \text{yellow} \).

18. A black cat has a litter of seven kittens: three black males, one black female, and three calico females. Comment on the probable paternity of this litter and explain.

\[ X^B^X^b \]
\[ x \]
\[ 3 \text{ } X^bY \]
\[ 1 \text{ } X^bX^b \]
\[ 3 \text{ } X^bX^b \]

Father? There would have to be 2 fathers! One father is \( X^bY \) and the other is \( X^bY \).

19. A yellow cat has a litter of four kittens: one yellow, and three calicos. Assuming a single father for the litter, what is the sex of the yellow kitten?

\[ X^bX^b \]
\[ x \]
\[ 3 \text{ } X^bX^b \]

Father must be \( X^bY \). This kitten must be male!