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Unit VII
Biology – Heredity
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VII

Quiz 5B Retest Practice

SEX LINKED TRAITS

As many of you know boys are different than girls. In humans sex is determined by the twenty-third pair of chromosomes known as “sex chromosomes”. If you have two x-shaped (XX) chromosomes you are destined to be a female. If you have an x and a Y-shaped (XY) chromosome you are destined to be a male. Since the X and Y chromosomes carry different information, any genes found on the X chromosomes are referred to as **sex-linked genes**. Therefore, women will have two alleles for these genes because they have two (XX) chromosomes. On the other hand, men have only one allele for each of these genes because they have only one X chromosome (XY). This is clearly a violation of Mendel’s Principle of Unit Characteristics, which implies that you receive one set of alleles from each parent.

E.g. In fruit flies, the gene for eye color is carried on the X chromosome which is a sex chromosome (sex-linked). The allele for red eyes is dominant over the allele for white eyes. **If a white-eyed female fruit fly is mated with a red-eyed male, predict the possible offspring.**

Step 1: Since the female has white eyes, she must be “ X^rX^r ”. The male is red-eyed and because he has only one X chromosome, he has only one allele for eye color. His eyes are red - he only has one allele for eye color, so he must be “ X^RY ”. Since the allele “R” is present on the X chromosome only, and there is no other allele for eye color because in the male other sex chromosome is a Y chromosome.

Step 2: For sex-linked traits we need to list the genotype in a different fashion. We must identify the individual as being male or female according to their sex chromosomes. Females are XX, and males are XY. Sex-linked traits are only found on the X chromosome, therefore the letters are placed as superscripts (above) the X chromosome. Therefore the genotype for the female fly is X^rX^r and the male is X^RY .

Step 3: The Punnett square for the parent flies are shown below.

	X^R	Y
X^r	X^RX^r	X^rY
X^r	X^RX^r	X^rY

Step 4: The genotypic ratio is 1:1 (X^RX^r : X^rY)

Step 5: The individual X^RX^r will be a female because she has two X chromosomes. She will have red eyes because she has Rr. The individual with X^rY will be a male because he has the X and Y chromosomes. He will have white eyes because he has only one allele and it is “r”. So from this cross you would expect all of the females to have red eyes and all of the males to have white eyes.

1. Hemophilia is a sex-linked trait. A person with hemophilia is lacking certain proteins that are necessary for normal blood clotting. Hemophilia is caused by a recessive allele so use “N” for normal and “n” for hemophilia. Since hemophilia is sex-linked, remember a woman will have two alleles (NN or Nn or nn) but a man will have only one allele (N or n). A woman who is heterozygous (a carrier) for hemophilia marries a normal man:

- a. What are the genotypes of the parents?
- b. Make a Punnett square for the above cross.

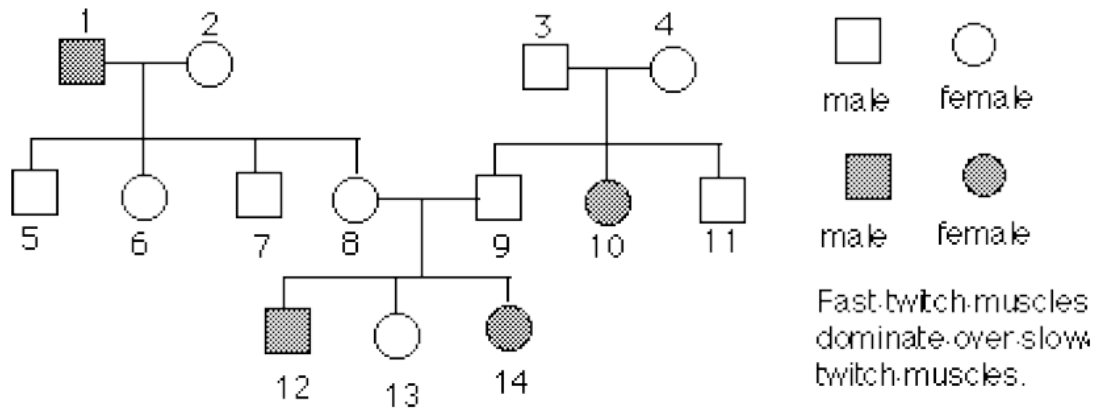
- c. What is the probability that a male offspring will have hemophilia? _____
- d. What is the probability of having a hemophiliac female offspring? _____

2. Can a color blind female have a son that has normal vision? Color blindness is caused by a sexlinked recessive allele. **use N = normal vision and n = color blind*

3. Baldness is a sex-linked trait. What parental genotypes could produce a bald woman? **use H = normal hair, and h = bald*

Pedigree Charts:

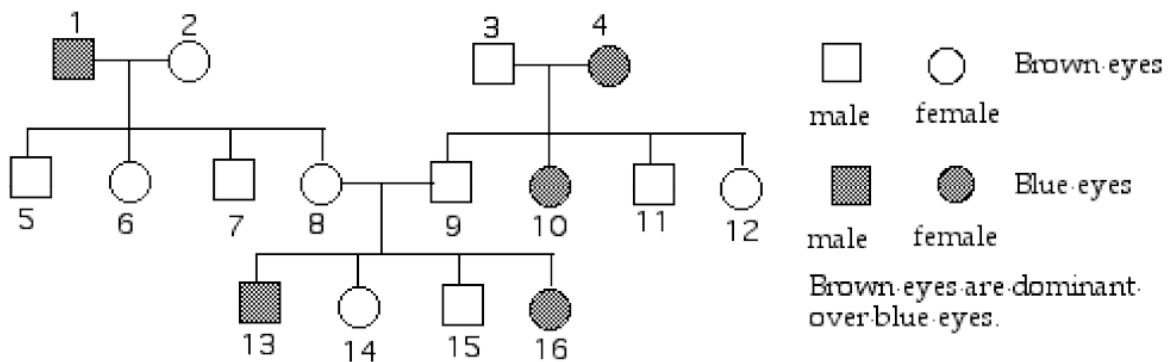
In genetics, traits can be traced over several generations similar to a family tree. This family tree is called a Pedigree chart. Pedigree charts are useful in gathering background genetic information that can be used for medical reasons. Horse race enthusiasts also rely heavily on pedigree charts to predict a horse's success. When interpreting pedigree charts remember squares are male and circles are females



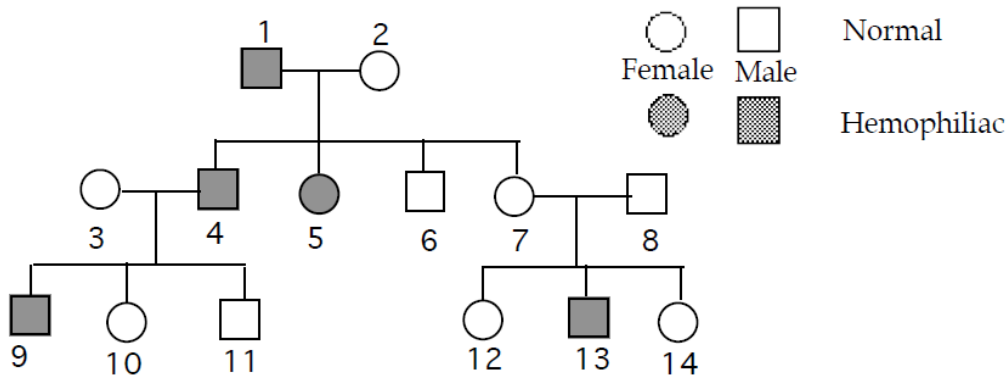
1. Use the below pedigree chart to answer the following three questions. Muscle type is not a sex linked characteristic.

- a. Place the genotypes of each individual below its symbol.
- b. What is the genotype of individual #3 and 4?
- c. Can either individual #8 or 9 be homozygous?
- d. Explain the family relationship that #12 has with #2.

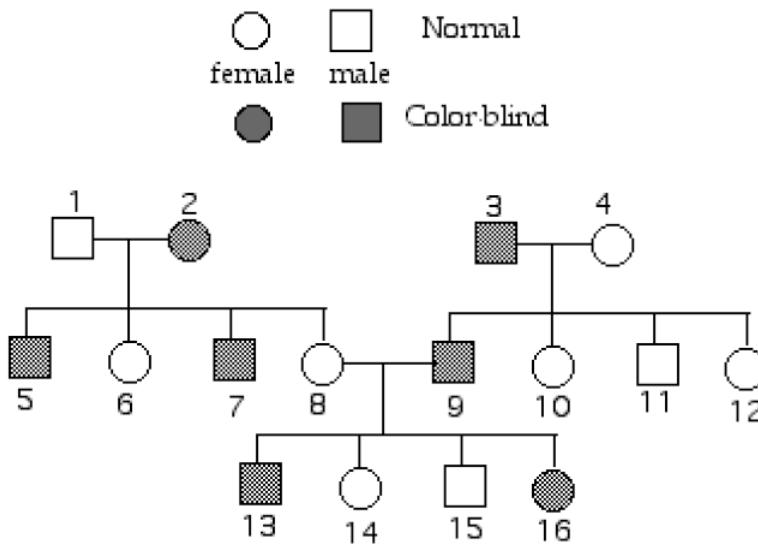
2. Label the genotype for each of the individuals below its symbol on the pedigree chart (note: eye color is **not** a sex-linked trait).



3. List the possible genotypes of the following hemophilia pedigree chart below. **Remember** hemophilia is a **sex linked trait** that is caused by a **recessive allele**, therefore you must denote the individuals sex chromosomes ($X^N X^n$ and $X^n Y$ or Nn and nY) as well as the hemophilia allele (n).



4. Examine the following pedigree chart of color-blindness. In humans, color blindness is caused by a **recessive sex-linked** allele. On the diagram, label the genotypes of the individuals 1-16.



5. A blue-eyed man (1) whose parents were brown eyed (2 & 3), marries a brown eyed woman (4), whose father was brown eyed (5) and whose mother (6) was blue eyed. They have one female child who is blue eyed (7). Blue eyes are recessive.

- Make a pedigree chart based on the above information.
- Label the genotypes of the individuals in the chart.