SEX LINKED TRAITS

Essential Questions:
What does “sex-linked” or “X-linked” mean?
How are sex-linked conditions inherited?
How do you solve sex-linked problems?

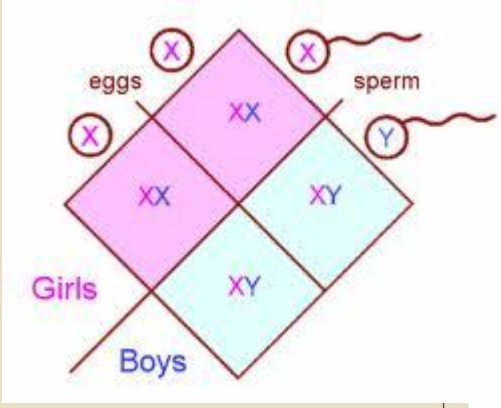
Sex-Linked Inheritance

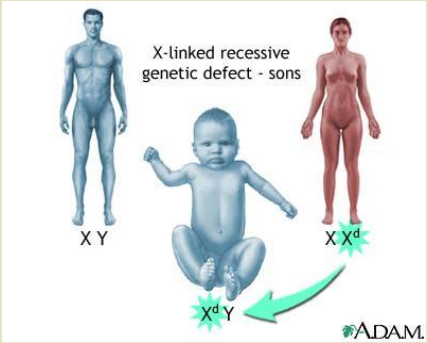
Comparison of the X and Y sex (23rd pair) chromosomes

- Sex linked inheritance varies the Mendel number of 3:1 by having males a **50/50** percent chance of inheriting the characteristic on the X chromosome only.
- Remember, Females have XX and Males are XY.
  - The Y carries little genetic information, mainly those that contribute to male characteristics. *(About 87 genes total.)*
  - The X carries a lot more genetic information. *(About 2000!)*

Who is affected by Sex-Linked Disorders?

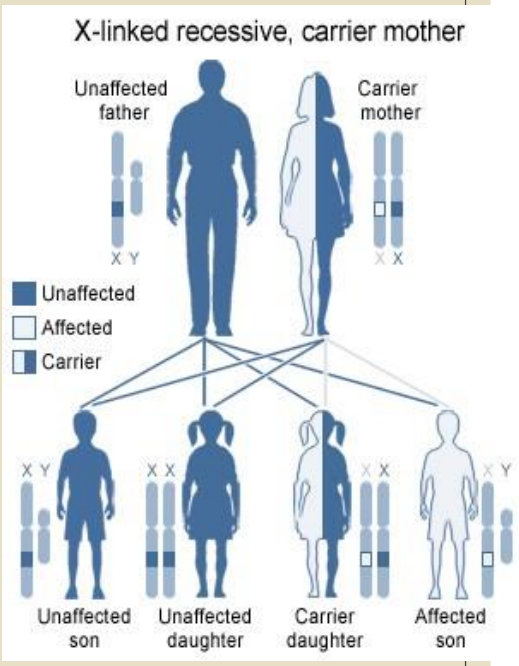
- Genes for certain traits are on the **X chromosome only…**
  - Since **Men** only receive one X chromosome then they are **more likely** to inherit these types of disorders.
    - Who gives men the X Chromosome?
  - Women are somewhat protected since they receive two X chromosomes and are less likely to inherit these types of disorders.
    - What do you think happens when they get only one defective copy of an X chromosome?

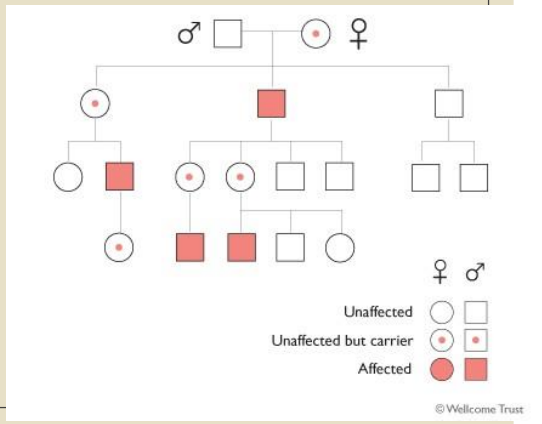




Sex-Linked Disorders

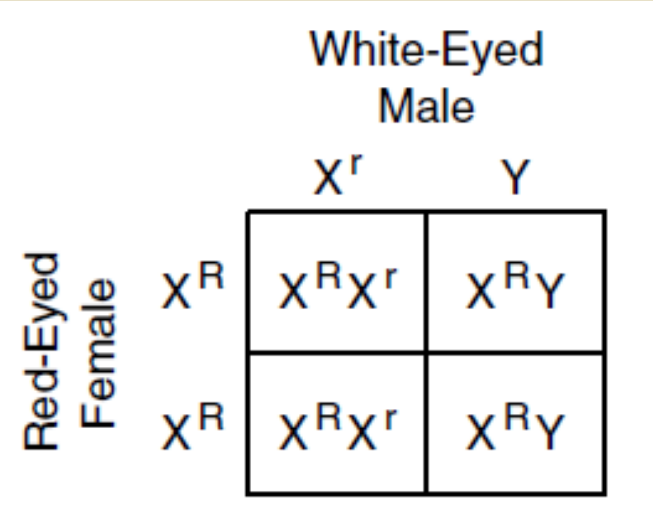
- **Affected males never pass the disease to their sons** because there is no male-to-male transmission of the X chromosome.
- Affected males pass the defective X chromosome to **all of their daughters**, who are described as **carriers**.
  - This means they carry the disease-causing allele but generally show no disease symptoms since a functional copy of the gene is present on the other chromosome.
- Female carriers pass the defective X chromosome to…
  - **half their sons** (who are affected by the disease)
  - **half their daughters** (who are therefore also carriers).
  - The other children inherit the normal copy of the chromosome.
- **Affected females,** with two deficient X chromosomes, are the rare products of a marriage between an **affected male and a carrier (or affected) female.**





How do you solve Sex-linked Problems?

If Red eyes are dominant and sex-linked, show the cross between a homozygous red eyed female and a white eyed male.



1. You determine which trait (or disorder) is **dominant** or **recessive**.
2. Set up a punnett square using <u>XX for females</u> and <u>XY for males</u>.
    1. **Assign alleles for X only**!
3. Solve as usual, keeping in mind that the Y chromosome has **<u>no</u> allele**!

<u>Genotypes</u>: X^RX^r, X^RY <u>Phenotypes</u>: All offspring have red eyes.

Practice: Your Turn!

- Hemophilia is a sex-linked trait where X^H gives normal blood clotting and is dominant to the hemophilia allele X^h.
- Identify the genotypes of…

  1) a woman with normal blood clotting whose father had hemophilia

  2) a normal man whose father had hemophilia.

- What is the probability that a mating between these two individuals will produce a child, regardless of sex, that has hemophilia?

Check your work

1) the woman has normal clotting so she has one X^H but she got a X^h from her father, so she is $\mathbf{X^HX^h}$

2) the man is X^HY since he got the Y from his father and he is normal so must be $\mathbf{X^HY}$

	X^H	X^h
X^H	$\mathbf{X^HX^H}$	$\mathbf{X^HX^h}$
Y	$\mathbf{X^HY}$	$\mathbf{X^hY}$

Genotypes: ¼ $\mathbf{X^HX^H}$
¼ $\mathbf{X^HX^h}$
¼ $\mathbf{X^HY}$
¼ $\mathbf{X^hY}$

Phenotypes: ½ unaffected girls
¼ unaffected boy
¼ affected boy

Notice how girls are "protected" from disorders and carry them.