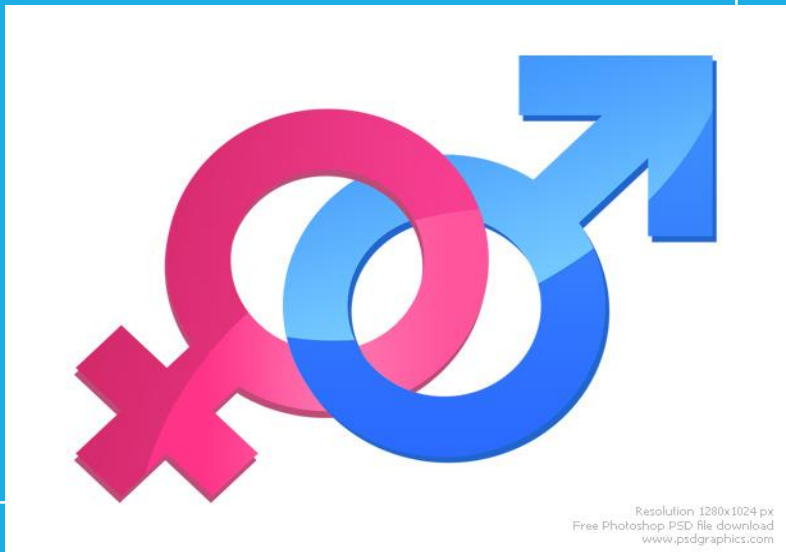
NON-MENDELIAN GENETICS

Sex-Linked Traits



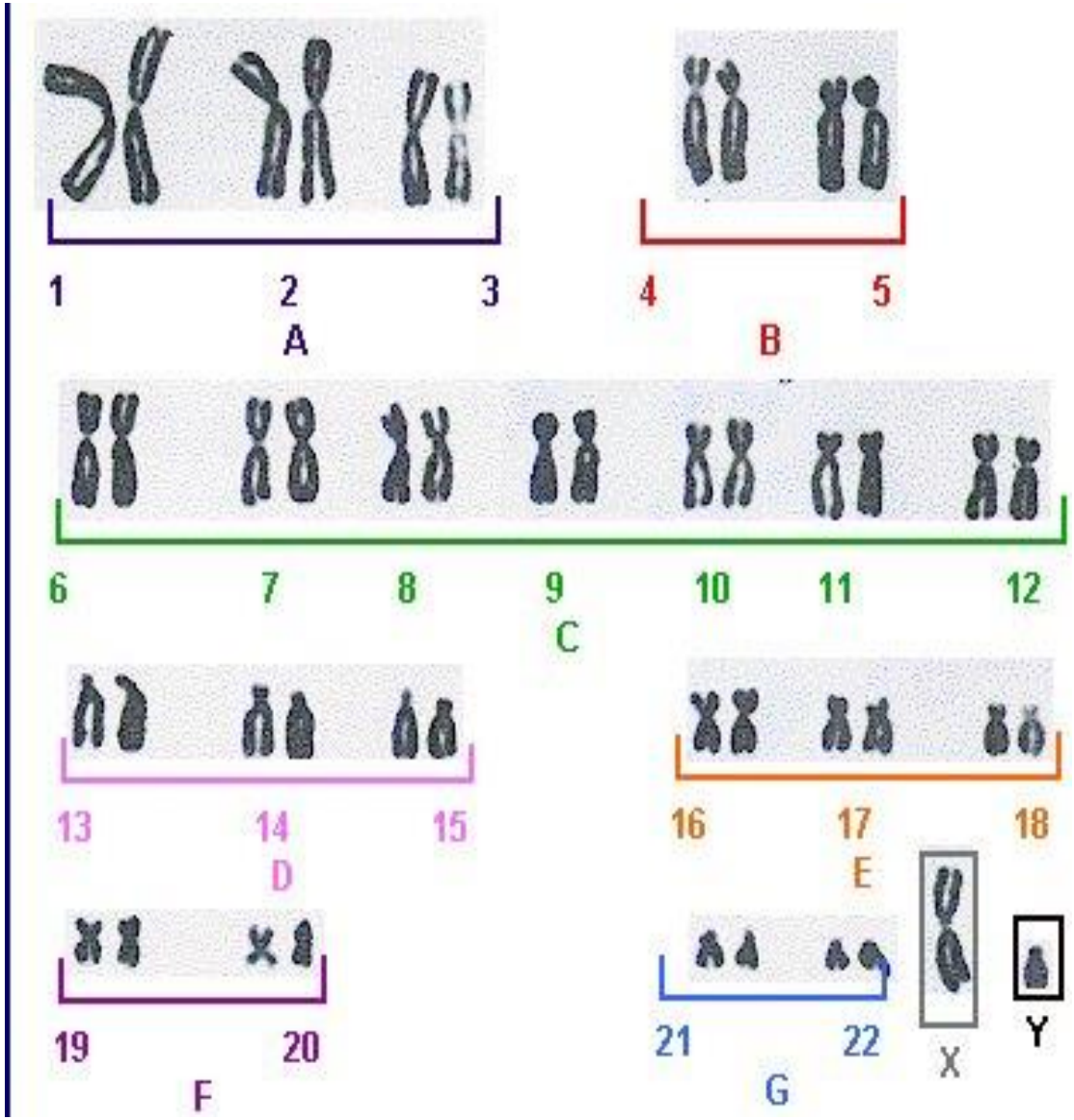
Sex-linked Traits

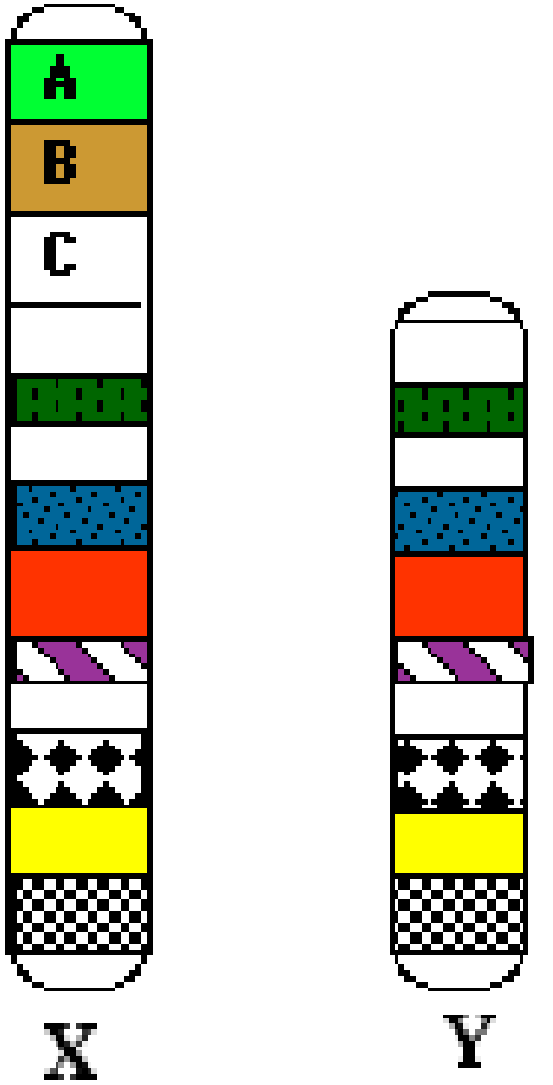
- Remember… humans have **23 pairs** of chromosomes
  - **last pair** of chromosomes code for gender
    - Male: **XY**
    - Females: **XX**
- **Genes** on these chromosomes will code for the **sex-linked traits**

Sex-linked Traits

- **chromosomes** are paired based on **being a similar length (homologous)**
- This is **NOT** the case with the **X and Y chromosomes**
  - The **X** chromosome is **longer** than the **Y** chromosome

X and Y Chromosomes





X and Y Chromosomes

- Due to the **X** chromosome being **longer** any trait on that piece **will be** expressed in **males**
  - **May be** expressed in females **IF** the other X chromosome "allows"
- This means that **males will exhibit** sex-linked traits **more frequently** than females

- **Genes** that are located on the **X** chromosome are called **sex-linked genes**
- Traits determined by sex-linked genes are called **sex-linked traits**

(**b** = colorblind, **B**= normal)

Ex. Color blindness

female X^bX^b

male X^bY

Sex-Linked Traits

- Sex-linked traits can be **Dominant** or **Recessive**

- A = **dominant** a = **recessive**

Question…

- *What would be the genotypes of a male and female that have a sex-linked DOMINANT trait and DO NOT express (show) the trait?*

- Expresses Trait: Male - $X^A Y$ Female - $X^A X^A$ or $X^A X^a$
- No Expression: Male - $X^a Y$ Female - $X^a X^a$

Question…

- *What would be the genotypes of a male and female that have a sex-linked RECESSIVE trait and DO NOT express the trait?*

- Expresses Trait: Male - X^aY Female - X^aX^a
- No Expression: Male - X^AY Female - X^AX^A or X^AX^a (Carrier)

- **Most Sex-linked traits are Recessive!**

Carriers

- A **carrier** is a person that has the trait on **only one chromosome** and does **NOT** express the trait. Carriers of sex linked traits are **always women**.

(**B**= normal, **b**= colorblind)

Ex. Color blind carrier X^B X^b ← **carrier**

How to write Sex-Linked Traits

- Since traits are located on the sex chromosomes we do not use the usual single letter system for abbreviation
- must **signify** if the individual is **male or female** AND if they **have** the trait or **not**

Example

- Red-green colorblindness is a sex-linked trait resulting in the individual not being able to tell the difference between Red and Green
  - We will use “B” to indicate normal vision and “b” to indicate colorblindness

Example

- Must tell if male or female so:
  - Normal Vision Female
    - X^BX^B
  - Carrier Female (normal vision but can pass trait to offspring)
    - X^BX^b
  - Color-blind Female
    - X^bX^b

Example

- Normal Vision Male
  - X^BY
- Color-blind Male
  - X^bY

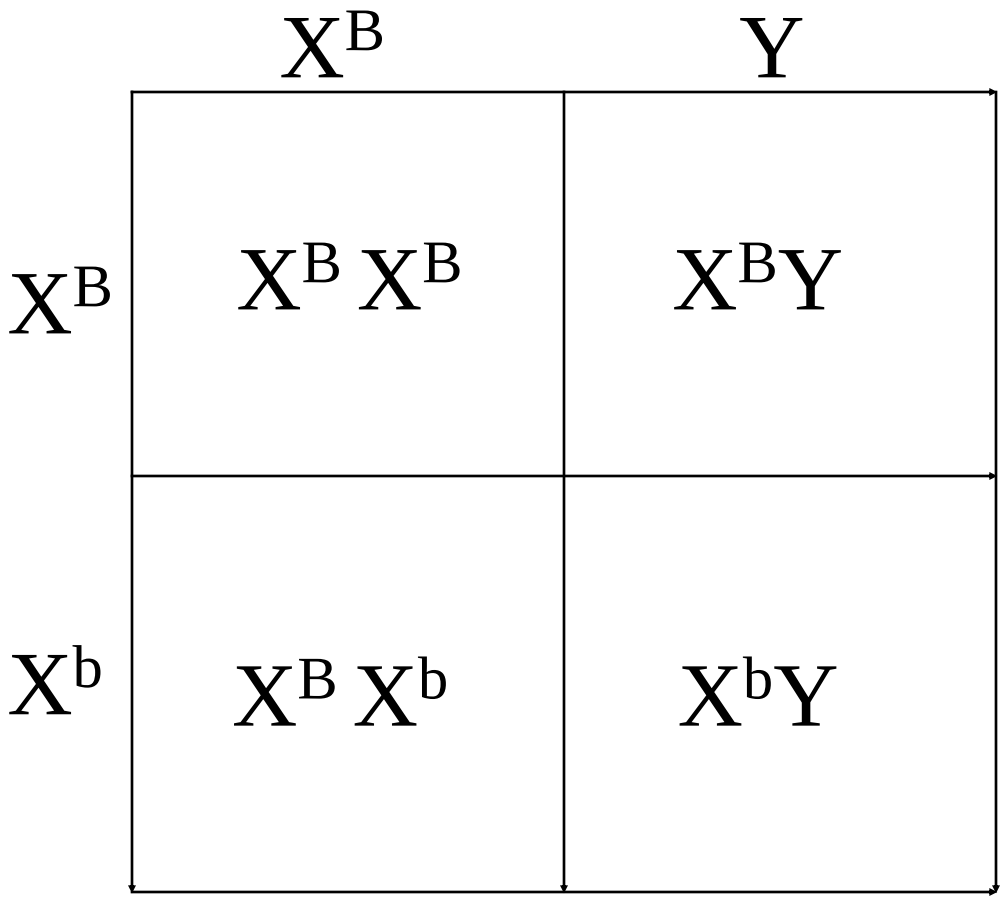
- Notice it only takes **one recessive allele** for the trait to be expressed in **males**. Why?

- Due to shorter Y chromosome

Test Cross (Punnett Squares)

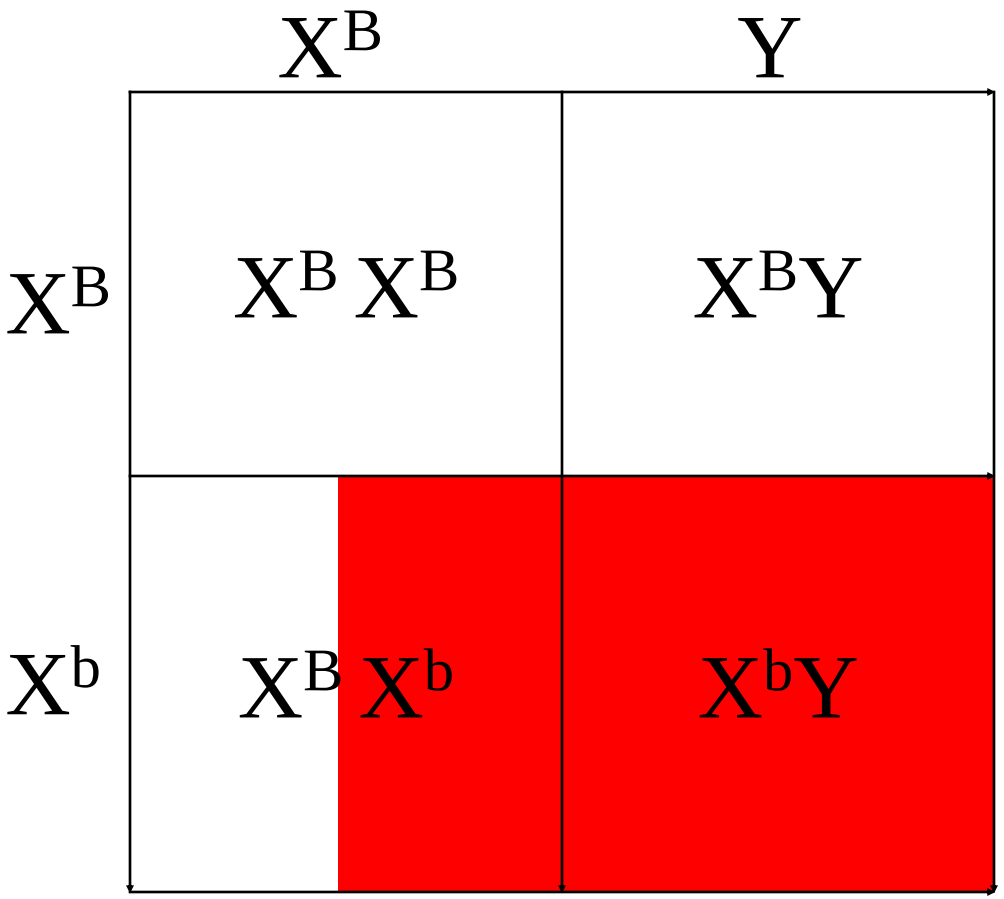
- As with all traits we can complete Punnett squares to determine the possibility that an offspring will exhibit a certain genetic trait.
  - If a male with normal vision is crossed with a female that is a carrier for the colorblind trait:
    - What is the probability that their sons will be colorblind?
    - What is the probability that their daughters will be colorblind?

Test Cross

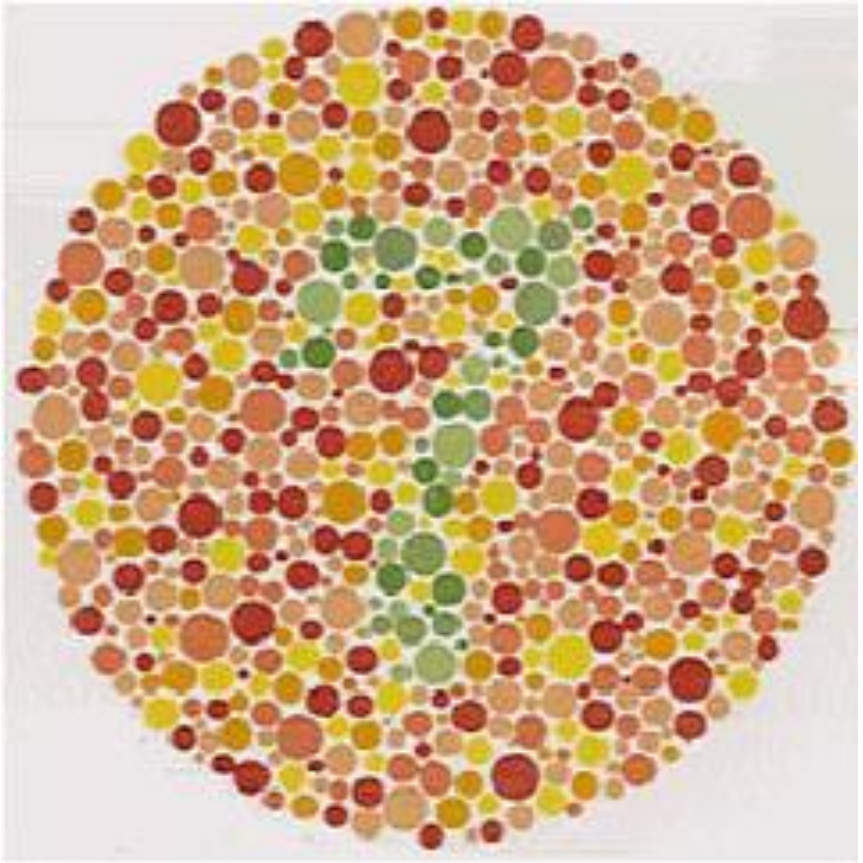


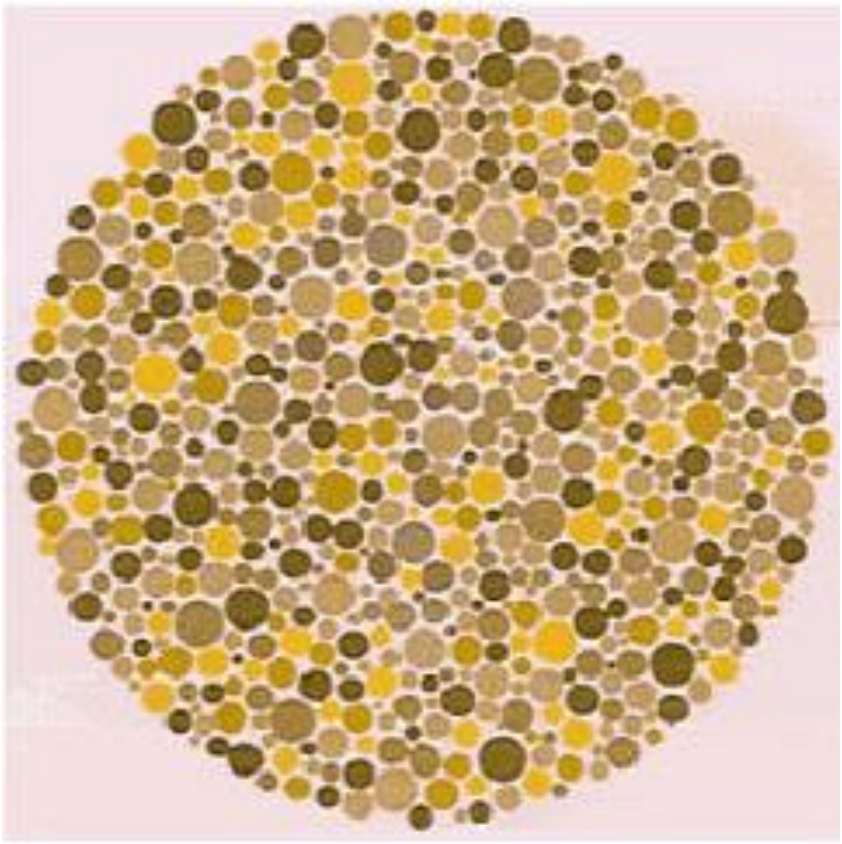
Probability Son will be colorblind: 50%

Probability Daughter will be colorblind: 0%


X^B
Y
X^B
$X^B X^B$
$X^B Y$
X^b
$X^B X^b$
$X^b Y$

Normal vs. Colorblind





Question

- A colorblind male marries a normal female. What are the offspring genotypes and phenotypes?

	X^b	Y
X^B	$X^B X^b$	$X^B Y$
X^B	$X^B X^b$	$X^B Y$

Genotypes:

$X^B X^b = 100\%$

$X^B Y = 100\%$

Phenotypes:

Carrier female = 100%

Normal male = 100%

Other Sex-Linked Traits

- Male Pattern Baldness
- Hemophilia
  - Disorder that results in poor clotting of the blood

Ameoba Sisters

- https://www.youtube.com/watch?v=h2xufrHWG3E