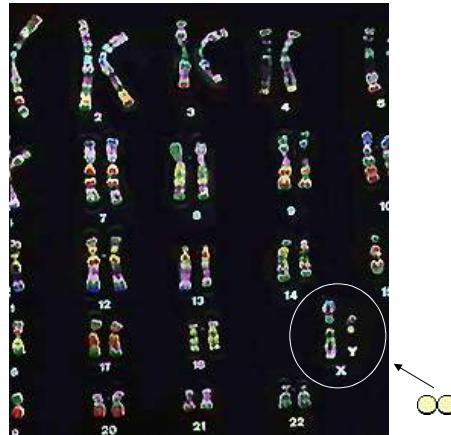


Sex Linked Traits

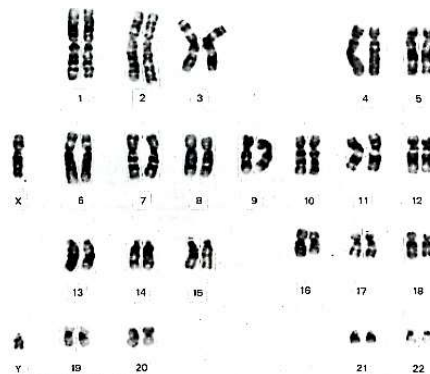
- Humans have 23 pairs of chromosomes.
- One pair of chromosomes is related to the sex of an individual, these chromosomes are called **sex chromosomes**



Sex Linked Traits

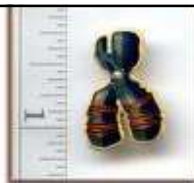
- The other 22 pairs of chromosomes are called **autosomes (1-22)**

XY male
XX female



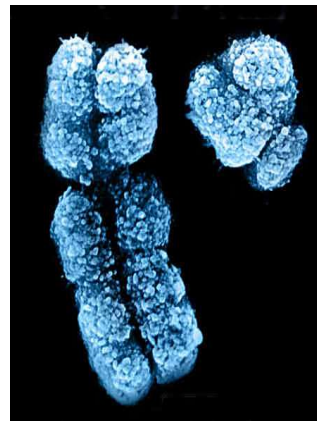
X chromosome

- The X chromosome contains genes that code for all aspects of femaleness and genes unrelated to gender.
- Including genes for:
 - Vision
 - Immunity



The Y chromosome

- The Y chromosome is much smaller than the X.
- It carries a small number of genes, most of which are for “male characteristics”



Sex Linked Traits

- Traits controlled by genes which are located on the X and Y chromosome
- X-linked genes are genes found on the X chromosome, symbolized by X^r , X^R
- Y-linked genes are found on the Y chromosome, symbolized by Y^r , Y^R

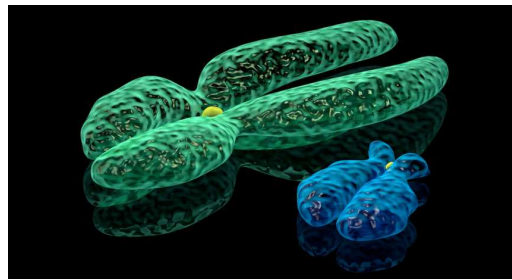
SEX-LINKED INHERITANCE

- Most known sex-linked traits are **X-linked** (carried on the X chromosome). This is probably because the X chromosome is much larger than the Y chromosome.

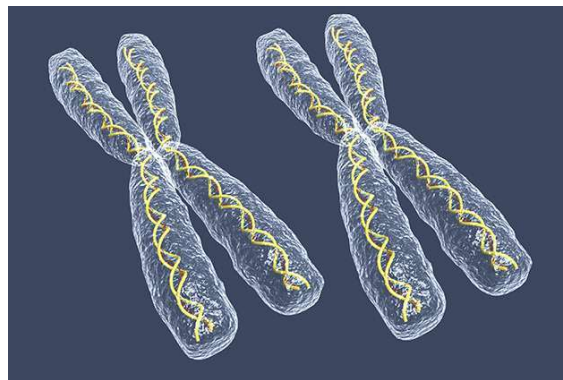


Sex Linked Traits

- males have one X chromosome
- Recessive sex linked traits (eg color blindness) are therefore expressed with one copy of the gene



- Females have two X chromosome
- Two copies of a recessive sex linked traits (eg color blindness) are necessary before a female is colour blind.



Carriers

- **Carriers** - a person that has one dominant and one recessive gene for a trait.
- Only women, with two X chromosomes can be carriers of sex linked traits.
- Ex. Color blind carrier $X^C X^c$ (C = normal, c = colorblind)

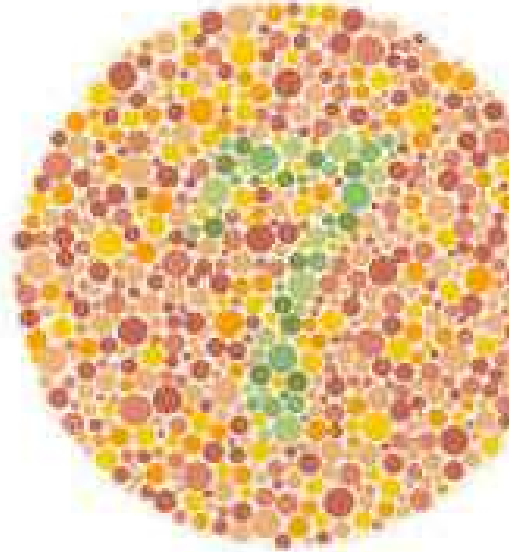
EXAMPLES OF SEX-LINKED TRAITS and DISORDERS

- Male pattern baldness, red-green colour blindness, myopia, night blindness, hemophilia



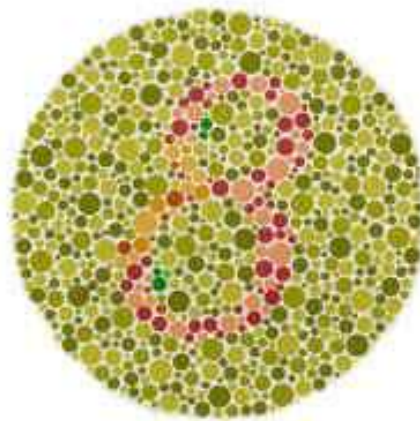
Colorblindness

- A person with normal color vision sees a number seven in the circle above.
- Those who are color blind usually do not see any number at all.



Colorblindness

- RED-GREEN COLORBLINDNESS:
- People with red-green color blindness see either a three or nothing at all.
- Those with normal color vision see an 8.





Sex Linked Punnett Squares

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

(C = normal, c = colorblind)

	X^c	Y
X^C		
X^C		

Sex Linked Punnett Squares

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

(\underline{C} = normal, c = colorblind)

	X^c	Y
X^C	$X^C X^c$	$X^C Y$
X^C	$X^C X^c$	$X^C Y$

Sex Linked Punnett Squares

- A normal male (not colorblind) marries a carrier. What are the offspring genotypes and phenotypes?

	X^C	Y
X^C		
X^c		

Sex Linked Punnett Squares

- A normal male (not colorblind) marries a carrier. What are the offspring genotypes and phenotypes?

	X^C	Y
X^C	$X^C X^C$	$X^C Y$
X^c	$X^c X^C$	$X^c Y$

Sex Linked Punnett Squares

- A normal male (not colorblind) marries a colorblind female. What are the offspring genotypes and phenotypes?

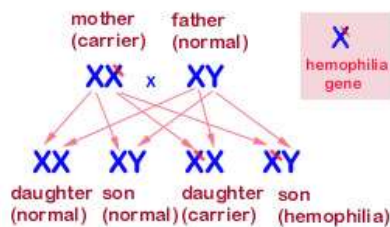
	X^C	Y
X^c		
X^c		

Sex Linked Punnett Squares

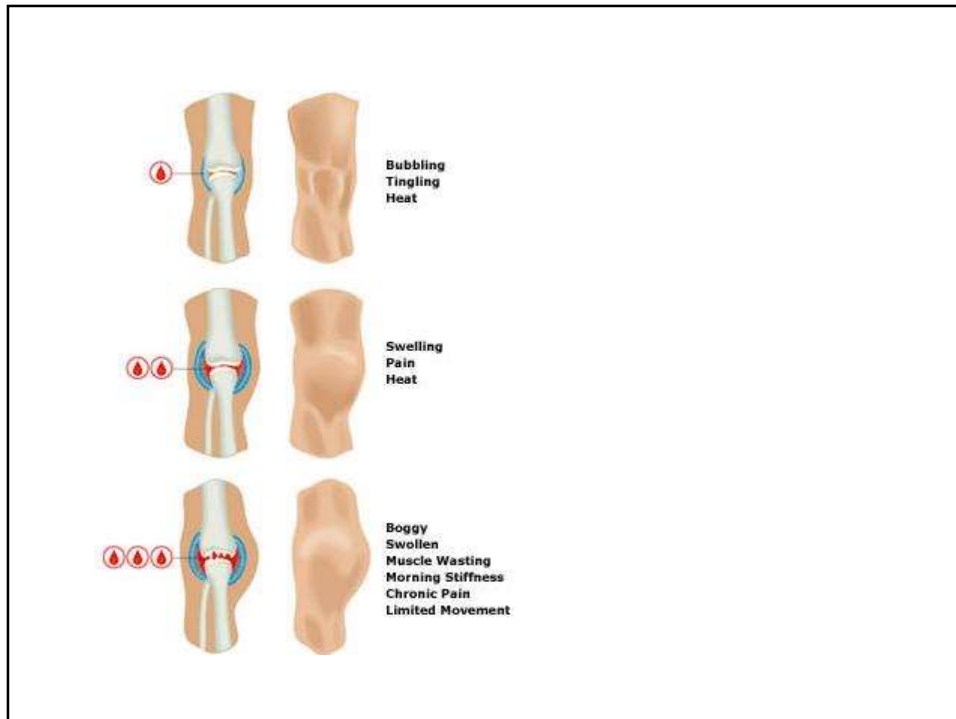
- A normal male (not colorblind) marries a colorblind female. What are the offspring genotypes and phenotypes?

	X^c	Y
X^c	$X^c X^c$	$X^c Y$
X^c	$X^c X^c$	$X^c Y$

Hemophilia

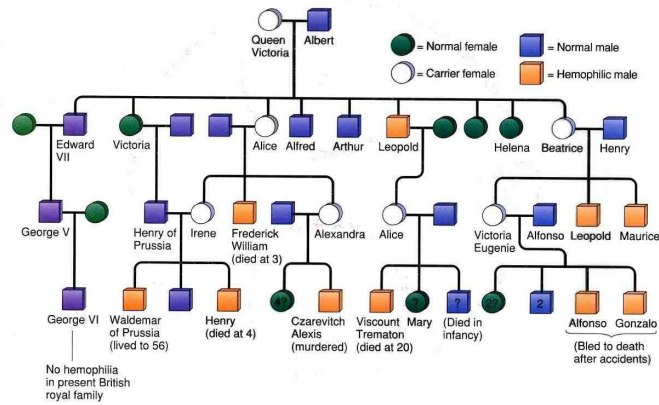


- Hemophilia is characterized by **uncontrolled bleeding**
- It is a sex linked disorder caused by **errors in the DNA** that codes for the proteins involved in clotting



Complications from hemophilia include: bruising and bleeding into the muscles, bleeding into the joints, infection, adverse reaction to transfusions and serious bleeding.

PEDIGREE OF QUEEN VICTORIA



Czar Nicholas II & Family



- Cross a carrier mother with a hemophiliac father.

	X^H	X^h
X^H	$X^H X^H$	$X^H X^h$
Y	$X^H Y$	$X^h Y$

- What is the only way for a female to show a recessive sex-linked trait?
 - She must inherit a recessive trait from both her mother and father. (her father must have the disorder)
- How does a male show a recessive sex-linked trait?
 - He must inherit the recessive trait from his mother. He gets the Y from his father so it has no bearing on a sex-linked disorder.

	X^h	Y
X^h	$X^h X^h$	$X^h Y$
X	XX^h	XY

Sex determination in other species

- [TED Ed - Sex Determination](#)