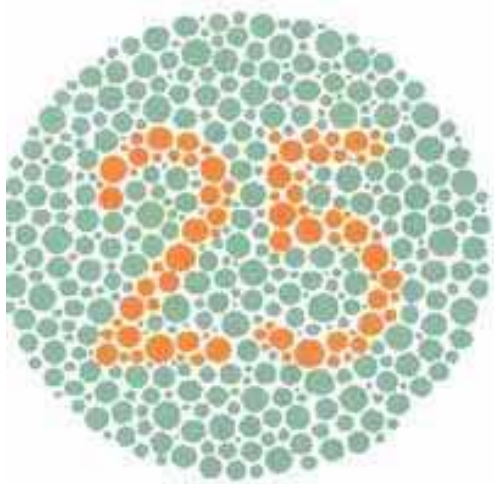
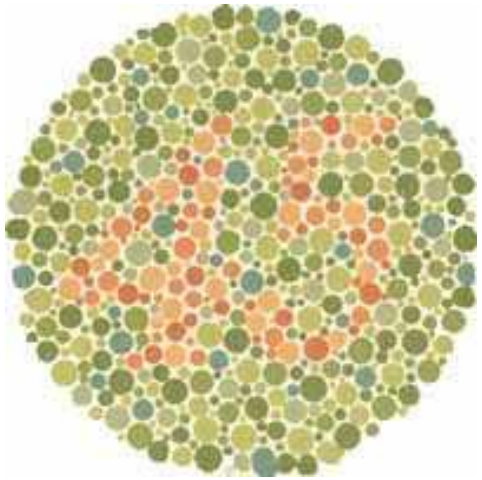
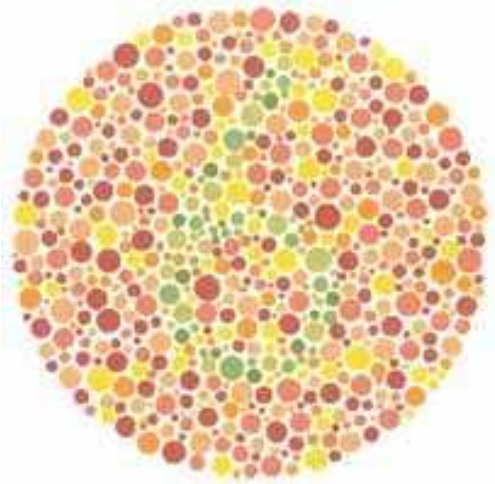
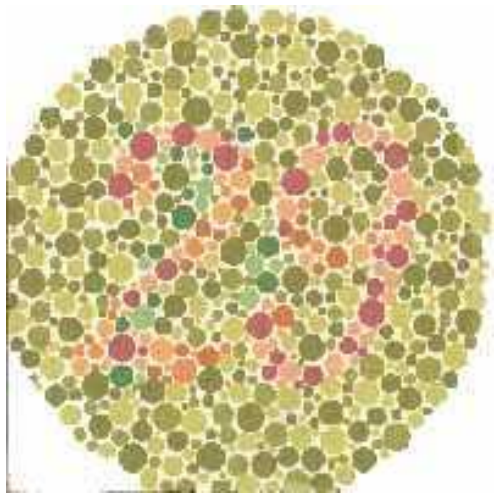
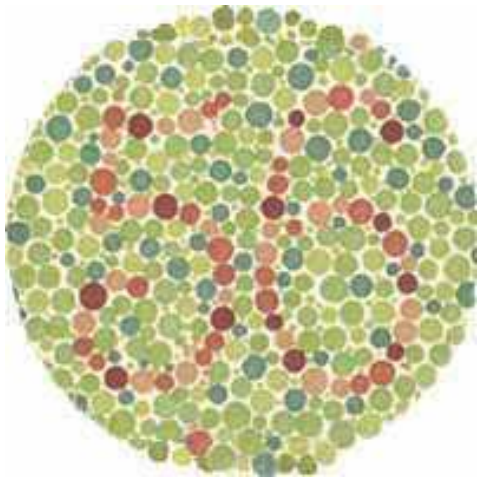
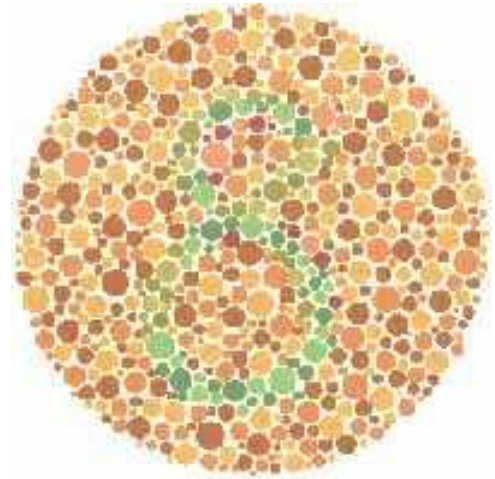
Sex Linked Traits

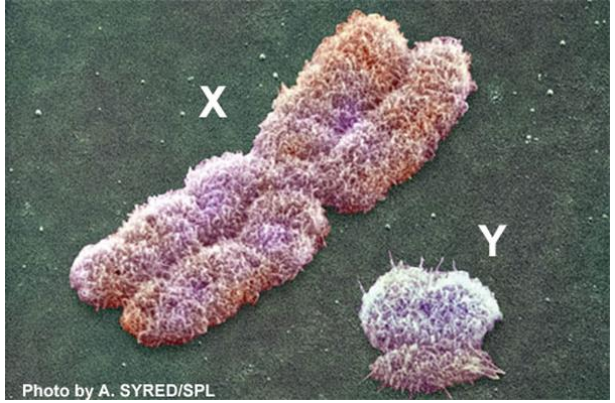
X-linkage

Colorblindness Test
http://enchroma.com/test/instructions/

Note:
Set your screen to the **brightest** setting!

Sex Determination



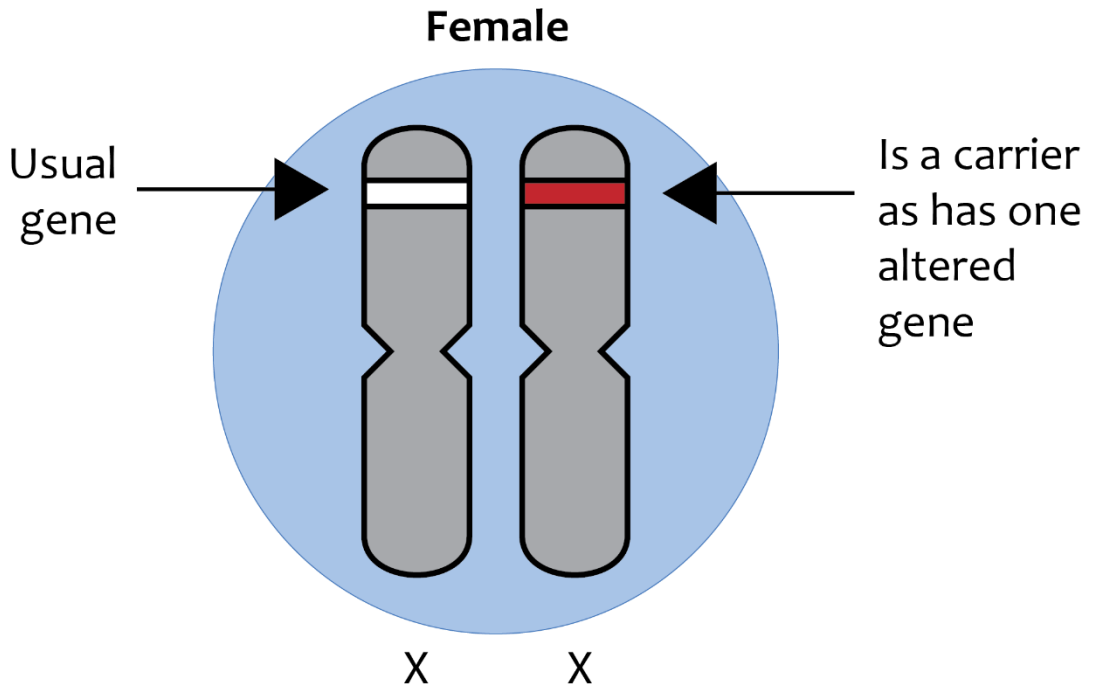
- Each human body cell (somatic cell) has 22 pairs of autosomes and one pair of sex chromosomes.
- XX= female, XY=male
- Biological sex is determined at fertilization
  - Male sperm cell contains either an X or a Y chromosome
  - Female egg cell contains an X chromosome.

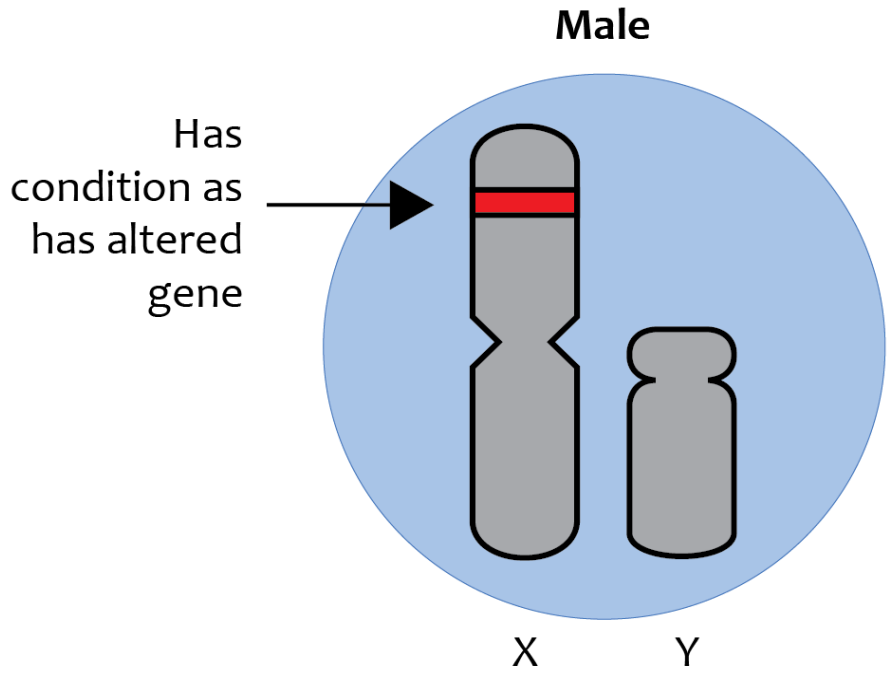
Sex Linkage

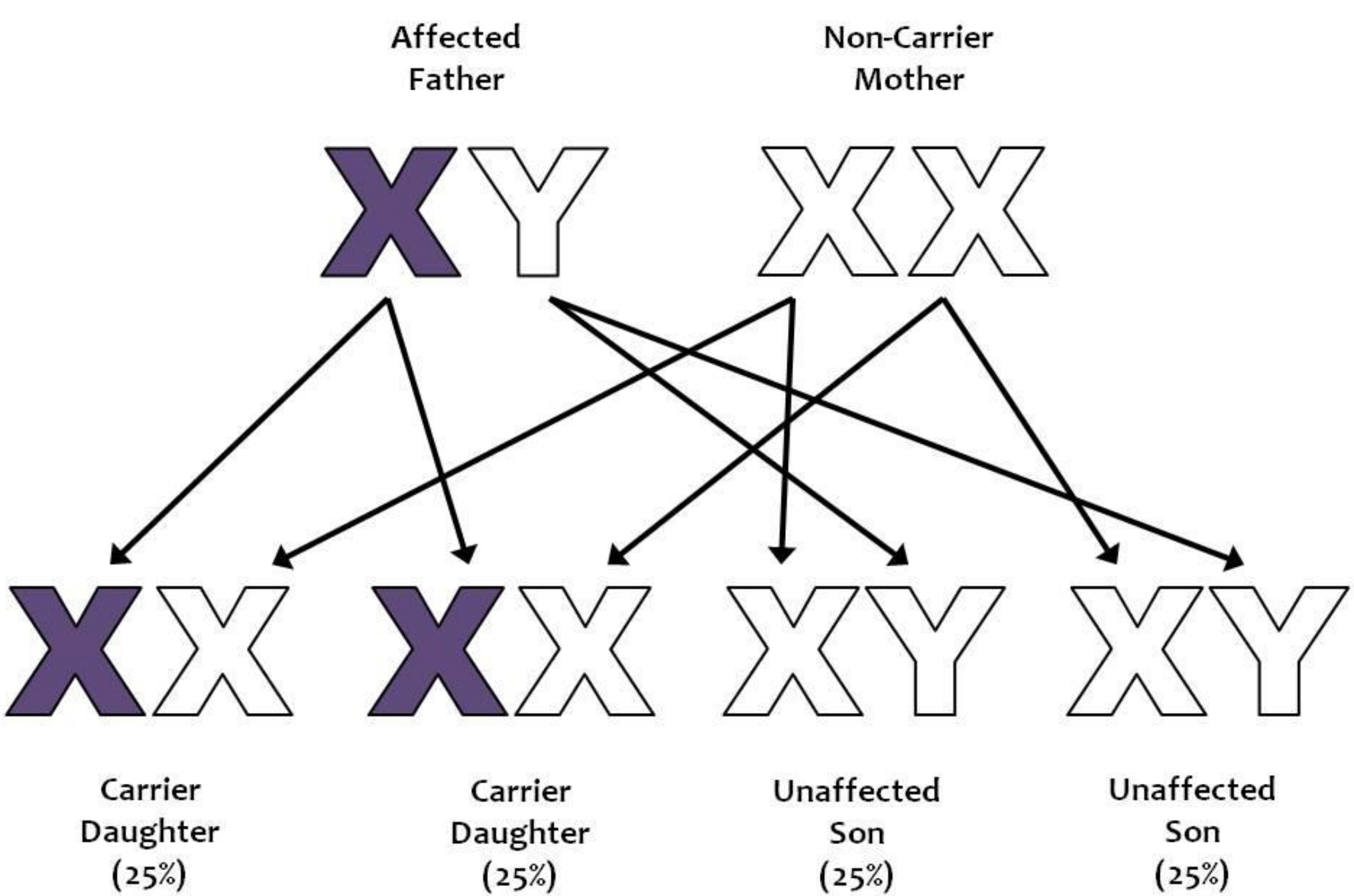
- Thomas Hunt Morgan's work with Drosophila (fruit flies) demonstrated that genes for certain traits are located on the X chromosome.
- Why fruit flies?
  - Easy to breed
  - New generation every 2 weeks
  - Only 4 pair of chromosomes

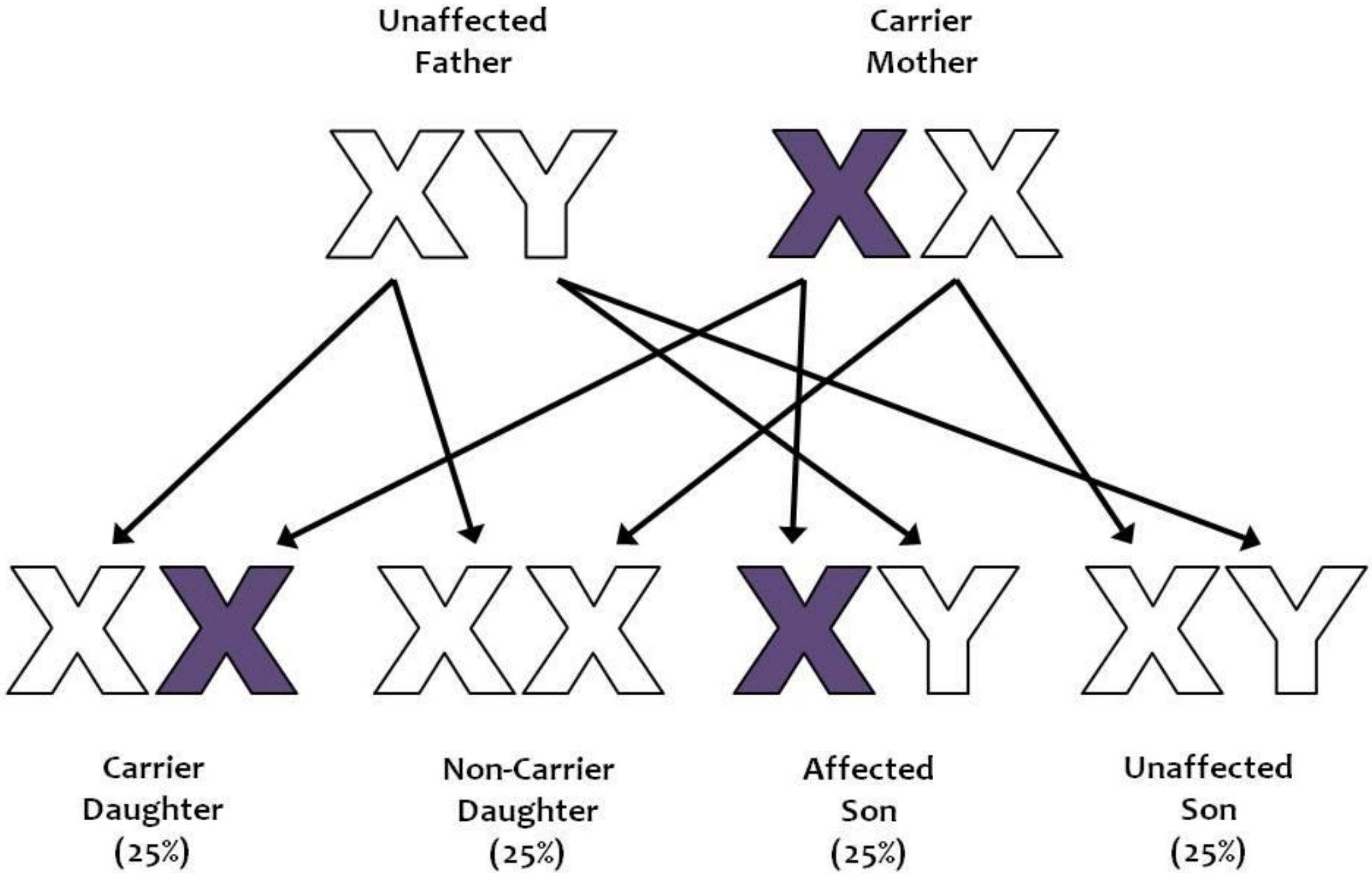
Sex Linkage

- Most sex-linked genes are recessive and are located on the X chromosome (very few on the Y)
- X-linked disorders are expressed more frequently in males than in females because males only have 1 X chromosome



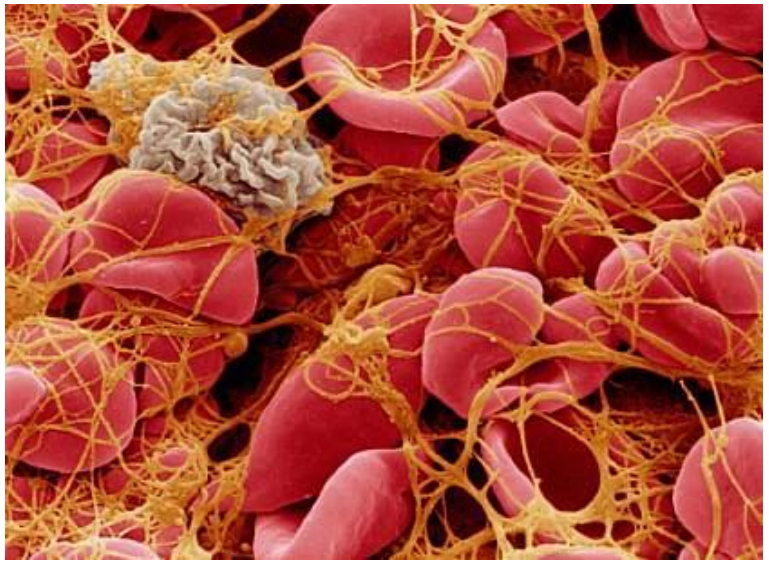


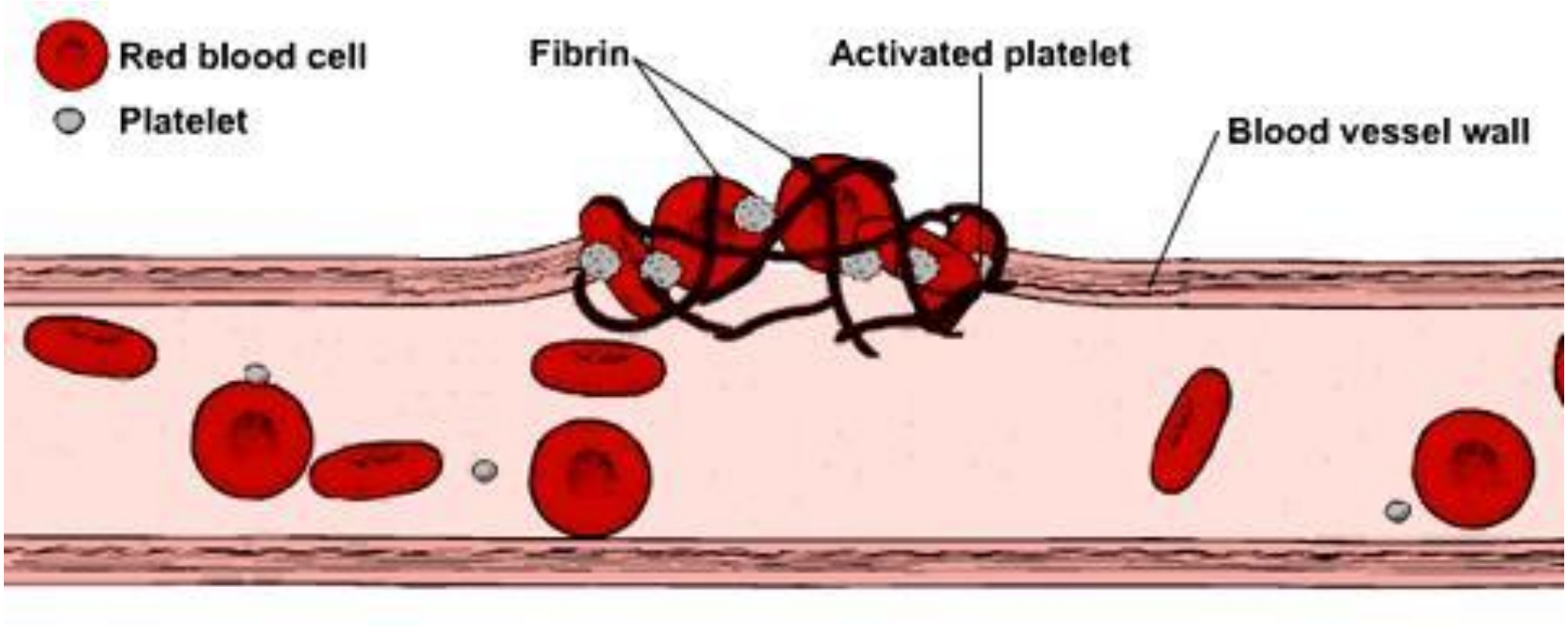

Affected
Father
Non-Carrier
Mother
XY
XX
XX
XX
XY
XY
Carrier
Daughter
(25%)
Carrier
Daughter
(25%)
Unaffected
Son
(25%)
Unaffected
Son
(25%)


Unaffected
Father
Carrier
Mother
XY
XX
XX
XXX
XY
XY
Carrier
Daughter
(25%)
Non-Carrier
Daughter
(25%)
Affected
Son
(25%)
Unaffected
Son
(25%)

X-linked diseases:

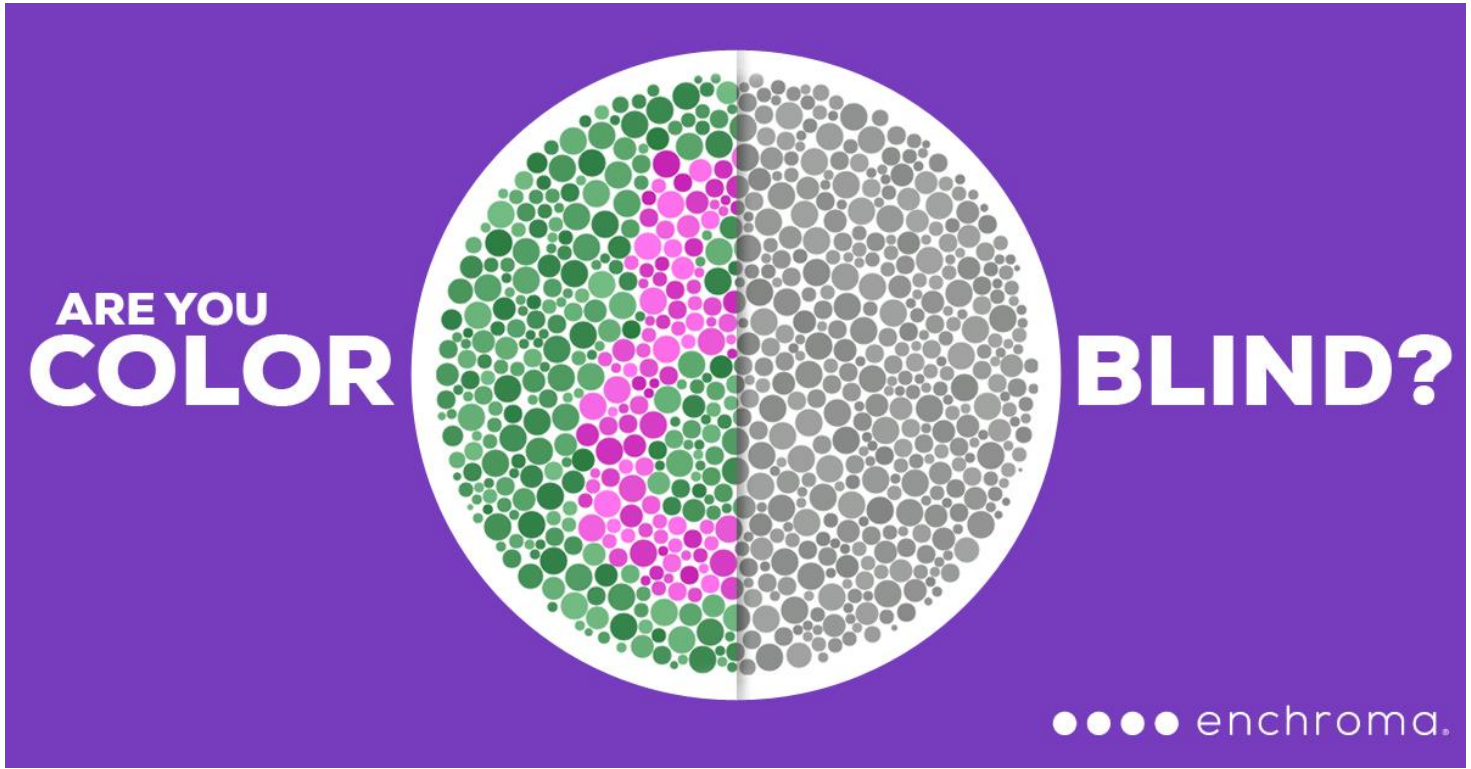
1. Hemophilia
   - blood clotting disorder
   - lack of clotting factor proteins





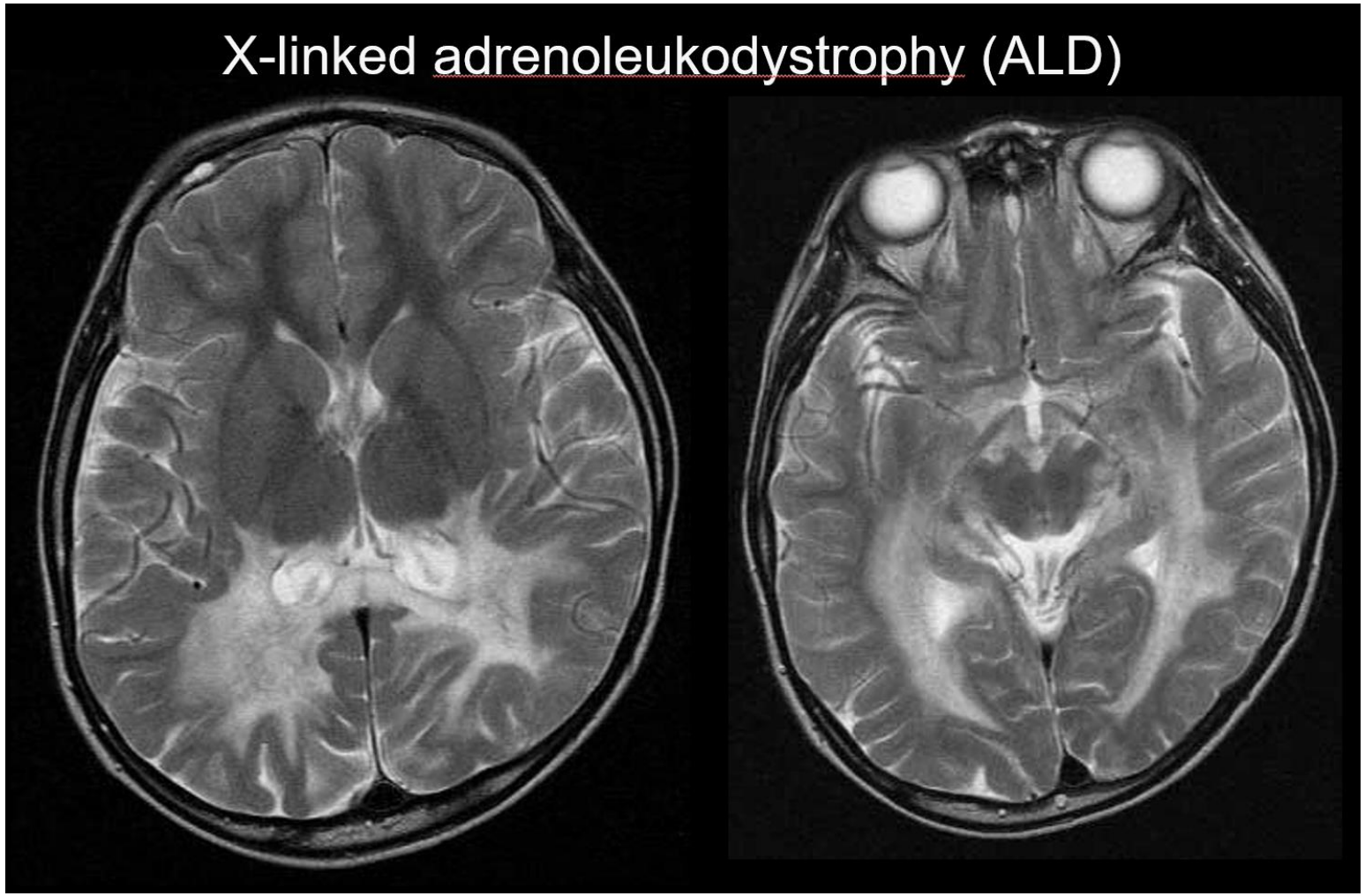
X-linked diseases:

2. Colorblindness
   - inability to perceive colors in a normal fashion
   - most common form is red-green colorblindness



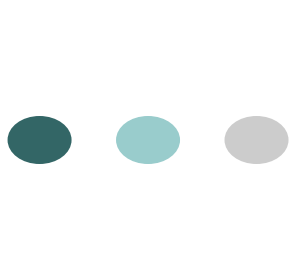
3. Adrenoleukodystrophy (ALD)

- breakdown or loss of myelin, the fatty covering surrounding nerve cells in the brain



- X-linked genotypes: Ex. Colorblindness

	normal	carrier	affected
Females:	$X\ X$ or $X^N\ X^N$	$X^C\ X$ or $X^N\ X^n$	$X^C\ X^C$ or $X^n\ X^n$
Males:	$X\ Y$ or $X^N\ Y$	**NO male carriers**	$X^C\ Y$ or $X^n\ Y$



Practice Problems

Sex Linked Dominance

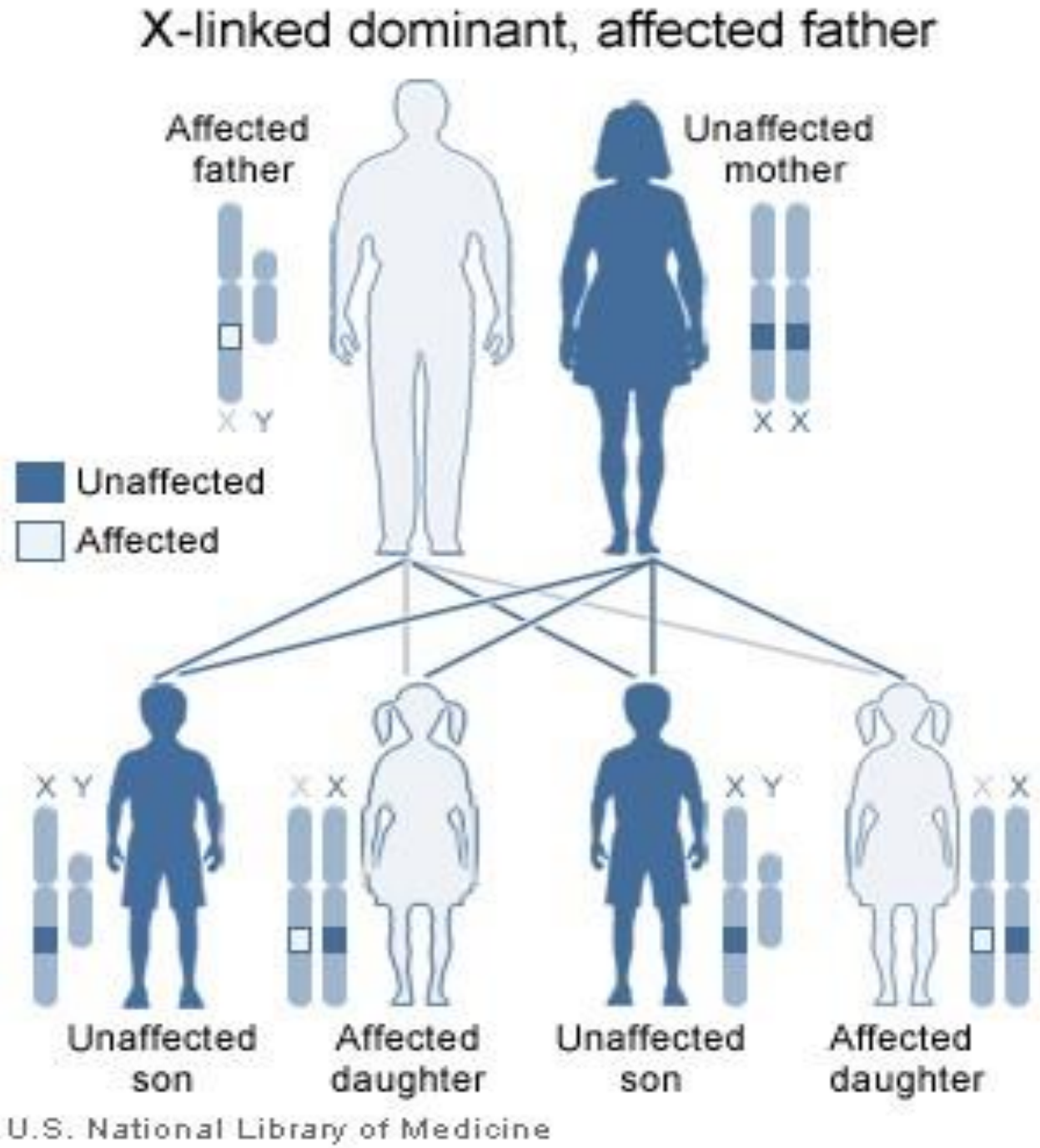
Y-Linkage

Mitochondrial Inheritance

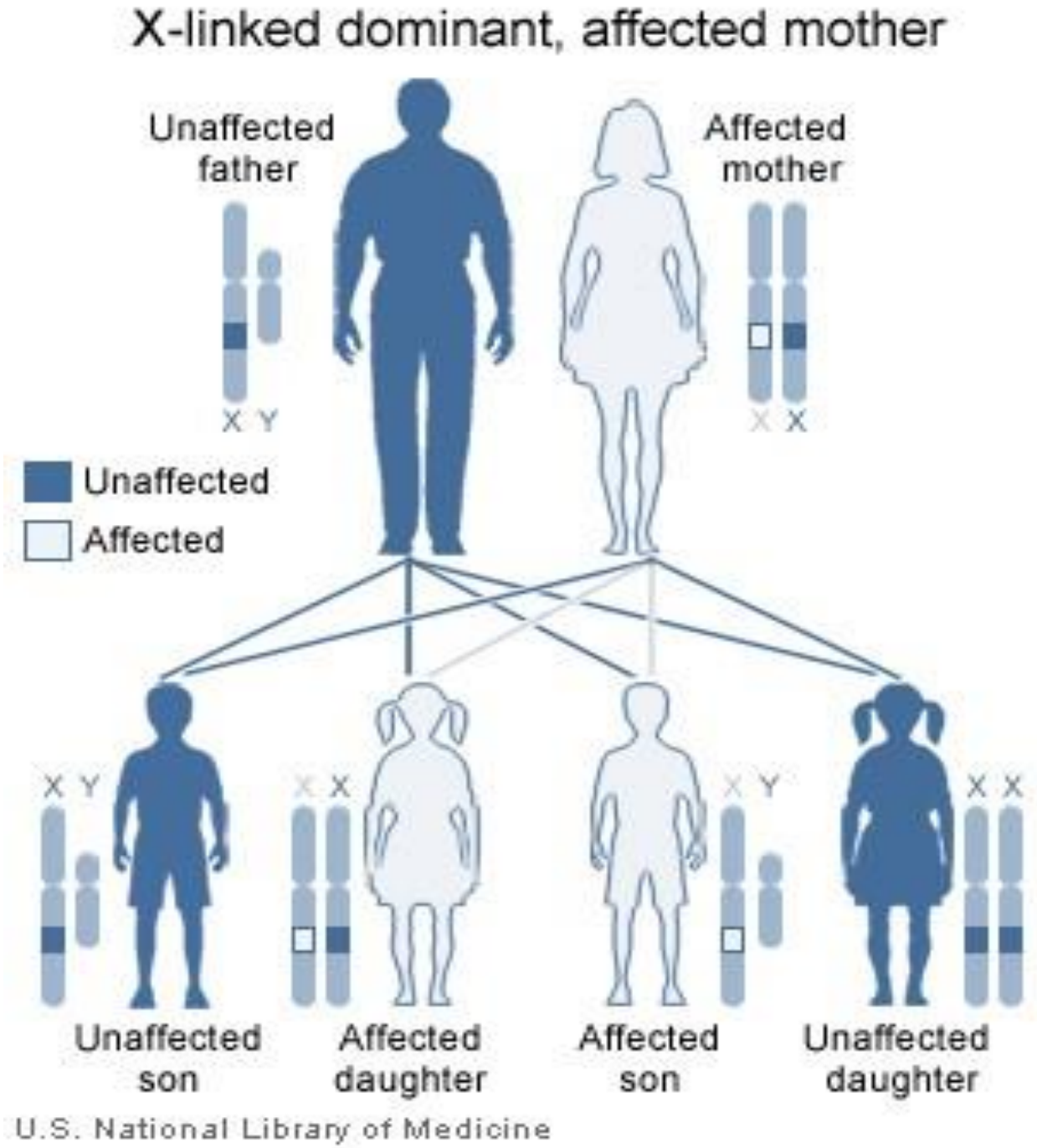
Sex Linked DOMINANCE

- Most sex linked traits are recessive
- Sex-linked dominance is a rare inheritance pattern
- A single abnormal gene on the X chromosome can cause a sex-linked dominant disease
- There are no “carriers”

- If the **father** has the abnormal X gene:
  - he has the disease (because it is dominant)
  - ALL of his daughters will inherit the disease
  - NONE of his sons will have the disease



- If the **<u>mother</u>** has the abnormal X gene:
  - she has the disease
  - <u>HALF</u> of her children (daughters and sons) will inherit the disease



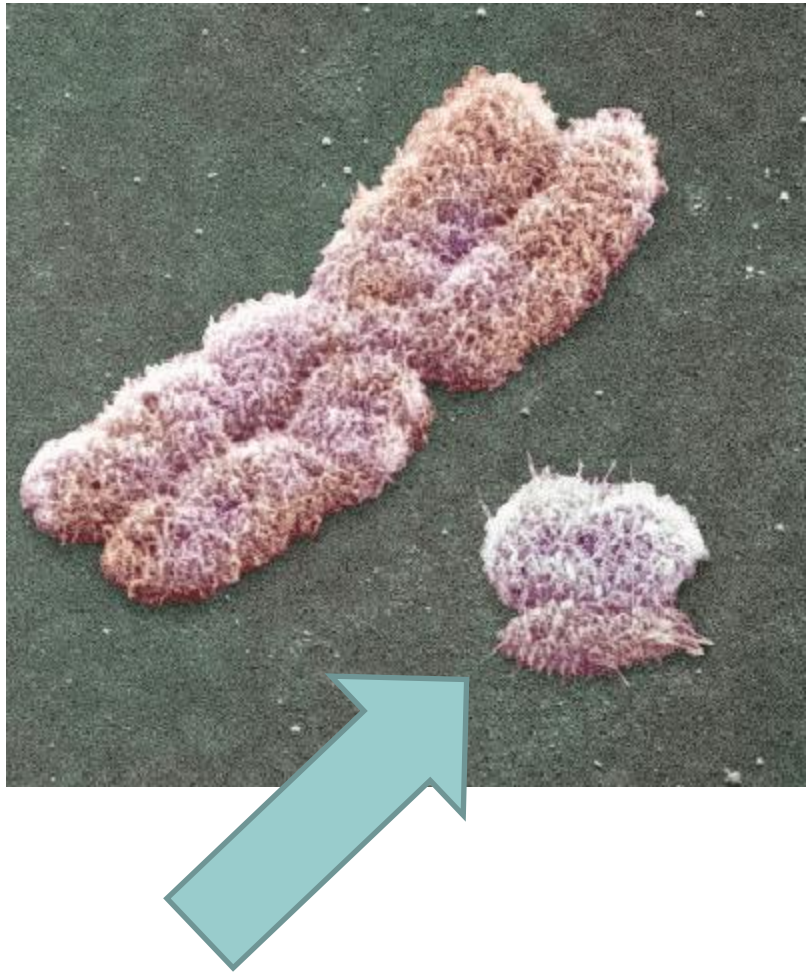
- Ex: Hypertrichosis: excessive hair growth
  - AKA Werewolf syndrome

Video - Hairiest Girl in the World

Video: hypertrichosis (Larry Gomez)

Y-Linkage

- Few genes are located on the Y chromosome (it's small)
- present only in males
- disorder would be passed on to all of a man's sons but never to daughters
  - Y chromosome infertility
  - Azoospermia

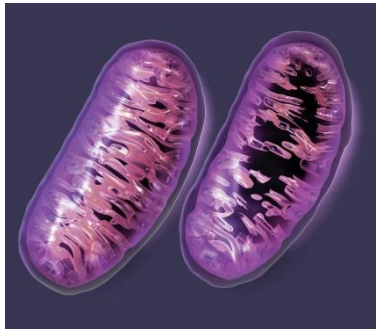


Y

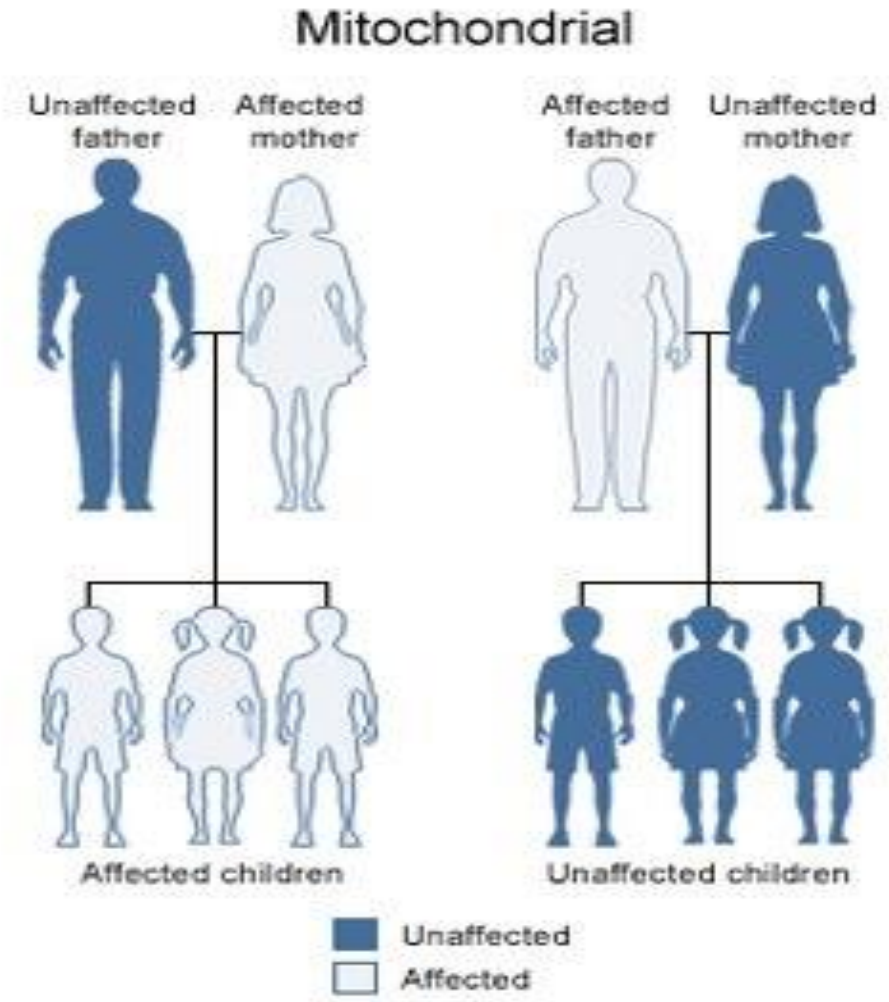
50 million base pairs

Short stature homeo box, Y-linked
Short stature
Leri-weill dyschondrosteosis
Langer mesomelic dysplasia
Interleukin-3 receptor, Y chromosomal
Sex-determining region Y (testis-determining)
Gonadal dysgenesis, XY type
Protocadherin 11, Y-linked
Azoospermia factors
Male infertility due to spermatogenic failure
Growth control, Y-chromosome influenced
Chromodomain proteins
Retinitis pigmentosa, Y-linked

Mitochondrial Inheritance



- Mitochondria are organelles cellular respiration (energy release)
- They have their own DNA
- Transmission is from mother's egg cell to ALL offspring
- Sons and daughters are equally effected by mutations



Mitochondrial Inheritance

- Ex. Leber's Hereditary Optic Neuropathy (LHON)
  - rare condition, can cause sudden painless loss of central vision