# SEX-LINKED, SEX-LIMITED
# &
# SEX- INFLUENCED INHERITANCE

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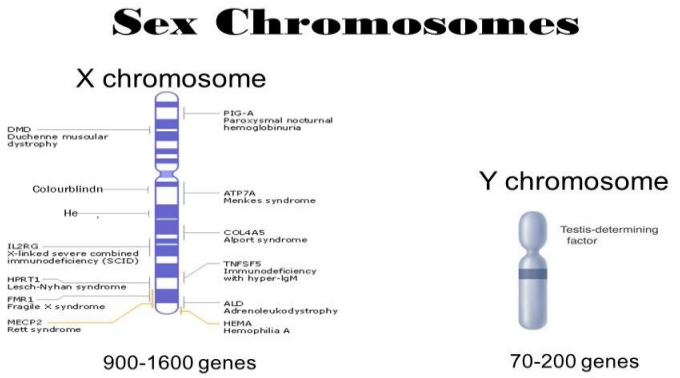
# INTRODUCTION

- There are two types of chromosomes- Autosomes and Sex chromosomes.
- Autosomes are those chromosomes that are not involved in sex determination.
- Sex chromosomes are those chromosomes that determine the sex of an organism.
- A human somatic cell has two sex chromosomes: XY in male (hetero-gametic) and XX in female (homo-gametic).
- **X-chromosome** is large and bears large number of sex-linked genes, controlled sex-linked characters, called sex-linked inheritance.
- **Y-chromosome** is small and bears no or very small number of genes, called holandric genes.

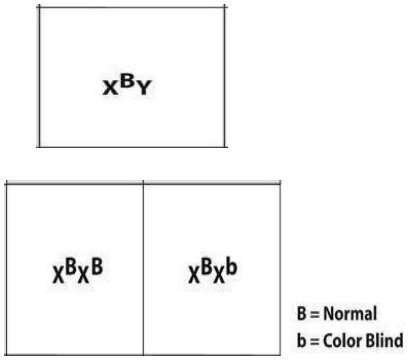


# TYPES OF SEX-LINKED INHERITANCE

- X-linked inheritance:- controlled by genes located in the non-homologous part of X- chromosomes.
- Y-linked inheritance:- controlled by genes located in the non-homologous part of Y- chromosomes.
- XY or incomplete sex linked inheritance:- controlled by genes located in the homologous part of X and Y- chromosomes.

# PROPERTIES OR CHARACTERS OF RECESSIVE X-LINKED INHERITANCE

1. Genes lies on X-chromosome and their alleles on Y-chromosome are absent.
2. Male:- Hemizygous condition- single gene on X- chromosome
   Female:- homozygous or heterogygous
3. Males are normal or diseased
   heterozygote females are carriers
4. Sex-linked or skip generation or
   criss-cross inheritance
5. Frequency in male is much more than females
6. Mating between carrier female and normal male
   a) 50% males are diseased
   b) 50% females are carrier
7. Mating between normal female and diseased male
   a) all males are normal
   b) all females are carrier



# EXAMPLES OF RECESSIVE X-LINKED INHERITANCE IN HUMANS

## Color blindness or color vision deficiency:-

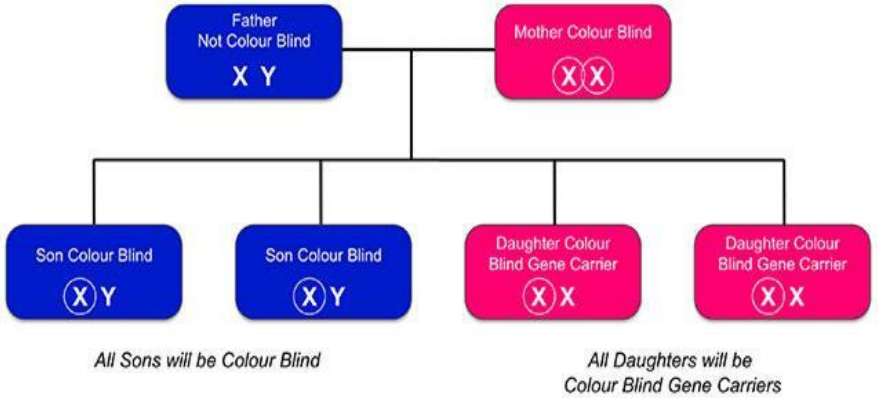
the inability to see color or perceive color differences under normal lighting conditions. Color blindness affects a significant percentage of the population. There is no actual blindness but there is a deficiency of color vision. The most usual cause is a fault in the development of one or more sets of retinal cones that perceive color in light and transmit that information to the optic nerve. This type of color blindness is usually a sex-linked condition.

Types of colorblindness:-

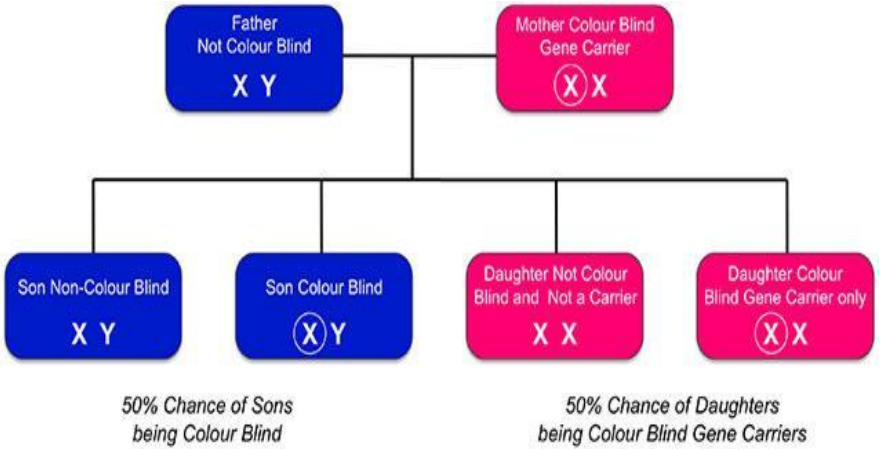
- Deuteranopia or deutan colorblindness:- inability to discreminate green color.
- Protanopia or protan colorblindness:- inability to discreminate red color.

# INHERITANCE OF COLOR BLINDNESS

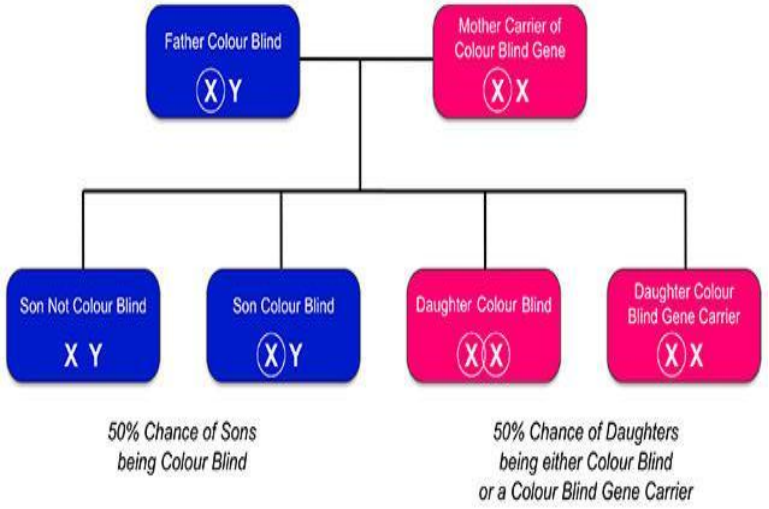
When mother is colorblind, all sons will come out colorblind, and all daughters will be carrier



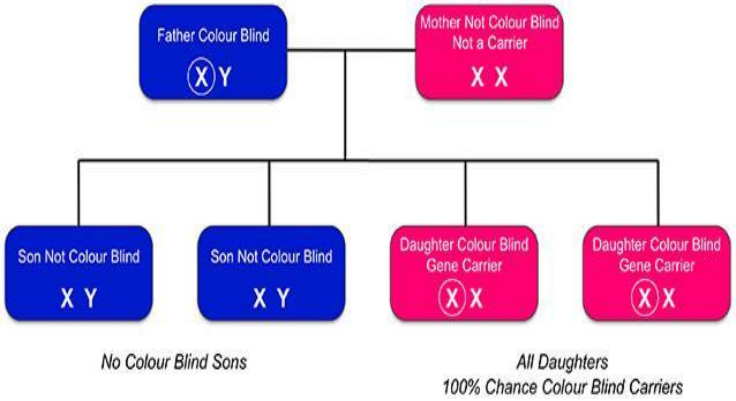

When mother is a carrier, none of the daughters are colorblind, but could be a carrier with a normal father. Sons could be colorblind.

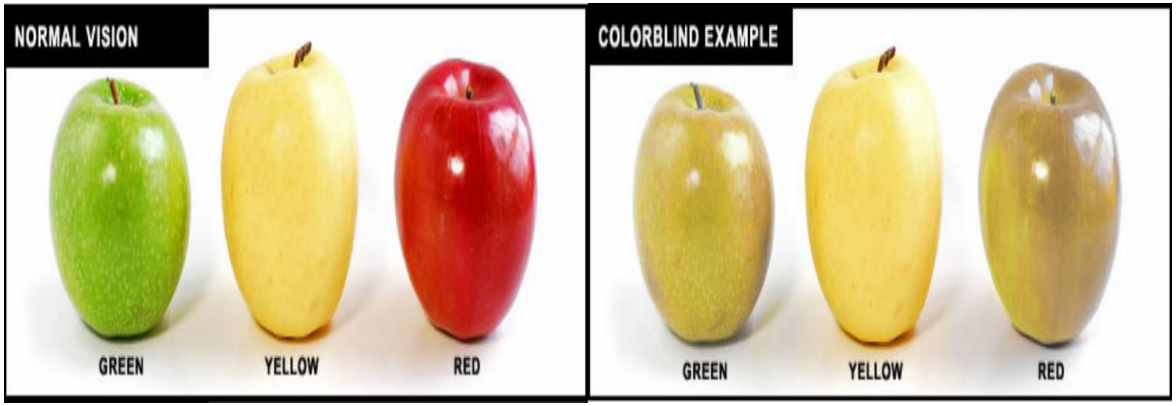


When father is colorblind and mother carrier, both sons and daughters have a change of becoming colorblind




No colorblind sons when mother is normal. All carrier females when father is colorblind.






The result of these pedigrees means that colors are perceived differently in color blind individuals. They cannot distinguish between greens and reds and thus colors on either end of the spectrum are more difficult to discern. Blue-yellow

# Haemophilia (Bleeder's disease)

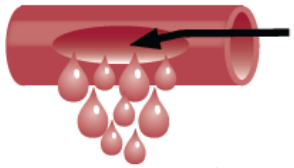
Haemophilia is a inherited genetic disorder that impairs the body's ability to make blood clots, a process needed to stop bleeding. This results in people bleeding for a longer time after an injury, easy brusing and an increased risk of bleeding inside joints or the brain.

**Types:-**

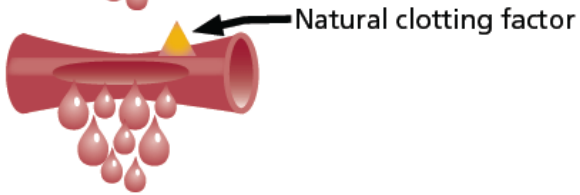
1. Haemophilia–A: Due to deficiency of plasma factor VIII,called Anti-Haemophilic factor(AHF) occurs in about 83% population.
2. Haemophilia–B: Due to deficiency of plasma factor IX,called Plasma Thromboplastin Components (PTC) or Christmas Factor occurs in about 83% population .
3. Haemophilia–C: Due to deficiency of plasma factor XI,called Plasma Thromboplastin Antecedent(PTA)

# Injury Occurs

Injury to blood vessel results in bleeding.

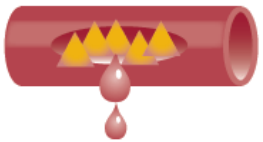



Vessel constricts and clotting factors are activated.




## Normal

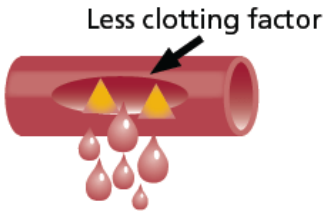
Natural clotting factor helps form a strong platelet plug.



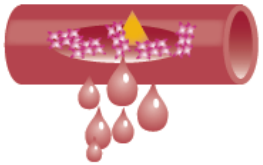
A stable fibrin mesh forms a sealed clot over the platelet plug to stop the bleeding.

## Hemophilia

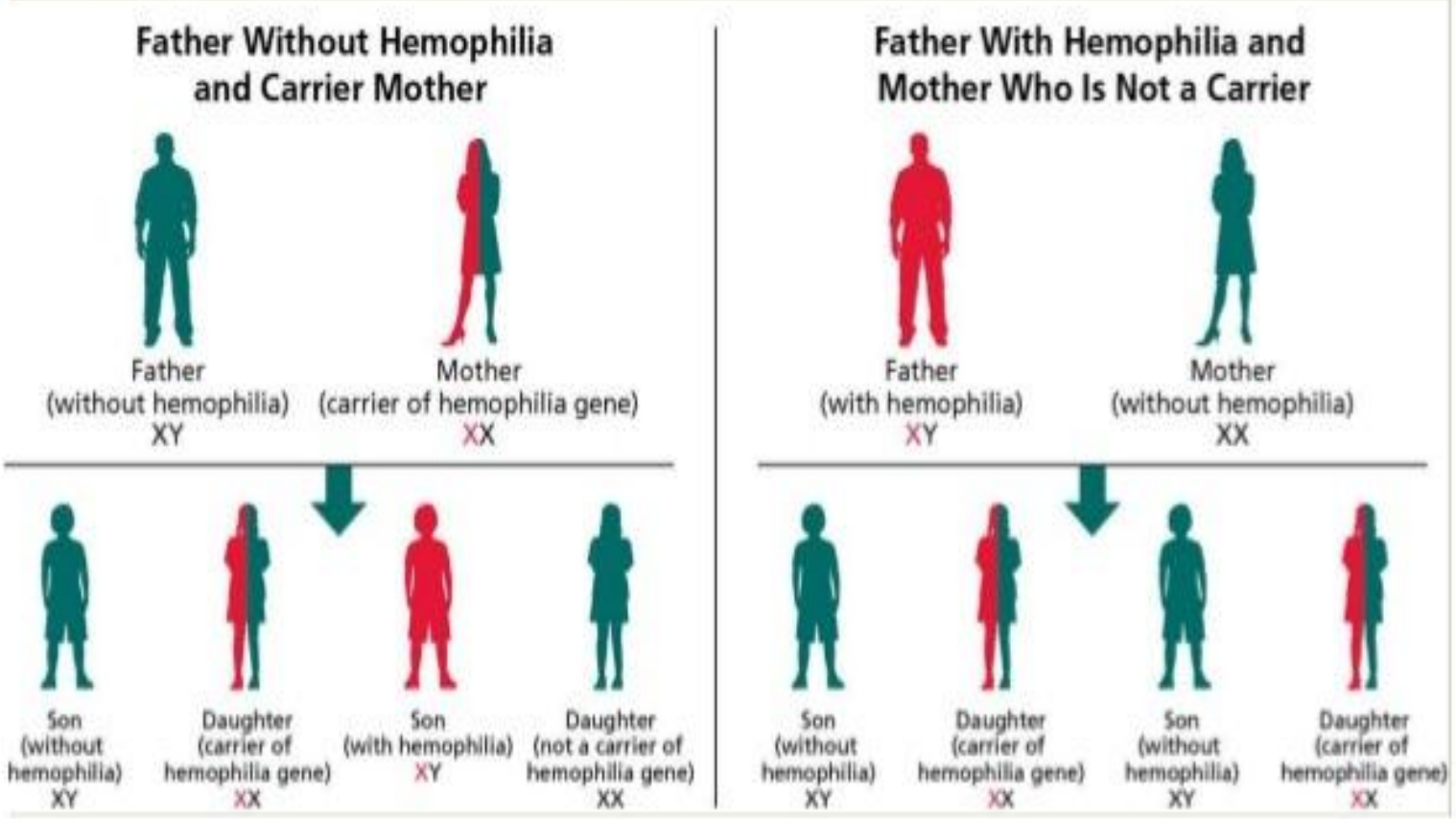
Lack of natural clotting factor means only a weak platelet plug can form.



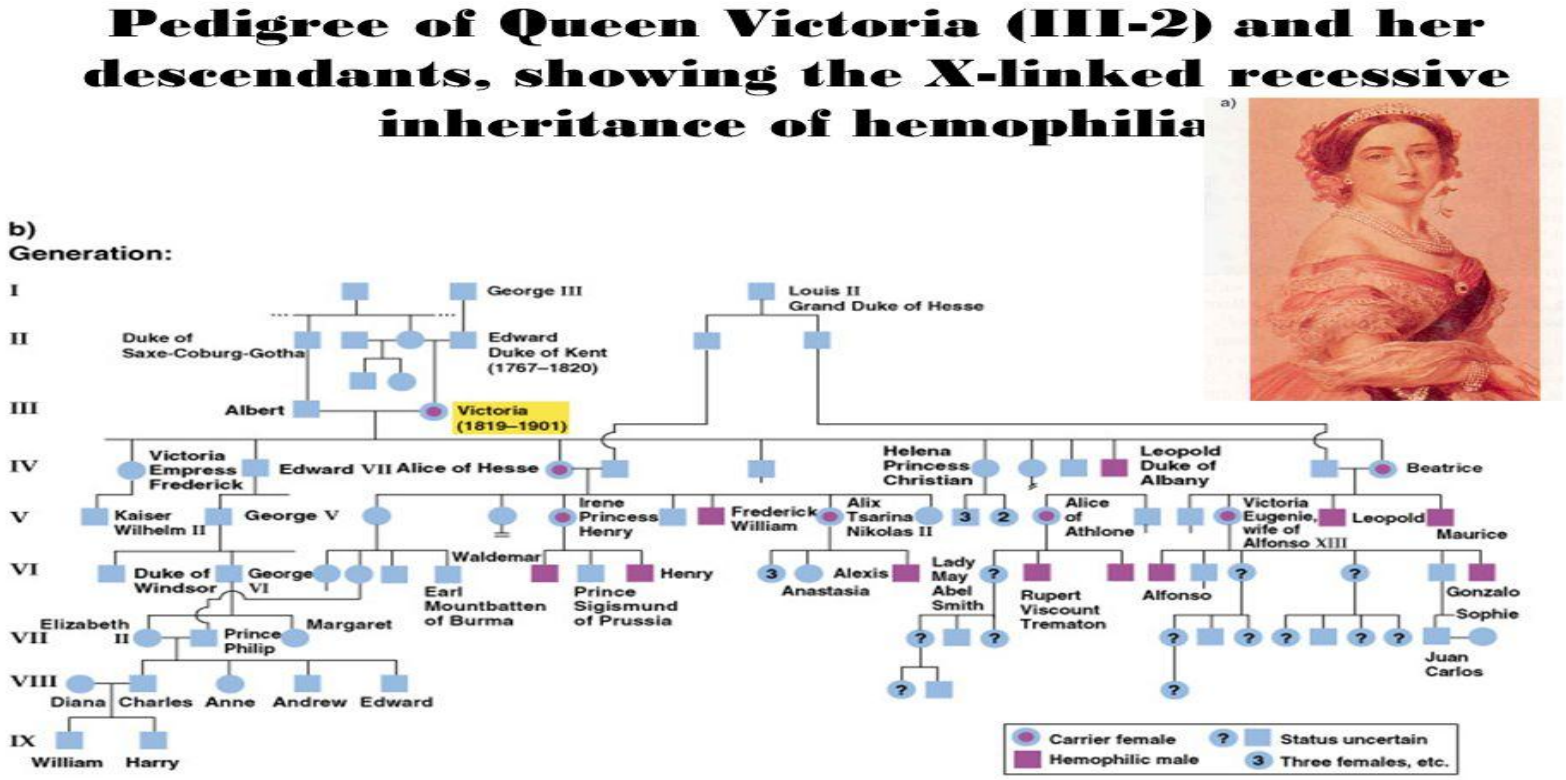

Incomplete fibrin mesh allows bleeding to continue.



# Causes of Haephilia

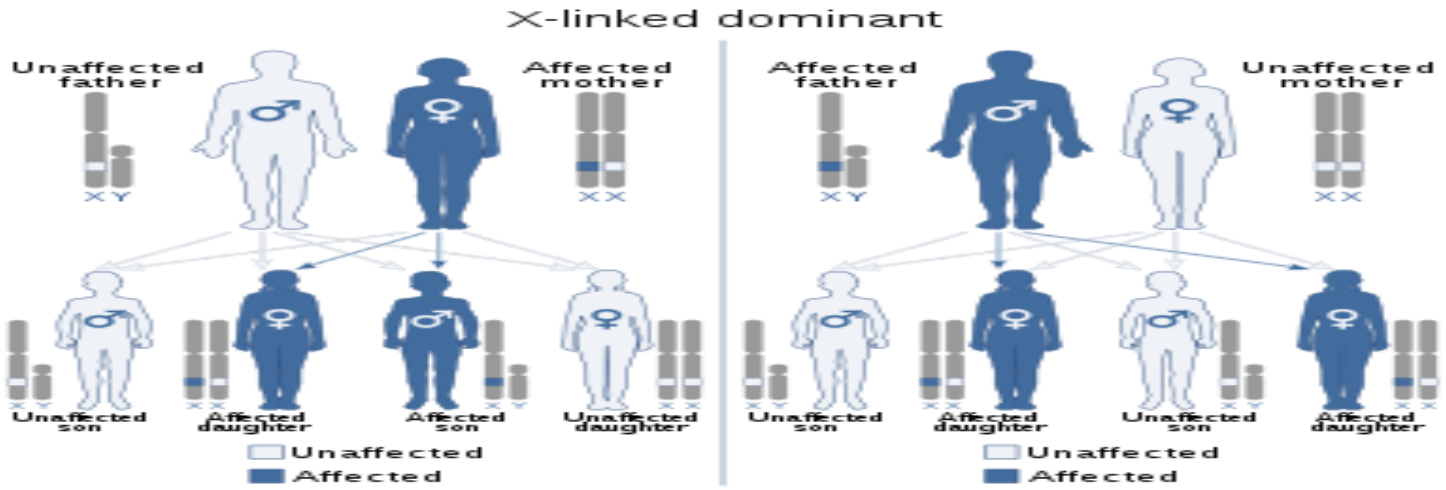


# Most famous pedigree of haemophilia was discovered by J.B.S. Haldane in royal families of Europe



# X-LINKED DOMINANT INHERITANCE

X-linked dominant inheritance is a mode of genetic inheritance by which a dominant gene is carried on the X chromosome. It is less common than the X- linked recessive type. X-linked dominant inheritance indicates that a gene responsible for a genetic disorder is located on the X chromosome and only one copy of the allele is sufficient to cause the disorder when inherited from a parent who has the disorder.




**when mother is carrier of a mutated or defective gene associated with a disease. Her children will inherit the disorder as follows:**

Daughters and sons: 50% will have the disorder, 50% will be completely unaffected.

**When father is carrier of a defective gene associated with a disease. His children will inherit the disorder as follows:**

Daughters: 100% will have the disorder, since all of his daughters will receive one copy of his single X chromosome.

Sons: none will have the disorder; sons do not receive an X chromosome from their father.

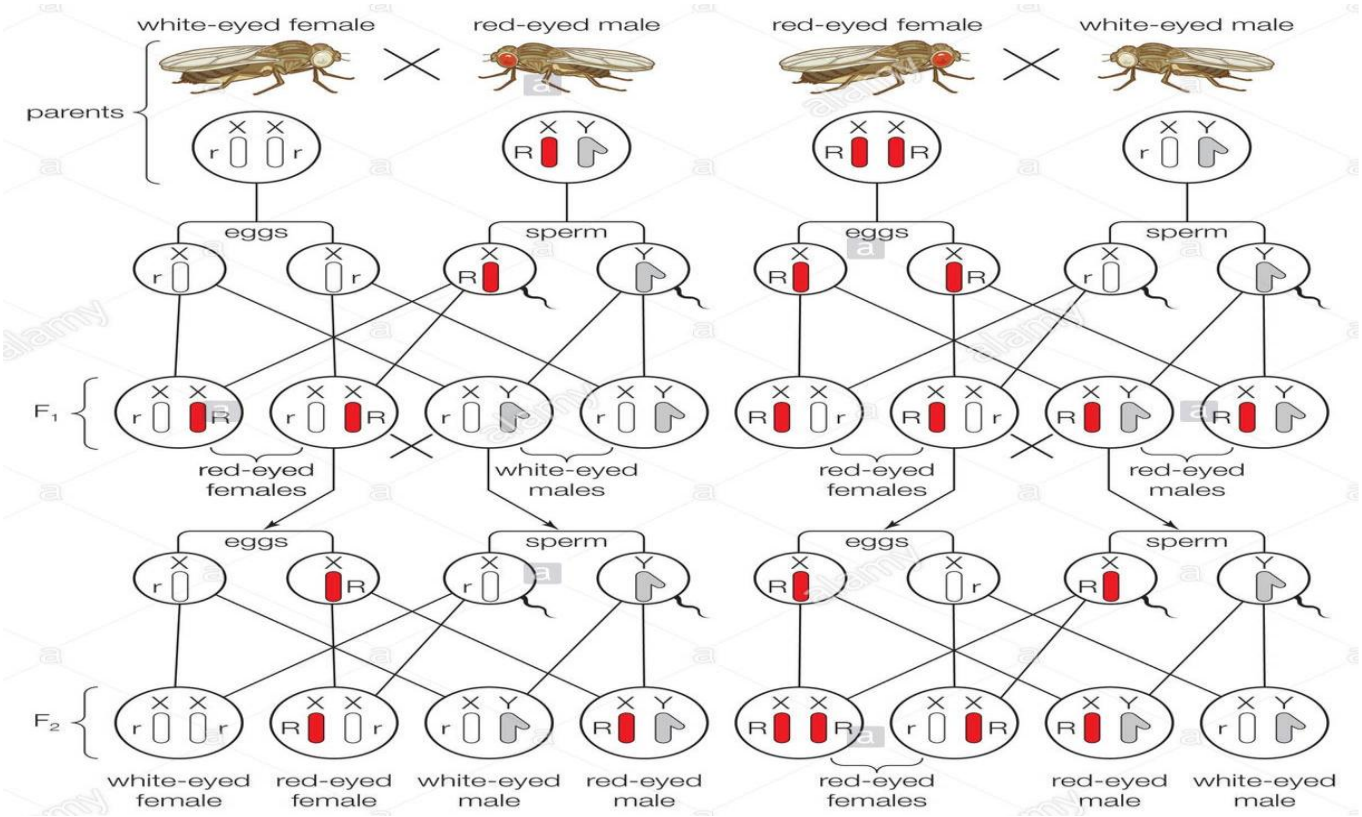
# LIST OF DOMINANT X-LINKED DISEASES

Vitamin D resistant rickets: X-linked hypophosphatima
Rett syndrome
Alport syndrome
Incontinentmentiia pigpigmenti
Goltz syndrome
X-linked dominant porphyria
Fragile X syndrome

# SEX LINKAGE IN DROSOPHILA

i) White eyed male X Red eyed female

ii) Red eyed male X White eyed female

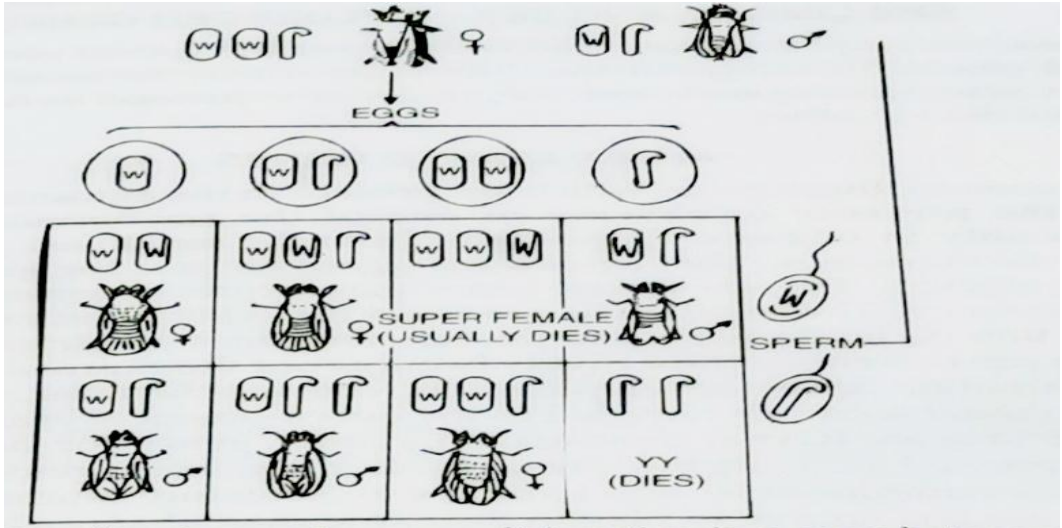


# NON -DISJUNCTION IN DROSOPHILA

Non-disjuntion is a phnomenon in which two x- chromosome fail to separate during the meiotic division discovered by C.Bridge(1930) explained the abnormality in drosophila as:-

1- Primary non-disjunction

2- Secondary non-disjunction




Results of secondary non-disjunction in a cross between
XXY white-eyed female and an XY red-eyed male.

# Y-LINKED GENE INHERITANCE

Genes located on the Y chromosome  pass directly male to male. In human and other mammalian males the Y chromosome carries genes other than for sex determination. Examples are:-

Hypertrichosis(hairy ears)

Pebbed toes

Porcupine man.

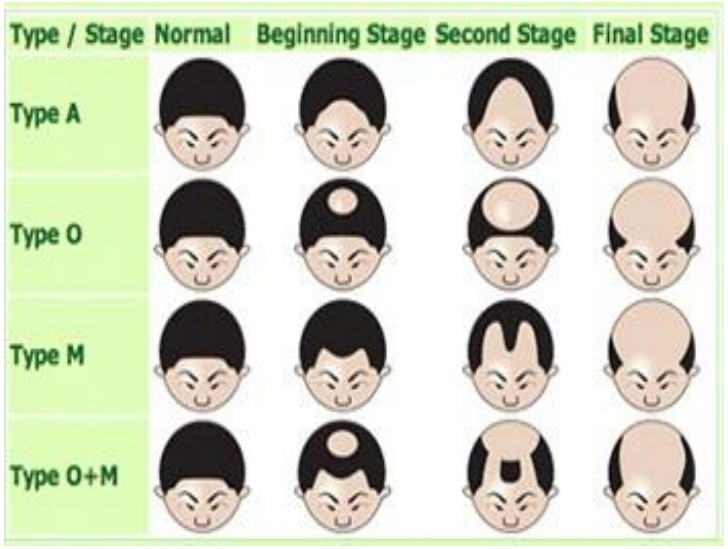
# XY OR INCOMPLETE SEX LINKED INHERITANCE:-

controlled by genes located in the homologous part of X and Y-chromosomes. Examples

- Total colorblindness
- Two skin disease ( xeroderma pigmentosum & epidermolysis bullosa)
- Retinitis pigmentosa

# SEX -INFLUENCED GENES

Sex influenced genes are those whose dominance is influenced by the sex of the bearer. The male and female individuals may be similar for a particular trait but give different phenotypic expressions of the same trait.Example:- Baldness pattern in human




| Genotype | Man (♂♂) | Woman (♀♀) |
|---|---|---|
| BB | Bald | Bald |
| Bb | Bald | Non-bald |
| bb | Non-bald | Non-bald |

# SEX -LIMITED GENES

Sex limited genes are autosomal genes whose phenotypic expression is determind by the presence or absence of one of the sex hormone. Their phenotypic effect is limited to one sex or other. Sex limited genes mainly responsible for secondary sexual characters in cattles, humans and fowl. For example male voice, body hairs and physique are autosomal in human beings, but they are expressed only in the presence of androgens which are absent in female.

# Thank You