Pedigree Analysis in Genetic Inheritance Patterns

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Outline

- What is Pedigree Analysis.
- Why do Pedigrees
- Symbols Used in Pedigrees Analysis
- Patterns of Inheritance
- Steps in Pedigree Analysis
- Applications of Pedigree Analysis

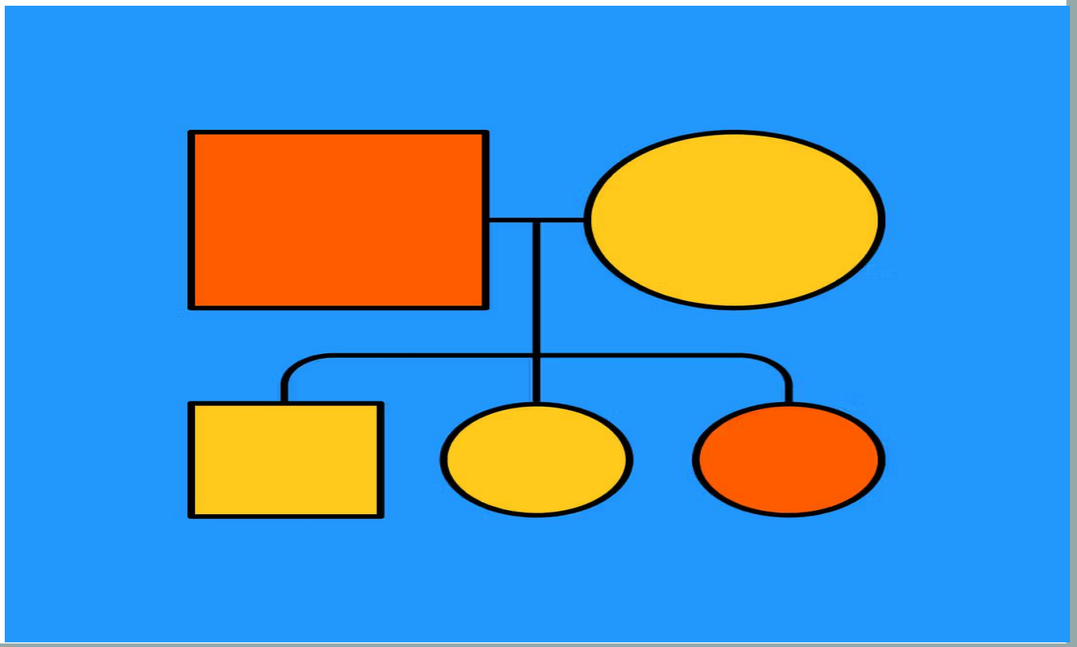
Objectives

To acquaint students with the concepts of Pedigree Analysis in Genetic Inheritance Patterns.

❖ What is Pedigree Analysis?

- A **pedigree chart** is a diagram that shows the occurrence of **phenotypes** and **genotypes** across multiple generations within a family.

- Pedigree analysis helps in understanding how **genetic disorders** are passed down, and can **identify carriers**, **affected individuals**, and **predict future occurrences** in offspring.



❖ Why do Pedigrees?

- Individuals may wish to be tested if:

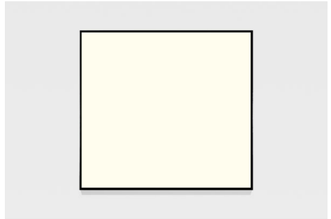
A.) There is a family history of one specific disease.

B.) They show symptoms of a genetic disorder.

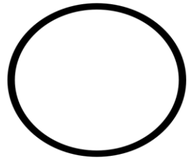
C.) They are concerned about passing on a genetic problem to their children.

❖ Major Symbols Used in Pedigrees Analysis

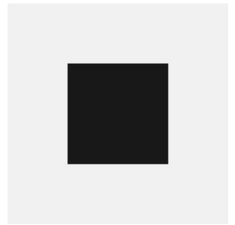
i. Square: – Represents a male.



ii. Circle: – Represents a female.



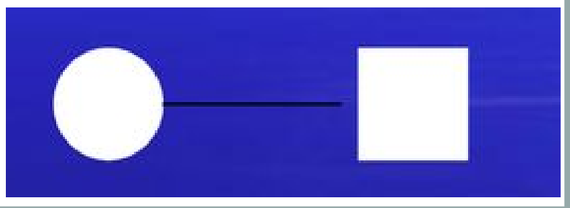
iii. Shaded Symbol: – Indicates an affected individual.



iv. Unshaded Symbol – Represents an unaffected individual.

v. Half-Shaded Symbol – Denotes a carrier

vi. Horizontal Line Between Male & Female – Represents mating

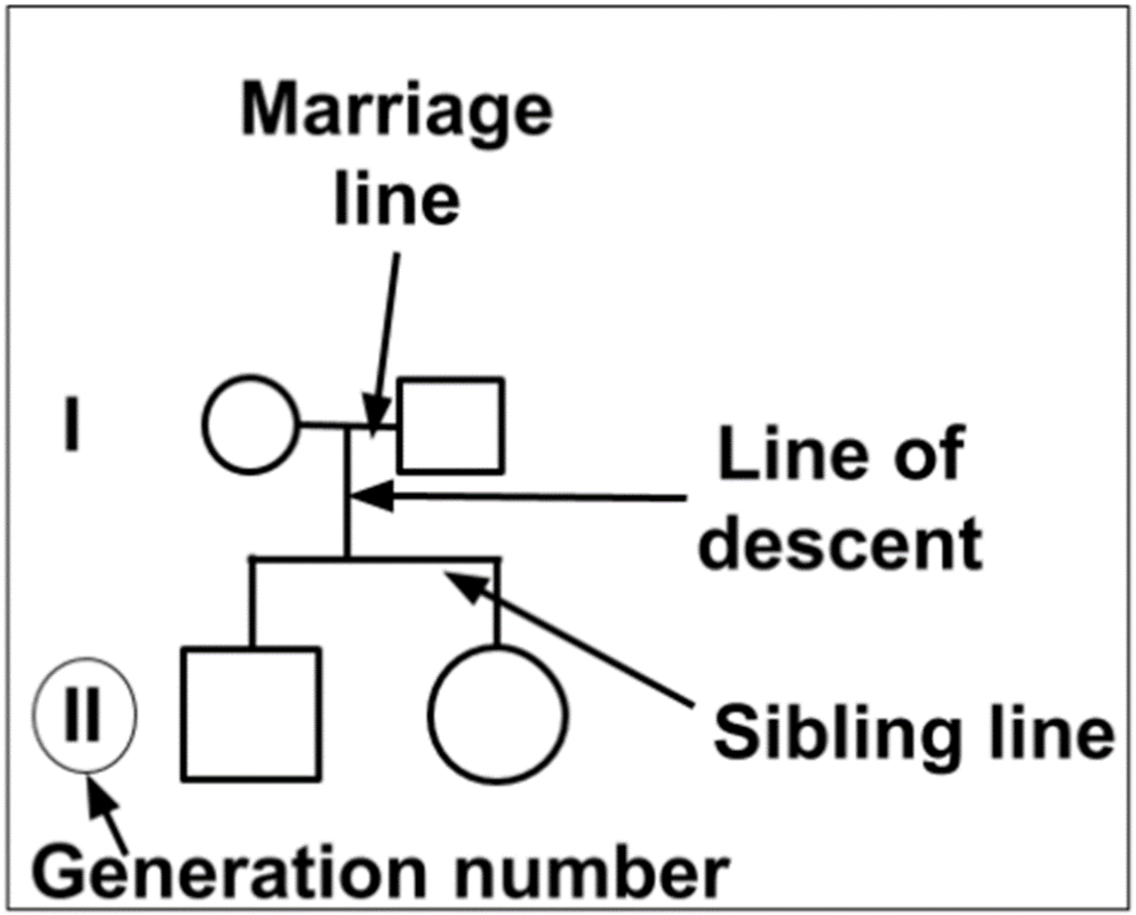


❖ More Symbols in Pedigrees Analysis

Twins

Adopted

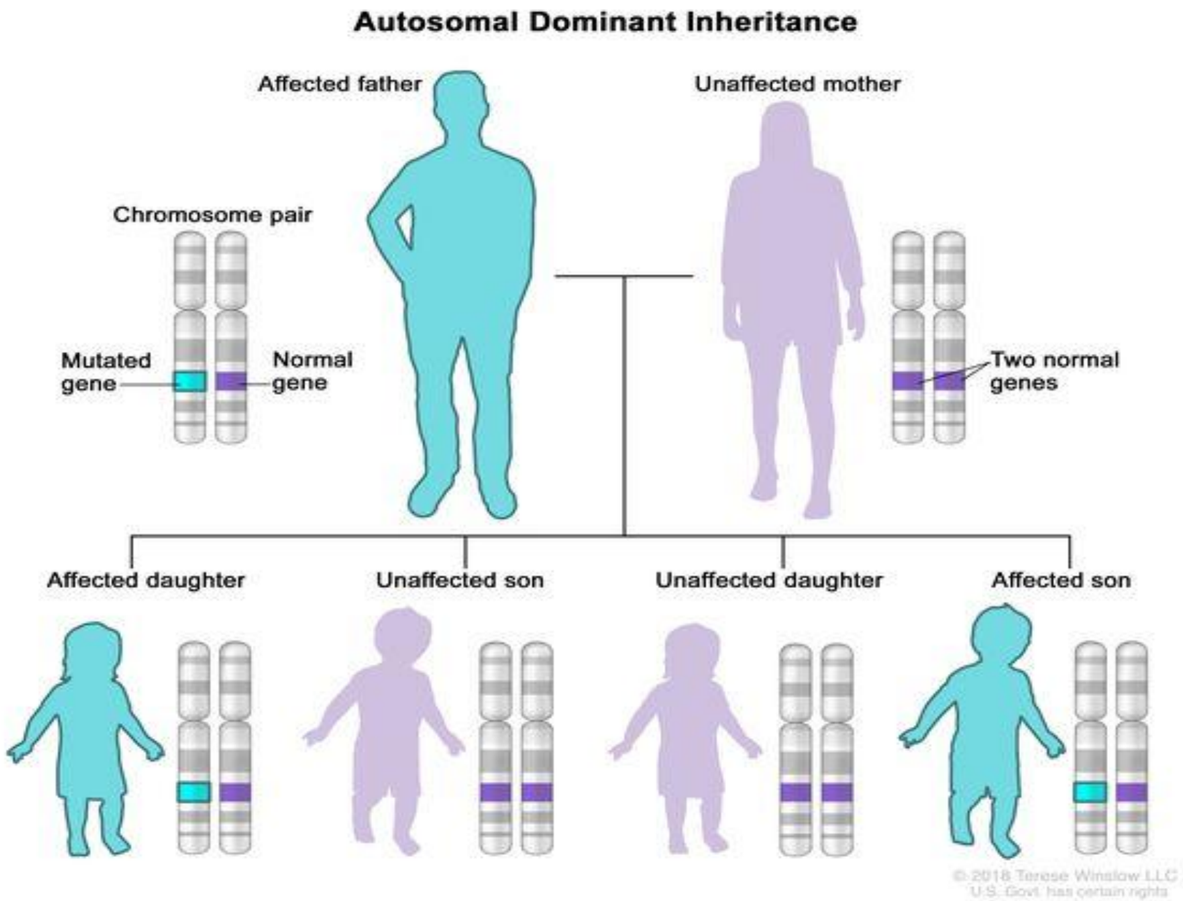
Miscarriage



❖ Patterns of Inheritance:

1. Autosomal Dominant Inheritance Disorder:

- ✓ Disorder typically appears in every generation.
- ✓ Affected individuals have at least one affected parent.
- ✓ Equal occurrence in males and females.
- ✓ Example: Huntington’s disease, Marfan syndrome

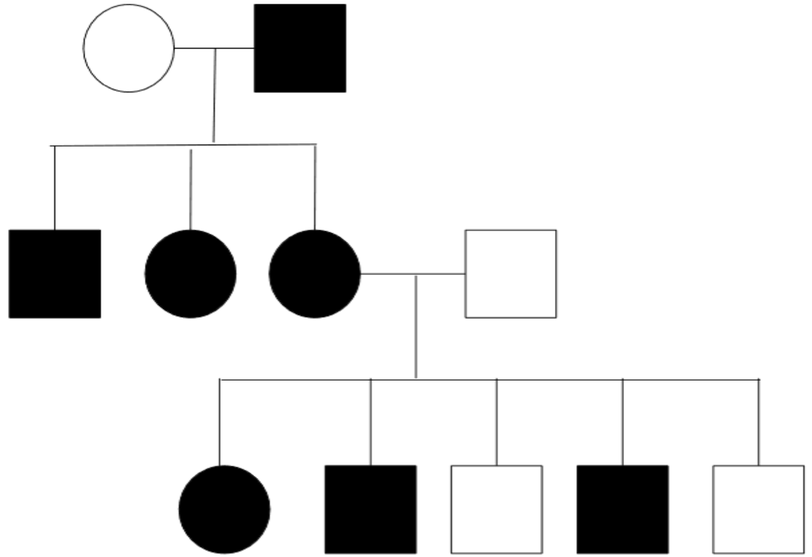


Generation

I

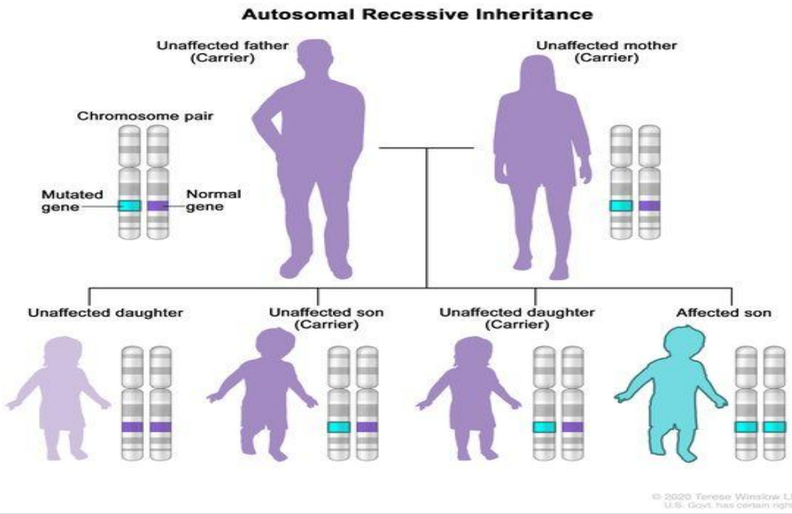
II

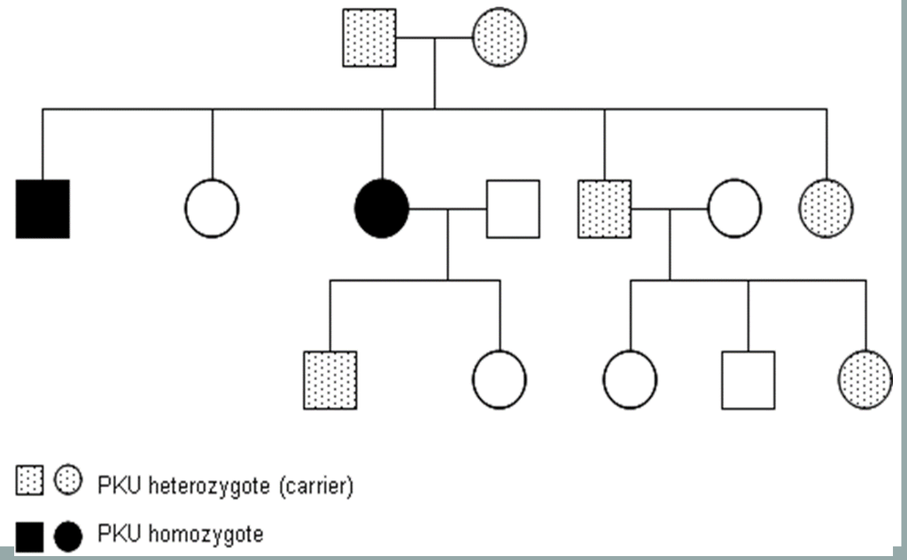
III



2. Autosomal Recessive Inheritance Disorder:

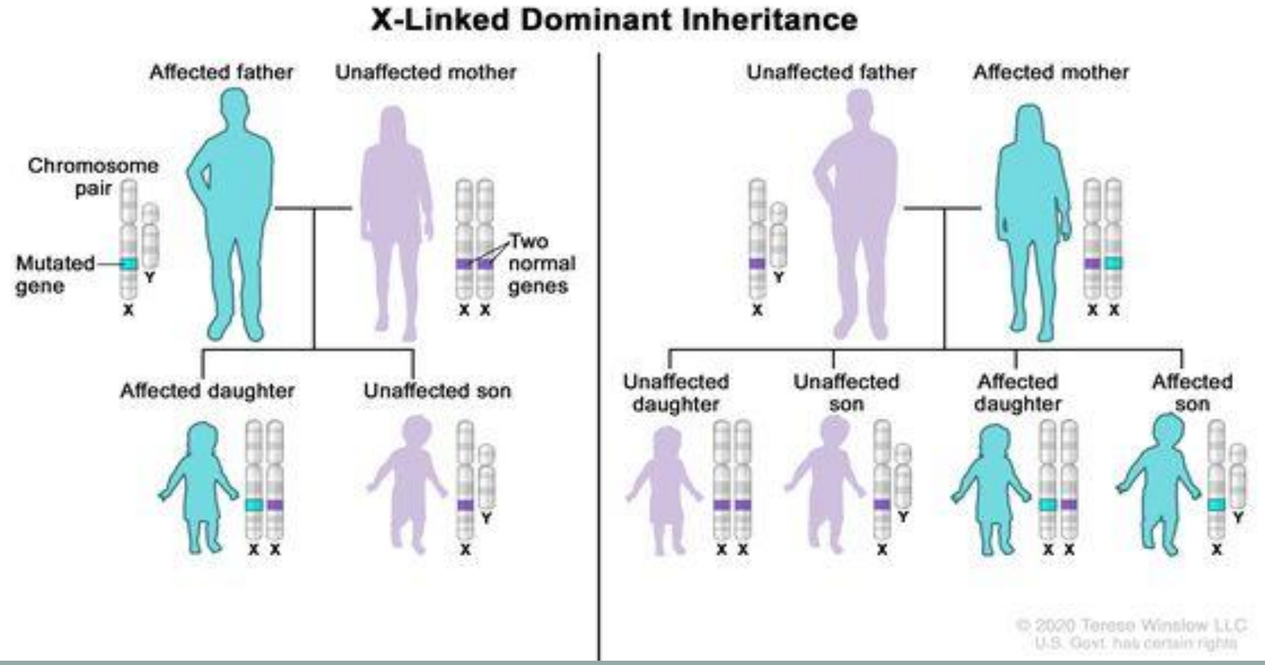
- ✓ Disorder may skip generations.
- ✓ Affected individuals may have unaffected parents (carriers).
- ✓ Equal occurrence in males and females
- ✓ Example: Cystic fibrosis, Sickle cell anemia, Phenylketonuria (PKU).





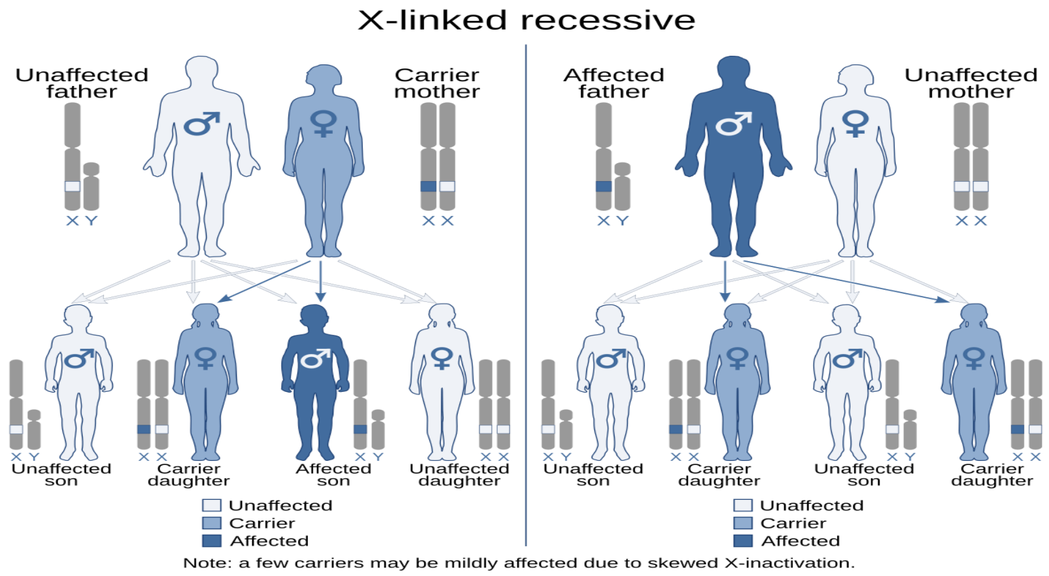
3. X-linked Dominant Inheritance Disorder:

- ✓ No male-to-male transmission.
- ✓ Affected males pass the disorder to all daughters, but not sons.
- ✓ Affected females can pass the disorder to both sons and daughters.
- ✓ Example: Rett syndrome.



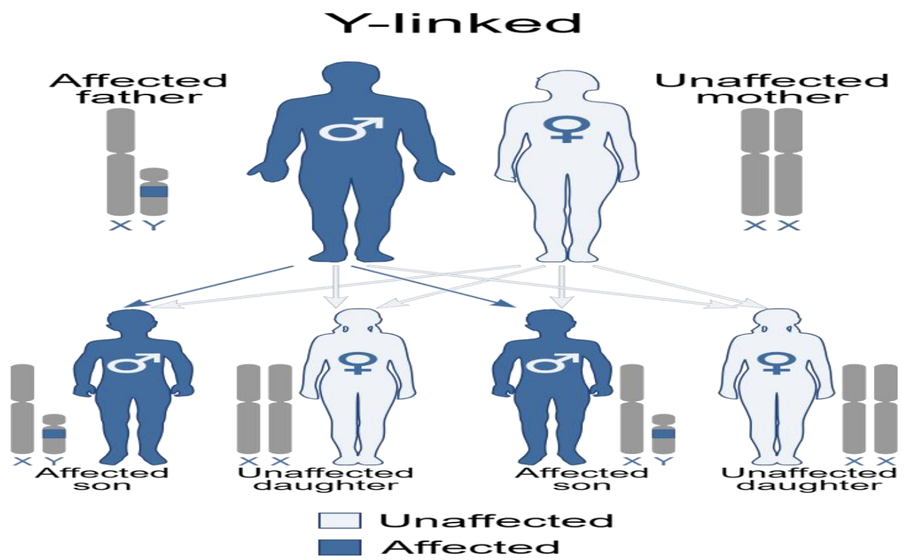
4. X-linked Recessive Inheritance Disorder:

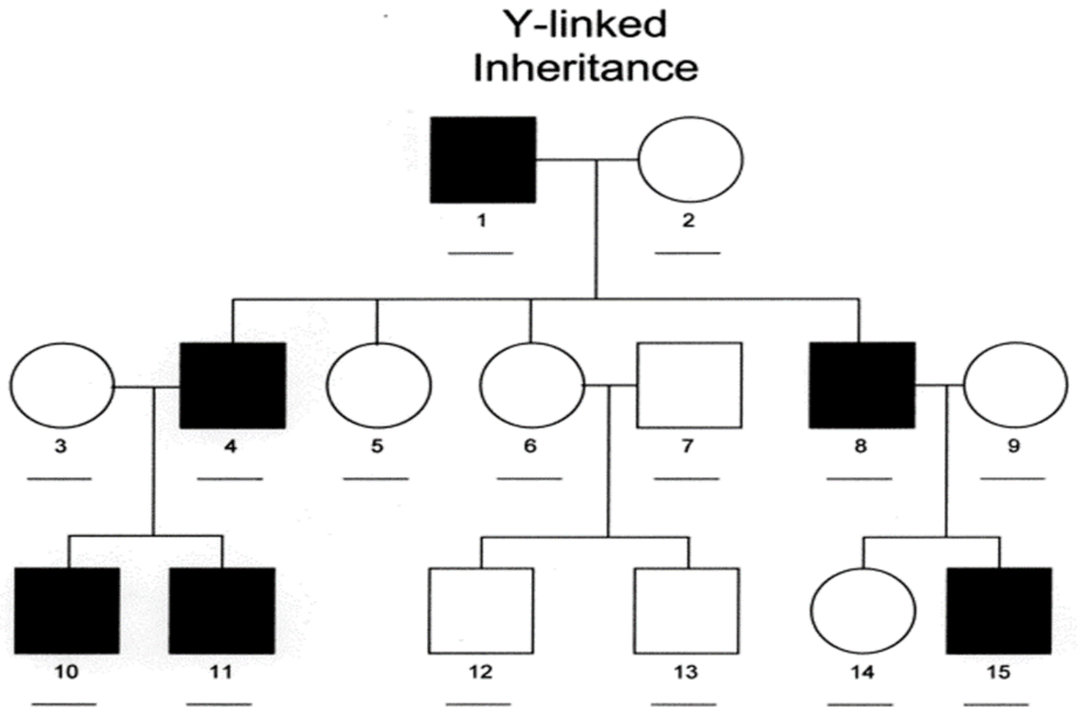
- ✓ More common in males (as they inherit only one X chromosome).
- ✓ Affected males typically inherit from carrier mothers.
- ✓ No male-to-male transmission.
- ✓ Example: Hemophilia, Duchenne muscular dystrophy



5. Y-linked Inheritance Disorder:

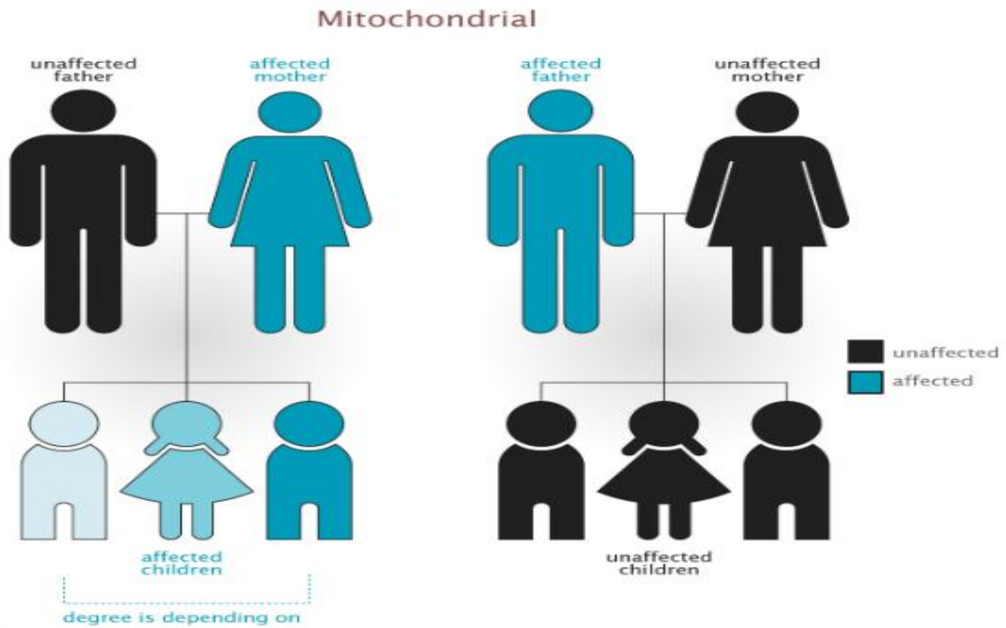
- ✓ Only males are affected.
- ✓ Affected males pass the disorder to all of their sons.
- ✓ No female carriers or affected females
- ✓ No skipping of generations





6. Mitochondrial Inheritance Disorder:

- ✓ Passed only through the mother.
- ✓ All offspring of an affected mother inherit the disorder.
- ✓ Example: Leber's hereditary optic neuropathy



❖ Steps in Pedigree Analysis:

1. Step 1: Collect Family History Data
2. Step 2: Construct the Pedigree Chart.
3. Step 3: Identify the Mode of Inheritance.
4. Step 4: Confirm with Additional Data.
5. Step 5: Calculate Risk Probabilities
6. Step 6: Interpret Findings and Provide Recommendations

❖ Applications of Pedigree Analysis:

1. Medical Genetics.

2. Evolutionary Biology

3. Forensic Science

4. Animal Breeding & Agriculture

❖ Classwork: Pedigree Analysis Activity:

Question: A family has a history of hemophilia (an X-linked recessive disorder). The mother is a carrier, and the father is unaffected. Draw the pedigree using standard symbols for three generation and determine the probability of their son having hemophilia.

References

- Babcock, E. B., & Collins, J. L. (1918). Genetics laboratory manual. McGraw-Hill Book Company Incorporated.

- Blair, C. (2018). BIO2450L Genetics Laboratory Manual.

- VENNISON, S. (2009). Laboratory manual for genetic engineering. PHI Learning Pvt. Ltd..

Thanks