

Preparation and Analysis of Human Karyotypes

Course instructor: Jibril H. Yusuf PhD.

E-mail: jibril.habib@tiu.edu.iq

Assistant: Mr. Ahmed

Course: Genetics II (MA 206)

Summer Class

Lab-3

Date 23-8-2026



Outline



- Karyotype.
- Classification of Chromosomes for Karyotyping
- What is an Ideogram
- Materials Required for Karyotyping
- Procedure of Karyotyping
- Expected Results
- Safety Precautions

■ Objectives

To acquaint students with the concepts of karyotypes and ideograms, their significance in genetics, and their applications in diagnosing chromosomal abnormalities.

❖ Karyotype



- A karyotype is a **visual representation of an individual's chromosomes, organized and arranged** in a **standard format**.
- **It is created by:**
 1. Collecting cells
 2. Arresting cells during metaphase
 3. Staining the chromosomes
 4. Arranging the chromosomes in pairs

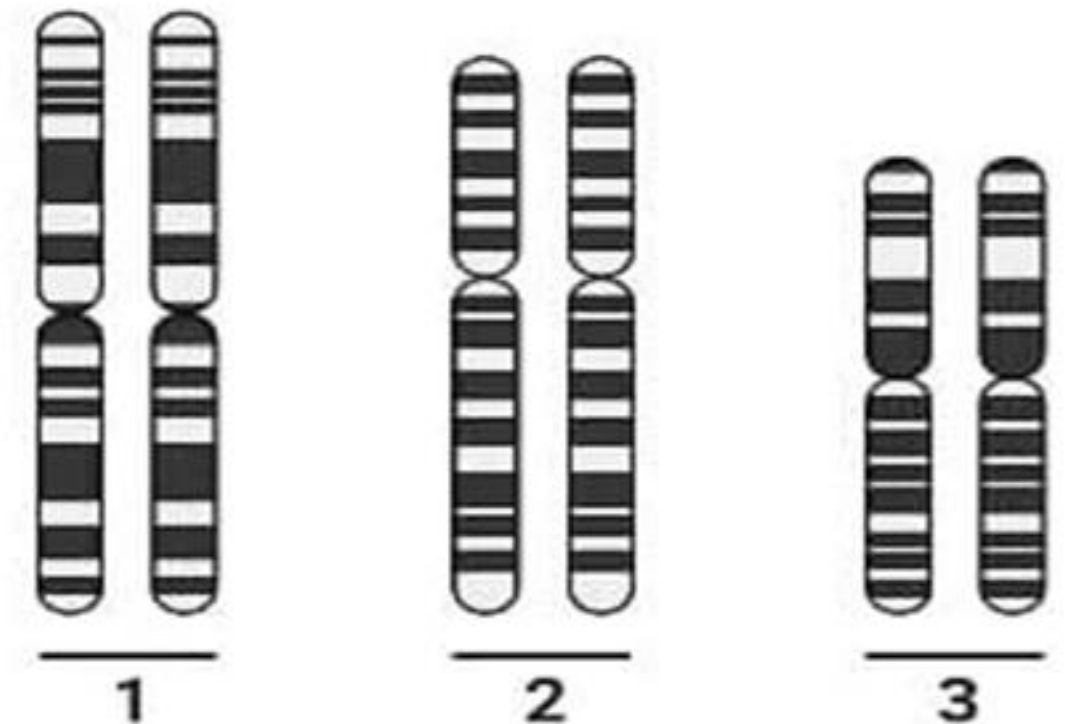
❖ Classification of Chromosomes for Karyotyping



- Based on size and centromere position, human karyotyping divides chromosomes into **seven groups** (A to G):

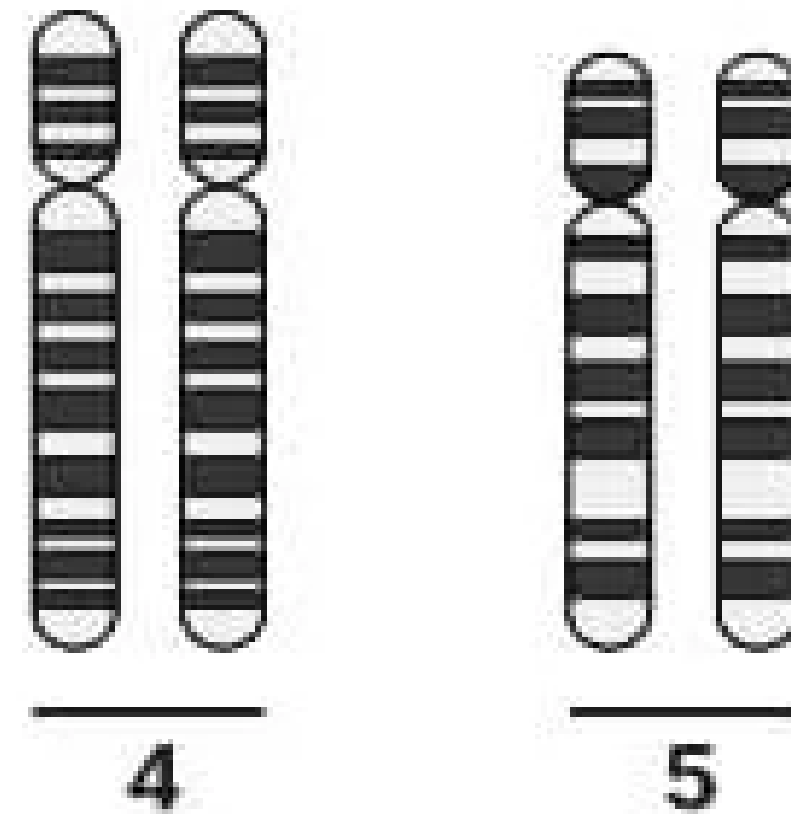
1. Group A:

- Chromosomes 1-3 largest **metacentric** and submetacentric.
- 1 - Contains over 2,000 genes
- 2- Contains 1,300 genes
- 3- Contains around 1,100 genes



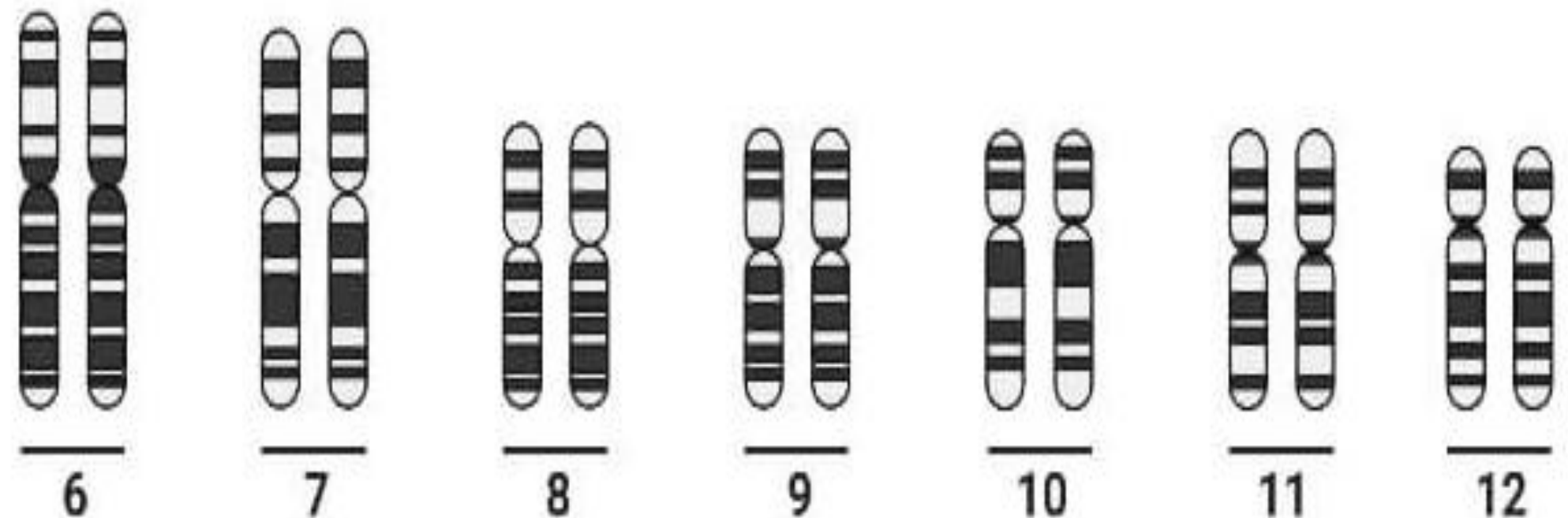
2. Group B:

- Chromosomes 4-5 largest submetacentric.
- 4- Contains 1,000 genes
- 5- Contains 900 genes



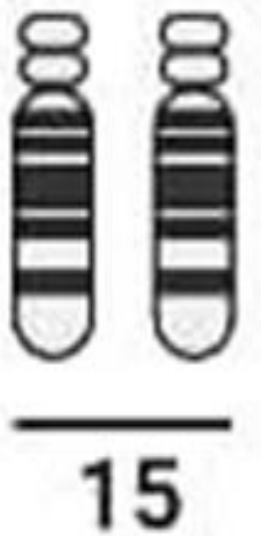
3. Group C:

- Chromosomes 6-12 medium submetacentric.
- 6- 7 Contains 1,000 genes
- 8 & 10 Contains 700 genes
- 9- Contains 800 genes
- 11- Contains 1,300 genes
- 12- Contains 1,100 genes



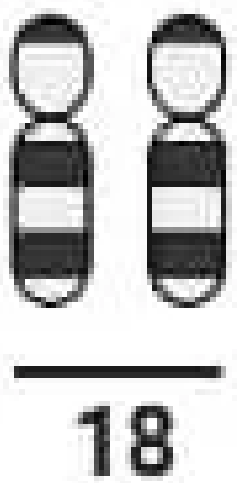
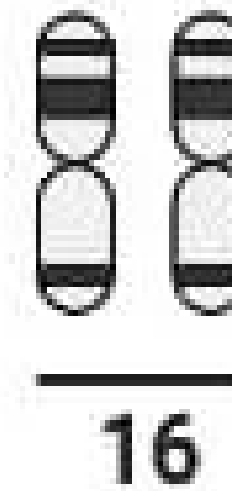
4. Group D:

- Chromosomes 13-15 medium, acrocentric.
- 13- Contains 300 genes
- 14- Contains 800 genes
- 15- Contains 600 genes



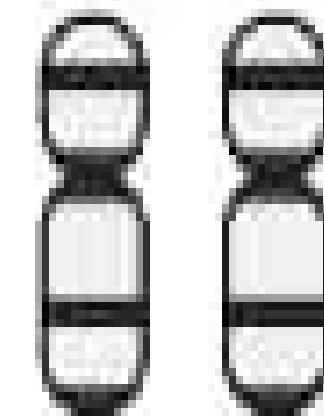
5. Group E:

- Chromosomes 16-18 small, metacentric or submetacentric.
- 16- Contains 900 genes
- 17- Contains 1,200 genes
- 18- Contains 300 genes

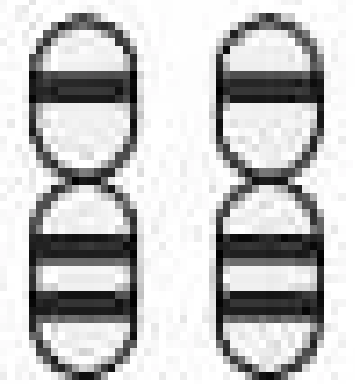


6. Group F:

- Chromosomes 19-20 small, submetacentric.
- 19- Contains 1,500 genes
- 20- Contains 600 genes



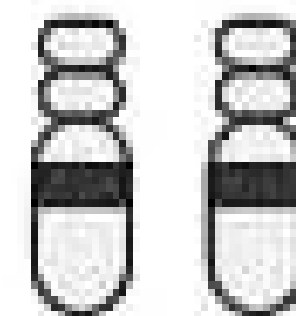
19



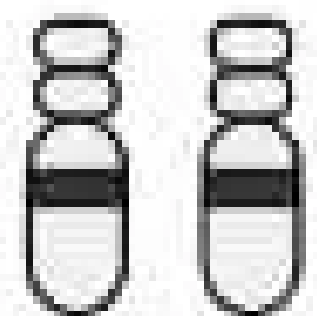
20

7. Group G:

- Chromosomes 21-22 small, acrocentric.
- 21- Contains approximately 200 genes
- 22- Contains around 500 genes

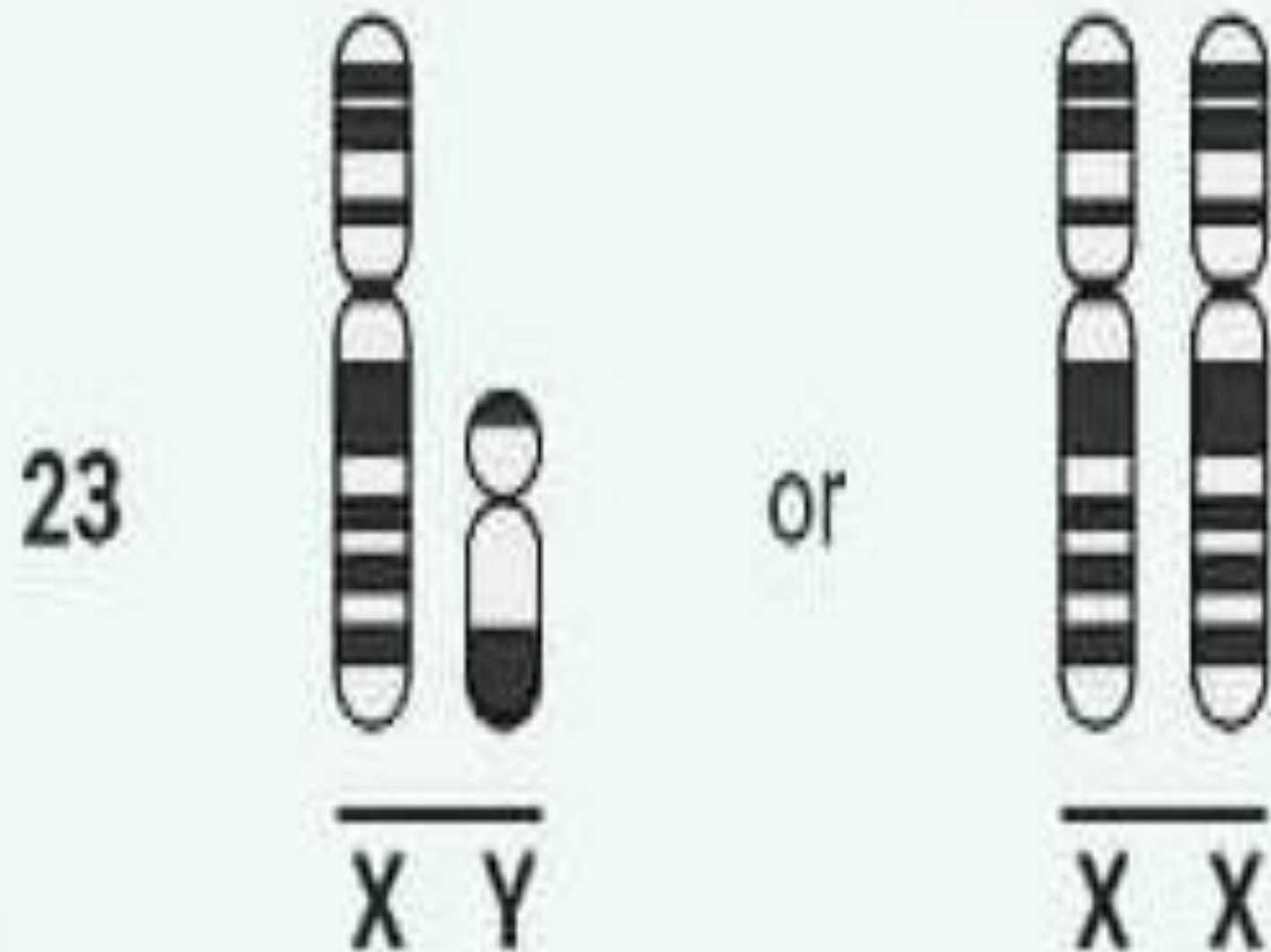


21



22

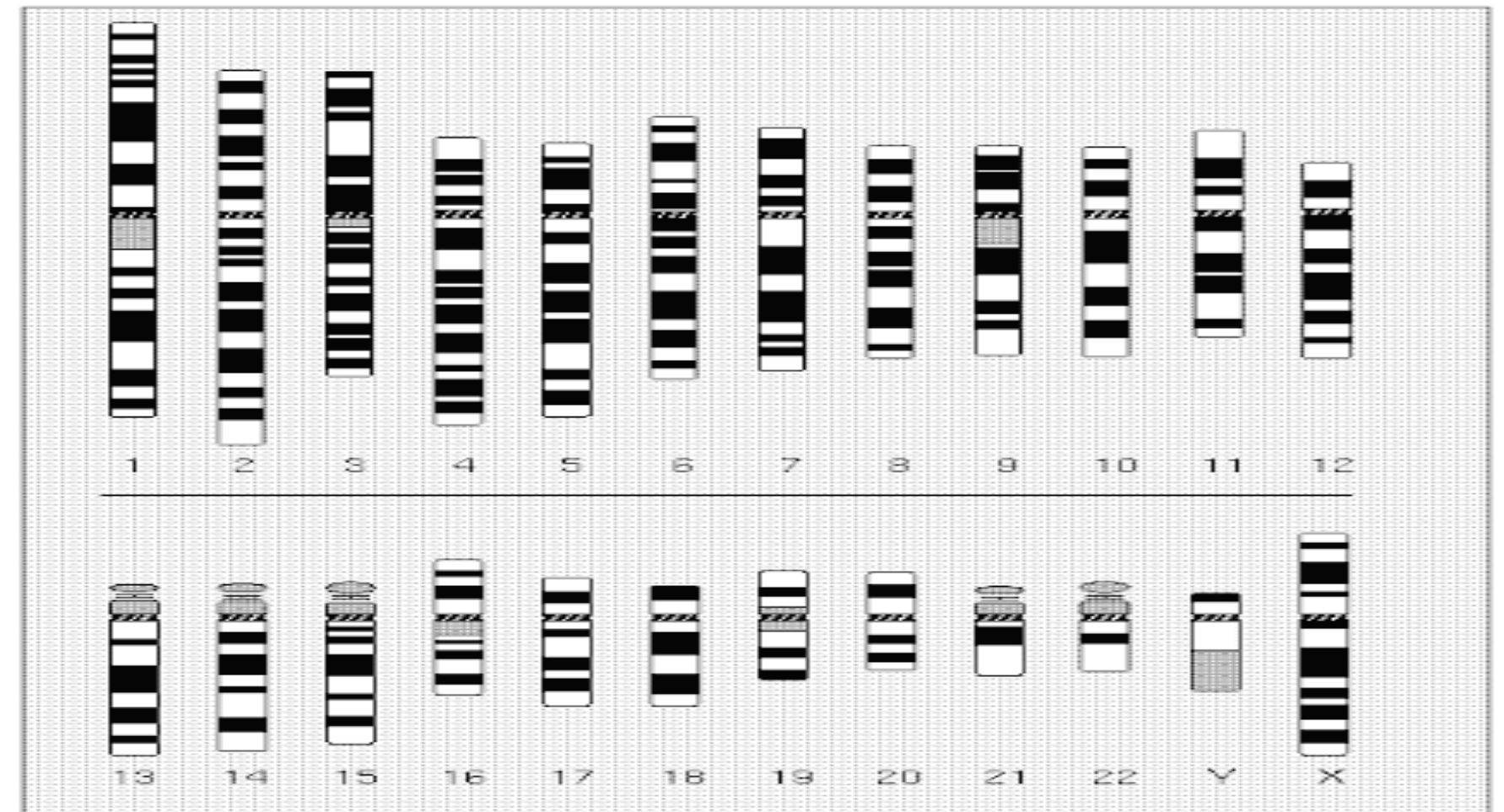
- X-chromosome – Submetacentric.
- Y-chromosome – Acrocentric.



❖ What is an Ideogram?



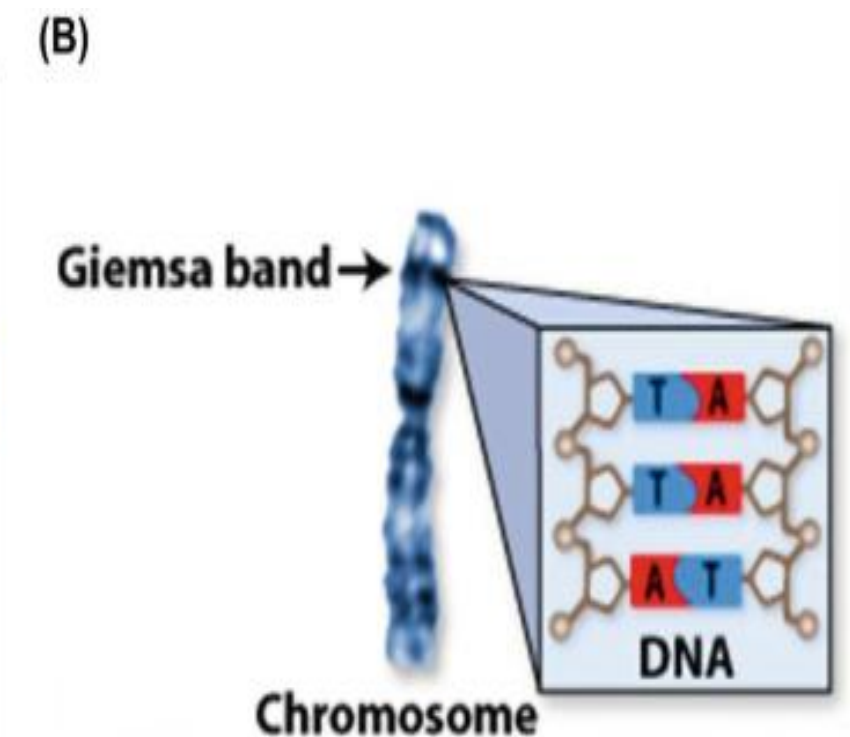
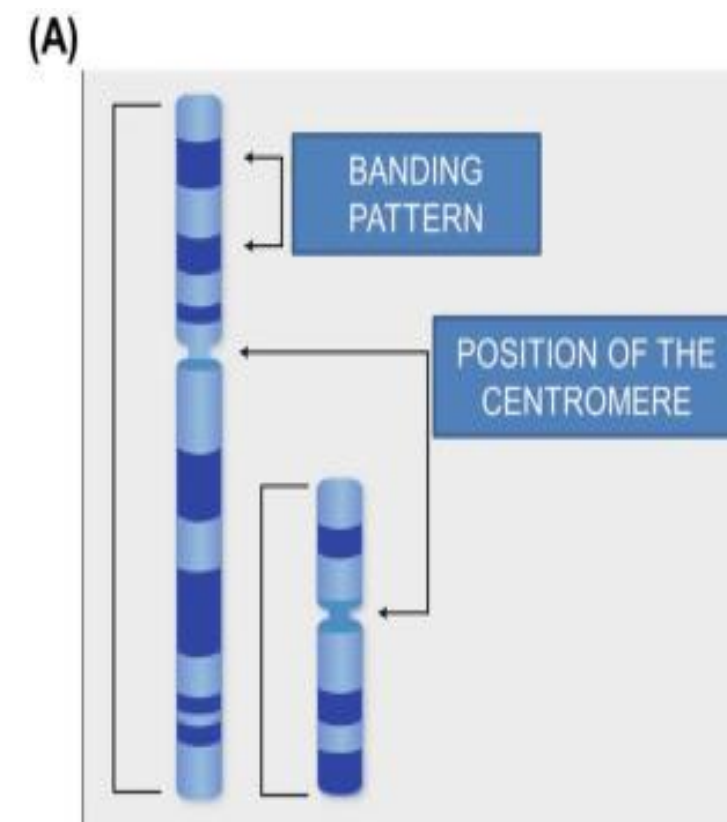
- An ideogram is a schematic representation of a karyotype.
- Used to compare the karyotype of one species with the other
- Ideograms are used as reference tools to identify chromosomal regions and abnormalities.



❖ What is Banding Pattern in Chromosomes?



- Is the unique arrangement of **dark and light** bands that appear along the length of a chromosome when stained using specific techniques.
- These bands help identify individual chromosomes, detect structural abnormalities, and analyze genetic material.



❖ Materials Required for Karyotyping:



1. Biological Sample

2. Chemicals and Reagents (**Colchicine**, **Hypotonic solution**, **Fixative**, **Trypsin**, **Giemsa stain**).



Stopping cells from dividing



Swell cells and spread chromosomes



preserve chromosome structure.



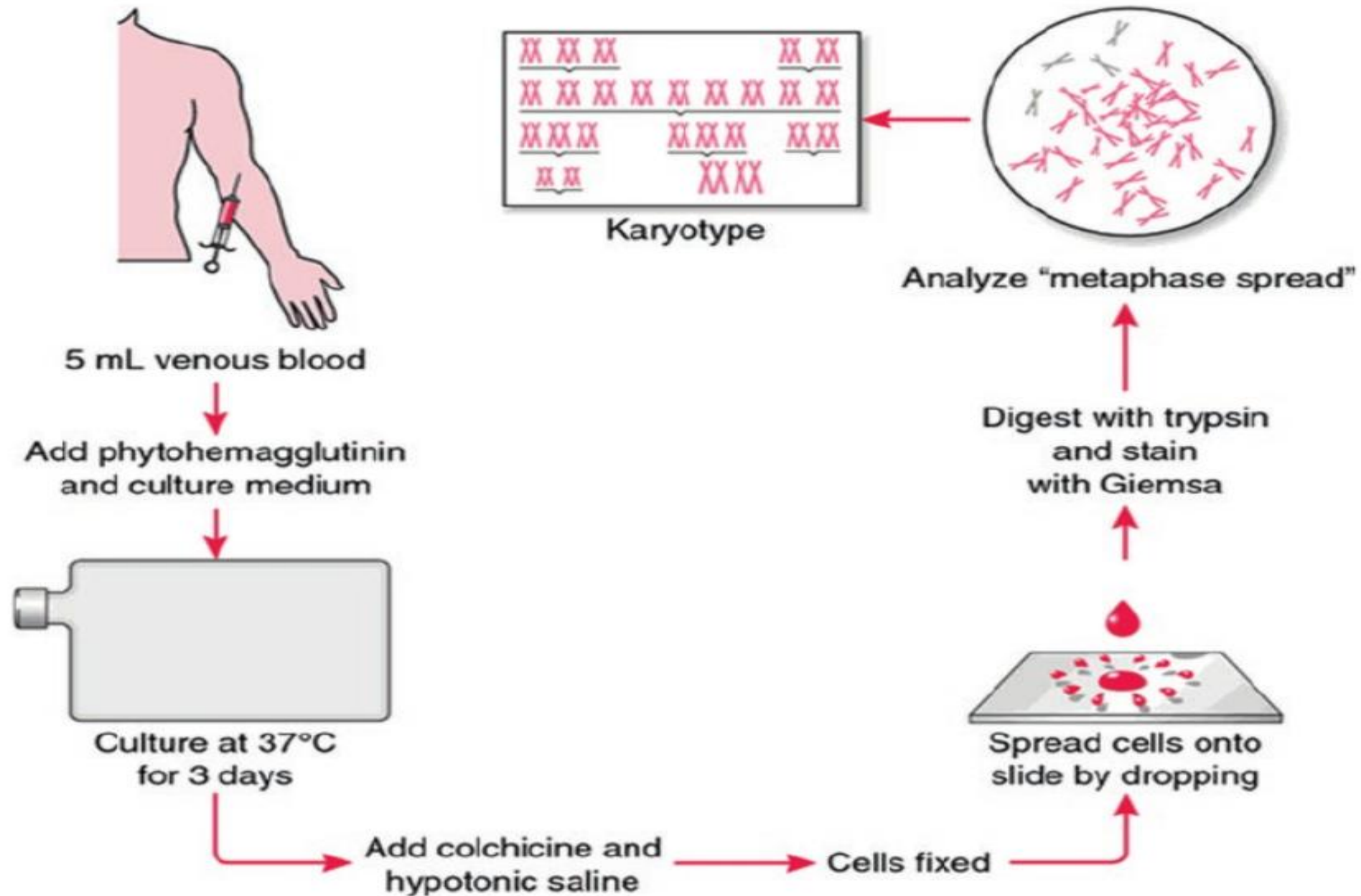
Digests chromosomal proteins



Coloring the chromosomes,

3. Equipment: Microscope, Centrifuge, Incubator, Slides and coverslips and Imaging system for capturing chromosome images.

❖ Procedure of Karyotyping



❖ Expected Results?



1. Normal Karyotype:

- 46 chromosomes arranged in 23 pairs.
- 22 pairs of **autosomes** and 1 pair of sex chromosomes (XX or XY).
- Chromosomes should show normal size, structure, and banding patterns.

2. Abnormal Karyotype:

- Numerical Abnormalities
- Structural Abnormalities

❖ Safety Precautions:



- Wear gloves, lab coats, and safety goggles.
- Handle biological samples and chemicals with care.
- Dispose of waste materials according to laboratory protocols

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