



STRUCTURE AND FUNCTION OF CHROMOSOME



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- Physical structure
- Number of chromosome
- Types of chromosome
- Functions of chromosome



INTRODUCTION

The chromosome are darkly stained small bodies present in the nucleus and determine the mechanism of inheritance, which helps in the inheritance (transmission) of characters in the form of Genes from generation to generation are known as **CHROMOSOMES**.

- It is a combination of two words, i.e., “**Chroma**”- means ‘**colour**’ and “**Somes**”-means ‘**body**’.

PHYSICAL STRUCTURE

➤ Size varies from 1 to 30 micron in length and diameter from 0.2 to 2 micron.

❖ **CENTROMERE**:- The non-stainable part of the chromosome making a primary constriction.

❖ **CHROMATIDS**:- Two chromatids join at the centromeres to form a chromosome.

❖ **CHROMONEMA**:- In each chromatid, there are two longitudinal chromonemata coiled with each other.

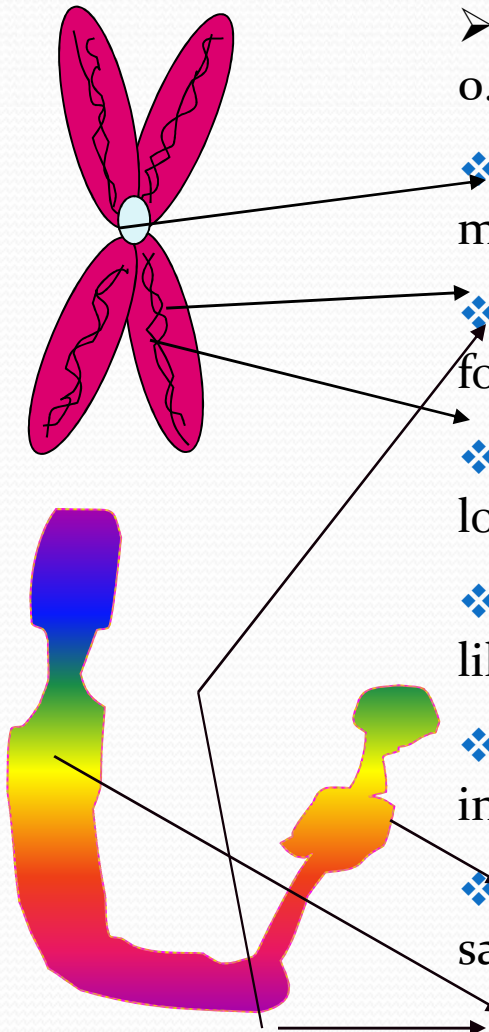
❖ **CHROMOMERES**:- In each chromonemata, there are “bead” like chromomeres present through out the coil.

❖ **GENES**:- Each chromomeres contains genes, the unit of inheritance of character.

❖ **SATELLITE**:- In some chromosomes a round and elongated satellite is present.

❖ **CONSTRICTION**:- Presence of centromere shows the primary constriction. But in some cases there is an additional Secondary Constriction.

SURFACE VIEW

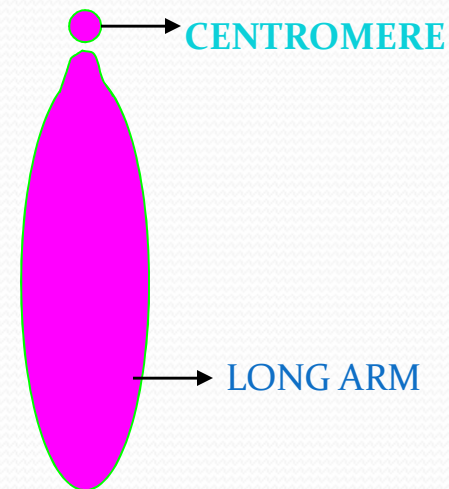
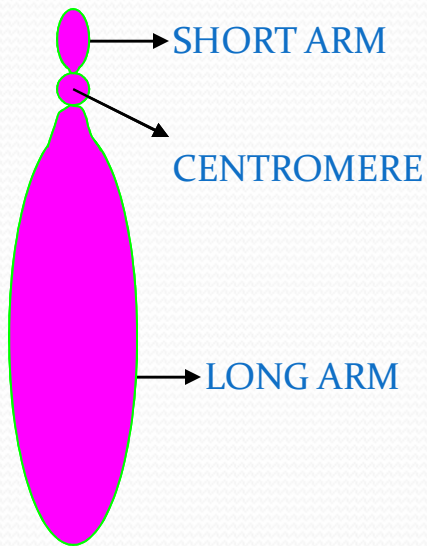


NUMBER OF CHROMOSOMES

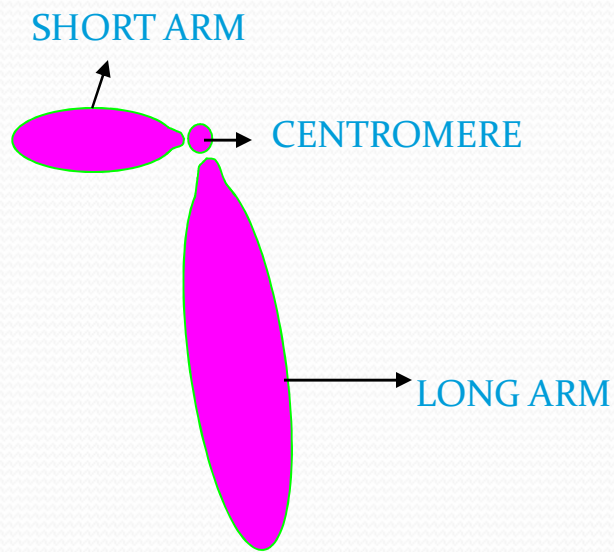
Species	chromosome numbers
Catla, Rohu, Mrigal, Magur	50
Grass carp, Silver carp	48
Common carp, gold fish	104
<i>H.fossilis</i>	56
<i>O.mossambicus, O.niloticus</i>	44
<i>C. Striatus</i>	40
<i>C.gachua</i>	78
<i>C.punctatus</i>	32
<i>M. rosenbergii</i>	118
<i>Penaeus monodon</i>	88

TYPES OF CHROMOSOMES

1. **TELOCENTRIC** :- The centromere is present at the end of the chromosomes.

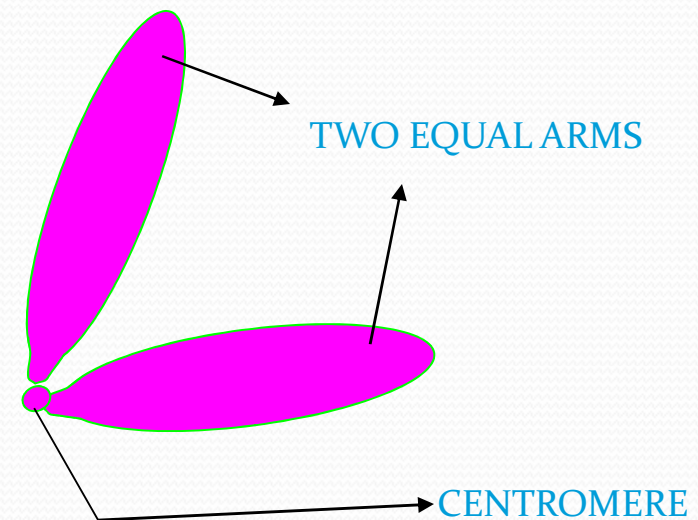


2. **SUB-TELOCENTRIC** :- The centromere is almost terminal. It has one large and another very small arm.



3. SUB-METACENTRIC:- Here the centromere is not at the middle position of the chromosomes. So the arms are unequal and it is 'L-Shaped' in appearance.

4. METACENTRIC:- The centromere is at the middle position. So the arms are equal and it is 'V-Shaped' in appearance.



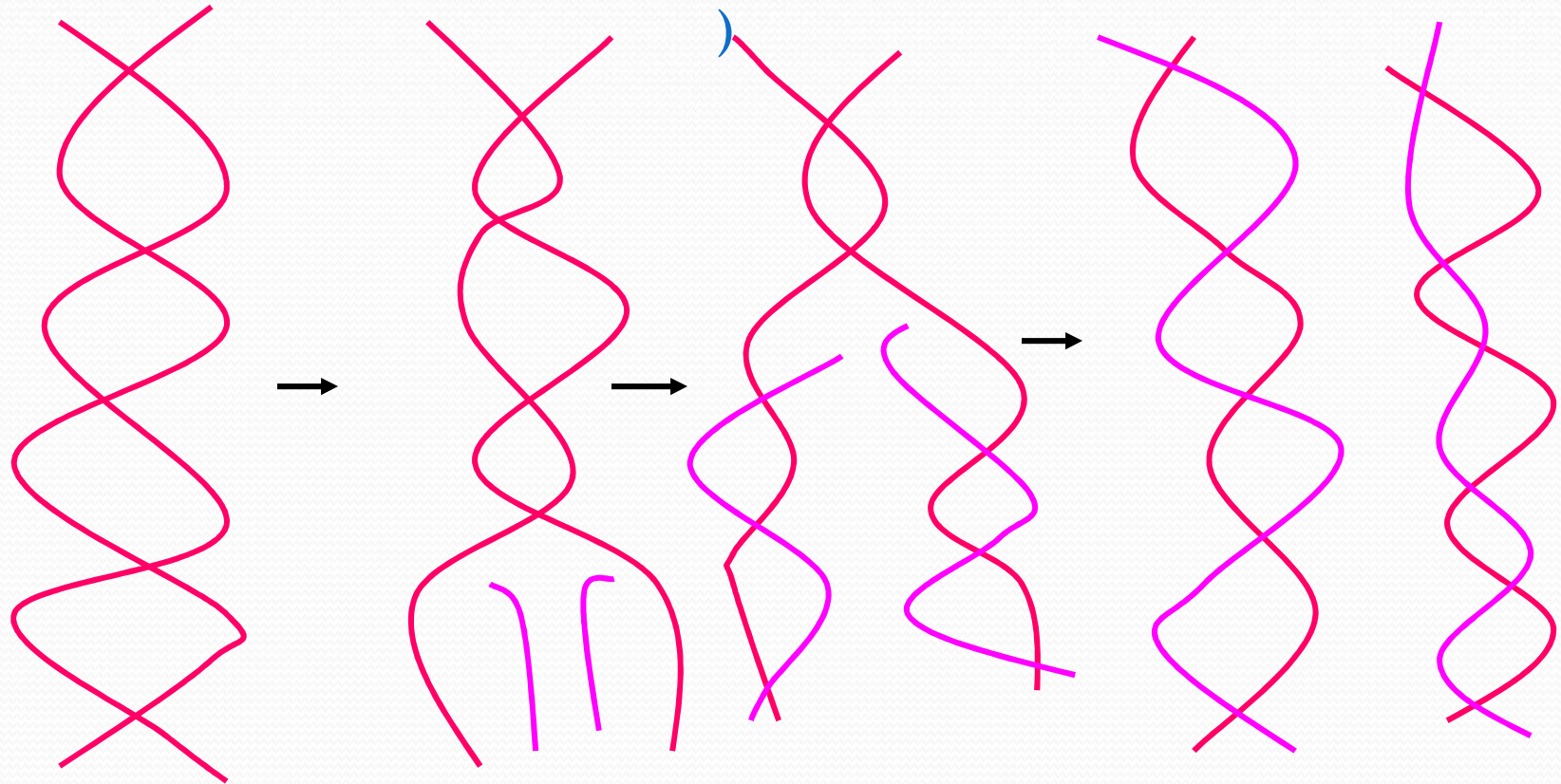


FUNCTION OF CHROMOSOME

- The chromosome are capable of self – duplication, during duplication process the DNA strand unwind. As unwind start, each template of DNA forms its complementary strand in double-helix nature. The conversion of the old DNA molecule into two new molecules, help in duplicating the chromosomes

SELF DUPLICATION OF DNA MOLECULE

(IT HELPS IN THE DUPLICATION OF CHROMOSOMES)

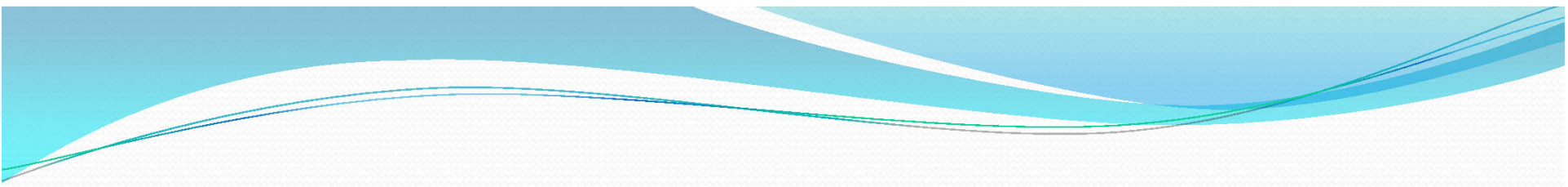


Single DNA molecule in double helical structure

Mother templates unwind and new complementary strands originate

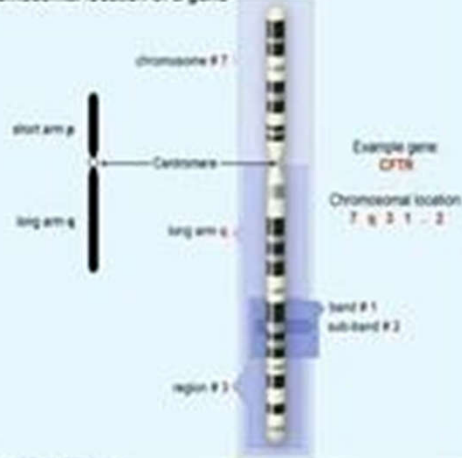
Unwinding continues along with new template formation

Two separate DNA molecules formed having an old and a new strand

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- They help in expression of different characters in an organism by synthesizing proteins in cells. A definite protein is accumulated to produce a definite character.
 - As carrier of genes they transmit characters from generation to generation. i.e. parent to offspring.
 - The chromosome control the physiological & biochemical processes in the body of the organism.

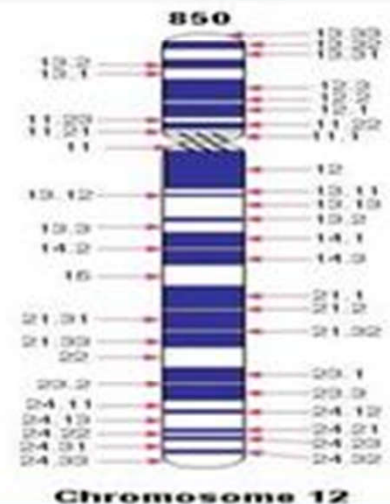
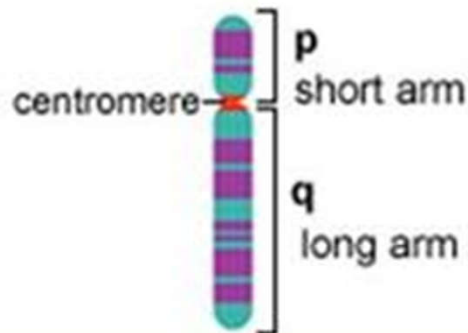
CHROMOSOME BANDING

Chromosomal location of a gene



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Short and Long Arms of a Chromosome



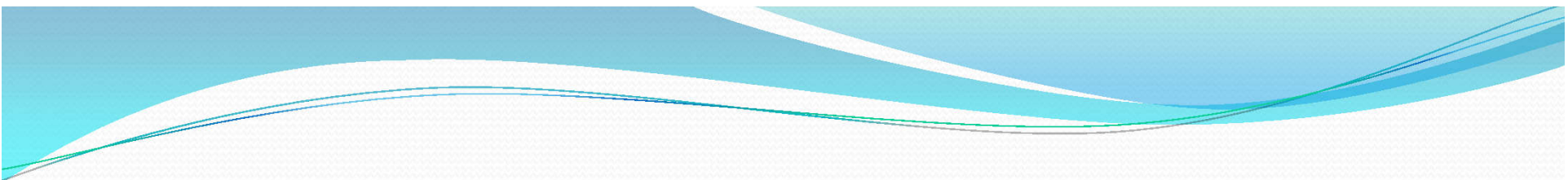
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INTRODUCTION

- **Cytogenetics** – it is the study of the structure and properties of chromosomes, chromosomal behaviour during mitosis and meiosis, chromosomal influence on the phenotype and the factors that cause chromosomal changes (Hare and Singh, 1979).
- Karyotype analysis is the basis of cytogenetics .it involves the study of chromosome no. size & morphology at the metaphase stage.

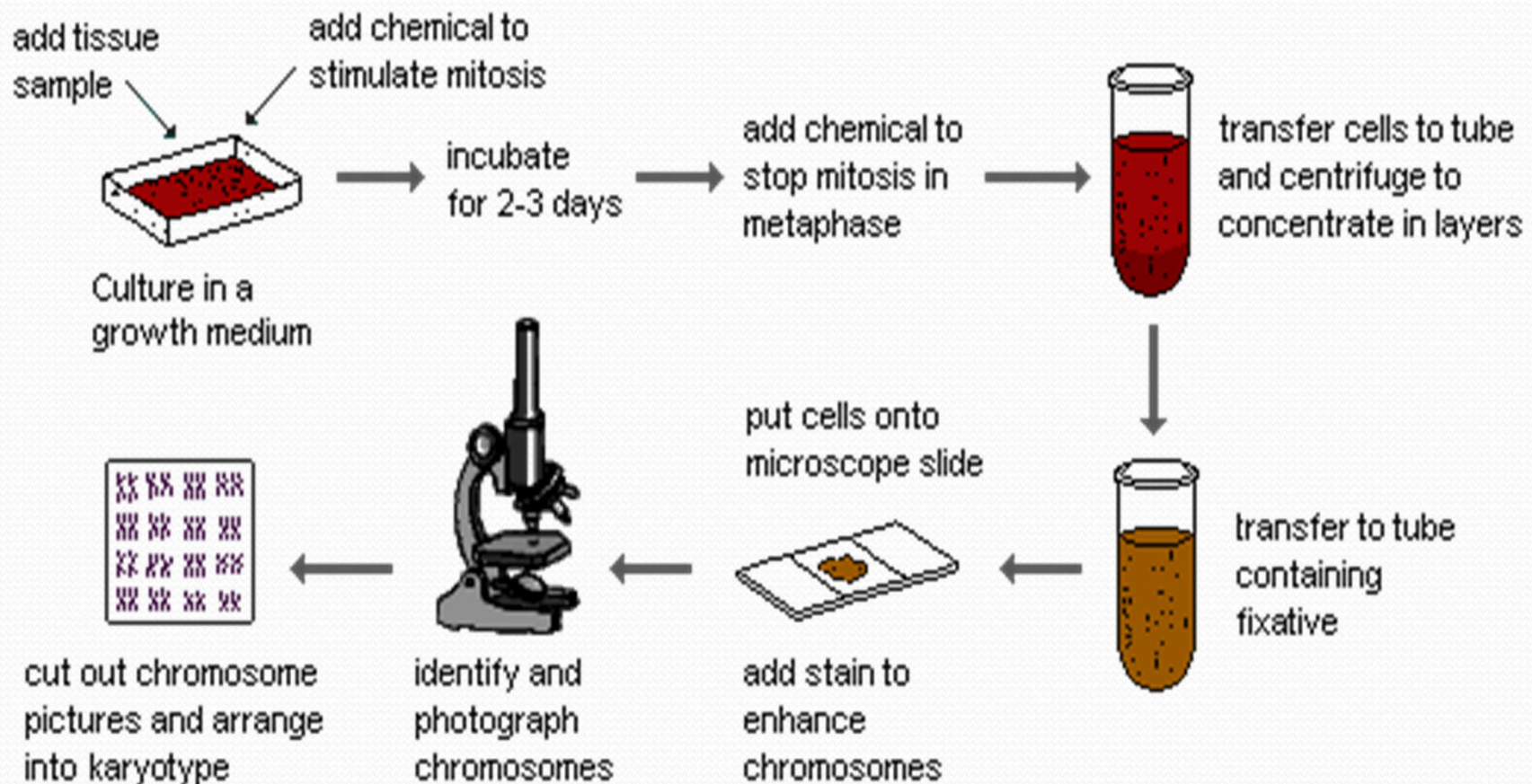
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- Chromosome banding technique produce a series of metaphase chromosome that allow for both recognition of individual chromosome within a genome and identification of specific segment of individual chromosome.
 - This unit covers basic banding technique i.e. Q-banding, R-banding, G-banding & C-banding.
 - **Chromosome - The most important objects in the living world, for the genes they carry determine the existence and form of organisms.**



Chromosome banding technique

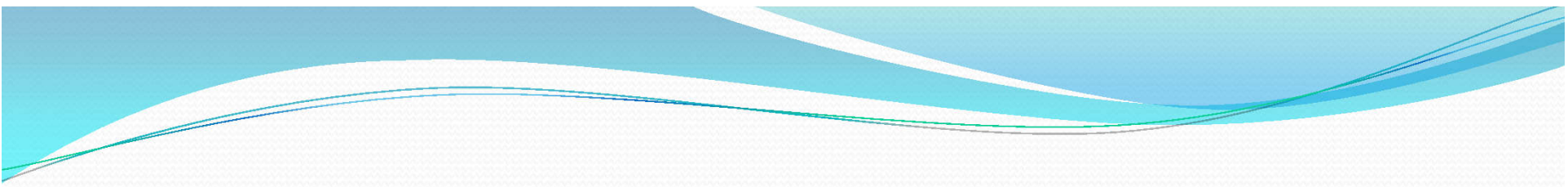
- G - Banding
- Q - Banding
- C - Banding
- R - Banding
- T - Banding
- NOR - Banding
- High Resolution Banding
- Restriction Endonuclease Banding

PREPARATION OF CHROMOSOMES



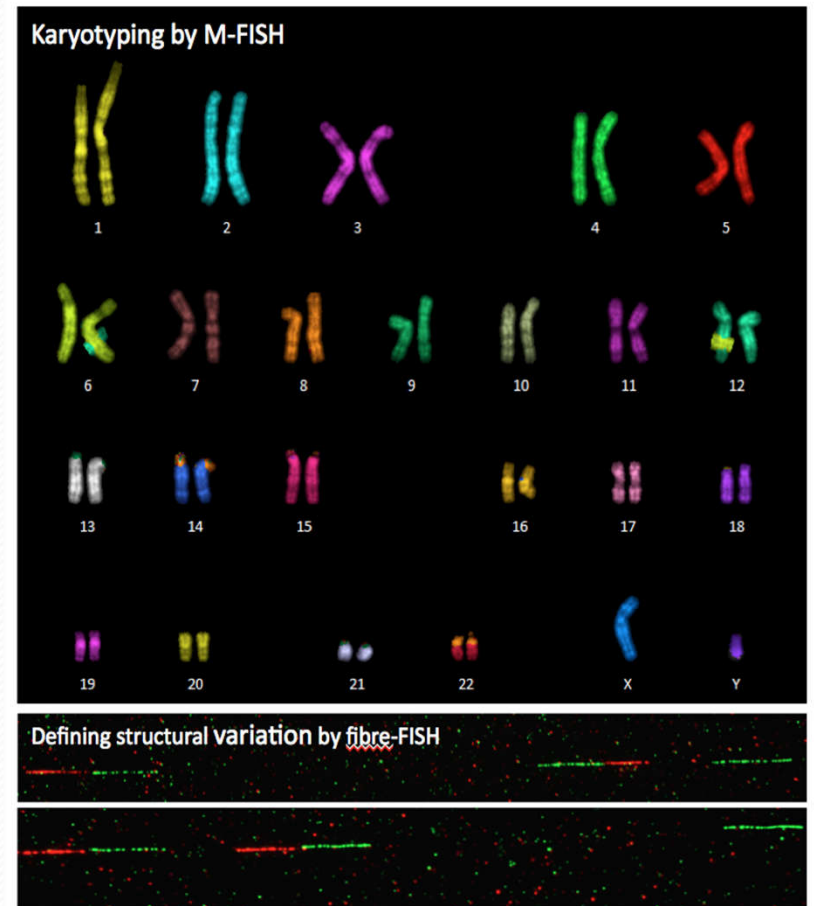
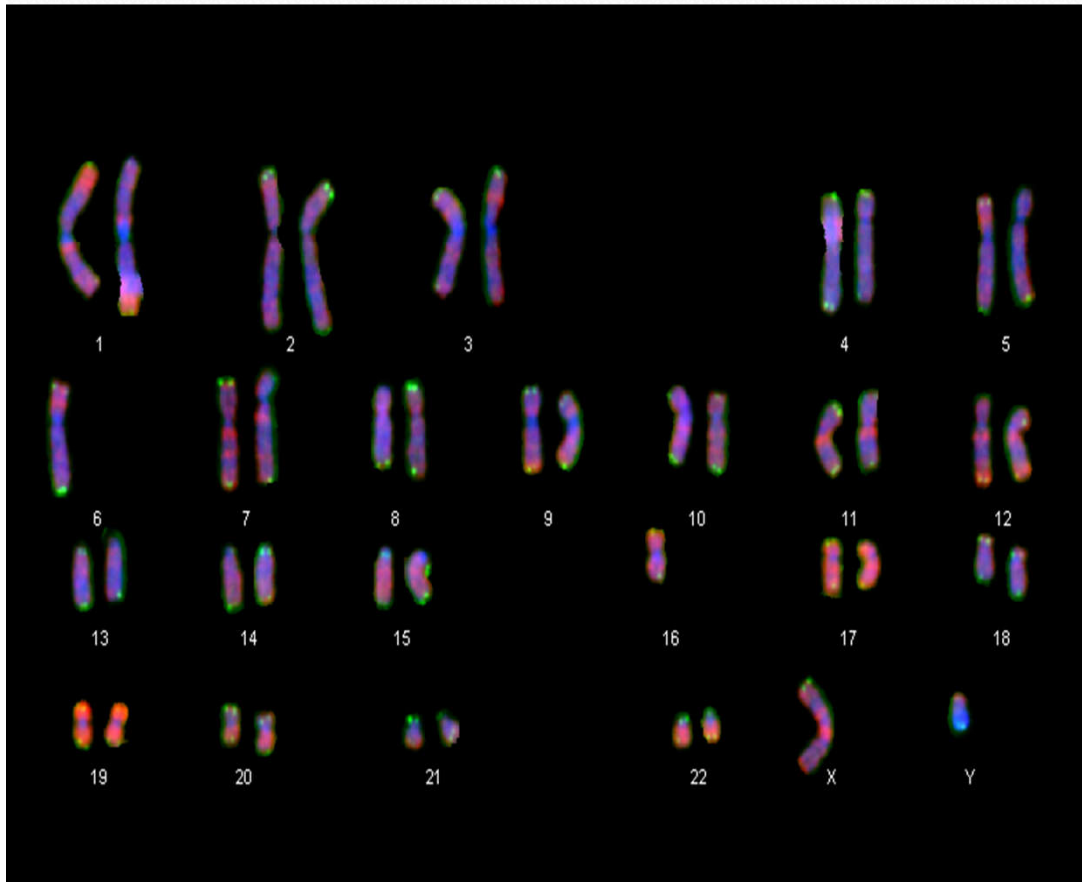
G - banding

- Thaw 1ml of trypsin stock solution and make upto 50 ml with 0.9% NaCl in a couplin jar.adjust pH to 7.5-7.8 using pH paper.
- Add 50 ml phosphate buffer to a second couplin jar.
- Prepare another couplin jar containing 7-10% giemsa stain in phosphate buffer.
- Dip the slide in trypsin for 5 second .

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- Rinse the slide in phosphate buffer immediately after trypsin exposure.
 - Stain the slide in phosphate buffer immediately after trypsin exposure.
 - Stain the slide for 3-5 min in giemsa .
 - Rinse in water and monitor under the microscope.



G banding





Q - banding

1. Dehydrate the slides by dipping in alcohol with decreasing concentration 90%, 70% and 50% one min each.
2. Rinse in distilled water. .
3. Wash the slide in phosphate buffer at pH 6.8.
4. Stain the slide in quinacrine mustard (5 mg in 100 ml) or in quinacrine dihydrochloride 5% for 20 min.
5. Rinse in phosphate buffer and mount in the same buffer.
6. Examine under fluorescent microscope.



C-banding

1. Treat the slides in 0.2 N HCl for one hr at room temperature.
2. Rinse in de-ionized water.
3. Immerse in 1% barium hydroxide at 50°C for 5-15 min.
4. Rinse in deionized water.
5. Incubate at 60°C in 2XSSC buffer for one hr.
6. Rinse in de-ionized water and stain in 4% Giemsa stain for 90 min.
7. Rinse in de-ionized water, dry and examine under oil immersion.



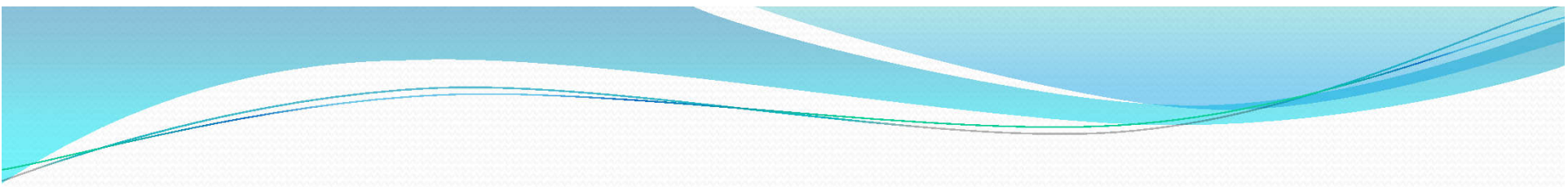
R-banding

1. Age the slides for 7 -10 days .
2. Place the slides in a Coplinjar containing phosphate buffer of pH 6.5 at 85°C and incubate for 20-25 min.
3. Stain the slides in 0.01% acridine orange in the phosphate buffer pH 6.5 for 4-6 min. Rinse in phosphate buffer and mount in the same buffer.
4. Examine under fluorescent microscope.



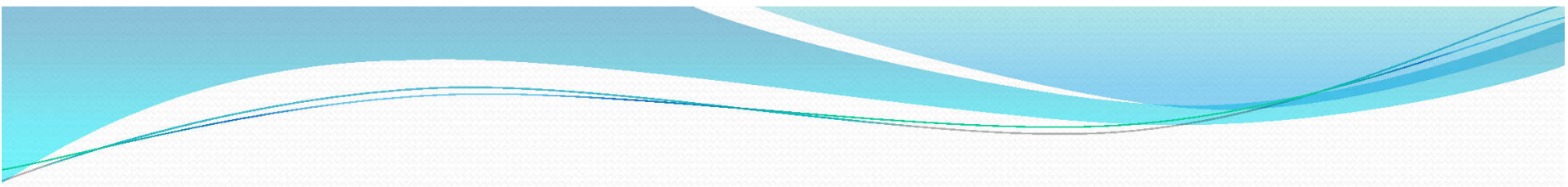
T - banding

1. Age the slide for 7 days.
2. Place the slides in PBS pH 5.0 for 20-60 min at 87°C.
3. Rinse in PBS.
4. Stain in 3% Giemsa in phosphate buffer pH 6.8 at 87°C, leave for 5-30 min and rinse.
5. Slides are stained in Hoechst 33258 stain for 10 min (Hoechst stain 0.5 µg/ml of phosphate buffer). Rinse in phosphate buffer and examine in fluorescent microscope.

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6. Alternatively, the stained slides are covered with a cover slip and placed in a wet chamber under UV lamp for 2 to 3 hrs or under direct sunlight for 2 hrs.
 7. Remove the cover slip and stain in Giemsa stain for 10 min.
 8. Rinse in buffer, dry and mount in DPX.

NOR - banding

- Place 3 drops of 5% AgNO_3 on the chromosome spread, gently place a cover glass on the drop & incubate at 60°C until AgNO_3 is crystalline.
- Rinse slide in distilled water to remove cover glass. Place 3 drops of 3% formalin solution & 3 drops of ammoniacal silver nitrate on slide and place a cover glass.

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- Monitor staining reaction under low magnification of a microscope.
 - When nuclei develop a golden brown colour rinse the slide in distilled water.
 - The cover glass will fall off.
 - Air dry the slide & observed under high magnification of microscope.

Thank

