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# Lecture – 1

## Pre & Post Mendelian concept of genetics

by

**Dr. Praveen Kumar**

*Asst. Prof. GPB*

MSSSoA, CUTM, Odisha



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# Introduction

- **GENETICS** – branch of biology that deals with heredity and variation of organisms
- **Heredity** – Transmission of Characters from parents to offspring
- **Chromosomes** carry the hereditary information (genes)
  - Arrangement of nucleotides in DNA
  - DNA → RNA → Proteins



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# Pre - Mendelian concept

**Preformation theory:** Swammerdam and bunnet (1720-1793)

This theory states that a miniature human called homunculus was already present in egg and sperm

However, this theory was soon given up because this could not be proved scientifically



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# Theory of epigenesis:

- **Wolff** (1738-1794)
- This theory states that egg or sperm cells do not contain miniature human
- Egg/sperm cells are undifferentiated.
- The differentiation into various organs or parts takes place only after fertilization from the zygote resulting into development of adult tissues and organs.
- universally accepted.



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# Theory of inheritance of acquired characters:

## **Lamarck (1744-1829)**

This theory states that a new character once acquired by an individual shall pass on to its progeny

This theory was disproved by Weismann



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# Theory of pangenesis:

- **Charles Darwin (1809-1882)**
- This theory states that very small, exact but invisible copies of each body organ and component (**gemmules**) are transported by the blood stream to the sex organs
- This theory was given up because it did not have **scientific basis**



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# Germplasm theory:

- **August Weismann (1889)**
- This theory states that body tissues are of two types, *viz.*, **germplasm** and **somatoplasm**.
- **Germplasm** - reproductive tissues or cells which produce gametes.
- **Somatoplasm** - other body tissues which are not related to sexual reproduction



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- Transmission of characters from one generation to other generation takes place only through germplasm.
- Any change in the germplasm will lead to change in the next generation.
- This theory is accepted in broad sense.





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# POST-MENDELIAN CONCEPTS OF HEREDITY

- The basic principles of heredity were initially discovered by Mendel in 1886 and rediscovered by de vries, correns and tschermak in 1900
- Later on these principles were clarified and confirmed by several researchers and some new concepts were investigated.
- some of the new concepts were at variance with the findings of Mendel (Mendelian deviation)



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# Incomplete dominance:

Mendel always observed complete dominance of one allele over the other for all the seven characters

A cross between **red** and white flowered plants produced plants with intermediate flower colour, *i.e.*, **pink** color in four 'O' clock plant (*Mirabilis jalapa*)



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- **Codominance:** both alleles express their phenotypes in heterozygote
- The example is AB blood group in human.
- **Multiple alleles:** gene has more than two allelic forms
- ABO blood group



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- **Linkage:** Mendel always observed independent assortment of genes
- Cases of linkage were reported by Bateson and Punnett in 1906 in pea, Hutchinson in maize and Morgan (1910) in Drosophila.
- Dihybrid test cross, they observed higher frequencies of parental types than recombinants instead of 1:1:1:1 ratio



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- **Lethal genes:** Genes which cause death of its carrier when in homozygous condition
- Mendel's findings were based on equal survival of all genotypes
- In the presence of lethal genes, the normal segregation ratio of 3:1 is modified into 2:1 ratio.
- Lethal genes have been reported in both animals as well as plants



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- **Gene interactions:** When the expression of an allele of one gene pair depends on the presence of a specific allele of another pair
- Mendel always observed 9:3:3:1 ratio in F<sub>2</sub> from a dihybrid cross.
- The modified ratios include 9:7, 9:3:4, 12:3:1, 13:3, 15:1 and 9:6:1 in different crop plants.



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- **Pleiotropic gene effects:** One gene was found to govern the expression of two or more characters.
- Examples - white eye allele in drosophila.
- This allele affects eye colour, shape of spermathica, fecundity and testicular membrane.





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- **Polygenes:** Some characters are controlled by several genes and each of such gene has additive effect in the expression of character
- **Environmental effects:** phenotype is the result of the interaction between genotype and environment
- Johannsen -coined the terms genotype and phenotype.





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- **Maternal effects:** Mendel did not observe any difference between direct and reciprocal crosses
- Later investigations revealed the presence of significant difference in the reciprocal crosses, which led to the concept of cytoplasmic inheritance



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**THANK YOU**