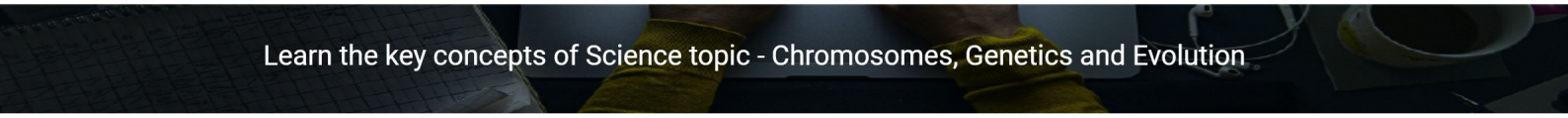


Hi guys, hope you all are doing great. Present blog will cover the following topics: Chromosomes, Genetics and Evolution. Let's dive deep and learn well.

In Biology, **evolution** is the change in heritable characteristics of biological populations over successive generations. These specifications are defined by Genes which are passed on to the offspring.

Genetics is the study of science which involves Genes, Genetic Variation in organisms. Genetic processes work in combination with an organism's environment and experiences to influence development and behavior.

Chromosomes

A chromosome is a long DNA molecule with part or all of the genetic material of an organism. Chromatin contain DNA and some basic protein called histone. Every chromosome has a primary constriction called centromere. Chromosome can be of different types on the basis of position of centromere.

Cell cycle

The sequence of events by which a cell duplicates its genome, synthesizes the other constituent of cell and eventually divides into two daughter cells is termed as cell cycle.

Phases of cell cycle:

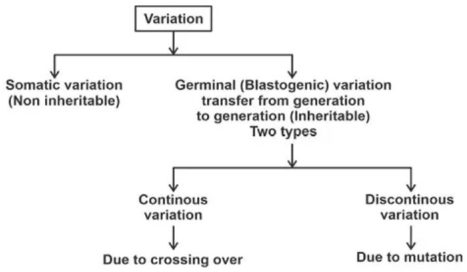
INTERPHASE	**M PHASE**
Resting phase during which the cell is preparing for division.	The phase when the actual cell division occurs.
• G1 phase • S phase • G2 phase	• Mitosis • Meiosis

M Phase:

Mitosis	Meosis
Refers to the cell division that forms two daughter cells each with the same number and type of chromosome as the parent cell	Refers to the cell division which forms four daughter cells each with half the number of chromosomes as the parent cell
There is asexual type of reproduction	There is sexual type of reproduction
Number of chromosomes in the daughter remain the same	Number of chromosomes in the daughter cells reduce by half
Division take place only one time	Two-time division take place
Crossing over does not occur	Mixing of chromosome occur
Take place in somatic cell	Take place in germ cell

Principles of inheritance and variation:

The progenies of the same parent are not identical to each other, the reason behind it is variations



Mendelism

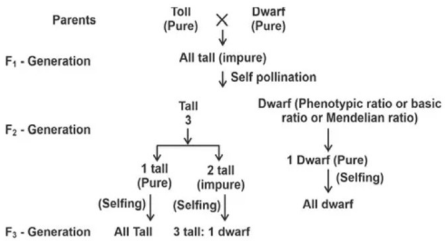
Experiments performed by Mendel in genetics and description of mechanisms of hereditary processes and formulation of principles are known as Mendelism.

- (1822-1884) Mendel was born on July 22,1822 at Heinzendorf in Austria Silesian village.
- In 1856-57, he started his historical experiments of heredity on pealPhum sativum) plant. His experimental work continued on the pea plant till 1865 (19th century).

1. He developed the technique Emasculation and Bagging for hybridization in plants.
2. Flowers of pea plant and bisexual. In this method one is considered as male and another as female.
3. Stamens of the plant which are used as females are removed in bud condition, this is called Emasculation.
4. Emasculation is done to prevent self-pollination.
5. Emasculated flowers covered by bags; this is called bagging Bagging is used to prevent undesirable cross pollination.
6. Mature pollen grains are collected from male plant and dusted on the stigma of emasculated flower.
7. Seeds are formed in the female flower after pollination.
8. The plants that are obtained from these seeds are called first filial generation or F, generation according to Mendel.
9. The plants of F, generation are self pollinated & F, generation is produced.

Monohybrid cross

When we consider the inheritance of one character at a time in a cross this is called a monohybrid cross



Dihybrid cross

A cross in which study of inheritance of two pairs of contrasting traits is carried out is called a Dihybrid cross. Mendel wanted to observe the effect of one pair of heterozygous traits on another pair. Mendel selected traits for dihybrid cross for his experiment as follows.

1. Color of cotyledons →Yellow (Y) & Green (y)
2. Seed shape → Round (R) and Wrinkled (r)

Yellow and round characters are dominant and green and wrinkled are recessive characters. Mendel crossed, yellow and round seeded plants with green and wrinkled seeded plants.

Linkage and recombination

- Both terms given by Morgan.
- Collective inheritance of character is called linkage.
- Genes present on a chromosome inherited together because such genes are physically attached to the same structure.
- Linkage was first seen by Bateson and Punnett in Lathyrus odoratus and gave a coupling and repulsion phenomenon.
- Sex linkage was first discoverd by Morgan in Drosophila. He proposed the theory of linkage.

Theory of linkage:

1. Linked genes are linearly located on the same chromosome.
2. Linked genes enter together into the gametes hence only parental combinations are obtained. But linkage is not absolute i.e. linked genes could be separated during meiosis due to crossing over. Thus, a new combination of genes (non parental/ recombinant) formed.
3. Recombination separation of linked genes and formation of new genes combination is recombination. It's a result of crossing over.

Strength of linkage is inversely proportional to the distance between the genes. It means, if the distance between two genes is increased then strength of linkage is reduced and it proves that greater is the distance between genes, the greater is the probability of their crossing over. Morgan by his investigation on the Drosophila found two types of linkage: 1. Complete linkage 2. Incomplete linkage

Complete linkage: The complete linkage is the phenomenon in which parental combinations of characters appear together for two or more generations inherited as such. In this type of linkage genes are closely associated and tend to transmit together over the generation due to absence of crossing over.

Incomplete linkage: The linked genes are widely located in chromosomes and have chances of separation by crossing over. Genes present in the same chromosomes produce recombinant progeny besides the parental type.

Sex determination

There are different methods for sex determination in organisms like environmental, non-allosomic genetic determination, allosomic sex determination and haplodiploidy. Chromosomes are of two types:

1. Autosomes or somatic chromosomes. These regulate somatic character.
2. Allosomes or Heterosomes or Sex chromosomes.

Mutation

- Sudden heritable change in genetic material of an organism is called Mutation.
- Mutations are discontinuous.
- Frequency of mutation at present is 1×10^{-6} (1 per 1 million individuals). Mutation word was given by Hugo de Vries.
- De Vries studied mutations in the plant Oenothera lamarckiana (evening primrose). It is a hybrid plant.
- De Vries gave the mutation theory of evolution.
- This theory was given in support of Darwinisth because Darwin was unable to explain the source of variations.
- Darwin called variations as sports.

According to De Vries there are two types of variations:

(i) Continuous variations: These variations develops in every generation of an organisms, these are developed by crossing over meiosis sexual reproduction. Only minor variations are developed by crossing over.

(ii) Discontinuous variations: These variations develop by mutations suddenly appear in any generation both minor and major types of variations are developed by mutations (mostly major type).

Seth Right: Mutation was first observed by him. He observed some short-legged sheep (Ancon variety) In a population of long-legged sheep.

Morgan: Credit for the discovery of mutation is given to him. He observed some white eyed male Drosophila in a population of red eyed Drosophila.

In Drosophila eye colour is a sex-linked character. Gene of eye color is located on the X chromosome.

Genetic disorders

Thalassemia: Thalassemia is a genetic blood disorder that affects the production of hemoglobin, the protein in red blood cells that carries oxygen throughout the body. People with thalassemia have abnormal hemoglobin production, which can result in anemia, a condition where the body doesn't have enough red blood cells to carry oxygen.

Phenylketonuria: Phenylketonuria (PKU) is a genetic disorder in which the body cannot break down an amino acid called phenylalanine, which is found in many types of protein containing foods. This results in a buildup of phenylalanine and its byproducts in the body, which can cause brain damage and other serious health problems if left untreated.

Cystic Fibrosis: Cystic fibrosis (CF) is a genetic disorder that affects the lungs, pancreas, and other organs. It is caused by a mutation in a gene called CFTR, which produces a protein that regulates the movement of salt and water in and out of cells. In people with CF, this protein is not working properly, which leads to a buildup of thick, sticky mucus in the lungs, pancreas, and other organs.

Alzheimer's Disease: Alzheimer's disease is a progressive neurological disorder that affects memory, thinking, and behavior. It is the most common cause of dementia, a group of brain disorders that affect a person's ability to function independently.

Huntington's Chorea: It is an autosomal dominant disorder. The gene responsible for this disorder is present on chromosome.

Evolution

Origin of life: This theory was proposed by **Abbe Lemaitre**. According to it, the universe originated about 20 billion years ago due to a thermonuclear explosion of a dense entity. This thermonuclear explosion is called Big-bang. About 4.6 billion years ago, the origin of our solar system took place by the gaseous clouds formed due to this explosion.

Evidences of organic evolution

In support of organic evolution some important evidences are: occurrence of homologous and vestigial organs.

Paleontological evidences:

The study of fossils is known as paleontology.

1. Types of Rocks (Sedimentary, Igneous, Metamorphic)
2. Types of fossils (Unaltered, Petrified, Human teeth, Mold, Cast, Print and coprolites)

Morphological and Anatomical Evidence:

1. **Homology**: The similarity based on common origin, similar basic plan of organization and embryonic development is called homology. Ex: forelimbs of mammals, legs of invertebrates, mouthparts of insects, radish and carrot, potato and ginger
2. **Anatomy**: It is similar in organs based on similar functions. Organs which have different origin and dissimilar fundamental structure but have similar function are called analogous organs. Ex: wings of bats and birds to wings of insects, hands of man and trunk of elephant, potato and sweet potato.

Hope all your queries related to this topic are clear. Stay tuned with us.