

## INTRODUCTION TO BIOLOGY

The Big Bang Theory was credited to Fred Hoyle based on the theory that all matter was created in one big bang.

The first organisms (living things) were single celled. Over time, organisms changed or evolved as theorized by Charles Darwin. New organisms arose from older kinds, today there are millions of species and inhabit almost every region of the Earth today.

## THE SCIENCES OF LIFE

**Botany** – The study of plants

**Zoology** – The study of animals

**Anatomy** – The study of the physical characteristics

**Biochemistry** – The application of chemistry in Biology

**Ecology** – The study of environment

**Pathology** – The study of diseases

**Phytopathology** – The study of diseases in plants

**Physiology** – The study of the functions of the body

**Taxonomy** – The way organisms are classified

**Genetics** – The study of heredity

**Embryology** – The study of the progress of embryo

**Pharmacology** – The study of drugs in tracking diseases

**Endocrinology** – The study of endocrine glands

**Cytology** – The study of the cells

**Histology** – The study of tissues

**Protozoology** – The study of one-celled organisms

**Bacteriology** – The study of bacteria

**Mammalogy** – The study of mammals

**Ornithology** – The study of birds

**Ichthyology** – The study of fishes

**Virology** – The study of viruses

**Helminthology** – The study of worms

**Herpetology** – The study of reptiles and amphibians

**Mycology** – The study of fungi

**Phycology** – The study of algae

**Biogeography** – The application of geography in Biology

**Entomology** – The study of insects

**Microbiology** – The study of microorganisms

## MILESTONES IN BIOLOGY

The **Human Genome Project** is a global, long-term research effort to identify the estimated 50,000 – 100,000 genomes in human DNA to figure out the sequence of the chemical bases that make up human DNA.

**Stem Cell Technology** is a rapidly developing field that combines the efforts of cell biologists, geneticists, and

clinicians and offers hope of effective treatment for a variety of malignant and non-malignant diseases.

**Biological Engineering** is the application of engineering principles and design concepts to medicine and biology for healthcare purposes.

**Genetic Engineering Cloning** is one of the most controversial uses of genetic engineering has been cloning or producing a genetically identical copy of organism. While the ethics of cloning are hotly debated, the first ever sheep (named **Dolly**) was cloned in 1996.



**Hello Dolly** or *Dolly the Sheep* was the first mammal cloned from an adult cell. It was born in 1996 and died in 2006. It was 6 years old when it died, about half the usual age of sheep.

## UNIFYING THEMES IN BIOLOGY

### CELL STRUCTURE AND FUNCTION

Cells are the structural, functional, biological units of all living beings. It is the basic unit of life. It was **Robert Hooke** who first discovered cells.

All organisms are made up of cells. They may be made up of single cell or **unicellular**, or many cells or **multicellular**. Mycoplasmas are the known smallest cells. The cells provide structure to the body and convert the nutrients taken from food into energy.

Cells are the lowest level of organization in every life form. It is composed of several cell organelles with specific structure, performing specialized functions to carry out life processes.

The characteristics of the cells are as follows:

1. **Cells** provide structure and support to the body
2. The **cell interior** is organized into different individual organelles surrounded by a separate membrane.
3. The **nucleus** or major organelle holds generic information necessary for reproduction and cell growth.
4. Every cell has one nucleus and membrane-bound organelles in the cytoplasm.
5. **Mitochondria**, a double membrane-bound organelle is mainly responsible for energy transactions vital for the survival of the cell.
6. **Lysosomes** digest unwanted materials in the cell.
7. **Endoplasmic reticulum** plays a significant role in the internal organization of the cell by synthesizing selective molecules and processing.

## Lipids

These organic compounds are nonpolar molecules, which are soluble only in nonpolar solvents and insoluble in water because water is a polar molecule. In the human body, these molecules can be synthesized in the liver and are found in oil, butter, whole milk, cheese, fried foods and also in some red meats.

### Classification of Lipids

1. **Nonsaponifiable Lipids** – cannot be disintegrated into smaller molecules through hydrolysis. Nonsaponifiable lipids include cholesterol, prostaglandins, etc.

2. **Saponifiable Lipids** - comprises one or more ester groups, enabling it to undergo hydrolysis in the presence of a base, acid, or **enzymes**, including waxes, triglycerides, sphingolipids and phospholipids.

### Types of Lipids

1. **Simple Lipids** - esters of fatty acids with various alcohols.

- Fats
- Waxes

2. **Complex Lipids** – esters of fatty acids containing groups in addition to alcohol and a fatty acid.

- Phospholipids
- Glycolipids
- Other complex lipids

3. **Precursor and Derived Lipids** – these includes fatty acids, glycerol, steroids, other alcohols, fatty aldehydes, and ketone bodies, hydrocarbons, lipid-soluble vitamins, and hormones.

**Fatty Acids** – are carboxylic acid, usually with long aliphatic tails, either unsaturated or saturated.

a. **Saturated Fatty Acids** - lack of carbon-carbon double bonds indicate that the fatty acid is saturated. The saturated fatty acids have higher melting points compared to unsaturated acids of the corresponding size due to their ability to pack their molecules together thus leading to a straight rod-like shape.

b. **Unsaturated Fatty Acids** - unsaturated fatty acid is indicated when a fatty acid has more than one double bond.

### Role of Fats

- Necessary for the proper functioning of body
- Fat-soluble vitamins need to be associated with fats
- Provides insulation to the body

## MECHANISMS OF ORGANIC EVOLUTION

**Genetic drift** – is an evolutionary change in allelic frequencies of a population as a matter of chance. It occurs in very small population but its effects are strong. It occurs due to an error in selecting the alleles for the next generation from the gene pool of the current generation. It does not occur due to any environmental influences.

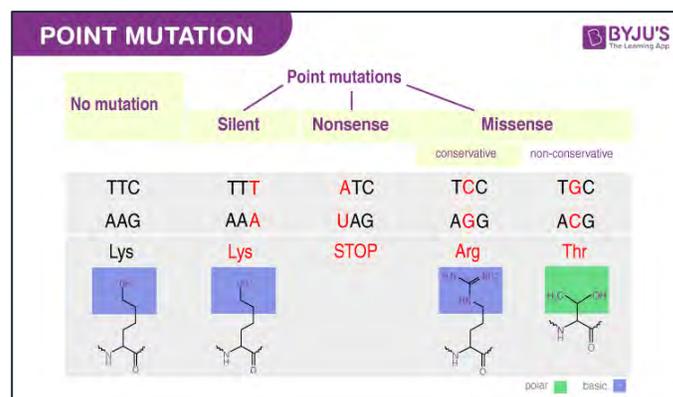
**Adoptive Radiation** – it is the process of evolution of various species in a particular geographical region starting from one point and radiating literally to other areas of geography.

**Allopatric Speciation** - the physical isolation of the population due to the extrinsic barrier is called allopatric speciation.

**Mutation** - abrupt but stable change of a gene that result in heritable modification of a trait that causes change in life forms.

### Types of Mutation

Mutations occur due to change in the nucleotide sequence of DNA due to deletion, insertion, duplication or substitution of nucleotides. The two types of mutations are point mutation and frameshift mutation.



## DIVERSITY OF LIFE FORMS

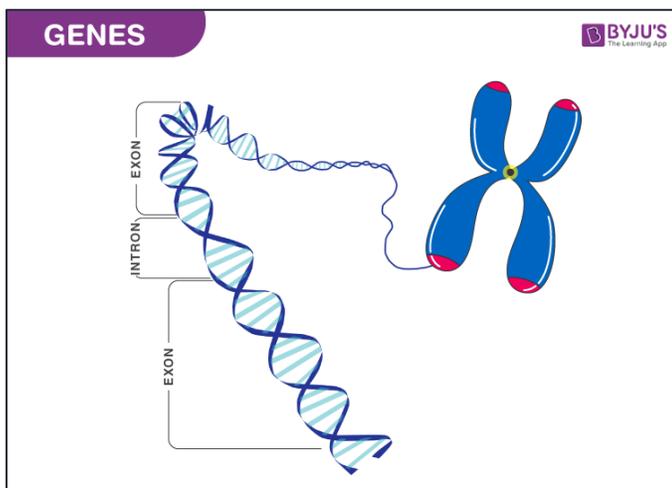
### Kingdom Plantae

Kingdom Plantae includes all the eukaryotic, multicellular plants, that perform photosynthesis to prepare their food. Plants have rigid cell walls made of cellulose and pectin. They possess organelles like chloroplast and chlorophyll that facilitate photosynthesis.

## GENETICS

The exploration of the working and major codes of variation and heredity is termed as **Genetics**. The groundwork on which heredity stands is known as **inheritance**. It is defined as the **procedure by which characteristics are handed down from one generation to the other**. **Gregor Johann Mendel** is known as the “**Father of Modern Genetics**” for his discoveries on the basic principles of heredity.

**Variation**, as the name suggests is the **amount of dissimilarity** that exists in between children and their parentages. It can be determined to keep in view the behaviouristic, cytological, physiological, and morphological characters of individuals fitting into similar species.



### Law of Inheritance by Gregor Mendel

**Garden Pea** (*Pisum Sativum*) was the plant that Mendel experimented on for 7 years to get to the point to propose the laws of inheritance in live creatures.

Mendel carefully chose seven distinct characteristics of *Pisum Sativum* for the investigation concerning hybridization. Mendel used true-breeding lines i.e. those that go through constant self-pollination and display steady characteristic inheritance.

### Principles of Inheritance

1. **Law of Dominance** – distinct elements termed as **factors control the characteristics**. These factors at all times exist as a couple. One of the constituent genes of the couple dominates over the former.

2. **Law of Segregation** – **alleles don't blend, and the two characteristics are recuperated all through the gamete formation** (in the F<sub>2</sub> generation). The characters apart from each other and pass on to diverse

gametes. Comparable types of gametes are produced by **Homozygous** and **heterozygous** produces diverse sorts of a gamete with varied characteristics.

3. **Incomplete Dominance** – it is the discovery that was done after Mendel's work. Incomplete dominance is the **situation in which both the alleles do not display a dominant trait** resulting in a fine combination or a midway amid the characteristics of the alleles.

4. **Codominance** – when **two alleles lack the dominant-recessive association** and thus the duo affects the creature together.

### Law of Independent Assortment

Separation of one set of the characteristic is autonomous of the other set of the characters when they are pooled in a hybrid.

### The Chromosomal Theory of Inheritance

Both genes and chromosomes exist in sets of two. The **homologous chromosome** contains the **two alleles of a gene pair in the homologous sites**. The coupling and split of a set of chromosomes will cause a split in the set of genes (factor) they carry.

### Sex Determination

A particular nuclear arrangement was perceived by **Henking**. He perceived that this particular nuclear arrangement was found in only **fifty per cent of sperms**. He termed this body as **x**. Later it became clear that only Ovum's that obtain only the x chromosome is born female and those that don't have such a case are born male. Thus, the **X-chromosome** was termed as **sex chromosome** and the remaining ones were termed as **autosomes**.

### Notations Used in Breeding Experiments

1. **Dominant Trait** – upper case letter
2. **Recessive Trait** – lower case letter
3. **Homozygous** – a pair of same alleles
4. **Heterozygous** – different alleles of a trait

### Genetic Disorders

1. Disorders of a **Mendelian nature** include:
  - a. **Haemophilia**
  - b. **Sickle Cell Anemia**
  - c. **Phenylketonuria**

2. Disorders of a **chromosomal nature** includes:
  - a. **Down's Syndrome**
  - b. **Klinefelter's Syndrome**
  - c. **Turner's Syndrome**