Chapter One

Introduction

The meaning and scope of biology

- Biological Sciences is the study of life and living organisms.
- The Greek word ‘bio‘ means life and ‘logos‘ means study of.
- In the late 1700s Pierre-Antoine de Monet and Jean-Baptiste de Lamarck coined the term biology.
- Earlier study of living things was restricted to the pure Science like Botany and Zoology that together comprise the Biology, but as the time passed new branches evolved.

- New technologies developed in pure subjects as well as in applied fields, which gave rise to a very broad concept of science called Biological Sciences.
- Biological Sciences is an extensive study covering the minute workings of chemical substances inside living cells to the broad scale concepts of ecosystems and global environmental changes.

- It is also concerned with the physical characteristics and behaviors of organisms living today and long ago.
  - How they came into existence and what relation they possess with each other and their environments?
- Intimate study of details of the human brain, the composition of our genes, and even the functioning of our reproductive system are dealt in Biological sciences.

- Therefore, Biology is the science of Living Things. That is why Biology is sometimes known as Life Science. The life sciences can be defined as “a systematic study of living beings or study of nature.”

The origin and nature of life

- One of the biggest and most important of emergent phenomena is that of the origin or emergence of life.
- The mystery of life's origin is still a big debating issue in science.
- The question “what is life?” is so hard to answer; we really want to know much more than what it is, we want to know why it is, “we are really asking, in physical terms, why a specific material system is an organism and not something else”.
- To answer this why question we need to understand how life might have originated. There are a number of theories about the origin of life.

- The evolution of life on earth has involved the following sequence of events.
- The first living things to appear were the simplest creatures, single-celled organisms.
- From these came more complex, multi-cellular organisms.
- Becoming more complex meant more than just an increase in cell number but more cells showed cellular specialization, where certain cells within the multi-cellular organism carried out specific tasks.
- Millions, even billions of years of changes of organisms led to the living things we now call plants and animals.

- Since this basic sequence of events is in accord with that agreed upon by most geologists, paleontologists, biologists, and even theologians, one might conclude that Moses, Aristotle, and Darwin were all keen observers and naturalists who were able to logically assess the most probable creation story.
- Scientists generally concur (agree) that the time from the formation of our solar system until now has been on the order of some 4.5 billion years.
- Those who believe the world as we know it was created in six days are often called creationists.
  - Their method of inquiry is based on the belief that the Bible is to be accepted as a completely accurate accounting of all about which it speaks.
- Scientists, on the other hand, utilize what they call the scientific method, which allows them to test hypotheses and theories and to develop concepts and ideas.

Theories on Origin of life

Theory of Special Creation: according to this theory, all the different forms of life that occur today on planet earth have been created by God, the almighty.

Theory of Spontaneous Generation: this theory assumed that living organisms could arise suddenly and spontaneously from any kind of non-living matter. One of the firm believers in spontaneous generation was Aristotle, the Greek philosopher (384-322 BC).

Theory of Catastrophism: It is simply a modification of the theory of Special Creation. It states that there have been several creations of life by God, each preceded by a catastrophe resulting from some kind of geological disturbance. According to this theory, since each catastrophe completely destroyed the existing life, each new creation consisted of life form different from that of previous ones.

Cosmozoic Theory (Theory of Panspermia): according to this theory, life has reached this planet Earth from other heavenly bodies such as meteorites, in the form of highly resistance spores of some organisms. This idea was proposed by Richter in 1865 and supported by Arrhenius (1908) and other contemporary scientists. The theory did not gain any support. This theory lacks evidence, hence it was discarded.

Theory of Chemical Evolution: this theory is also known as Materialistic Theory or Physico-chemical Theory. According this theory, Origin of life on earth is the result of a slow and gradual process of chemical evolution that probably occurred about 3.8 billion years ago. This theory was proposed independently by two scientists - A.I.Oparin, a Russian scientist in 1923 and J.B.S Haldane, an English scientist, in 1928.

Nature and characteristics of life

- Life is defined as a "condition" that distinguishes animals and plants from inorganic materials and dead organisms.
  - Life is comprised of processes and is a maintained state.
  - The most sophisticated form of life is man as a result of this we focuses upon the nature of the life and death of man.
- Man demonstrates three lives or aspects of life:
  - Physical life is basic existence
  - Mind contributes effectiveness and scope
  - Spiritual entity contributes maximum living
- Physiology: The existence of life physical is demonstrated by the presence of functions.

- Living tissues and organisms exhibit:
  - Irritability: the ability to be excited or detect stimuli and to respond thereto
  - Growth and reproduction: this consists of the power of multiplication and duplication, regeneration and differentiation
  - Adaptability: permitting both change and maintenance of balances (homeostasis) Finally and most characteristic of all is
    - Metabolism: the transformation of energy and the use of materials.

- These properties, however, can be retained for a while by tissues after death of the organism so there is another mystery of life which we understand only in part.
- Excretion: excretion and osmoregulation regulation are two important homeostatic processes occurring in living cells, helping them to maintain a constant internal environment, or steady state.
  - Excretion is the removal from the cell of waste products of metabolism

Scientific methods

- The scientific method is a process for experimentation that is used to explore observations and answer questions.
- It is an empirical method of acquiring knowledge. It is also the technique used in the construction and testing of a scientific hypothesis.
- The scientific method has five basic steps, plus one feedback step:
  - Make an observation.
  - Ask a question.
  - Form a hypothesis, or testable explanation.
  - Make a prediction based on the hypothesis.
  - Test the prediction.
  - Iterate: use the results to make new hypotheses or predictions.

- Observation - Quantitative and qualitative measurements of the world.
- Inference - Deriving new knowledge based upon old knowledge.
- Hypotheses –A suggested explanation.
- Rejected Hypothesis - An explanation that has been ruled out through experimentation.
- Accepted Hypothesis - An explanation that has not been ruled out through excessive experimentation and makes verifiable predictions that are true.
- Experiment - A test that is used to rule out a hypothesis or validate something already known.
- Scientific Method - The process of scientific investigation.
- Theory - A widely accepted hypothesis that stands the test of time.
  - Often tested, and usually never rejected.

- The scientific method is based primarily on the testing of hypotheses by experimentation.
  - This involves a control, or subject that does not undergo the process in question. A scientist will also seek to limit variables to one or another very small number, single or minimum number of variables. The procedure is to form a hypothesis or prediction about what you believe or expect to see and then do everything you can to violate that, or falsify the hypotheses. Although this may seem unintuitive, the process serves to establish more firmly what is and what is not true

Thank you!