Biology

- Is the scientific study of life
- Is a quest, an ongoing inquiry about the nature of life
Life’s levels of organization

- Atom - Fundamental unit of all substances
- Molecule - Two or more atoms joined in a chemical bond
- Cell - Smallest unit of life
- Tissue – Organized array of cells
- Organ – Structural unit of 2 or more tissues
- Organ System – Organs that interact in one or more tasks
- Multicelled Organism – Individual made of different types of cells
Life’s levels of organization

- Population – Group of individuals of the same kind of organism
- Community - All population of all species in a specified area
- Ecosystem – A community that is interacting with its physical and chemical environment
- Biosphere – All regions of Earth’s crust, waters, and atmosphere in which organism live.
Levels of Organization

- **molecule**: Two or more atoms joined in a chemical bond. In nature, only living cells make the molecules of life: complex carbohydrates and lipids, proteins, DNA, and RNA.

- **cell**: Smallest unit that can live and reproduce on its own or as part of a multicelled organism. A cell has DNA, an outermost membrane, and other components.

- **tissue**: Organized array of cells and substances that are interacting in some task. Bone tissue consists of secretions (brown) from cells such as this (white).

- **organ**: Structural unit of two or more tissues that interact in one or more tasks. This parrotfish eye is a sensory organ used in vision.

- **organ system**: Organs that interact in one or more tasks. The skin of this parrotfish is an organ system with tissue layers, organs such as glands, and other parts.

- **atom**: Atoms are fundamental units of all substances. This is a model for a single hydrogen atom.
Levels of Organization

- **multicelled organism**: Individual made of different types of cells. Cells of most multicelled organisms, such as this Red Sea parrotfish, make up tissues, organs, and organ systems.

- **population**: Group of single-celled or multicelled individuals of a species in a given area. This is a population of one fish species in the Red Sea.

- **community**: All populations of all species in a specified area. These populations belong to a coral reef community in a gulf of the Red Sea.

- **ecosystem**: A community that is interacting with its physical environment through inputs and outputs of energy and materials. Reef ecosystems flourish in warm, clear seawater throughout the Middle East.

- **biosphere**: All regions of Earth's waters, crust, and atmosphere that hold organisms. In the vast universe, Earth is a rare planet. Life as we know it is impossible without its abundance of free-flowing water.
Energy and Life’s Organization

- Energy – Capacity to do work
- Nutrient – Type of atom or molecule that has an essential role in growth and survival

- Categories of organisms
  - Producers - plants
  - Consumers - animals
Ecosystem: Energy Flow and Material Cycling

- Energy input from the sun flows through producers, then consumers. All energy that entered this ecosystem eventually flows out of it, mainly as heat.
- Nutrients get concentrated in producers and consumers. Some nutrients released by decomposition may be cycled back to the producers.
Organisms sense and respond to change

- Receptor - A molecule or cellular structure that responds to specific form of stimulation
- Homeostasis – By sensing and adjusting to a change, organisms keep conditions in their internal environment within a range that favors cell survival
Organisms grow and reproduce

- Based on information in DNA
- DNA is the signature molecule of life
- Proteins - Long chains of amino acids
- Inheritance - Transmission of DNA from parents to offspring
- Reproduction - Refers to actual mechanism by which parents transmit DNA to offspring
Grouping of organisms

- Species --- Genus --- Family --- Order --- Class --- Phylum --- Kingdom --- Domain

- Scientific Name
  - First part of the name is Genus
  - Second part of the name is Species
  - eg. Scarus gibbus – parrotfish
Grouping of organisms

- The Three Domains of Life
  - Bacteria ______ 
  - Archaea ______ Prokarya – single celled organisms
  - Eukarya

- Prokarya – Single celled organisms
- Protists - Simplest Eukaryotic organisms
- Plants - Multicelled species
Bacteria and Archaea
Eukarya
Eukarya
Grouping of organisms

- Fungi
  - Multicelled
  - Many are decomposers

- Animals
  - Multicelled consumers that ingest tissues or juices of other organisms
Eukarya
Eukarya
An Evolutionary View of Diversity

- Most of the evolutionary views are based on the works of Charles Darwin.
- Darwin defined *Natural Selection* as the process by which organisms change over time, as those best suited to their environment survive to pass their traits to next generation.
Critical Thinking and Science

- Critical thinking – judging information before accepting it

- **Scope and limits of Science**

- **Science**
  - Systematic study of nature
  - Does not address the supernatural or anything that is beyond nature
How Science Works

Example of a scientific approach to a question

- Observation – Observe some aspects of nature
- Question – Frame a question that relates to observation
- Hypothesis – Testable answer to question
- Prediction – Using hypothesis as a guide, make prediction
How Science Works

- Observational Test – To test the accuracy
- Experimental Test – To assess the result of test that confirms your predictions
- Report – Report the test results

About the word “theory”
- A set of ideas that tie together many observations
- Theories are based on the ideas that have been tested and shown to be true over time
- Eg. Gravitational theory, Cell theory
How Science Works

- Experiment – tests designed to support or falsify a prediction

Some terms used in experiments
- Variables – factors that affect the result of an experiment
- Control – the factor that is kept constant, or held fixed in an experiment
Power of Experimental Tests

- Asking useful questions – all scientific investigations begin with a question
- Sampling error in experiment - the error caused by observing a sample instead of the whole population