Biology is the subject of life and living organisms. And perhaps, most importantly today, how we humans interact with and impact the lives of each other and the other organisms that share our earth. By studying the living organisms with which humans share this earth, biologists try to answer questions about diversity and about the common characteristics of living organisms. We try, in science to make "sense" of all we see in our world around us.

Living Organisms are virtually everywhere on earth, and are found in all sizes, shapes and colors. From bacteria to aspen groves, blue whales and California redwood trees, there is a remarkable array of living organisms to catalog (or classify) and observe on earth.

All of us have some understanding of what it is to be alive and what non-living stuff is. However, coming up with a good definition of life is not so easy. There are a number of things we can state which are characteristics of living organisms, the sum of which can be of help to us in distinguishing life from non-life:

Although both living and non-living things share the same fundamental properties of matter and energy (which we shall look at) living organisms and non-living materials differ in the degree to which energy is used and materials are organized. To help us determine how life and non-life can be distinguished we can study some of the following common "features" of living organisms:

**Biological Organization**

Living organisms have an **organized** structure, with each level of biological structure building on the level below it. Atoms form molecules that are organized to form cell components, called organelles. Organisms may be unicellular or multicellular. Multicellular organisms have structural levels above the cell: tissues, organs and organ systems.

Groups of organisms form populations and groups of different populations (or species) living in the same geographical area form communities and ecosystems. This is our life on earth.
Response to Stimuli and Homeostasis

Organisms constantly sense changes in their surroundings and make controlled responses to those changes. Organisms have specialized receptors that detect environmental stimuli, and their cells adjust metabolism in response to signals from receptors. This constant monitoring and interaction between cells and their environment is called homeostasis.

Energy

All organisms require energy input to maintain the processes of life. Living organisms must have the capacity to obtain and convert energy from their surroundings to grow and maintain themselves. In biology this is known as metabolism.

Growth and Reproduction

All living organisms have a common molecular inheritance based on the nucleic acid, DNA. DNA contain the instructions for the structure and function of cells, the common structural component of living organisms. DNA guides growth, development and maintenance of tissues and organs of multicellular organisms. DNA instructions are passed from generation to generation (inherited) by the process of reproduction.
Interdependence of Life – Change through Time
Just as the cells of multicellular organisms are dependent upon each other for the survival of the organism, life on earth involves an interdependence of energy and nutrients in ecological processes. Much of biology focuses on the linking of life processes:
- The dependence of life processes on each other
- The interaction of organisms with their environment
- The changes that occur in groups of organisms through time
- The mechanisms of evolution as a foundation for change

While looking for the unity of life processes, we recognize the great diversity of appearance and behavior of species on this earth, as well. Species differ greatly in their adaptations to the many distinct environments on earth. Both the unity and diversity of organisms can be explained by the mechanisms of evolution.

Diversity of Life
For thousands of years humans have categorized living organisms into groups sharing some kind of common features. In the 1700's, Linnaeus proposed a hierarchical scheme, which we continue to follow. For some time, biologists grouped organisms into general groups, called **Kingdoms**, based on broad general features (which are not so easy to see all of the time). Recently, biologists added a new category above Kingdom, called **Domain**. Your textbook uses Domains in its classification of living organisms. There are three Domains:
- Domain Archaea
- Domain Eubacteria
- Domain Eukarya
  - Kingdom Plantae
  - Kingdom Animalia
  - Kingdom Fungi
  - Kingdom Protista

We will discuss a bit about the cellular differences and distinctions are the basis of classification when we discuss cell structure and function.
At times during Biology 160, we will have reason to look a little more closely at the characteristics of these domains and kingdoms, and for those who go on to study diversity in other courses, you'll have the opportunity for greater observations. Unfortunately, we do not have time in Biology 160 to study the wonderful diversity of life on earth in any detail. Biology 162, and Biology 212 and 213 have diversity sections.
Evolution as the Guiding theme of Biology
Evolution is the core of biology. Life has the capacity to change genetically from generation to generation – to evolve. The processes of evolution are fundamental to life on earth. The natural genetic variation found among members of a species provides for the capacity of organisms to respond to changing environmental conditions from generation to generation. Those who have characteristics, or adaptations, more favorable in the environment will reproduce more offspring that those with less successful characteristics.

Camouflage Adaptations

These statements, first presented by Charles Darwin and Albert Wallace in the mid-1800s are fundamental to all that we do in biology and our understanding of life.

Diversity and unity are the two faces of life on earth. Biologists have described more than 1.5 million different kinds of organisms, including more than 750,000 insects alone. There are 260,000 plants and 50,000 vertebrates (the animals with which we are most comfortable). There may be millions of additional organisms not yet described by humans.

We shall spend some time this term looking at the mechanisms of evolution, as well as seeing the results of evolution as we study the structure and functioning of cells.

How Biologists Ask Questions
Before we leave our introduction, we need to mention how biologists look at the world around them. Each of us is curious about any number of things. Often when we are curious we ask questions to try and find out whatever it is that we are curious about.

Biologists try and find answers to their questions about living things by using the scientific method of problem solving, or some variant of this method, to study the processes of life.
**Scientific Principles**
A Scientific Principle is an idea supported by repeated experiments and observations. The assumptions behind which scientific principles are based have been thoroughly tested and found valid over many years.

**How the Scientific Process Works:**
Find something about which you are curious.

- Make observations and ask questions based on your observations to produce a "model" or preliminary explanation for your question.
- Based on your observations and model, make a **testable** hypothesis (reasoned guess) by using the information available to make a general statement (called the hypothesis).
- Predict what will happen if the hypothesis is correct
- Test the hypothesis by models, experiments and/or observations. When possible, science uses **controlled** experiments.

Science also uses **comparative data**, looking for patterns in nature that are consistent with predictions. Data may be **quantitative**, such as measurements, or **qualitative**, in the form of descriptions of phenomena observed.

- Repeat tests to see if results are consistent with the hypothesis.
- Objectively note results and draw conclusions. Conclusions may support the hypothesis or not support the hypothesis. The purpose of scientific inquiry is to find answers, but not to find only those answers that support the original idea. Examine alternative hypotheses in the same manner.
Scientists work in as many different ways as there are scientists; but all share a critical attitude that requires being shown, not being told, and use logic in their thinking. Conclusions must support evidence and observations.

Science is limited to questions that can be tested. Experimental design is important. When possible, science uses controlled studies, in which the control group is a standard for comparison with the experimental group. The variables of the experiment are aspects, events or objects that may differ or change over time. When testing a hypothesis, scientists are as prepared to find the hypothesis false as they are for validating the hypothesis.

Tested and supported hypotheses in science are known as theories. In this sense, theory is not the same as in some fields where theory means a speculation. A science theory has tested evidence that supports and lacks evidence that disproves it. Other fields may look at issues and ideas that are untestable. These ideas are not appropriate for science.

This term, in Biology 160 we will look at some of these life processes. Chapter One of your text reviews many of the ideas I've mentioned here. Read this chapter with thought. Much of what is written there may help you think more deeply and with greater understanding of what we are to do in Biology 160 as well as in subsequent biology courses you will take.