Introduction
Here we go…

So, what is science?
Well…

Science

- Science is the observation of phenomena and the theoretical explanation of it.
- Simply, it is the state of knowing.

Biology

- Biology is the study of life. It is a branch of science that deals with living things and their vital processes.
- This is a general field of study which can branch out into specific fields including marine biology, ecology, cell and molecular biology and microbiology.

Where, oh, where…?

- Biology is literally everywhere.
- Arguably, the most important biological theme is the organism's environment.

What is Life?

- There are basic properties that living things share.
- Taking some of these characteristics alone can describe some *inanimate* objects.
- So, in order to characterize living things, these all need to apply.

The Big Seven

- Organization
- Response to stimuli
- Homeostasis
- Growth
- Reproduction
- Metabolism
- Evolution

- Organization
  - All living organisms are composed of at least one cell.
- Metabolism
  - The flow of energy.
  - Living things need energy for everyday processes.
  - Energy is needed to maintain organization and is required for growth.

- Homeostasis
  - the organism's ability to maintain a constant internal environment.
- Response to stimuli
  - an organism's behavior or activity in relation to an external agent.

- Growth
  - an increase in size that results from an increase in the number of cells and/or the size of individual cells.
- Reproduction
  - can include either the formation of new cells for growth, repair, or replacement, or the production of a new individual from a specific set of genetic instructions.

- Evolution
  - accounts for the diversity of life.
  - Simply put, it can be defined as change(s) in living organisms over a period of time

Levels of biological organization

- Biosphere, ecosystem, community, and population (Populational)
- Organism, organ system, organ, and tissue (Organismal)
- Cell, organelle, molecule, atom, and subatomic particle (Cellular)

- Biosphere
  - the region on, below, and above the Earth's surface where life exists.
  - Living things can be found everywhere including the atmosphere, the deepest parts of the ocean, and at least in some areas, microbes live in rock several kilometers below the surface of the earth.

- Ecosystem
  - distinguishable groups of species and the abiotic (non-living) components of the environment with which the living creatures interact.
  - Abiotic means the nonliving parts of this distinct area
  - Examples of ecosystems include ponds, forests, prairies.

- Community
  - populations of different species living and interacting together in a distinct area. (e.g: all the species in a desert).

- Population
  - a group of freely interacting and breeding individuals of the same species.
  - For example, all the ducks in a pond can be considered a population of ducks.
  - Typically, populations are subdivided into smaller groups: a pack of wolves, pride of lions, colony of ants, herds of cattle, etc.

- Organism
  - that level of biological organization that has its own distinct existence as a complex, self-reproducing unit.
  - We are multicellular organisms in that we are made of many highly specialized cells which cannot exist independently of other cells in the organism.
  - Many organisms are unicellular, that is they consist of a single independent cell.

- Organ system

  - Multicellular organisms, especially animals typically have groups of organs that function together to carry out broad sets of functions.
  - For instance, an organ system in humans is the digestive system.
  - Some of the organs in the digestive system are the stomach, liver, small intestine, pancreas.

- Organs
  - groups of tissues organized together to carry out a particular set of functions.
  - Organs typically have several kinds of tissue.
  - The stomach, for example, has an inner lining of tissue that secretes digestive enzymes and outside the stomach there are several layers of muscle and connective tissue.

- Tissue
  - a group of distinct and similar cells that carry out a specific set of functions.
  - For example, muscle tissue is for contraction.
  - Connective tissue is tissue consisting of cells surrounded by a large amount of non-living material.
  - Nerve tissue is for the conduction of nerve impulses and secretion of specialized chemicals called neurotransmitters.

- Cell
  - the smallest unit of biological organization that biologists consider alive.
  - Cells come in a wide variety of shapes and sizes.

- Organelle
  - Specialized structures inside some cells.
  - Often organelles are "membrane-bound" (surrounded by a plasma membrane), but are not always!
  - Examples of organelles you will become familiar with are the nucleus, mitochondria, and endoplasmic reticulum.
  - Sometimes the ribosome is not considered an organelle because it's not a membrane-bound structure.

- Molecule
  - the smallest particle of a substance that retains the chemical and physical properties of the substance and is composed of two or more atoms.
  - Associated with this level are molecular assemblies, macromolecules, and small molecules.

- Atom
  - the smallest unit of matter that have the chemical properties of a particular chemical element.
  - Atoms are comprised of subatomic particles

- Subatomic particles

- Neutrons and protons are in the atomic nucleus.
- Protons have a positive electrical charge, neutrons have no charge.
- Electrons have a negative electrical charge.
- Electrons occur in only certain energy levels or shells and only so many electrons can occupy each energy level.
- An important concept is that electrons can carry and release energy.
- The last subatomic particle you need to know of is the photon.
- A photon is a packet of light energy.
- It has no mass, moves at the speed of light, and is associated with electrons, in that electrons can absorb and release photons.

A little more on metabolism…

- Metabolism is a process in which energy is transferred and used.
- There are different types of metabolism.
- They are: catabolism and anabolism.
- In a catabolic reaction, complex molecules are being broken down into simpler ones. An example would be the breakdown of a protein into amino acids.

- In an anabolic reaction, complex molecules are being *made*, from simpler molecules (i.e. amino acids to proteins)
- One is a creative process and one is a degradative process.
- Keep in mind that different organisms may utilize different metabolic pathways.

The study of taxes?

- No. Taxonomy is the field of study that deals with the classification of organisms.
- A taxon is a group of organisms at any one particular level.
- We started out with a polynomial system, but changed to a binomial system.
- Carolus Linnaeus started the binomial system of naming organisms.
- There are several levels of classification, ranging from very general to very detailed.
- Domain, Kingdom, Phylum, Class, Order, Family, Genus, and Species.

Domain Archaea

- Domain Archaea contains a kingdom of the same name.
- This domain contains several bacterial species which differ greatly from those found in Domain Bacteria.
- Diverged early in phylogenetic tree.

Domain Bacteria

- Contains Kingdom Bacteria.
- The most widespread organisms on the planet.
- Again, there are differences between this domain and that of Archaea.

Domain Eukarya

- Four kingdoms are in this domain: Animalia, Fungi, Plantae, and Protista.
- The first three are multicellular kingdoms, but protists are unicellular.
- Not as old as the other two domains, and do not have several metabolic processes available

for use, like bacteria.

Kingdoms

- Kingdom
  - The second most general of the taxonomic categories.
  - There are six kingdoms: Archaea, Bacteria, Protista, Fungi, Animalia, and Plantae.
- Linnaeus originally proposed a two-kingdom system consisting of animals and plants.
- Whittaker's five kingdom system took over and prevailed until Carl Woese entered the picture.
- Woese proposed a six-kingdom system that split the Monerans into Bacteria and Archaea.

How scientists think? (The Scientific Method)

- Step 1: What's going on?
  - Identify what the problem is.
  - Develop a hypothesis (what is a possible answer to my question)
- Step 2: I think…
  - Make a prediction using your hypothesis as a guide. Usually, an "if…then" statement is generated.
- Step 3: This is only a test…
  - Test your prediction by making observations and experimenting.
- Step 4: The finish line
  - Confirm predictions made.