This course is a study of "Human Anatomy and Physiology." So we must first define these three terms:

Humans

- **Animals** (we are multicellular, motile organisms that lack cell walls)
- **Vertebrates** (we have backbones)
- **Mammals** (we have hair, mammary glands, 3 bones in each ear)
- **Primates** (we have opposable thumbs, 2 clavicles, forward facing eyes)
- **Hominids** (we are bipedal and have a large brain size to body size ratio).

Anatomy

- the study of animal structure.
- from the Greek *ana-* which means "up" and *temnein* which means "to cut."
- literal meaning makes sense since knowledge of an animal's internal structure can be gained from dissection.

Physiology

- the study of animal function.
- from the Greek *physio-* which means "form" or "natural order" and *logos* which means "thought" or "discourse."

Human anatomy and physiology is the study of the form and function of the human animal.

A&P is a subset of **biology** which is the study of **living organisms** (Greek *bios* – "life").

There are a variety of types of anatomical study including:

Gross anatomy – the study of structures visible to the naked eye.
Histology – the study of **tissues** (Gr. *histos* – "tissue") with the aid of a microscope
Cytology – the study of cellular structure and function (Greek *kytos* – "container").
Embryology – the study of the origin, structure, and development of the **embryo** (the initial 8 week stage of human development).
Pathology – the study and diagnosis of disease (Gr. *pathos* – "suffering").

Human beings are **organisms** (contiguous living systems).
An organism is composed of groups of structures that work together to perform a common task. Such a group is known as an **organ system**.
There are 11 basic organ systems:

Integumentary System –external covering of the body; the **skin**.
Skeletal System –body's internal framework; the **bones**.
Muscular System –body's means of movement and manipulation.
Nervous System –body's control center; the **brain**, **spinal cord**, and **nerves**.
Endocrine System –glands that secrete **hormones** (chemical messages) into the blood
Cardiovascular System –body's major transport system body; **heart**, **blood vessels**, and **blood**.
Lymphatic/Immune System – returns fluid to the blood stream; detects and repels **pathogens**; **lymphatic vessels**, **spleen**, **lymph nodes**, **tonsils**, **thymus**, and more.
Respiratory System – delivers **O_2** to the blood and removes **CO_2**; **nasal cavity**, **pharynx**, **larynx**, **trachea**, **bronchi**, and **lungs**.
Digestive System – transports, breaks down, and absorbs food; eliminates indigestible remains; **oral cavity**, **pharynx**, **esophagus**, **stomach**, **small** and **large intestines**, **salivary glands**, **pancreas**, **liver**, and **gallbladder**.
Urinary System – eliminates **nitrogenous wastes** from the blood; regulates blood volume, pressure, pH, and electrolytes; **kidneys**, **ureters**, **urinary bladder** and **urethra**.

Male Reproductive System – produces **sperm** and **testosterone**; delivers sperm to the female reproductive tract; **testes**, **penis**, **vas deferenses**, **prostate gland**, **seminal vesicles**.
Female Reproductive System – produces **oocytes**, **estrogens**, and **progesterone**; receives, retains, and expels the embryo/fetus/infant; **ovaries**, **fallopian tubes**, **uterus**, and **vagina**.

Organ systems are composed of **organs** – discrete structures that perform specific defined functions and consist of multiple **tissues**.

Tissues are collections of similar **cells** that have a common function. There are 4 basic types of tissues:
Epithelial tissue – covers body surfaces and lines body cavities.
Muscle tissue – provides movement.
Connective tissue – supports and protects body organs.
Nervous tissue – controls body functions and allows for communication.

The human body contains roughly 100 trillion cells, of which there are about 200 different types.
There are a few general things about cells we should know:
- The cell is the basic structural and functional unit of life.
- All living organisms are composed of cells.
- An organism depends on the individual and collective activity of its cells.

Cells are composed of **organelles** (literally a "little" organ).
An organelle is a specialized subunit within a cell that carries out a specific function and is usually enclosed within a membrane.
Some major organelles include:
Nucleus – houses the cellular **DNA**; controls cellular activity.
Mitochondrion – converts the chemical energy in food into a form usable by the cell (**ATP**).
Endoplasmic reticulum – involved in the production of proteins and lipids.

Cells and organelles are composed of a variety of **chemical molecules**.
Some major molecules important to living systems include:
Carbohydrate – **sugars** and **starches**. Mostly used for cellular fuel. Some structural uses.
Protein – strings of **amino acids**. Multifunctional: structural support, **enzymes**, transport, etc.
Lipids – **fats**, **phospholipids**, **steroids**. Energy storage, structural support, signaling between organs.
Nucleic acids – **DNA** and **RNA**. DNA: Constitutes the genetic material of the cell; provides the instructions for protein synthesis. RNA: transports protein synthesis instructions from the nucleus to the protein building machinery outside the nucleus.
Adenosine Triphosphate – compound that is the energy currency of the cell. Produced w/i the mitochondria from molecules of food.

All cells have needs in terms of energy, gases, and wastes. The maintenance of a stable, optimal internal environment for body cells, tissues, organs, and organ systems is known as **homeostasis** (Gr. *homoios* similar + *stasis* standing still).
Maintaining homeostasis means regulating a wide variety of **homeostatic variables** such as: temperature, pH, pressure, volume, concentration, etc.
In order to maintain such variables the body must be able to do the following:
1. Measure the current state of the variable. The measurement is done by a cell (or cells) known as a **receptor**. Changes in the variable would be known as **stimuli**.

2. Transmit the information about the change (the **error signal**) to a **control center**. This flow of information is called the **afferent pathway** (Latin *af* to + *ferre* carry).
3. The control center (often a group of cells in the brain or spinal cord) compares the state of the variable to a **set point**.
4. The control center then transmits information to an **effector**. This flow of information is called the **efferent pathway** (Latin e*f* away + *ferre* carry).
5. The effector then **responds** in a way that returns the variable to within its normal range.

Typically homeostasis is achieved via **negative feedback mechanisms**.
In negative feedback systems, the output of the response diminishes the change in the variable.
For example, in response to a rise in body temperature, **sweat glands** increase their production of sweat. Evaporation of the sweat then causes a decrease in body temperature.
Control of almost all homeostatic variables is done via negative feedback mechanisms.

A different scenario is the **positive feedback mechanism**.
In positive feedback systems, the output of the response augments the change in the variable.
This is a less common situation since it tends to take the variable away from the set point.
One example is the **Ferguson reflex** that occurs during childbirth. During labor, the infant begins to stretch the **cervix**. In response to cervical stretch, the mother's **pituitary gland** releases the hormone **oxytocin**. Oxytocin stimulates uterine contraction. The contracting uterus forces the infant further into the cervix, thus increasing cervical stretch. This results in increased oxytocin production and so on until the delivery is complete.
Because positive feedback mechanisms are self-perpetuating, some external event (e.g., the delivery of the baby) is necessary to turn them off.
Positive feedback mechanisms are also involved in **blood clotting**, **lactation**, **nerve signaling**, and **protein digestion** in the stomach.