Introduction to Human Anatomy and Physiology
UNIT 1: Organization of the Human Body
PURPOSE OF THIS UNIT

In this unit we will be learning about basic concepts and terminology central to the study of the human body.
Characteristics of Living Things

The key features or properties of organisms
What’s the difference between living and nonliving things?
Working with your Neighbor, create a list of characteristics All living things have in common.
Now compare your answers with your group. Come up with a list the entire group can agree on.
What are the key processes all living things share?
1. Irritability or Responsiveness

- The ability to detect and respond to external and internal stimuli.
- A stimulus is a change in the environment.
2. Growth

- Increasing in **size**.
  - can occur due to
    - **an increase in the number of cells**
    - **or the size of the existing cell(s)**
3. Development or Differentiation

- Changes in an organism during development (maturation) that yield **new functions**.
- What are some examples?
4. Reproduction

- The ability to create **new cells**.
  - Can be:
    - **sexual** or
    - **asexual**
- How do we reproduce?
5. Movement

- The ability to move:
  - a part or the entire organism
  - a single cell
  - or substances within a cell

- What would be an example of each method of movement?
6. Metabolism

- The sum total of all the chemical reactions that occur in an organism.
- Can you think of an example?
How about these?

• Bacteria?

• Virus?

• Navel Orange?
Assessment

• Write a paragraph as to whether or not you believe a navel orange is a living or a nonliving thing.
• Use the characteristics of living things discussed in class. (Which characteristics lead you to your answer?)
WHAT IS THE DIFFERENCE BETWEEN ANATOMY AND PHYSIOLOGY?
Working with your neighbor, answer the following to the best of your ability. Record your answers on a piece of scrap paper.

1. What is the meaning of the term anatomy?
2. How do we learn about anatomy?
3. What is the meaning of the term physiology?
4. How do we learn about physiology?
DID YOU KNOW…..

- It wasn’t till the 1500’s that we realized the human mandible was in fact one bone. Before that we believed it to be made of 2 parts. Andreas Vesalius was able to disprove the teachings of Galen of Pergamon (AD 130-200).
ANATOMY

- The study of **structure**.
- From the Greek meaning “to cut up” (dissect)
- Knowledge from **observation**
SUBDIVISIONS OF ANATOMY

Surface Anatomy – Study of the outer surface and markings on the surface of the body.
Gross (macroscopic) anatomy – Study of structures that can be examined without the use of a microscope.
**Systemic anatomy** – Study of specific systems of the body such as the nervous system or respiratory system.
Regional anatomy – Study of a specific region or area of the body such as the head or chest.
MICROSCOPIC ANATOMY

- **Histology** – Microscopic study of the structure of tissues.
- **Cytology** – Microscopic study of the structure of cells.
PHYSIOLOGY

● The study of function or how the body parts work.

● Knowledge from experimentation.

● Ex: The way the heart pumps blood around the body. (William Harvey)
Structure dictates function

- “form follows function”
- A key biological principle that state: what a structure looks like determines what it does.
  - Ex: The function of the heart is to pump blood. The structure of the heart is open chambers that can squeeze.
Can you think of another example of structure dictating function? (Does not have to be biologically based)
PATHOLOGY

- Greek for the “study of suffering” or disease
- The study of disease and the disease process.
BAV

- Anatomy
- Physiology
- Gross Anatomy
- Pathology
1. The study of the structure and relationship of large body parts that are visible without a microscope is termed macroscopic or _____________ anatomy.
   a. radiographic
   b. pathologic
   c. gross
   d. surgical
2. The word root *pathos*, as in “pathologic anatomy”, means
   a. function
   b. disease
   c. to cut open
   d. to study
3. The study of anatomy that examines structures not readily seen by the unaided eye (structures that must be magnified first) is
   a. regional anatomy
   b. microscopic anatomy
   c. gross anatomy
   d. pathologic anatomy
Levels of Structural Organization
Objective

- Describe the structural organization of the human body.
When studying the human body we can organize its structures into several levels based on their complexity. We will look at these levels starting with the least complex and end with the most complex.
Analogy:

- Our written language has various levels of structural complexity; starting with **letters**, then **words**, then **sentences**, then **paragraphs**.
1. Chemical Level

- Includes **atoms** (the smallest unit of matter) and **molecules** (2 or more atoms connected together)
Ex: DNA, hemoglobin, glucose and vitamins.
2. Cellular level

- They are the basic **structural** and **functional** unit of a living organism.
• Ex: muscle cells, nerve cells, and blood cells.
3. Tissue Level

- A group of **cells** and surrounding material that work together to **perform a particular function**.
There are 4 types found in the human body: **epithelial tissue**, **connective tissue**, **muscle tissue** and **nervous tissue**.
4. Organ Level

- Organs usually have a characteristic **shape**, are made of 2 or more **tissue types**, and have a **specific function**.
Ex: Stomach, heart, etc.
5. System Level

• A group of related organs that have a common function.
• Some organs can be part of more than 1 system. Ex: pancreas
Ex: Digestive system
6. Organismal Level

- All of the body’s systems together.
- The highest level of organization.
Homeostasis
What does the body/organism or cell need to survive? Why?

- Working with your neighbor come up with as many as you can think of and why?
Homeostasis

- It is the body’s ability to maintain a relatively stable internal environment in an ever changing external world.
  - Ex: internal body fluids kept at about 98-99°F
It is a dynamic process. This means that a body’s/cell’s internal conditions can change over narrow ranges and still function and survive.

- Ex: blood glucose levels (45-96 mg; fasting)
Keeping the internal environment within its normal range is mainly controlled by 2 body systems:

1. **nervous system** (electrical signal; fast response)
2. **endocrine system** (chemical signal; slow response)
What would be an example of the body demonstrating homeostasis?
Example of homeostasis

Change: The body temperature goes up

Response: Nervous system detects change and counters change by causing sweat glands to release sweat and cools the body as the sweat evaporates.
Feedback Systems or Loops

- These are ways the body maintains homeostasis.
- Each is a sequence of events where the status of a body condition is continually: monitored, evaluated, changed (if needed), and reevaluated.
A **controlled condition** is something that one of these feedback systems (loops) are **monitoring**.

- Ex: **body temperature** or **blood glucose levels**.
A **stimulus** is something that changes the condition (temperature, glucose level, etc.) of the body’s internal environment.
When a stimulus moves a controlled condition away from normal we refer to this as the body being stressed.
Parts of a Feedback System

1. **Receptor** - specialized structures in the body that monitor changes in the **controlled condition** and send **messages** to other structures in the body.
   ○ Ex: nerve endings in the **skin** monitor temperature and send that information to the **brain** and **spinal cord**.
2. **Control Center** - these structures **evaluate** the input received from the receptors. If needed they will send **output** signals to another body structure.

- Ex: Brain and Spinal cord evaluates temperature **input** from skin and send **output** signals to muscles in the arm.
3. **Effector** - these are body structures (muscles and glands) that receive output signals from a **control center** and produce a **response or effect**.
   - Ex. the muscle in your arm (**effector**) receive signals from the brain and spinal cord (**control center**) and moves the hand away from a hot surface.
• stimuli
• controlled condition
• receptor
• effector
1. Negative Feedback System
   ○ **Reverses** or **negates** a change in a controlled condition.
   ○ Works to **bring the body back** to normal.
   ○ **Most common** type of feedback.
Ex. of negative feedback:

**Controlled Condition** - Blood Pressure

**Stimulus** - pressure increases in the blood vessels (typically because heart is beating faster or harder)
Receptors - there are specialized nerve cells in certain blood vessels that monitor pressure called baroreceptors.
Control Center - the baroreceptors send signal (input) to the brain. The brain evaluates this information and sends output signals if necessary.
**Effector** - The output signal is received by the heart. The response (effect) is that the heart rate decreases causing the blood pressure to return to normal.
Types of Feedback

2. Positive Feedback Systems

- Increase or add to a change in a controlled condition.
- They move the body further away from normal.
- These are less common.
- If they are not eventually stopped they can “run away” and cause life-threatening problems.
Example of positive Feedback

Controlled Condition - Lactation (milk production)

Stimulus - pregnancy and nursing
Receptors - nerve endings in breast tissue signal the brain if a baby is nursing.

Control Center - the hypothalamus in the brain releases oxytocin (hormone - endocrine system).
Effector - breast glands release milk.
Ferguson Reflex

• A type of **positive feedback loop**.
• Toward the end of pregnancy the baby **stretches** the uterus. This causes **Oxytocin** (hormone) to be released. This causes the uterus to **contract** (squeeze). The contractions become increasingly stronger until **the baby is born**.
Nerve impulses from cervix transmitted to brain

Brain stimulates pituitary gland to secrete oxytocin

Head of baby pushes against cervix

Oxytocin carried in bloodstream to uterus

Oxytocin stimulates uterine contractions and pushes baby towards cervix
How are positive feedback loops different than negative feedback loops? What is an example of each?
Anatomical Terms
How would you describe the location of your wrist?

Would your description change if you held your arms out to the side? over your head?
To avoid confusion, in anatomy and medicine we use very precise terminology.

We start with a **common starting point** (body position) and then use specific terms to describe location of one body part **relative** to another.
Anatomical Position

1. Patient is standing straight facing you.
2. Their head is level, with eyes looking forward.
3. Feet are flat on the floor with toes pointed forward.
4. Their arms are relaxed at the sides with palms facing forward.
Directional terms

• These are words that describe the position of one body part relative to another.
• Superior/Cephalic
  – Toward the head

Top
Bottom

- Inferior/Caudal
  - Toward the feet
Front

• Anterior/Ventral
  – The front of the body
Back

- Posterior/Dorsal
  - Toward the back of the body.
• Medial
  – Near the midline of the body. (towards the sternum)
Out

• Lateral
  – Toward the outside of the body (going away from the midline.)
• Intermediate
  – Between structures.
Close

- Proximal
  - Toward the point of origin.

**Figure F-4: Meaning of Proximal**

Proximal muscles are closer to the center of the body.
Far

• Distal
  – Away from the point of origin.
  – Distant
Together

• Ipsilateral
  – On the same side of the body.
Apart

- **Contralateral**
  - On the opposite side of the body
• Superficial
  – Toward the surface
  – Think of a superficial person.
• Deep
  – Away from the surface, deeper into the body.
Create a card for each of the following directional terms. Also put an arrow in the direction the term describes.

1. Superior
2. Inferior
3. Anterior
4. Posterior
5. Medial
6. Lateral
7. Intermediate
8. Proximal
9. Distal
10. Superficial
The Wrist is _______ to the hand.
The trachea is _______ to the spine.
The brain is ______ to the liver.
The kidneys are ______ to the liver.
The nose is _____ to the cheekbones.
The chest is _____ to the abdomen.
The ribs are _____ to the skin.
On your diagram identify the directional term that corresponds to the numbered lines.
Body Region terms
Body Planes and Sections

- Frontal plane (coronal plane)
- Sagittal plane (median plane)
- Transverse plane (horizontal plane)
WHAT ARE BODY PLANES AND WHY ARE THEY IMPORTANT?
BODY PLANES:

• Imaginary, flat 2-dimensional surfaces that separate the body into sections.
• Planes are used to locate or describe the location of structures in the body.
1. SAGITTAL PLANE

• A plane that passes from the **ventral/anterior** (front) to **dorsal/posterior** (back)

• Separates the body into **right and left** sections.
A. MIDSAGITTAL (MEDIAN) PLANE

• A sagittal plane that runs through the midline of the body.
• It separates the body into equal halves.
B. PARASAGITTAL PLANE

• Any sagittal plane other than the mid-sagittal plane.
2. CORONAL (FRONTAL) PLANE

- A plane that separates the body into ventral/anterior (front) and dorsal/posterior (back) sections.
3. TRANSVERSE (HORIZONTAL) PLANE

- A plane that separates the body into **superior** (top) and **inferior** (bottom) sections.
- It is **perpendicular** to the sagittal and coronal planes.
4. OBLIQUE PLANE

• Any plane through the body that is not parallel to one of the three planes already discussed.

• It is a plane at an angle to the other planes.
• Create a vocabulary box for the four major types of body planes:
  1. Sagittal
  2. Coronal
  3. Transverse
  4. Oblique
• Create a clay model of the human body in approximately anatomical position.
• Work with your neighbor to perform the described incisions.
• Make a cut (incision) along the **mid-sagittal plane** of the **anterior thorax** (think thoracic).
• Make a **transverse** incision across the **left femoral region**.
• Make a **coronal** incision in the **cephalic region**.
• Make an **oblique** incision into the **dorsal surface** of the model’s trunk (central part of the body the extremities and neck attach).
• Return your clay to it’s bag.
• Wash your hands, if you would like.
• Then take out a ½ sheet of paper and put your name and # at the top.
EXIT SLIP

1. What plane separates the body into top and bottom parts?
2. What plane separates the body into front and back parts?
3. What plane separates the body into right and left parts?
4. Why are planes important in the study of anatomy and physiology?
These are spaces within the body that **contain**, **protect**, **separate**, and **support** internal organs.
2 Principal Cavities

1. Dorsal body cavity
2. Ventral body cavity
Dorsal Body Cavity

- Located toward the back surface of the body.
- Contains 2 subdivisions:
  - cranial cavity
    - formed by the cranial (skull) bones
    - contains the brain
  - vertebral (spinal) canal
    - formed by the bones of the vertebral column
    - contains the spinal cord
(a) Lateral view

Key:
- Yellow: Dorsal body cavity
- Red: Ventral body cavity

- Cranial cavity (contains brain)
- Thoracic cavity (contains heart and lungs)
- Diaphragm
- Abdominal cavity (contains digestive viscera)
- Pelvic cavity (contains bladder, reproductive organs, and rectum)
Ventral Body Cavity

- Located toward the **front** surface of the body.
- Contains 2 main subdivisions:
  - **Thoracic cavity**
    - upper portion
    - “chest cavity”
    - contains the **heart** and **lungs**
  - **abdominopelvic cavity**
    - lower portion
    - contains **abdominal** and **reproductive** organs
- The **diaphragm** separates the thoracic and the abdominopelvic cavities.
Cranial cavity (contains brain)

Dorsal body cavity

Thoracic cavity (contains heart and lungs)

Vertebral cavity (contains spinal cord)

Diaphragm

Abdominal cavity (contains digestive viscera)

Pelvic cavity (contains bladder, reproductive organs, and rectum)

Key:
- Yellow: Dorsal body cavity
- Red: Ventral body cavity

(a) Lateral view
Subdivisions of the thoracic cavity

1. **Pericardial cavity**
   - A fluid-filled space surrounding the heart.

2. **Pleural cavities** (2)
   - Surround each lung

3. **Mediastinum**
   - The region between the right and left pleural cavities.
   - Contains the: heart, esophagus, trachea, and several large blood vessels.
Thoracic cavity (contains heart and lungs)

- Superior mediastinum
- Pleural cavity
- Pericardial cavity within the mediastinum
- Diaphragm

Ventral body cavity

Frontal Section
Subdivisions of the abdominopelvic cavity

1. **abdominal cavity**
   - upper portion
   - contains the: **stomach**, **spleen**, **liver**, **gallbladder**, **small intestines**, and most of the **large intestine**.

2. **pelvic cavity**
   - lower portion
   - contains the: **urinary bladder**, parts of the **large intestines**, and the internal organs of the **reproductive system**.

*There is no wall between these subdivisions.*
Create 3 review/test questions from the material we have studied so far. (Only one can on body cavities)
Abdominopelvic Regions and Quadrants
These are 2 different methods used to divide the abdominopelvic region into smaller compartments.

It allows for more precise description of structures, pain and injury.
Abdominopelvic Quadrants

• Right upper
• Left upper
• Right lower
• Left lower
9 Abdominopelvic regions
In order for the trillions of cells, that make up our body, to survive and function, they need relatively stable conditions.