An Introduction to Anatomy & Physiology

All living things share certain characteristics:

Responsiveness: organisms respond to their environment (adaptability)

Growth & Differentiation: all organisms start out as one cell, but most grow by adding more cells. Some cells become specialized for performing certain functions. This is called differentiation. Growth and differentiation often cause changes in form and function.

Reproduction: organisms make successive generations of similar organisms.

Movement: can be internal (moving nutrients, etc.) or external (moving the organism, or parts there of) or both.

Metabolism & Excretion: organisms carry out complex chemical rxns. to convert stored energy to a form that is useful for living. They also synthesize proteins, nucleic acids, fats, and carbohydrates. This chemistry is known as the Metabolism of organisms. The body also produces waste materials from these rxns.. These wastes need to be evacuated from the body, and this is known as excretion.

•These are the basic characteristics of all living things, however, more complex organisms (like humans) require some other functions in order to accomplish these.

*We are going to look at two specific subjects, Anatomy & Physiology, as they relate to the human body.

•As we go through the course, you will find it useful to learn some common prefixes and suffixes. Many anatomical words have Greek origins, because Galen who was the first world famous anatomist was Greek, and many of the terms he coined are still used today.

•A literal Greek translation of the word anatomy is "cutting open". **Anatomy** as it is used today is the study of internal and external structures and the physical relation among body parts.

•**Physiology** is another word adopted from the Greek. As we use physiology today is the study of how living things perform their vital functions. In simple terms, it is how the anatomical parts work.

•**Anatomy & Physiology** are generally studied together because they are intimately related. The anatomical FORM provides clues as to how the physiology FUNCTIONS. The old idea that "FORM follows FUNCTION and Function follows Form" is really true here.

•In the past, the structures of the body were well known, but sometimes the structures eluded our understanding. For example, the anatomy of the human heart was clearly described in the 1400s, but it wasn't till the 1600s that the pumping action of the heart was demonstrated (by William Harvey).

Anatomy

There are basically two types of Anatomy, that depend on the level of detail you are interested in:

Microscopic Anatomy: requires optical instruments to see , and is anatomy in fine detail (i.e.- Microvilli on the intestinal wall which absorb nutrients).

Gross Anatomy (Macroscopic Anatomy**): (**The word gross coming from the German, meaning Large): can be seen with the naked eye (i.e.- the small intestine)

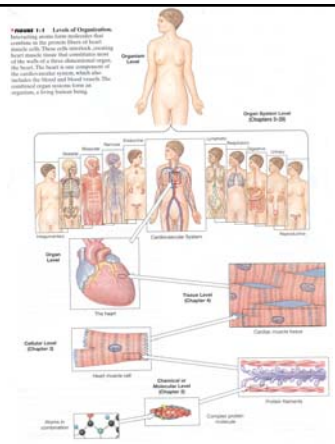
Microscopic Anatomy comprises two basic disciplines: Cytology and Histology

Cytology: is the analysis of the internal structure of living cells. Our lives depend on the chemical processes that happen within the trillions of cells that make up our bodies, and their organelles.

Histology: involves the study of tissues. Tissues are groups of specialized cells and cell products that work together to perform specific functions.

Organization of the human body (smallest to largest):

atom→ molecule → cell → tissue → organ → organ system → organism



Gross Anatomy involves the examination of relatively large structures that can be approached in several ways

Surface Anatomy: study of general form and superficial markings.

Regional Anatomy: study of anatomical organization in a specific part (region) of the body. Often the form used in advanced anatomy courses.

Systematic Anatomy: study of the entire organ system (digestive, reproductive, cardiovascular, etc.). Looks at how the groups of organs function in a coordinated manner. There are 11 organ systems in the human body.

Developmental Anatomy: looks at the changes in form that occur from conception through adulthood. The most extensive change takes place between conception and 2 months. The study of the early period is known as Embryology.

There are several other anatomical specialties that are important in a clinical setting:

Medical Anatomy (looks at changes that take place during illness)

Radiographic Anatomy (anatomical structures as seen by special imaging equipment)

Surgical Anatomy (anatomical landmarks that are important in surgery)

*Physician typically use a combination of anatomical, physiological an behavioral information when they evaluate a patient.

Physiology
Human Physiology is the study of functions of the human body. These tend to be complex and more difficult to study than Anatomy.

Cell Physiology: The study of the function of living cells. This discipline deals with the chemical rxns. within and between cells.

Special Physiology: The Study of the physiology of specific organs (i.e.- Cardiac Physiology is the study of how the heart works)

Systematic Physiology: The study of all aspects of the function of specific organ systems. (i.e.- Cardiovascular Physiology).

Pathological Physiology: the study of the effects of diseases on organs or organ systems. “Pathos” is the Greek word for disease. Modern medicine involves an understanding of both normal and pathological physiology.

*It is important to understand that things that adversely affect any ONE level or organization will eventually end up affecting ALL levels of organization.

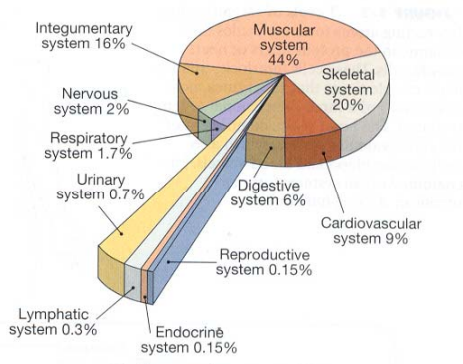
The Human Organ Systems

There are 11 systems in the human body

They are:

Organ System	Major Functions
Integumentary system	Protection from environmental hazards; temperature control
Skeletal system	Support; protection of soft tissues; mineral storage; blood formation
Muscular system	Locomotion; support; heat production
Nervous system	Directing immediate responses to stimuli, generally by coordinating the activities of other organ systems
Endocrine system	Directing long-term changes in the activities of other organ systems

Cardiovascular system	Internal transport of cells and dissolved materials, including nutrients, wastes, and gases
Lymphatic system	Defense against infection and disease
Respiratory system	Delivery of air to sites where gas exchange can occur between the air and circulating blood
Digestive system	Processing of food and absorption of nutrients, minerals, vitamins, and water
Urinary system	Elimination of excess water, salts, and waste products
Reproductive system	Production of sex cells and hormones



(b) Organ system composition of the human body by weight

Homeostasis

There are two general mechanisms involved in homeostatic regulation

1. **Autoregulation**
   - Occurs when activities of cell, tissue, organ or organ system automatically compensate for environmental variation.

(i.e.- when cells need more O_2 they release chemicals which dialate blood vessels in the immediate area)

2. **Extrinsic Regulation**

- Occurs when the nervous or endocrine systems control or adjust many systems simultaneously

- In general, the nervous system responds:
  a. fast
  b. locally
  c. specifically

i.e.- octopus color

- The endocrine system responds:
  a. slowly
  b. globally (systemically)
  c. affects many tissues or organs
  d. the effects may last for days or weeks

i.e.- chameleon color

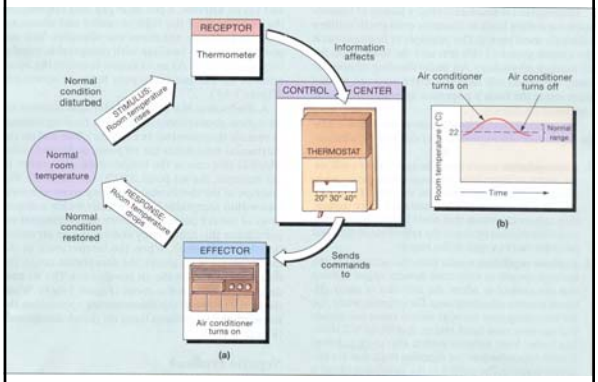
- The endocrine system accomplishes this task by releasing chemicals called hormones into the circulatory system.

Homeostatic control requires three parts

1. receptor (sensor)

2. a control center (integration of information)

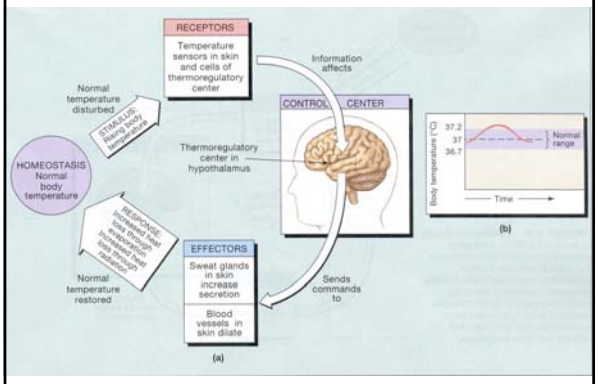
3. an effector (control center that responds to the cell, tissue or organ)



Negative Feedback

•Most homeostatic mechanisms work through a regulation mechanism known as negative feedback.

•During negative feedback the effectors act to either oppose or eliminate the initial stimulus.



Positive Feedback

Some feedback mechanisms are positive. In positive feedback some stimulus initiates a response which exaggerates or enhances the original stimulus.

i.e.- gag reflex, labor, etc.

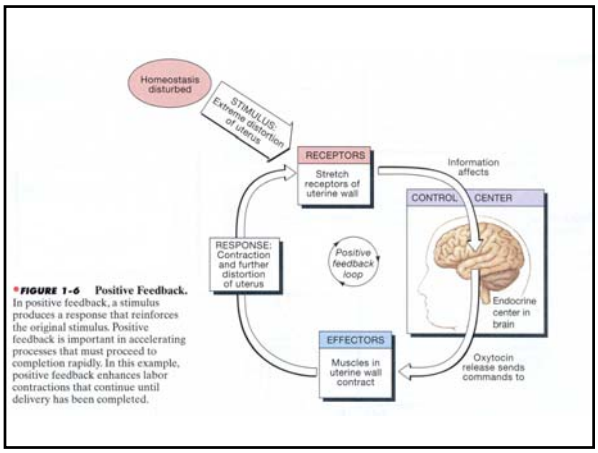


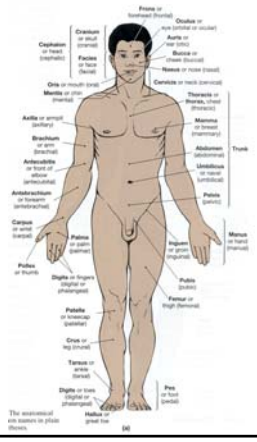
FIGURE 1-6 Positive Feedback. In positive feedback, a stimulus produces a response that reinforces the original stimulus. Positive feedback is important in accelerating processes that must proceed to completion rapidly. In this example, positive feedback enhances labor contractions that continue until delivery has been completed.

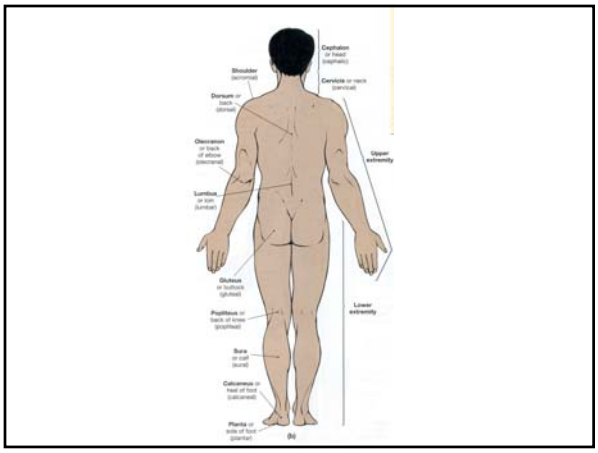
Anatomical Landmarks

Anatomical Position

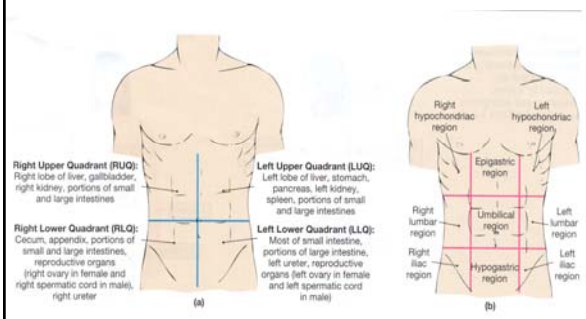
- supine (AP faces up)
  - prone (AP faces down)

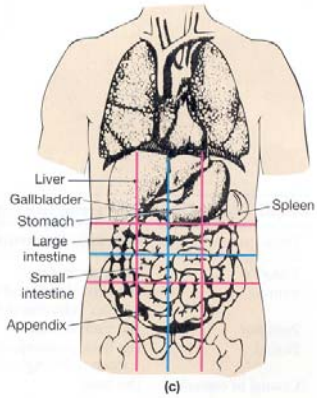
Structure	Region
Cephalon (head)	Cephalic region
Cervicis (neck)	Cervical region
Thoracis (thorax or chest)	Thoracic region
Brachium (arm)	Brachial region
Antebrachium (forearm)	Antebrachial region
Manus (hand)	Manual region
Abdomen	Abdominal region
Lumbus (loin)	Lumbar region
Gluteus (buttock)	Gluteal region
Pelvis	Pelvic region
Pubis (anterior pelvis)	Pubic region
Inguen (groin)	Inguinal region
Femur (thigh)	Femoral region
Crus (anterior leg)	Crural region
Sura (calf)	Sural region
Pes (foot)	Pedal region
Planta (sole)	Plantar region

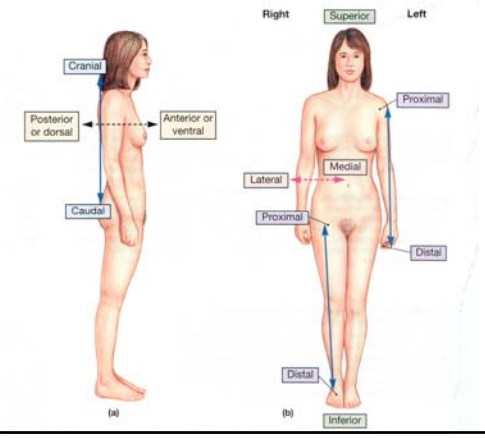




Abdominalpelvic Quadrants







Term	Region or Reference	Example
Anterior	The front; before	The navel is on the *anterior* surface of the trunk.
Ventral	The belly side (equivalent to anterior when referring to human body)	In humans, the navel is on the *ventral* surface.
Posterior	The back; behind	The shoulder blade is located *posterior* to the rib cage.
Dorsal	The back (equivalent to posterior when referring to human body)	The *dorsal* body cavity encloses the brain and spinal cord.
Cranial or cephalic	The head	The *cranial*, or *cephalic*, border of the pelvis is on the side toward the head rather than toward the thigh.
Superior	Above; at a higher level (in human body, toward the head)	In humans, the cranial border of the pelvis is *superior* to the thigh.
Caudal	The tail (coccyx in humans)	The hips are *caudal* to the waist.
Inferior	Below; at a lower level	The knees are *inferior* to the hips.
Medial	Toward the body's longitudinal axis	The *medial* surfaces of the thighs may be in contact; moving medially from the arm across the chest surface brings you to the sternum.
Lateral	Away from the body's longitudinal axis	The thigh articulates with the *lateral* surface of the pelvis; moving laterally from the nose brings you to the eyes.
Proximal	Toward an attached base	The thigh is *proximal* to the foot; moving proximally from the wrist brings you to the elbow.
Distal	Away from an attached base	The fingers are *distal* to the wrist; moving distally from the elbow brings you to the wrist.
Superficial	At, near, or relatively close to the body surface	The skin is *superficial* to underlying structures.
Deep	Farther from the body surface	The bone of the thigh is *deep* to the surrounding skeletal muscles.

Sectional Anatomy

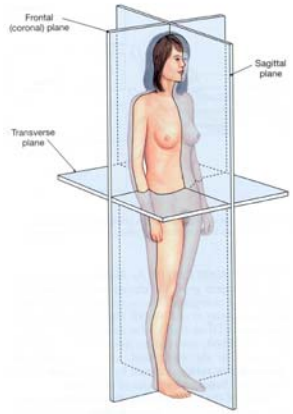


TABLE 1-3 Terms That Indicate Planes of Section (*see Figure 1-10*)

Orientation of Plane	Plane	Directional Reference	Description
Perpendicular to long axis	Transverse or horizontal	Transversely or horizontally	A *transverse*, or *horizontal*, *section* separates superior and inferior portions of the body.
Parallel to long axis	Sagittal	Sagittally	A *sagittal section* separates right and left portions. You examine a sagittal section, but you section sagittally.
	Midsagittal		In a *midsagittal section* the plane passes through the midline, dividing the body in half and separating right and left sides.
	Parasagittal		A *parasagittal section* misses the midline, separating right and left portions of unequal size.
	Frontal or coronal	Frontally or coronally	A *frontal*, or *coronal*, *section* separates anterior and posterior portions of the body; *coronal* usually refers to sections passing through the skull.

BODY CAVITIES

•Many internal organs are suspended in internal chambers called body cavities. These cavities have two essential functions.

(1) They protect delicate organs, such as the brain & spinal cord, from accidental shocks and cushions them from thumps and bumps that occur during walking, jumping, and running.

(2) They permit significant changes in size and shape of internal organs.
i.e.- lungs, heart, stomach, intestines, urinary bladder, etc. can expand and contract w/o distorting surrounding tissue.

Dorsal cavity

- Found within the skull and vertebral column.
- Contains two subdivisions

A. Cranial cavity

B. Spinal cavity

Ventral Cavity

•Often divided as follows

A. **Thoracic cavity**

1. Pleural cavity
2. Pericardial cavity

B. **Abdominopelvic cavity**

1. Abdominal cavity
2. Pelvic cavity
3. Scrotal cavity (males only)