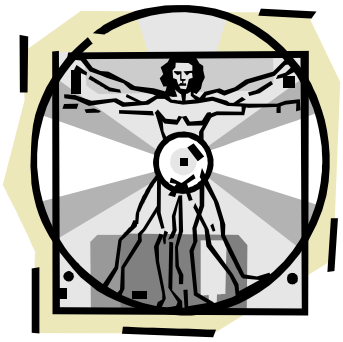
Bio& 241
Unit 1 / Lecture 1



Scientific Method

- **Bacon (1561-1626) and Descartes (1596-1650)**
  - ***new habits of scientific thought***
- **England and France**
  - ***academies of science --still exist today***
- **Science**
  - ***produces reliable, objective and testable information about nature***

Inductive Method

A process in which numerous experimental observations are made until investigators are confident enough to make generalizations and predictions from the data. What we hold as truth in Anatomy is based upon inductive reasoning.

- **Proof in science in dependent on:**
  - *reliable observations*
  - *Repeatedly tested data*
  - *not falsified by any credible observation*
  - *Falsifiability is the logical possibility that an assertion can be shown false by an observation or a physical experiment. That something is "falsifiable" does not mean it is false; rather, that if it is false, then this can be shown by observation or experiment*
- **In science, all truth is tentative**
  - *"proof beyond a reasonable doubt"*

Hypothetico-Deductive Method

This method involves the development of a Hypothesis, an educated speculation or reasonable answer to a specific question. Most of what we hold as truth in Physiology comes from this method

- **A Good hypothesis is:**
  - *consistent with what is already known regarding a question*
  - *testable through experiments and observations*
  - *falsifiable with credible evidence and observations*

- **Hypotheses are written as If-Then statements:**
  - *If these observations are correct*
  - *Then this should be the outcome.*

Deductive Reasoning or Logic

Reasoning which constructs or evaluates deductive arguments. An argument is *valid* when it is impossible for both its premises to be true and its conclusion to be false.

Consider the following arguments:

1. ***All men are mortal***
2. ***Socrates is a man***
3. ***(Therefore) Socrates is mortal***

and

1. ***Only quarterbacks eat steak.***
2. ***John eats steak.***
3. ***(Therefore,) John is a quarterback***

In which is the premise and conclusion both correct? Which argument is sound?

Proper Experimental Design

- **Sample size**
  - ***sufficient to prevent chance event***
- **Control group and treatment group**
  - ***identical treatment except for the variable being***
  - ***tested***
  - ***independent variable is typically the variable being manipulated or changed***
  - ***dependent variable is the observed result of the independent variable being manipulated.***
- **Prevention of psychosomatic effects**
  - ***use of placebo in control group***
- **Experimenter bias**
  - ***prevented with double-blind study***

Proper Experimental Design

- **Statistical testing**
  - ***difference between control and test subjects was not random variation***
  - ***due to the variable being tested***

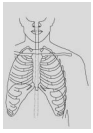
Peer Review

- **Critical evaluation by other experts in the field**
  - ***done prior to funding or publication***
  - ***done by using verification and repeatability of results***
- **Ensures honesty, objectivity and quality in science**

Facts, Laws and Theories

- **Scientific fact**
  - ***information independently observed and verified***
- **Law of nature**
  - ***description of the way matter and energy behave***
  - ***results from inductive reasoning and repeated observations***
  - ***written as verbal statements or mathematical formulae***
- **Theory**
  - ***summary of conclusions drawn from observable facts***
  - ***Not merely a guess or conjuecture***
  - ***it provides explanations and predictions***

An Introduction to the Human Body



- Anatomy
  - *science of structure*
  - *relationships revealed by dissection (cutting apart)*
  - *imaging techniques*
- Physiology
  - *science of body functions*
  - *normal adult physiology is studied in this class*
  - *some genetic variations occur*

ANATOMY AND PHYSIOLOGY DEFINED

- **Anatomy**
  - *the study of structure and the relationships among structures.*
- Subdivisions
  - *surface anatomy, gross anatomy, systemic anatomy, regional anatomy, radiographic anatomy, developmental anatomy, embryology, cytology, and pathological anatomy*

ANATOMY AND PHYSIOLOGY DEFINED

- **Physiology**
  - *the study of how body structures function*
- Subdivisions of physiology include
  - *cell physiology, systems physiology, pathophysiology, exercise physiology, neurophysiology, endocrinology, cardiovascular physiology, immunophysiology, respiratory physiology, renal physiology, and reproductive physiology*

Structural Organization of Matter

1. Chemical Level

a. Atoms

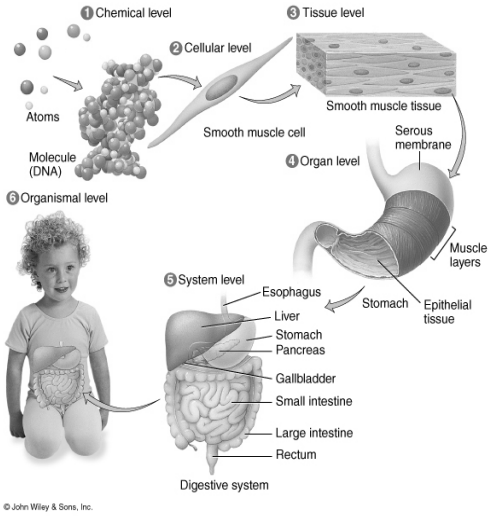
(Proton, Neutron, electrons)

b. Molecules

(Two or more atoms joined together by either covalent or ionic bonds)

Four biologically important organic molecules in the human body

a. Proteins which are made from 20 different Amino Acids



Structural Organization of Matter

Four Biologically-Important Organic molecules:

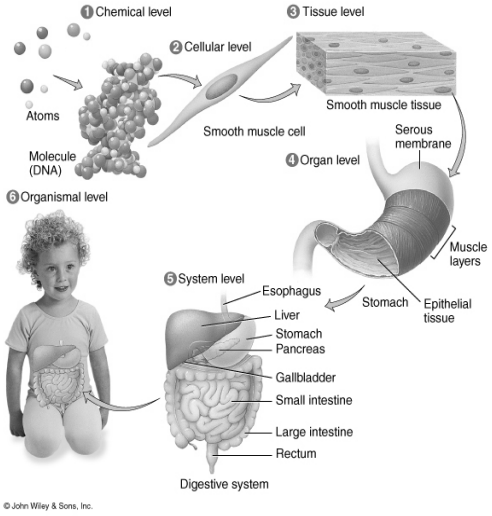
b. Complex Carbohydrates made from simple sugars

c. Nucleic Acids made for nucleotides

d. Lipids made from fatty acids and glycerol

2. Cells

(Smallest structural and functional units of the human body)



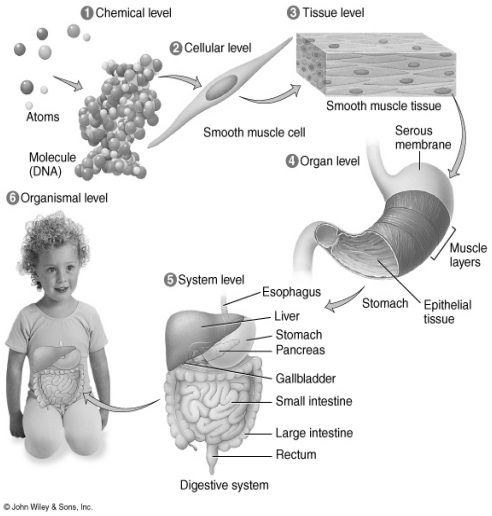
Structural Organization of Matter

3. Tissues

(group of cells and the materials surrounding them that work together to perform a particular function)

4. Organs

(composed of two or more tissues work together to provide specific functions and they usually have specific shapes)



Structural Organization of Matter

5. Organ systems

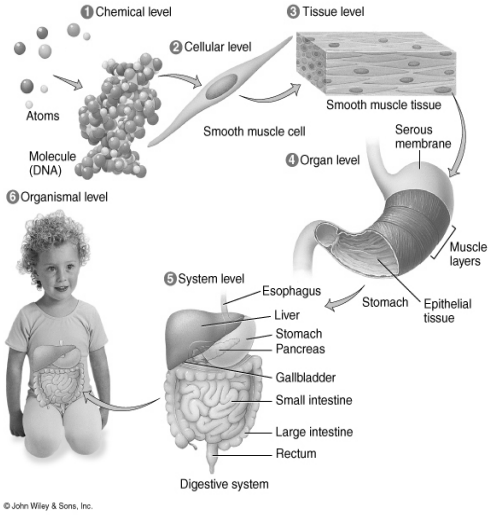
(consist of one or more organs that provide a common function) Examples covered in Anatomy & Physiology 241:

a. Integumentary system

b. Skeletal system

c. Muscular system

d. Nervous system



Structural Organization of Matter

Anatomy & Physiology 242:

e. Endocrine system

f. Cardiovascular system

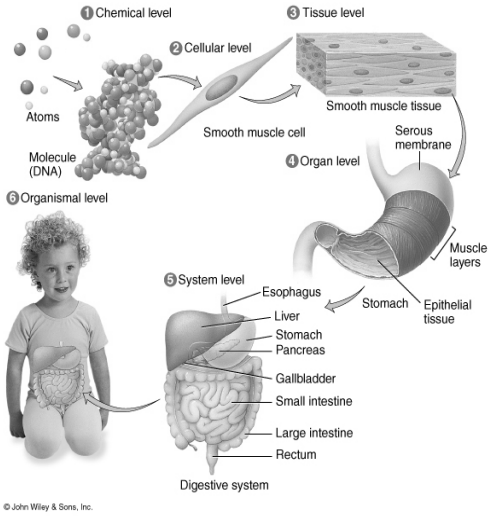
g. Lymphatic system

h. Respiratory system

I. Digestive system

j. Urinary system

k. Reproductive system



Basic Life Processes

1. **High level of organization**
2. **Composed of Cells**

   Either prokaryotic or Eukaryotic
3. **Metabolism**

   Sum of all biochemical processes of cells, tissues, organs, and organ systems
4. **Responsiveness/Movement**

   Ability to detect and respond to changes in the internal and external environment

   Movement occurs at the intracellular, cellular, organ levels

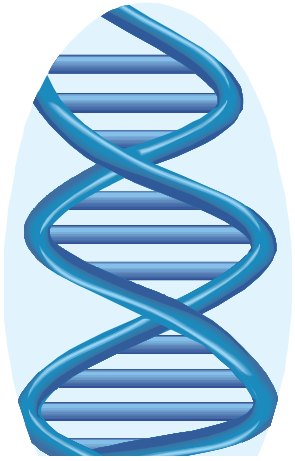
Basic Life Processes

5. **Homeostasis**

   ability to maintain Equilibrium of the body's internal environment
6. **Differentiation/Growth**

   Process a cell undergoes to develop from a unspecialized to a specialized cell. Increase in number of cells, size of cells, tissues, organs, and the body. Single cell to multicellular complex organism
7. **Reproduction**

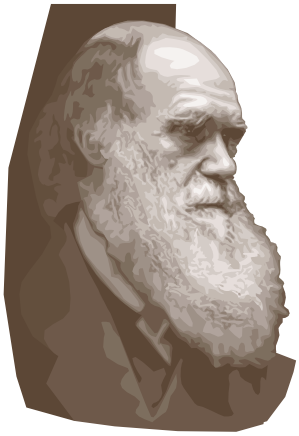
   Formation of new cells for growth, repair, or replacement, or the production of a new individual.



Basic Life Processes

7. Evolution: Genetic Change within populations from generation to generation due to genetic mutations and natural selection.

- ***Examples: Antibiotic bacteria (MRSA)*** *methicillin-resistant Staphylococcus aureus. It's a strain of staph that's resistant to the broad-spectrum antibiotics commonly used to treat it. MRSA can be fatal.*
- *Most MRSA infections occur in hospitals or other health care settings, such as nursing homes and dialysis centers. It's known as* ***health care-associated MRSA, or HA-MRSA.*** *Older adults and people with weakened immune systems are at most risk of HA-MRSA. More recently, another type of MRSA has occurred among otherwise healthy people in the wider community. This form,* ***community-associated MRSA, or CA-MRSA,*** *is responsible for serious skin and soft tissue infections and for a serious form of pneumonia.*



Basic Life Processes

- **Homeostasis**

produced by the interaction of organ systems and regulatory processes (feedback systems).

Homeostasis is a dynamic condition in response to changing conditions.

The two body systems that largely control the body's homeostatic state:

1. ***Nervous system***
2. ***Endocrine system***

Control of Homeostasis

- **Homeostasis** is continually being disrupted by
  - *external stimuli*
    - *intense heat, cold , and lack of oxygen*
  - *internal stimuli*
    - *psychological stresses*
    - *exercise*
- Disruptions are usually mild & temporary
- If homeostasis is not maintained, death may result

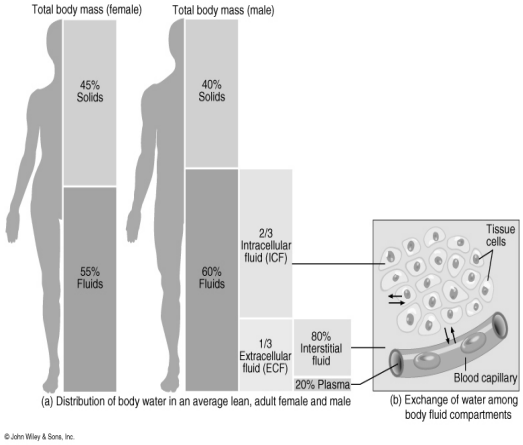
CONTROL OF HOMEOSTASIS

- **Homeostatic** imbalances occur because of disruptions from the external or internal environments.
  - *Homeostasis is regulated by the nervous system and endocrine system, acting together or independently.*
  - *The nervous system detects changes and sends nerve impulses to counteract the disruption.*
  - *The endocrine system regulates homeostasis by secreting hormones*.
- Whereas nerve impulses cause rapid changes, hormones usually work more slowly.
- ***Examples: CO2, O2, temperature, pH, blood pressure, …***

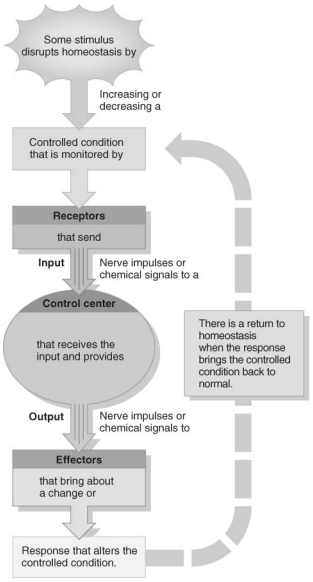
Example of Homeostasis
Fluid balance in the Body

- **Compartments for Body Fluids**

1. **Intracellular**
2. **Extracellular**
   - **a. *Interstitial***
   - ***b. Plasma***

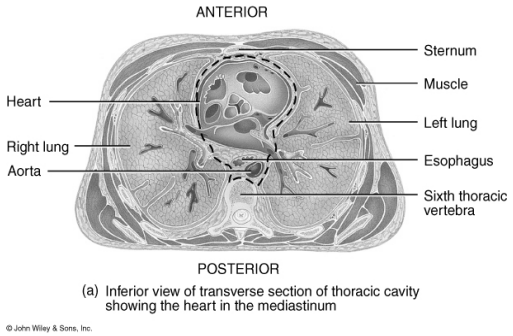


Components of Feedback Loop

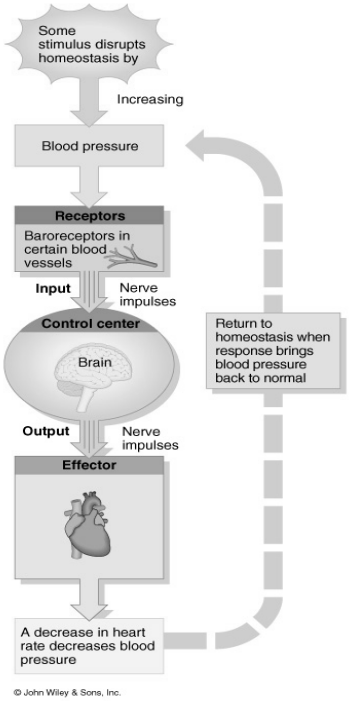


- **Receptor**
  - *monitors a controlled condition*
- **Control center**
  - *determines next action*
- **Effector**
  - *receives directions from the control center*
  - *produces a response that changes the controlled condition*

Basic Components of a Negative Feedback System



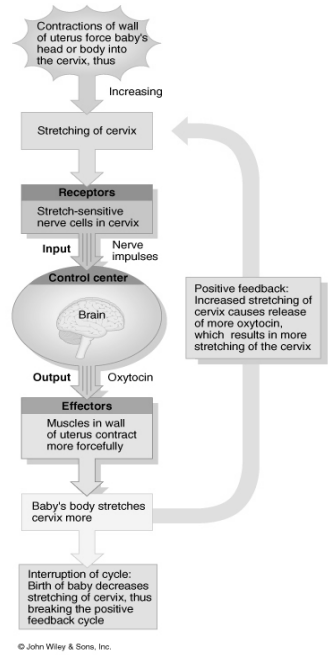
(a) Inferior view of transverse section of thoracic cavity showing the heart in the mediastinum



Positive Feedback Loops

- **Self-amplifying change**
  - ***leads to change in the same direction***
- **Normal way of producing rapid changes**
  - ***occurs with childbirth, blood clotting, protein digestion, and generation of nerve signals***

Basic Components of a Positive Feedback System



Homeostatic Imbalances

- Disruption of homeostasis can lead to disease and death.

- ***Disorder*** is a general term for any change or abnormality of function.
- ***Disease*** is a more specific term for an illness characterized by a recognizable set of signs and symptoms.
  - *A local disease is one that affects one part or a limited region of the body.*
  - *A systemic disease affects either the entire body or several parts.*

Homeostatic Imbalances

- ***Disease*** is a more specific term for an illness characterized by a recognizable set of signs and symptoms.
  - *Signs are objective changes that a clinician can observe and measure; e.g., fever or rash.*
  - *Symptoms are subjective changes in body functions that are not apparent to an observer; e.g., headache or nausea*.
- **Diagnosis** is the art of distinguishing one disease from another or determining the nature of a disease; a diagnosis is generally arrived at after the taking of a medical history and the administration of a physical examination.

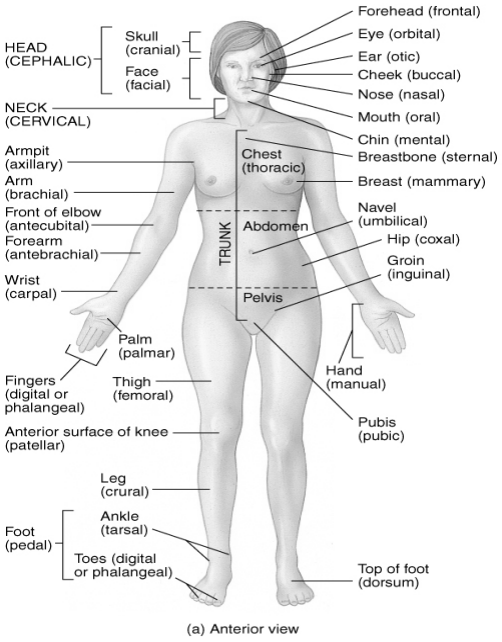
Anatomical Position

The ***anatomical position*** is a standardized method of observing or imaging the body that allows precise and consistent anatomical references.

When in the anatomical position, the subject stands (Figure 1.5).

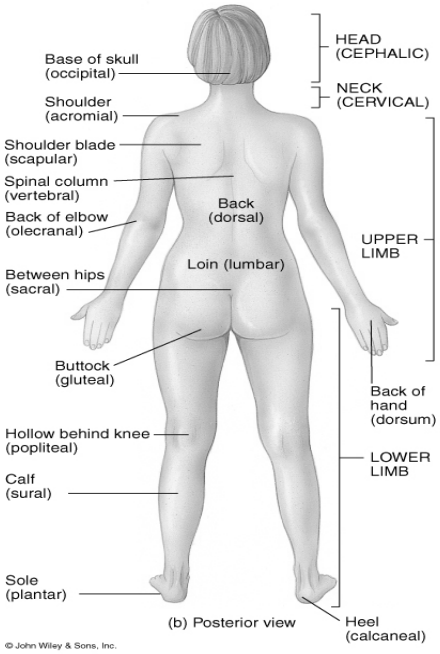
- **standing upright**
- **facing the observer, head level**
- **eyes facing forward**
- **feet flat on the floor**
- **arms at the sides**
- **palms turned forward** (ventral)

Basic Anatomical Terminology



(a) Anterior view

Basic Anatomical Terminology



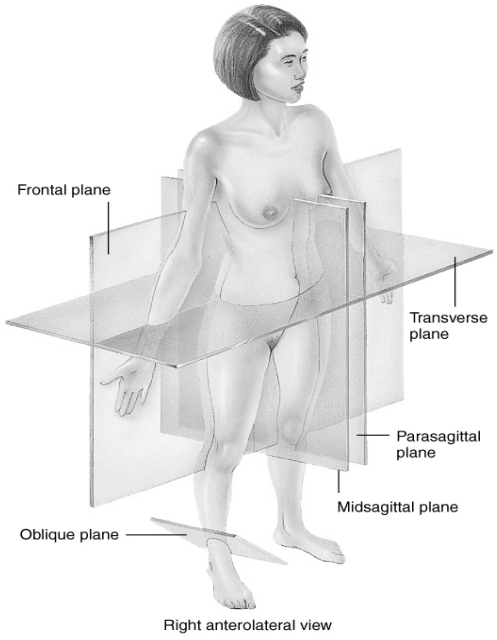
(b) Posterior view

Reclining Position

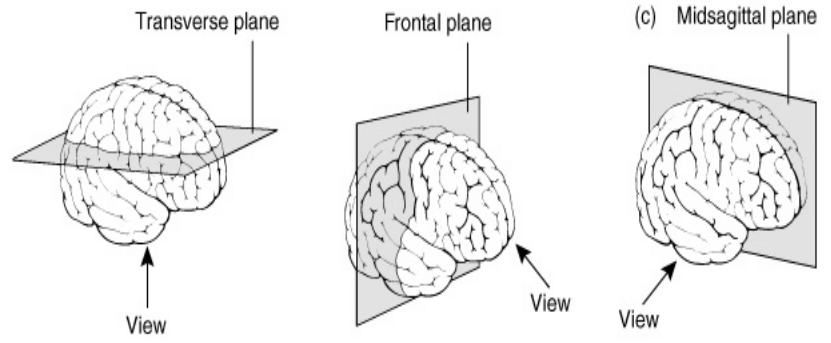
- If the body is lying face down, it is in the ***prone*** position.
- If the body is lying face up, it is in the ***supine*** position.

Basic body planes or sections

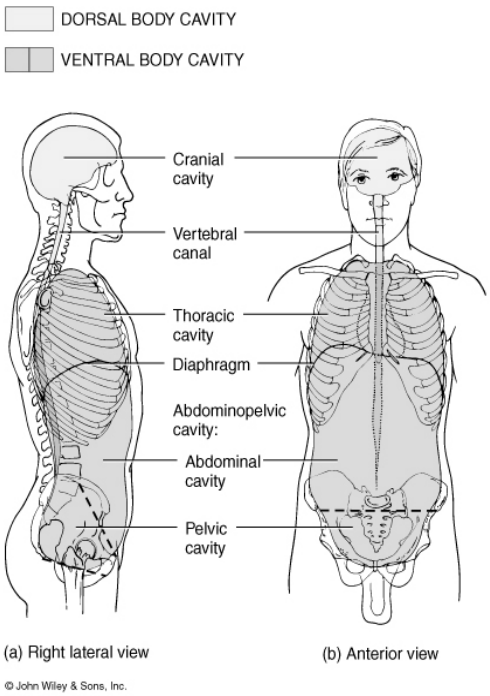
These terms are used for planes or sections that cut the body, organs, tissues, or cells



Example of how planes would cut the brain

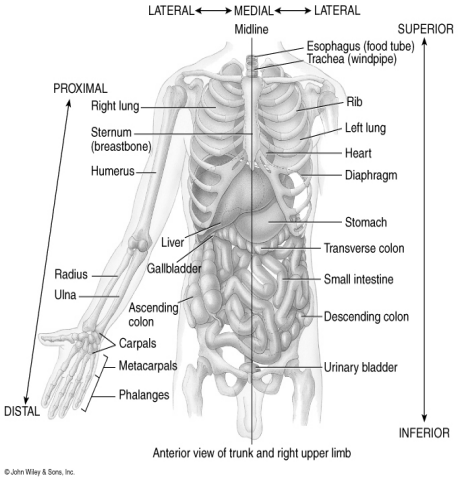


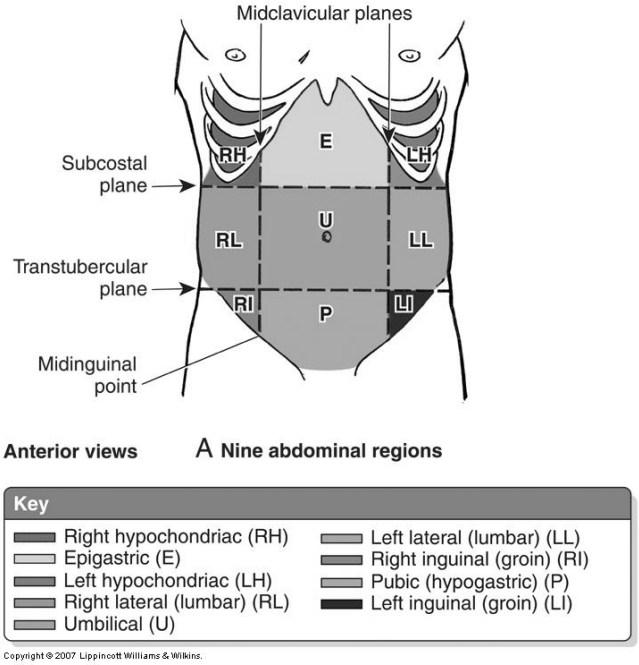
Two Principal Body Cavities and their Subdivisions



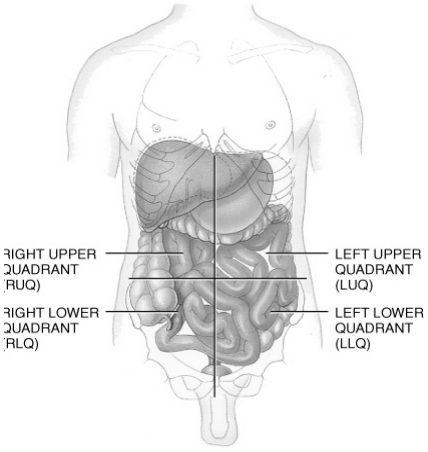
Directional Terms Used to Describe the Position of one Structure to Another

Superior/Inferior (Cephalic/Caudal)
Anterior/Posterior (Ventral/Dorsal)
Medial/Lateral
Intermediate: Between
Ipsilateral/Contralateral
Proximal/Distal
Superficial/Deep

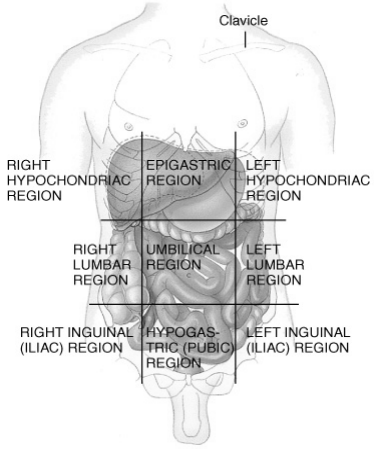




Methods of dividing the Abdominopelvic cavity



(b) Anterior view showing abdominopelvic quadrants



(a) Anterior view showing nine abdominopelvic regions