Chapter 1: An Introduction to the Human Body Overview

Meaning of anatomy and physiology

• Organization of the human body and properties

• Regulation of internal environment

• Basic vocabulary

## Anatomy and Physiology Defined

• Two branches of science that deal with body's parts and function

#### Anatomy

- The science of body structures and relationships
- First studies by dissection (cutting apart)
- Imaging techniques

#### Physiology

• The science of body functions

### Subspecialties of Anatomy and Physiology



### Structure and Function

- Structure and function of the body are closely related
- Structure of a part of the body allows performance of certain functions
  - Examples:
    - Bones of the skull provide protection for the brain
    - Thin air sacs of the lungs permit movement of oxygen



#### Levels of structural organization

- CHEMICAL LEVEL
  - Basic level
    - **Atoms** the smallest unit of matter
      - Essential atoms for life include carbon (C), hydrogen (H), oxygen (O), nitrogen (N), phosphorus (P), calcium (Ca), and sulfur
    - Molecules two or more atoms joined together
      - Deoxyribonucleic acid (DNA)
      - Glucose
- CELLULAR LEVEL
  - Molecules combine to form cells
    - Cells are the basic structural and functional units of an organism
    - Many kinds of cells in the body
    - Muscle cells, nerve cells, epithelial cells, etc.
- TISSUE LEVEL
  - Tissues are groups of cells and materials surrounding them
    - Four basic types of tissues:
      - Epithelial
      - Connective
      - Muscular
      - Nervous

#### ORGAN LEVEL

- Tissues are joined together to form organs
  - Organs are structures that are composed of two or more different types of tissues
  - Specific functions and recognizable shapes
    - Examples:
    - Heart, lungs, kidneys
    - Stomach is made of several tissues
    - Serous membrane, smooth muscle and epithelial layers for digestion

#### SYSTEM LEVEL

- A **system** consists of related organs with a common function
- Organ-system level
  - Digestive system breaks down and absorbs food
  - It includes organs such as the mouth, small and large intestines, liver, gallbladder, and pancreas
  - Eleven systems of the human body

#### ORGANISMAL LEVEL

- An organism or any living individual
- All parts of the body functioning together

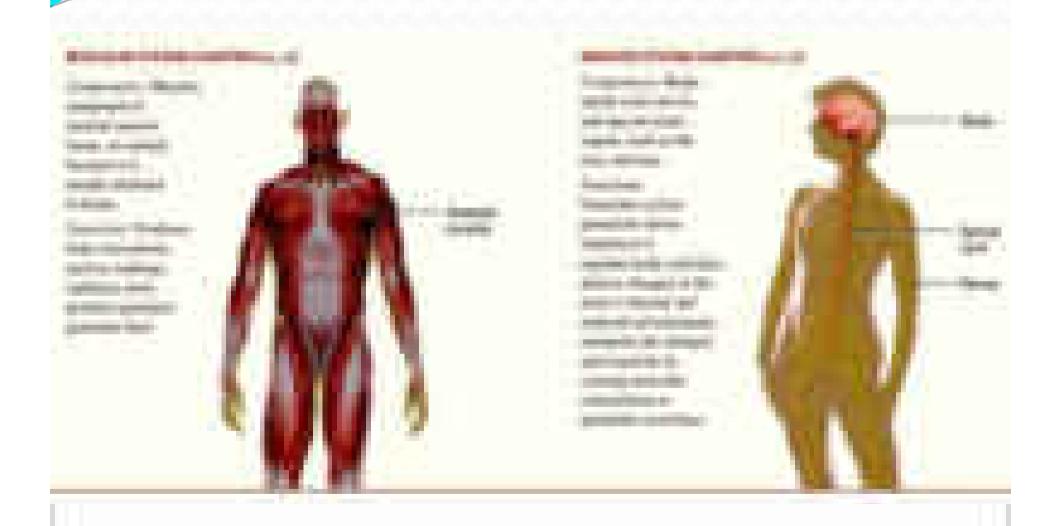
#### The Photos Science of the Harris Brid.

#### ATTENDED TO SHARE A STREET

And Committee of the Co







#### The Prince Rivings of the Reside Bride

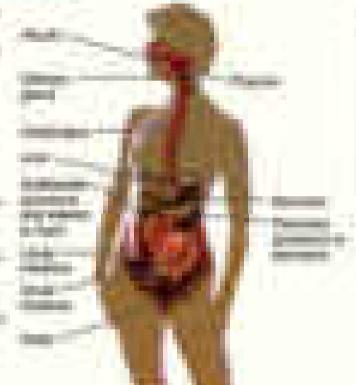
#### \_\_\_\_



# Street Berg. ALC: NOT THE Service Service Co. Street of Street Street Market Market

#### BARTON STREET, SALES

Depart plans Section of the Section of the Michigan with



#### and the barries of

man (mar) from



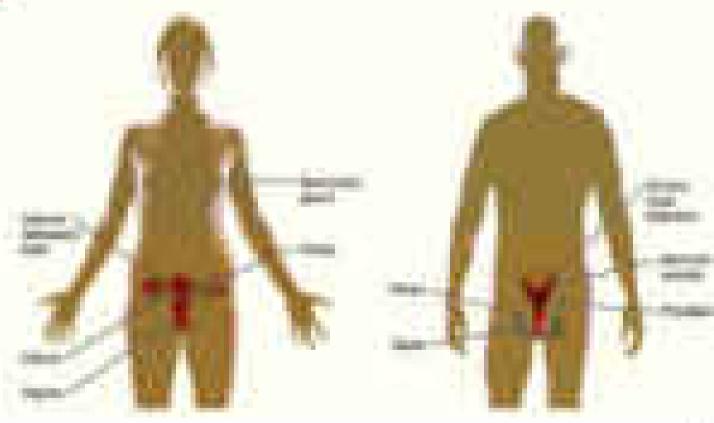
#### 

NUMBER





#### Andread of the Control of the Contro



# Clinical Connection: Noninvasive Diagnostic Techniques

- Used to assess aspects of body structure and function
  - **Inspection** of the body to observe any changes
  - Palpation
    - Gently touching body surfaces with hands
  - Auscultation
    - listening to body sounds (stethoscope)
  - Percussion
    - Tapping on the body surface with fingertips and listening to echoes

### Characteristics of Living Human Organism

- Basic Life Processes
  - Distinguish living from non-living things
  - Six important life process
    - Metabolism
    - Responsiveness
    - Movement
    - Growth
    - Differentiation
    - Reproduction

## Metabolism and Responsiveness

#### Metabolism

- Sum of all the chemical process that occur in the body
  - **Catabolism** or the breakdown of complex chemical substances into simpler components
  - **Anabolism** or the building up of complex chemical substances from smaller, simpler components

#### Responsiveness

- Body's ability to detect and respond to changes
  - Decrease in body temperature
  - Responding to sound
  - Nerve (electrical signals) and muscle cells (contracting)

### Movement and Growth

#### Movement

- Motion of the whole body
  - Organs, cells, and tiny subcellular structures
  - Leg muscles move the body from one place to another

#### Growth

- Increase in body size
  - Due to an increase in existing cells, number of cells, or both
  - In bone growth materials between cells increase

## Differentiation and Reproduction

#### Differentiation

- Development of a cell from an unspecialized to specialized state
  - Cells have specialized structures and functions that differ from precursor cells
  - Stem cells give rise to cells that undergo differentiation

#### Reproduction

- Formation of new cells (growth, repair, or replacement)
- Production of a new individual

## Homeostasis

- A condition of **equilibrium** (balance) in the body's internal environment
  - Dynamic condition
  - Narrow range is compatible with maintaining life
  - Example
    - Blood glucose levels range between 70 and 110 mg of glucose/dL of blood
    - Whole body contributes to maintain the internal environment within normal limits

# Homeostasis and Body Fluids

- Maintaining the volume and composition of body fluids are important
  - **Body fluids** are defined as dilute, watery solutions containing dissolved chemicals inside or outside of the cell
  - Intracellular Fluid (ICF)
    - Fluid within cells
  - Extracellular Fluid (ECF)
    - Fluid outside cells
    - **Interstitial fluid** is ECF between cells and tissues

# ECF and Body Location

- Blood Plasma
  - ECF within blood vessels
- Lymph
  - ECF within lymphatic vessels
- Cerebrospinal fluid (CSF)
  - ECF in the brain and spinal cord
- Synovial fluid
  - ECF in joints
- Aqueous humor and vitreous body
  - ECF in eyes

# Interstitial Fluid and Body Function

- Cellular function depends on the regulation of composition of interstitial fluid
- Body's internal environment
- Composition of interstitial fluid changes as it moves
  - Movement back and forth across capillary walls provide nutrients (glucose, oxygen, ions) to tissue cells and removes waste (carbon dioxide)

### Control of Homeostasis

- Homeostasis is constantly being disrupted
  - Physical insults
    - Intense heat or lack of oxygen
  - Changes in the internal environment
    - Drop in blood glucose due to lack of food
  - Physiological stress
    - Demands of work or school
  - Disruptions
    - Mild and temporary (balance is quickly restored)
    - Intense and Prolonged (poisoning or severe infections)

#### Cycle of events

- Body is monitored and re-monitored
- Each monitored variable is termed a controlled condition

#### Three Basic components

- Receptor
- Control center
- Effector

# Feedback Systems

- Receptor
  - Body structure that monitors changes in a controlled condition
  - Sends **input** to the control center
    - Nerve ending of the skin in response to temperature change

# Feedback Systems

- Control Center
  - Brain
  - Sets the range of values to be maintained
  - Evaluates input received from receptors and generates
    output command
  - Nerve impulses, hormones
    - Brains acts as a control center receiving nerve impulses from skin temperature receptors

# Feedback Systems

#### Effector

- Receives output from the control center
- Produces a response or effect that changes the controlled condition
  - Found in nearly every organ or tissue
  - Body temperature drops the brain sends and impulse to the skeletal muscles to contract
  - Shivering to generate heat

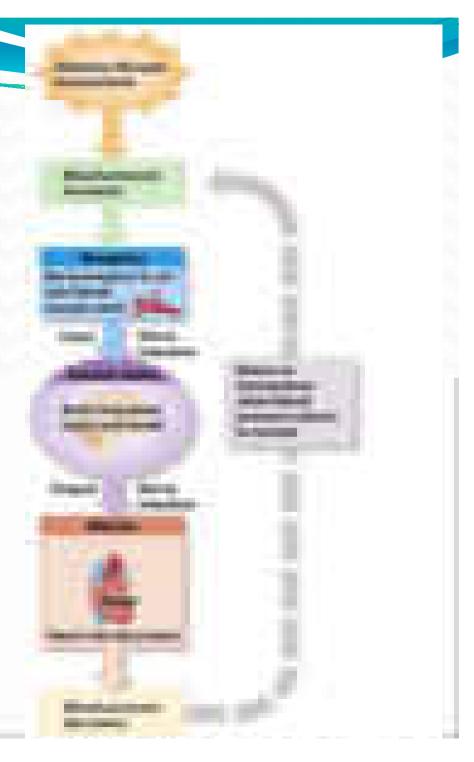
### Negative and Positive Feedback systems

- Negative Feedback systems
  - Reverses a change in a controlled condition
    - Regulation of blood pressure (force exerted by blood as it presses again the walls of the blood vessels)
- Positive Feedback systems
  - Strengthen or reinforce a change in one of the body's controlled conditions
    - Normal child birth

# Negative Feedback: Regulation of Blood Pressure

External or internal stimulus increase BP

- Baroreceptors (pressure sensitive receptors)
  - Detect higher BP
  - Send nerve impulses to brain for interpretation
  - Response sent via nerve impulse sent to heart and blood vessels
  - BP drops and homeostasis is restored
  - Drop in BP negates the original stimulus



### Positive Feedback Systems: Normal Childbirth

- Uterine contractions cause vagina to open
- Stretch-sensitive receptors in cervix send impulse to brain
- Oxytocin is released into the blood
- Contractions enhanced and baby pushes farther down the uterus
- Cycle continues to the birth of the baby (no stretching)



### Homeostatic Imbalances

- Normal equilibrium of body processes are disrupted
  - Moderate imbalance
    - Disorder or abnormality of structure and function
    - Disease specific for an illness with recognizable signs and symptoms
    - Signs are objective changes such as a fever or swelling
    - **Symptoms** are subjective changes such as headache
  - Severe imbalance
    - Death

# Clinical Connection: Autopsy

- Postmortem (after death) examination of the body and internal organs
- Several uses:
  - Determine the cause of death
  - Identify diseases not detected during life
  - Determine the extent of injuries and contribution to death
  - Hereditary conditions

### Homeostatic Imbalances: Areas of Science

- Epidemiology
  - Occurrence of diseases
  - Transmission in a community
- Pharmacology
  - Effects and uses of drugs
  - Treatment of disease

### Clinical Connection: Diagnosis of Disease

- Distinguishing one disorder or disease from another
  - Signs and symptoms
  - Medical history
    - Collecting information about event
    - Present illnesses and past medical problems
  - Physical examination
    - Orderly evaluation of the body and its function
    - Noninvasive techniques and other vital signs (pulse)

# Basic Anatomical Terminology

- Common language referring to body structures and their functions
- Anatomists use standard anatomical position and special vocabulary in relating body parts

### **Body Positions**

Descriptions of the human body assume a specific stance

### **Anatomical position**

- Body upright
- Standing erect facing the observer
- Head and eyes facing forward
- Feet are flat on the floor and forward
- Upper limbs to the sides
- Palms turned forward



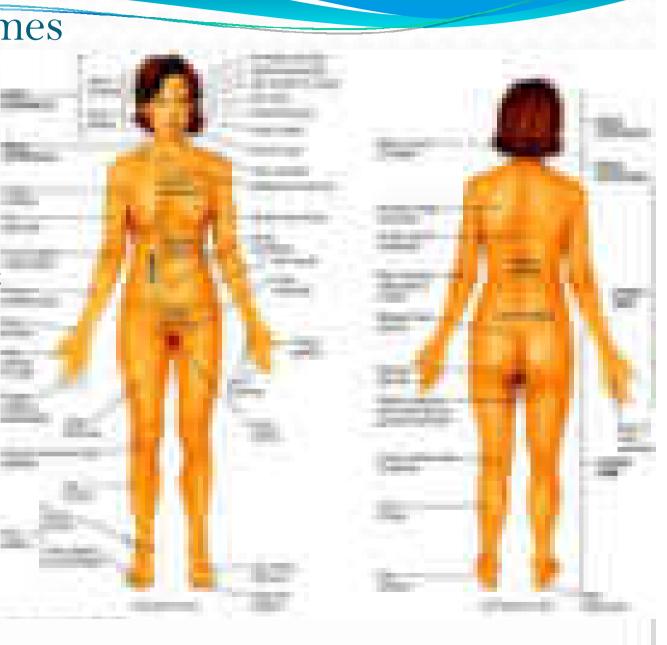
# Anatomical position

- Body is upright
- Terms for a reclining body
  - Prone position
    - Body is lying face down
  - Supine position
    - Body is lying face up

Regional Names

Several major regions identified.Most principal regions

- Head
  - Skull and face
- Neck
  - Supports the head and attaches to trunk
- Trunk
  - Chest, abdomen, and pelvis
- Upper limbs
  - Attaches to trunk (shoulder, armpit, and arm
- Lower limbs
  - Attaches to trunk (buttock, thigh, leg, ankle, and foot



## Directional Terms

- Describe the position of one body part relative to another
  - Group in pairs with opposite meaning
    - **Anterior** (front) and **posterior** (back)
  - Only make sense when used to describe a position of one structure relative to another
    - The esophagus is posterior to the trachea
    - Knee is superior to the ankle

CONTRACTOR AND		
Deficition (Fig.)	Selection of the second	7-01-00-01-0
THE PERSON NAMED IN		2-10-11-1
Supporter (exp. 1011) all regions	THE PERSON NAMED IN COLUMN TWO IS NOT THE OWNER.	The confidence of the control of the
Bedrick or at 1	The Control of the Co	Particular control of the control
-		Transcond and the same of
-	********	Chapter Control Control
Street Street Company	And a second contract of the second	
MARKET	Control of the Contro	Section between the state
bearing on a little	Andrew Ageg.	Service and the service of the servi
Sections	The State of	North an Association of the Section 1

And the first control and the first the form the control of the co

### Common Directional

### Terms

#### Anterior

• Nearer to the front of the body

#### Posterior

Nearer to the back of the body

### Superior

• Toward the head

#### Inferior

• Away from the head

#### Proximal

• Nearer to the attachment of a limb to the trunk

#### Distal

• Farther from the attachment of a limb to the trunk

#### Lateral

• Farther from the midline

#### Medial

• Nearer to the midline



### Planes and Sections

Imaginary flat surfaces that pass through the body parts

#### Sagittal plane

- A vertical plane that divides the body into right and left sides
  - **Midsagittal plane** divides body into equal right and left sides
  - Parasagittal plane divides body into unequal right and left sides

#### Frontal or coronal plane

• Divides the body or an organ into anterior (front) and posterior (back) portions

#### Transverse plane

- Divides the body or an organ into superior (upper) and inferior (lower) portions
- Also called cross-sectional or horizontal plane

#### Oblique plane

- Passes through the body or an organ at an angle
  - Between transverse and sagittal plane
  - Between transverse and frontal plane

#### Sections

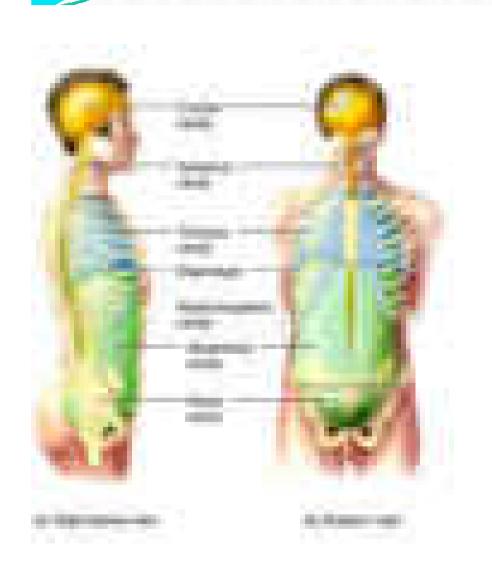
• Cut of the body made along a plane



# **Body Cavities**

- Spaces within the body that help protect, separate, and support internal organs
  - Cranial cavity
  - Thoracic cavity
  - Abdominopelvic cavity

## **Body Cavities**





### Cranial Cavity and Vertebral Canal

### Cranial cavity

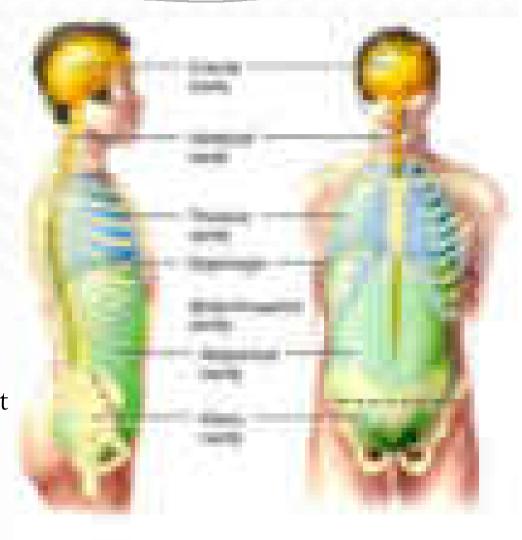
- Formed by the cranial bones
- Protects the brain

### Vertebral canal

- Formed by bones of vertebral column
- Contains the spinal cord

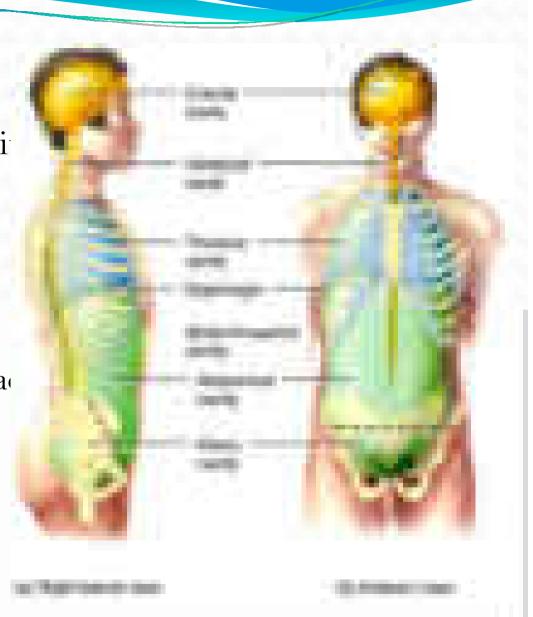
### Meninges

• Layers of protective tissue that line the cranial cavity and vertebral canal



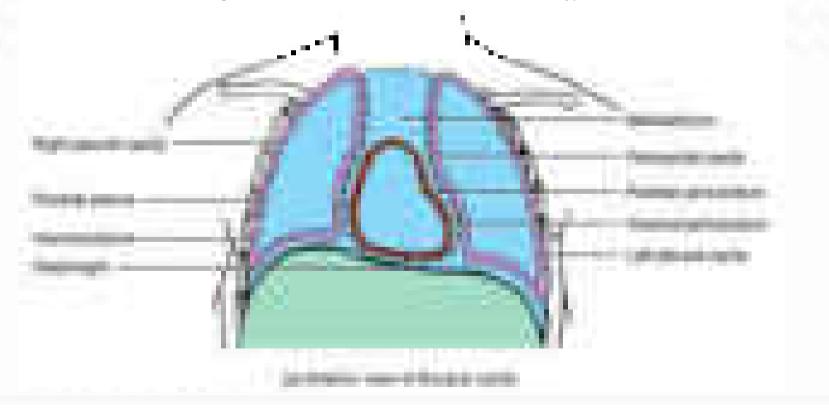
Thoracic Cavity

- Also called the chest cavir
- Formed by
  - Ribs
  - Muscles of the chest
  - Sternum (breastbone)
  - Vertebral column (thoraportion)





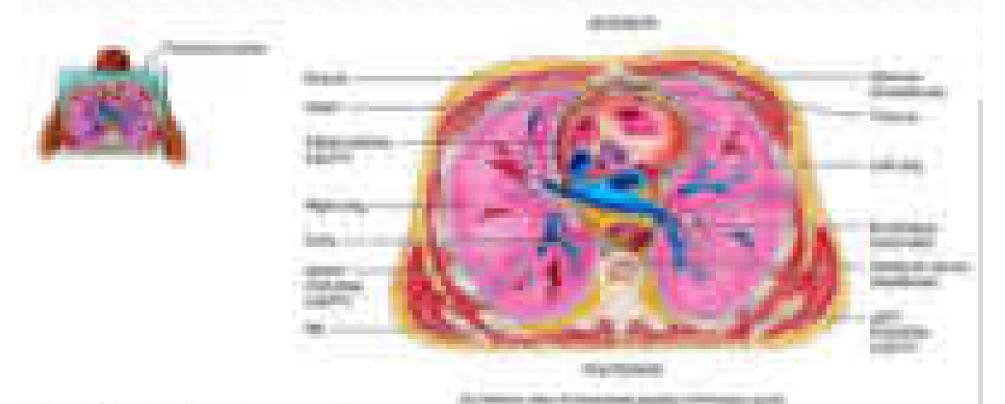
- Within the thoracic cavity
  - Pericardial cavity
    - Fluid-filled space that surround the heart
  - Pleural cavity
    - Two fluid-filled spaces that that surround each lung



# Thoracic Cavity

### Mediastinum

- Central part of the thoracic cavity
  - Between lungs
  - Extending from the sternum to the vertebral column
  - First rib to the diaphragm
    - Diaphragm
      - Dome shaped muscle
      - Separates the thoracic cavity from the abdominopelvic cavity



# Abdominopelvic Cavity

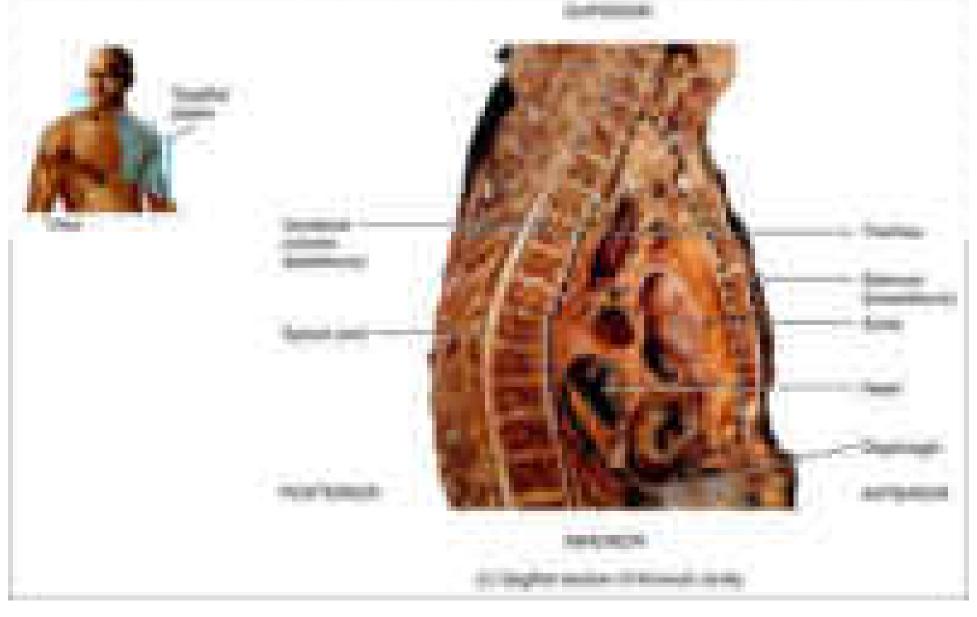
- Extends from the diaphragm to the groin
- Encircled by the abdominal wall and bones and muscles of the pelvis
- Divided into two portions:
  - Abdominal cavity
    - Stomach, spleen, liver, gallbladder, small and large intestines
  - Pelvic cavity
    - Urinary bladder, internal organs of reproductive system, and portions of the large intestine

### Thoracic and Abdominal Cavity Membranes

### Viscera

- Organs of the thoracic and abdominal pelvic cavities
  - **Serous membrane** is a thin slippery membrane that covers the viscera
  - Parts of the serous membrane:
    - Parietal layer
      - Lines the wall of the cavities
    - Visceral layer
      - Covers the viscera within the cavities





### Thoracic and Abdominal Cavity Membranes

### Pleura

- Serous membrane of the pleural cavities
  - Visceral pleura clings to surface of lungs
  - Parietal pleura lines the chest wall

### Pericardium

- Serous membrane of the pericardial cavity
  - Visceral pericardium covers the heart
  - Parietal pericardium lines the chest wall

### Peritoneum

- Serous membrane of the abdominal cavity
  - Visceral peritoneum covers the abdominal organs
  - Parietal peritoneum lines the abdominal wall

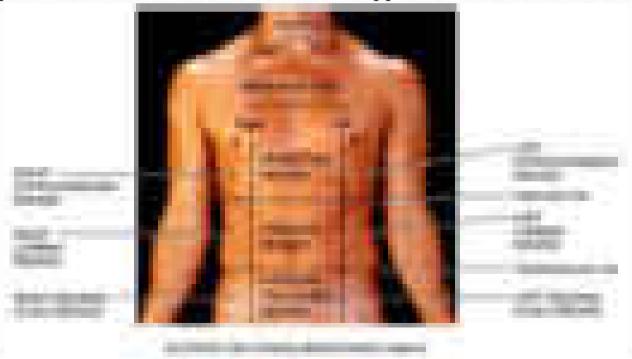
# Other Cavities

- Oral (mouth) cavity
  - Tongue and teeth
- Nasal cavity
  - nose
- Orbital cavities
  - eyeball
- Middle ear cavities
  - Small bones of the middle ear
- Synovial cavities
  - Joints

### Abdominopelvic Regions

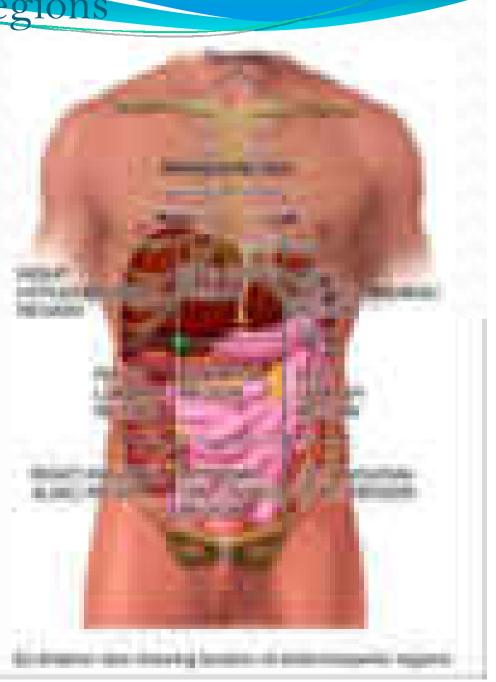
Tic-Tac-Toe grid (Used to describe the location of abdominal and pelvic organs)

- Two horizontal and two vertical lines partition the cavity
  - Subcostal line (top horizontal)
    - inferior to rib cage
  - Transtubercular line (bottom horizontal)
    - inferior to top of the hip bone
  - Midclavicular lines (two vertical lines)
    - midpoints to clavicles and medial to the nipples



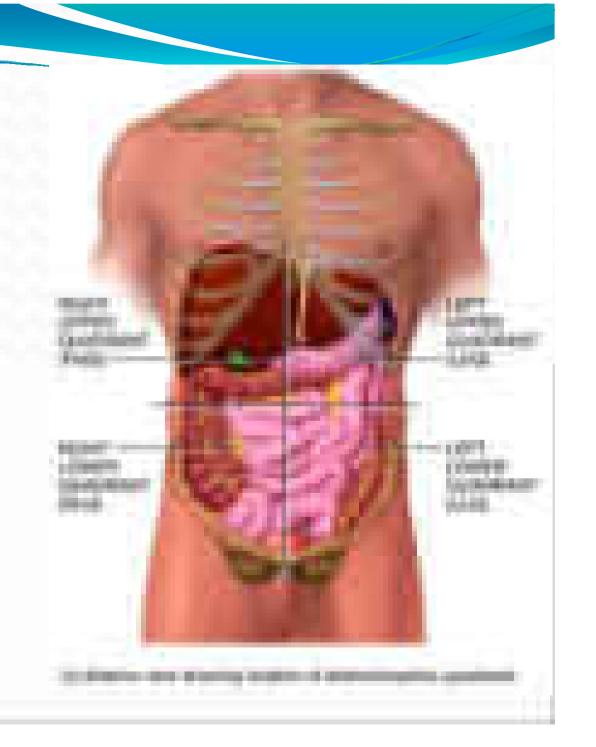
### Nine Abdominopelvic Regions

- Right and left hypochondriac
- Epigastric and Hypogastric (pubic)
- Right and left lumbar
- Right and left inguinal (iliac)
- Umbilical



# Quadrants

- Vertical and horizontal lines pass through the umbilicus
  - Right upper quadrant (RUQ)
  - Left upper quadrant (LUQ)
  - Right lower quadrant (RLQ)
  - Left lower quadrants (LLQ)



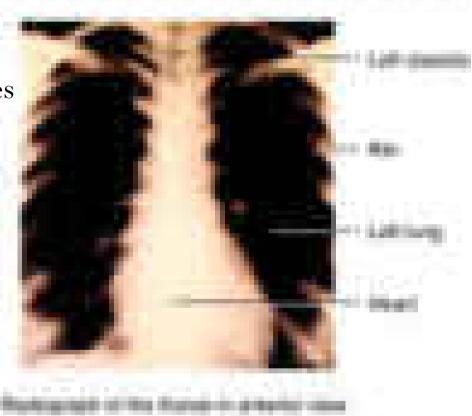
# Medical Imaging

- Techniques and procedures used to create images of the human body
  - Allow visualization of structures inside the body
  - Diagnosis of anatomical and physiological disorders
  - Conventional radiography (X-rays) have been in use since the late 1940's

# Radiography

### X-rays

- produce image of interior structures
- Inexpensive and quick
- Hollow structures appear black or gray
- Do not pass easily through dense structure (bone)
  - At low dose, useful for soft tissue (breast)
    - Mammography (breast)
    - Bone densitometry (bone density)



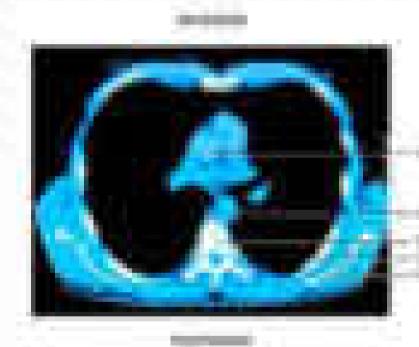
# Magnetic Resonance Imaging (MRI)

- High energy magnetic field
  - Protons in body fluid align with field
- Color image on a video monitor
  - 2D and 3D blueprint
- Relatively safe procedure
  - Not used on patients containing metal
- Used for differentiating normal and abnormal tissues
  - Tumors, brain abnormalities, blood flow



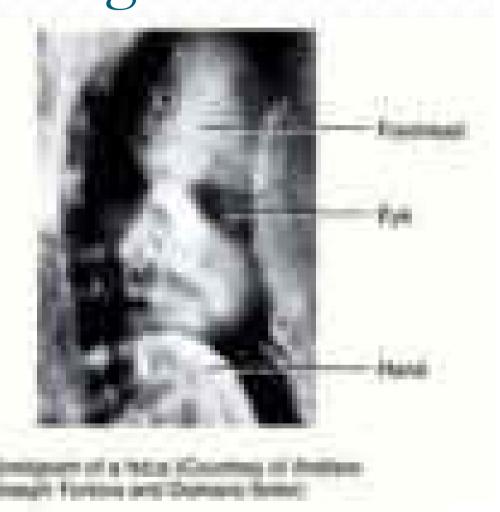
# Computed Tomography

- Computer-Assisted radiography (CT-Scan)
  - 3-D structures
  - Visualize soft tissue in more detail than conventional radiography
  - Tissue intensities show varying degrees of gray
  - Whole-body CT scan
    - Lung and kidney cancers, coronary artery disease



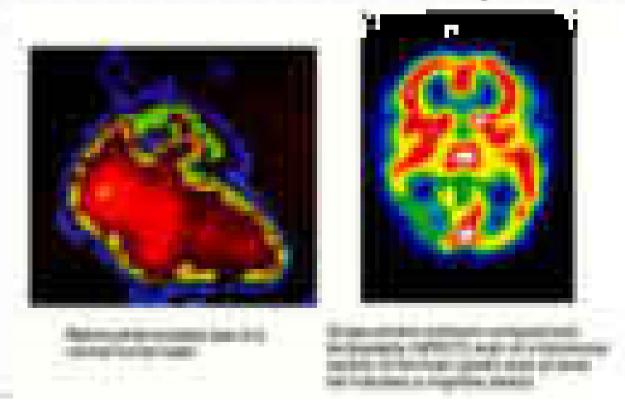
# Ultrasound Scanning

- Ultrasound Scanning
  - High frequency sound waves
    - Sonogram
    - Noninvasive, painless, no dyes
    - Pregnancy (fetus)



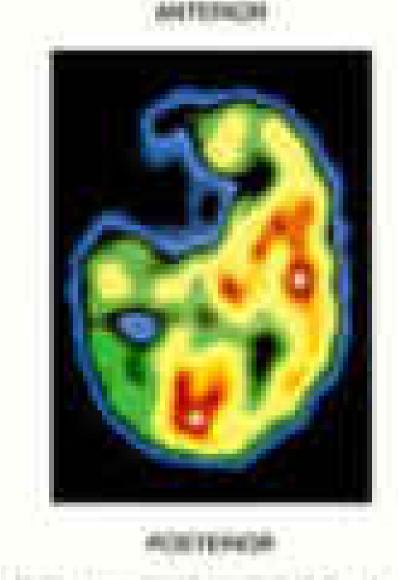
### Radionuclide Scanning

- Radioactive substance (radionuclide) given intravenously
- Gamma rays detected by camera
- Radionuclide image displays on video monitor
- Color intensity represents uptake
  - Single-photo-emission computerized tomography (SPECT)
    - Specialized technique used for brain, heart, lungs, and liver



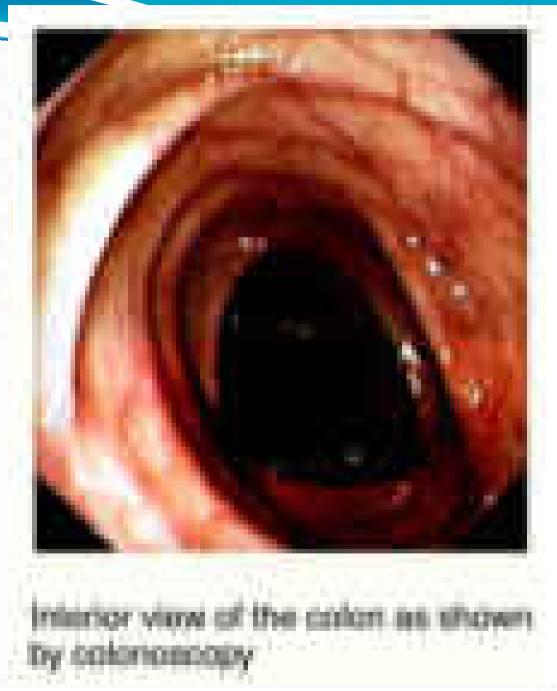
# Positron Emission Tomography (PET)

- Positron (positively charged particles) emitting substance injected into the body
  - Collision between positrons and negatively charged electron in body tissues
  - Gamma rays produced
  - Computer constructed a PET scan image in color
  - Used to study physiology of body structures (metabolism)



# Endoscopy

- Endoscope
  - Lighted instrument with lens
  - Image projected onto a monitor
- Colonoscopy
  - Interior of colon
- Laparoscopy
  - Organs in abdominopelvic cavity
- Arthroscopy
  - Interior of joint (knee)



# End of Chapter 1