# Chapter 12

# Introduction to Anatomy, Positioning, and Pathology

Copyright © 2013, 2010, 2006, 2002 by Saunders, an imprint of Elsevier Inc.

# Learning Objectives

- Explain the differences between cells, tissues, organs, and systems
- List the systems of the human body and state the basic components and function of each
- Describe the structure of bone
- List the three classifications of joints and give an example of each

# Learning Objectives (Cont'd)

- Use correct terminology to describe joint motion
- Demonstrate anatomic position
- List and define the planes of the body
- Use correct terminology to describe anatomic locations and relationships
- Use correct terminology when referring to radiographic positions and projections

# Learning Objectives (Cont'd)

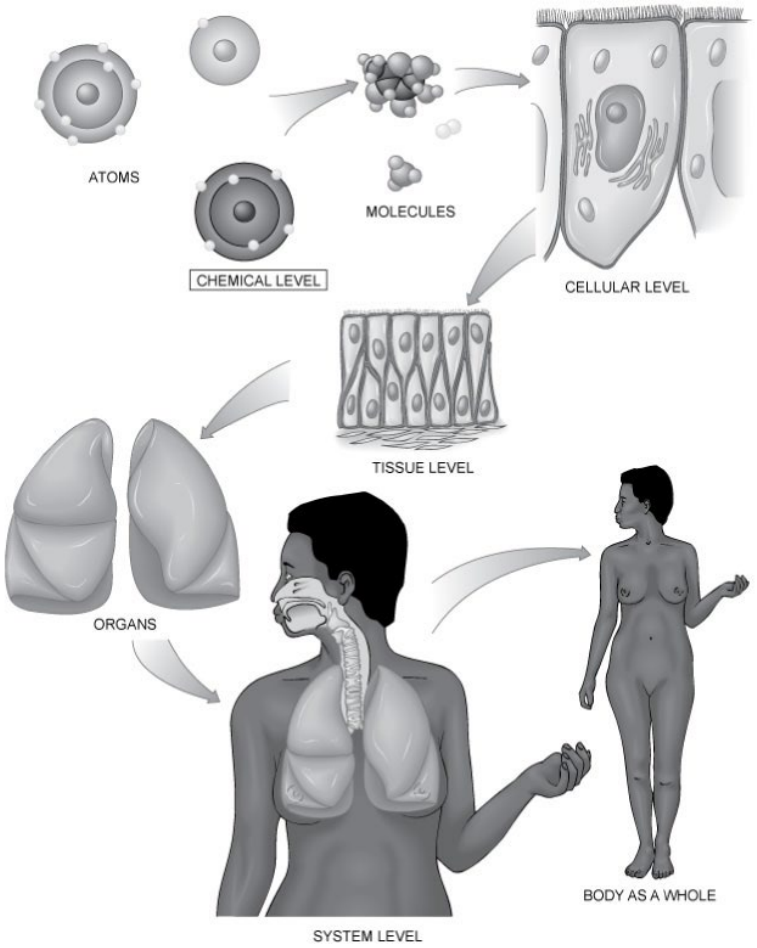
- Given a position/projection description from one of the following chapters, select, mark, and place the image receptor correctly
- Modify standard procedures to produce quality radiographic images of obese patients
- Define common terms used to describe or classify disease processes

# Learning Objectives (Cont'd)

- Explain the difference between acute and chronic conditions and between benign and malignant conditions
- Define inflammation and describe its possible consequences

# Organization of the Human Body

- Chemical = atoms and molecules
- Cells = smallest unit of living things
- Tissues = cells working together to perform a function
- Organs = groups of tissues that perform special functions
- Systems = groups of organs that perform complex functions
- Body = composed of all systems




Thibodeau GA, Patton KT: *Structure and function*, ed 13, St Louis, 2008, Mosby.

# Body Systems

- Integumentary
  - Secretes oil and sweat and responds to pain, pressure, touch, and temperature
    - Skin, hair and nails
- Muscular
  - Helps control movement and body temperature
    - Voluntary and involuntary
- Nervous
  - Conducts impulses between the central nervous system and other parts of the body
    - Brain, spinal cord, and nerves
- Endocrine
  - Secretes hormones to regulate certain body functions
    - Glands such as the thyroid, pituitary, adrenal

# Body Systems (Cont'd)

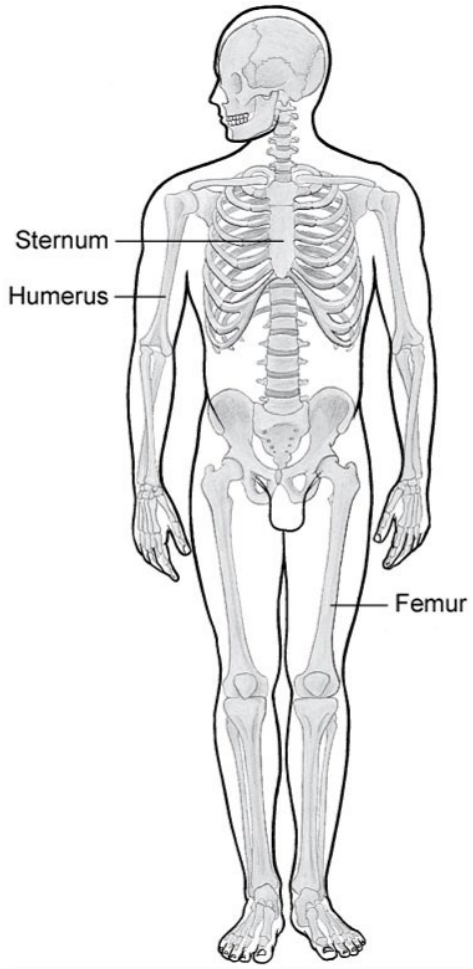
- Circulatory or Cardiovascular
  - Transports blood throughout the body
  - Heart and blood vessels (arteries, veins, etc.)
- Lymphatic
  - Provides lymph for movement of fluid and certain molecules and assists with immunity
  - Lymph nodes, lymph vessels, spleen, tonsils, thymus
- Respiratory
  - Functions in the exchange of carbon dioxide and oxygen
  - Trachea, lungs, bronchi, pharynx, nose, mouth

# Body Systems (Cont'd)

- Digestive
  - Functions in the digestion of food
  - Mouth, esophagus, stomach, small/large intestine
- Urinary
  - Eliminates excess fluid and waste products
  - Ureters, bladder, urethra
- Reproductive
  - Supports reproduction
  - Gonads
- Skeletal
  - Provides a framework for the body
  - 206 bones and other cartilage and ligaments

# Skeletal System

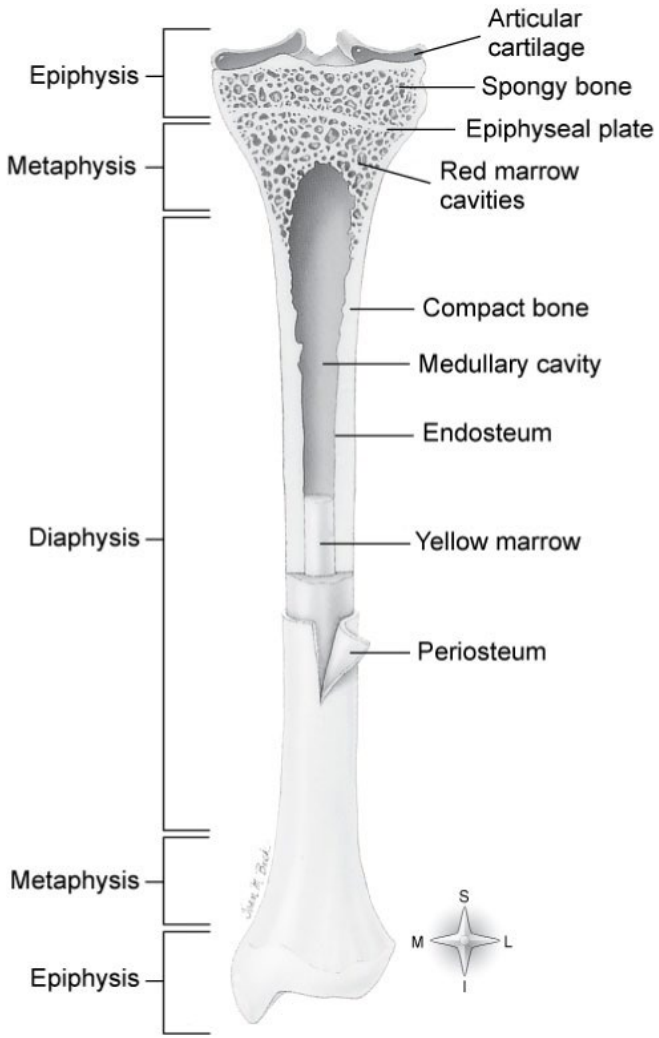
- Divided into axial and appendicular portions
  - Axial – skull, spine, sternum, ribs
  - Appendicular – extremities (arms and legs), pelvis, and shoulders
- Contains 206 bones, cartilage, ligaments, and tendons
- Ligaments
  - Connect bone and cartilage
- Tendons
  - Attach muscles to bones



Thibodeau GA, Patton KT: *Structure and function*, ed 13, St Louis, 2008, Mosby.

# Bone Structure

- Cortex = hard outer portion
- Cancellous = spongy inner portion
- Medullary canal = central cavity
- Periosteum = fibrous outer membrane
- Long bone structure includes
  - Diaphysis or shaft
  - Metaphysis or ends of diaphysis
  - Epiphysis or rounded joint forming ends



Thibodeau GA, Patton KT: *Structure and function*, ed 13, St Louis, 2008, Mosby.

# Types of Bones

- Long
  - Thick cortex and medullary canal
  - Example: humerus
- Short
  - Thin cortex and cancellous bone
  - Example: wrist bones
- Flat
  - Thin cancellous layer between two layers of cortex
  - Example: scapula
- Irregular
  - Various shapes
  - Example: vertebrae

# Joint Types

- Synarthrosis or immovable
  - Example = skull
- Amphiarthrosis or limited motion
  - Example = vertebrae and pelvis (SI joints)
- Diarthrosis or move freely
  - Example = hip

# Joint Movement

- Circular motion: arc-like rotation of a structure around an axis
  - Rotation: pivoting of a bone on its axis (C1 around C2)
  - Circumduction: moves the distal end of a bone in a circle, resulting in a conical-shaped motion (arm at the shoulder)
  - Supination: lateral (or external) rotation of the bones of forearm so the palm of the hand is facing up or anterior
  - Pronation: the opposite of supination, is medial (or internal) rotation of the bones of the forearm so the palm of the hand is facing down or posterior

# Joint Movement (Cont'd)

- Angular motion: bending, resulting in a change in angle between the long axis of the two bones making up the joint
  - Flexion: bending motion that decreases the angle between two bones (elbow joint, so forearm moves closer to the humerus)
  - Extension: opposite of flexion (elbow joint movement from flexion, returning to anatomic position)
  - Abduction: movement of a part away from the middle, or midline, of the body (arm straight out from side)
  - Adduction: opposite of abduction, movement of a part toward the midline

# Joint Movement (Cont'd)

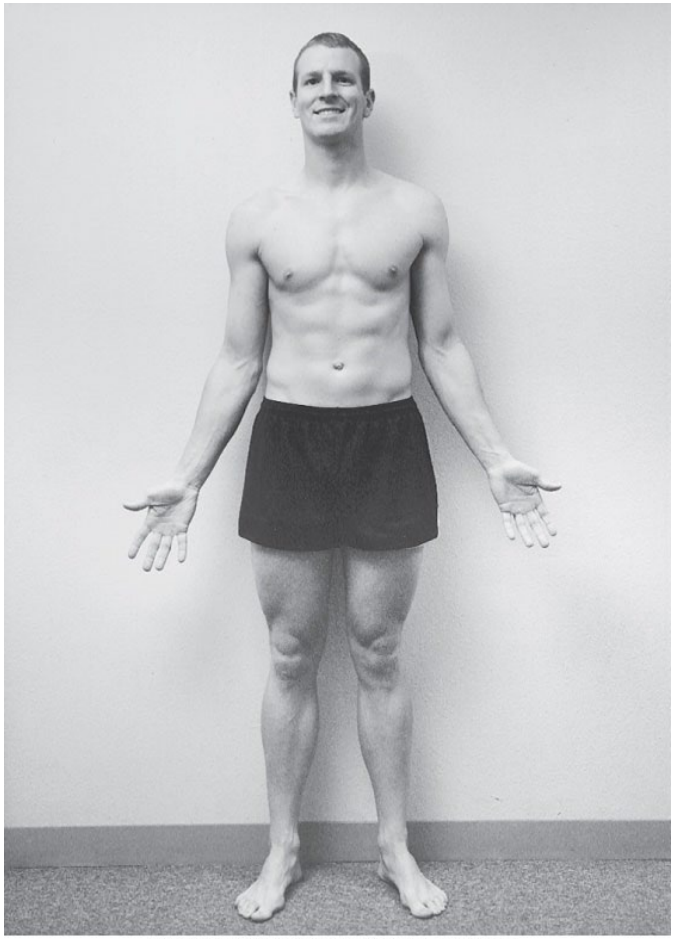
- Gliding motion: occurs when one bone slides over another; these simple motions occur without any circular or angular movements
  - An example would be the movement of the patella over the femur with knee flexion or extension

# Joint Movement (Cont'd)

- Special movements are another type of joint movement, which occur in a limited number of joints
  - *Inversion* is turning the sole, or plantar surface, of the foot inward
  - *Eversion*, the opposite of inversion, is turning the sole of the foot outward
  - *Protraction* is moving a part forward, or anterior; holding an arm straight out in front requires protraction
  - *Retraction*, the opposite of protraction, is moving a part backward, or posterior
  - *Elevation* moves a part up, or superior; moving top of your shoulder toward your ear
  - *Depression*, the opposite of elevation, moves a part down, or inferior

# Positioning Terms

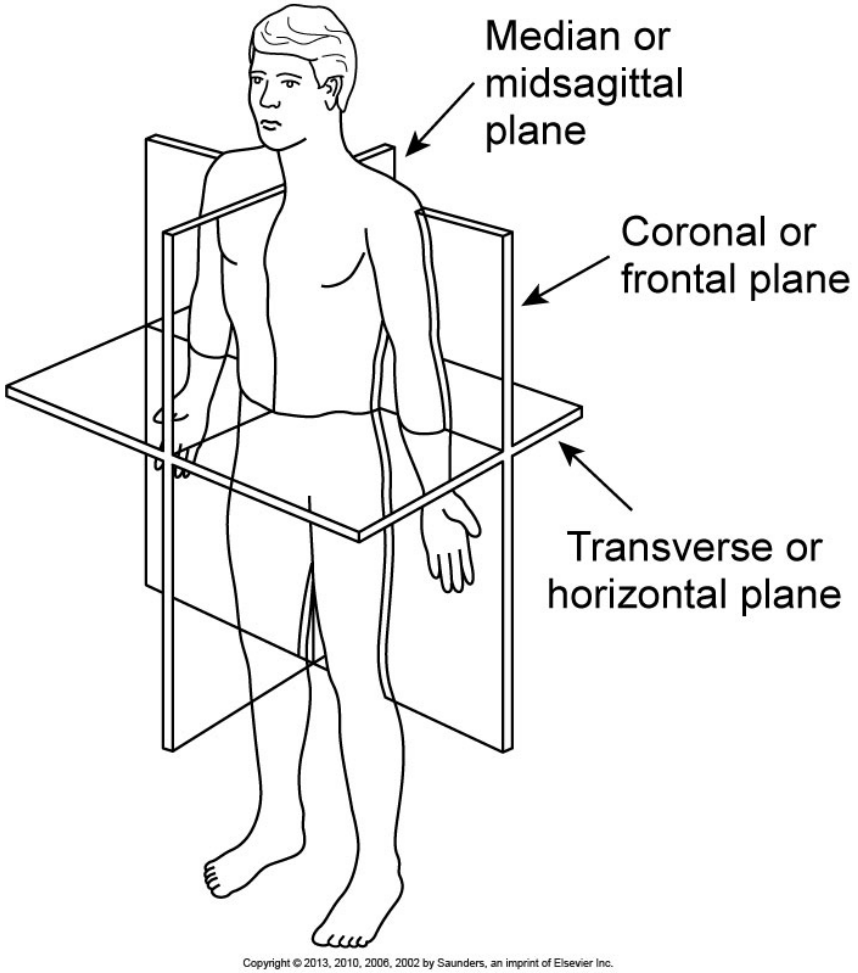
- Anatomic position
  - Patient facing forward with palms up
- Radiographic position
  - Placement of body part for procedure
- Radiographic projection
  - Path of the CR



Copyright © 2013, 2010, 2006, 2002 by Saunders, an imprint of Elsevier Inc.

# Body Planes

- Used to place the patient in the proper position
  - Median or midsagittal
  - Coronal or frontal
  - Transverse or horizontal



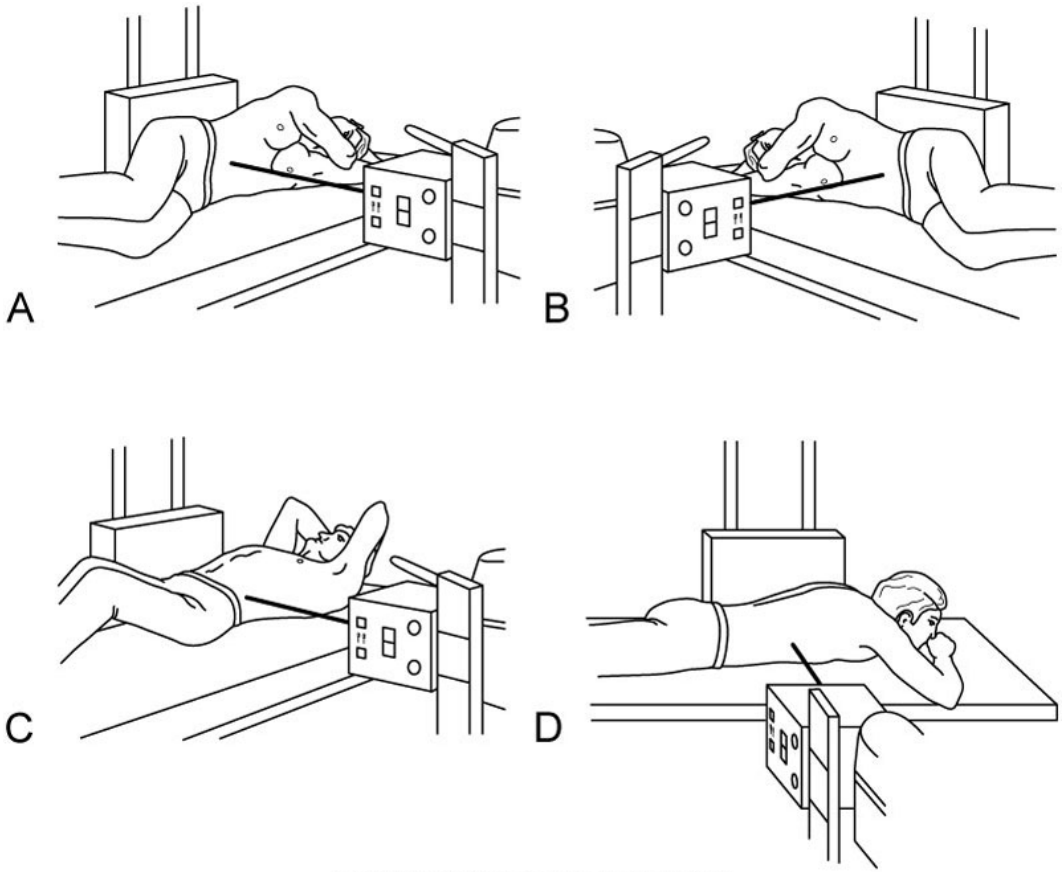
Copyright © 2013, 2010, 2006, 2002 by Saunders, an imprint of Elsevier Inc.

# Body Positions

- Describe how the patient's body is oriented
  - Prone
  - Recumbent
    - Dorsal recumbent
    - Lateral recumbent
    - Ventral recumbent
  - Supine
  - Upright

# Radiographic Positions

- Describe body-part placement in relationship to the x-ray table and/or IR
- Positions include:
  - Decubitus – recumbent with CR horizontal
  - Lateral – sagittal plane parallel to IR
  - Lordotic – angulation of coronal plane of chest to IR
  - Oblique – coronal plane not parallel to IR; stated as degree of rotation

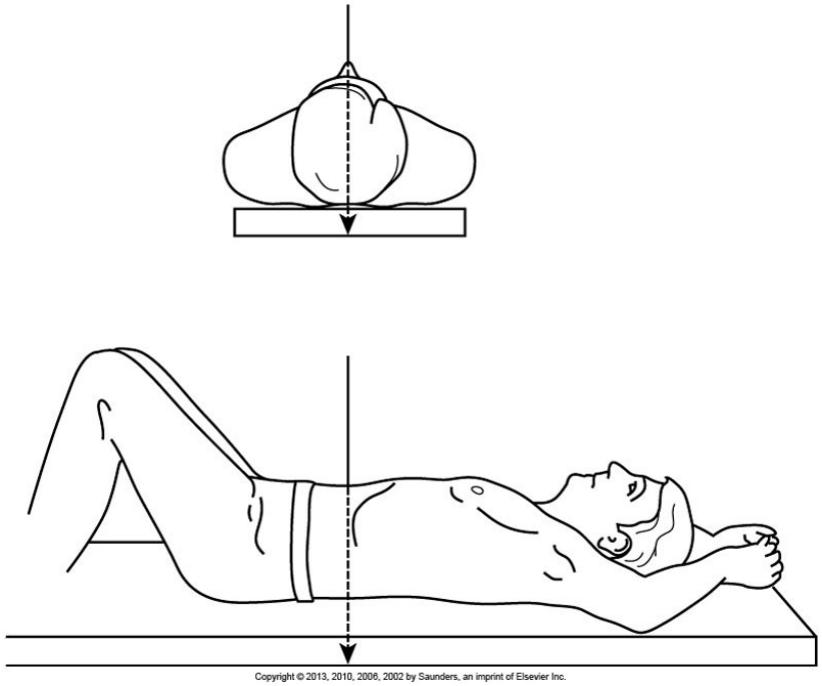


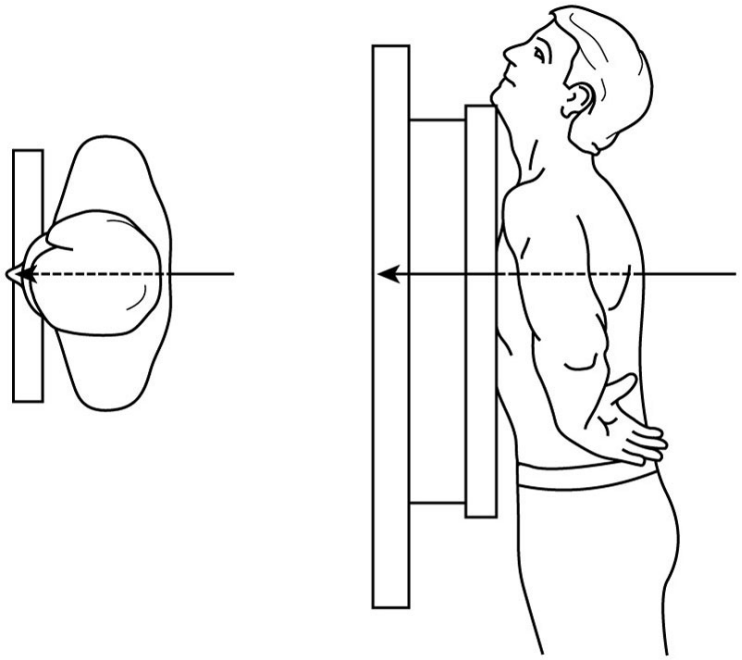

Copyright © 2013, 2010, 2006, 2002 by Saunders, an imprint of Elsevier Inc.

# Radiographic Projections

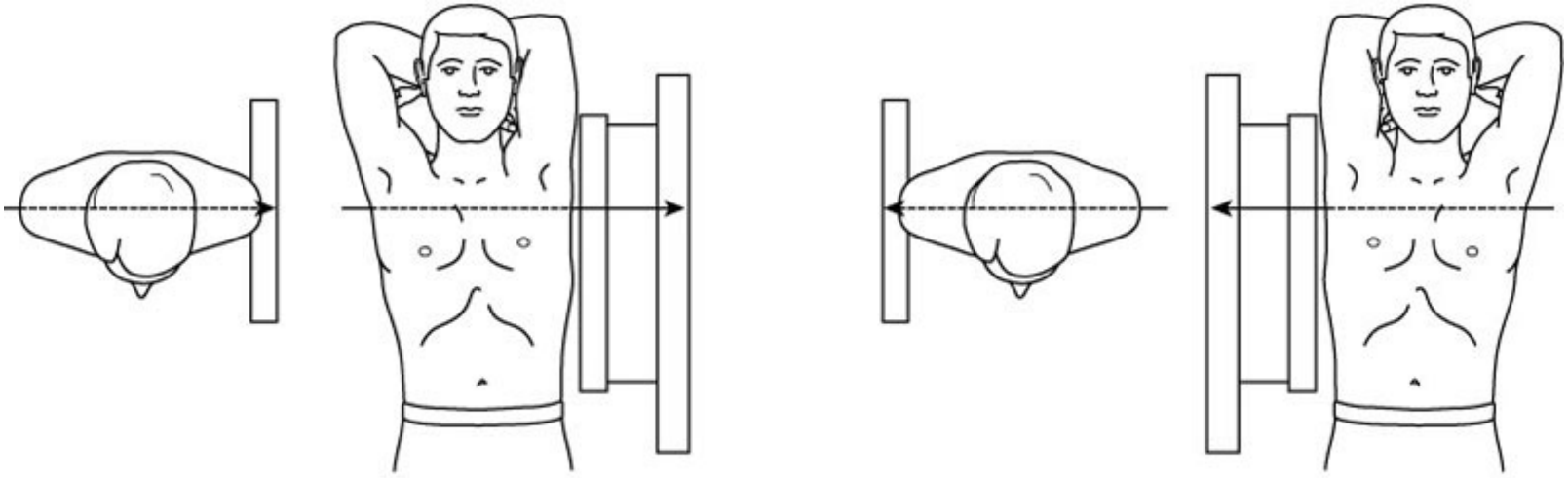
- Path of the CR from the x-ray tube, through the patient, to the IR
- Names may correspond to entrance and exit points of the CR
- Projections include:
  - AP or anteroposterior
  - PA or posteroanterior
  - Lateral
  - Oblique
  - Axial – CR angulation
  - Tangential – skim the profile

# AP and PA Projections


Copyright © 2013, 2010, 2006, 2002 by Saunders, an imprint of Elsevier Inc.


Copyright © 2013, 2010, 2006, 2002 by Saunders, an imprint of Elsevier Inc.

# Lateral Projections

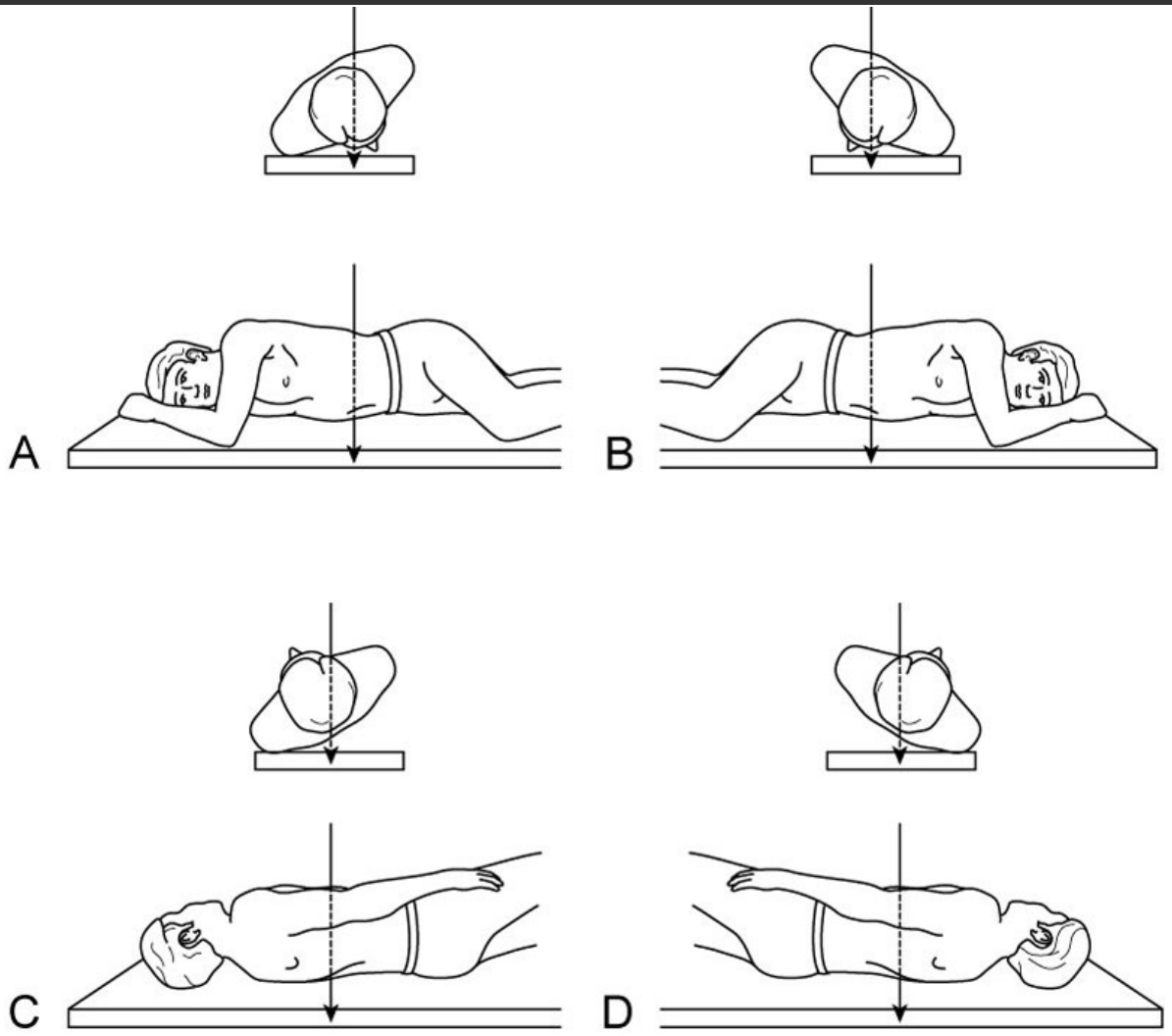


Left lateral

Right lateral

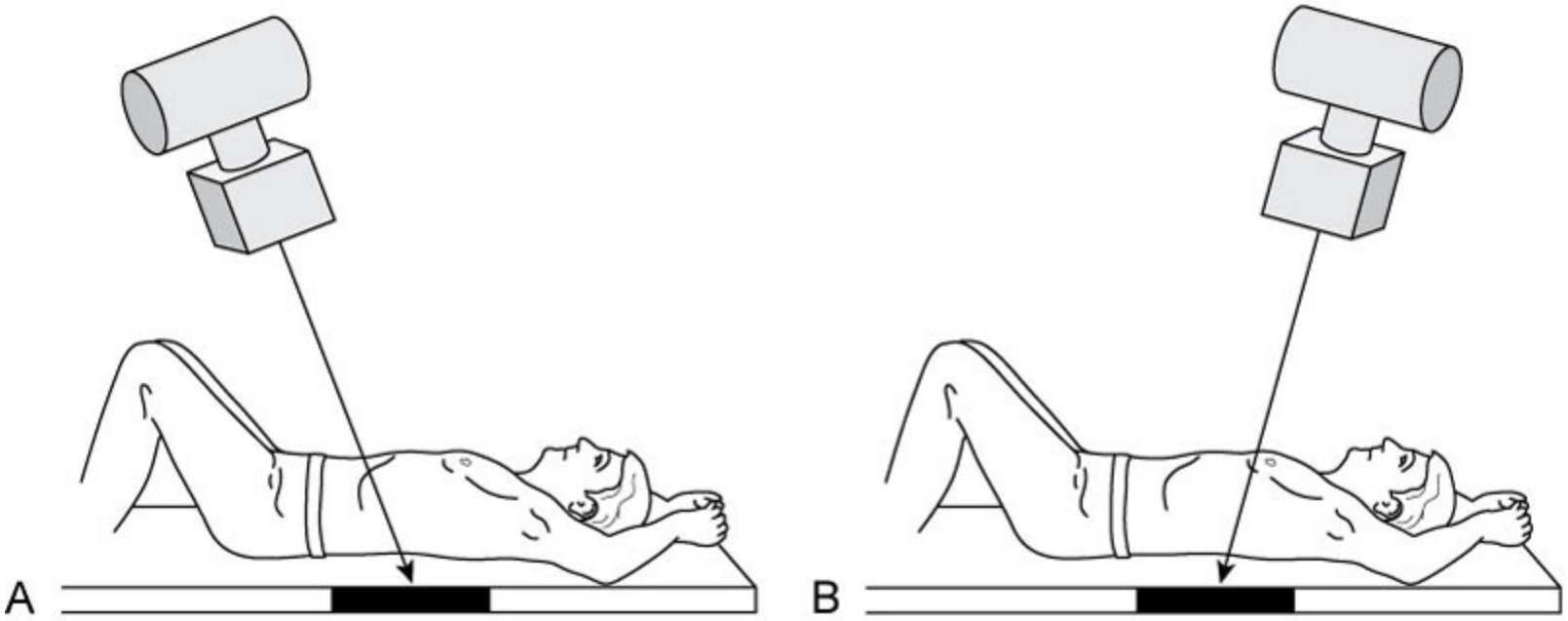
Copyright © 2013, 2010, 2006, 2002 by Saunders, an imprint of Elsevier Inc.

# Oblique Projections



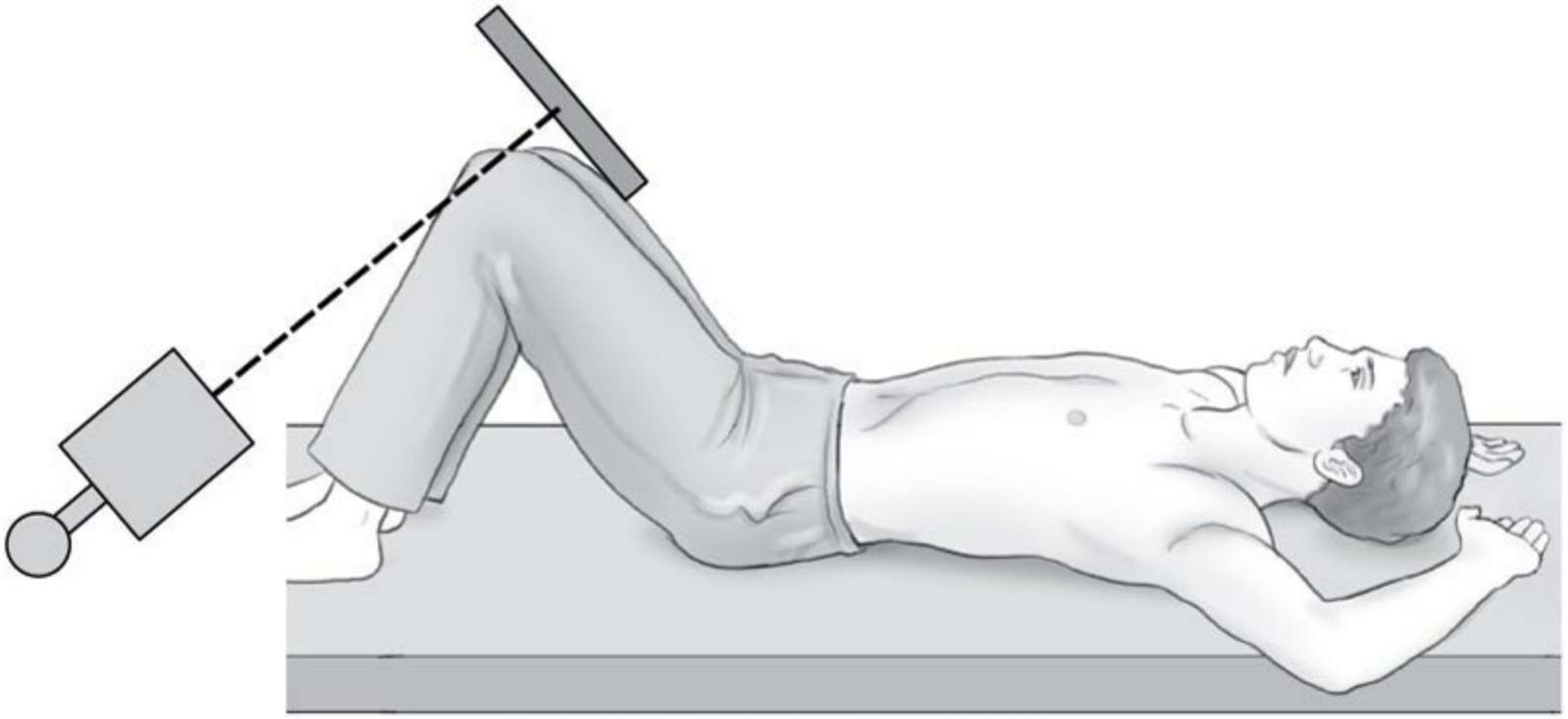

Copyright © 2013, 2010, 2006, 2002 by Saunders, an imprint of Elsevier Inc.

# Axial Projections




Copyright © 2013, 2010, 2006, 2002 by Saunders, an imprint of Elsevier Inc.

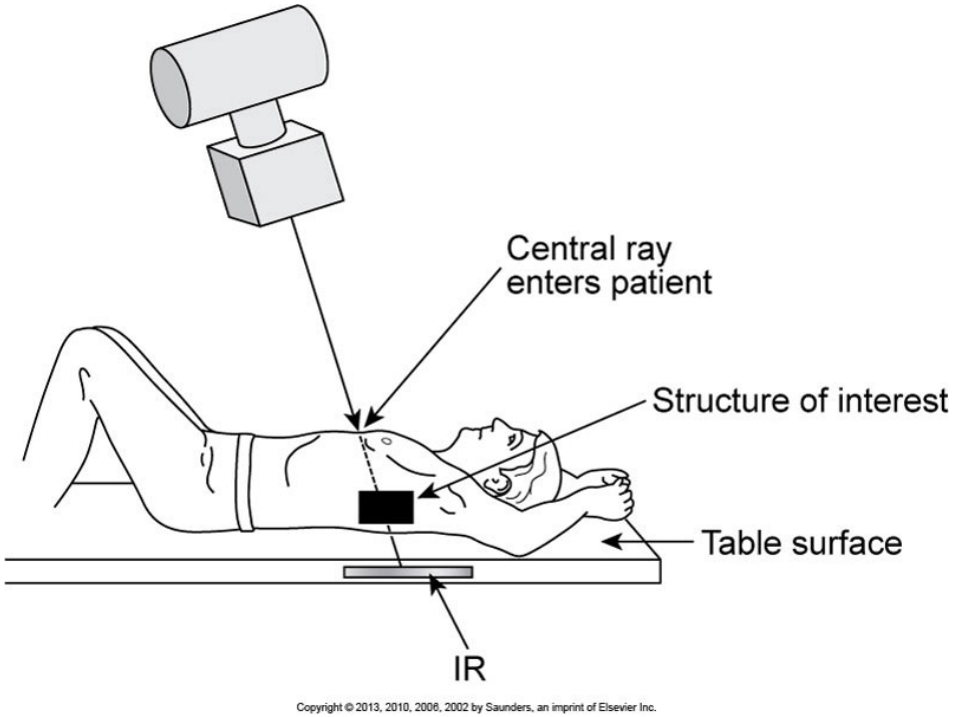
# Tangential Projections



Copyright © 2013, 2010, 2006, 2002 by Saunders, an imprint of Elsevier Inc.

# Components of a Radiographic Procedure

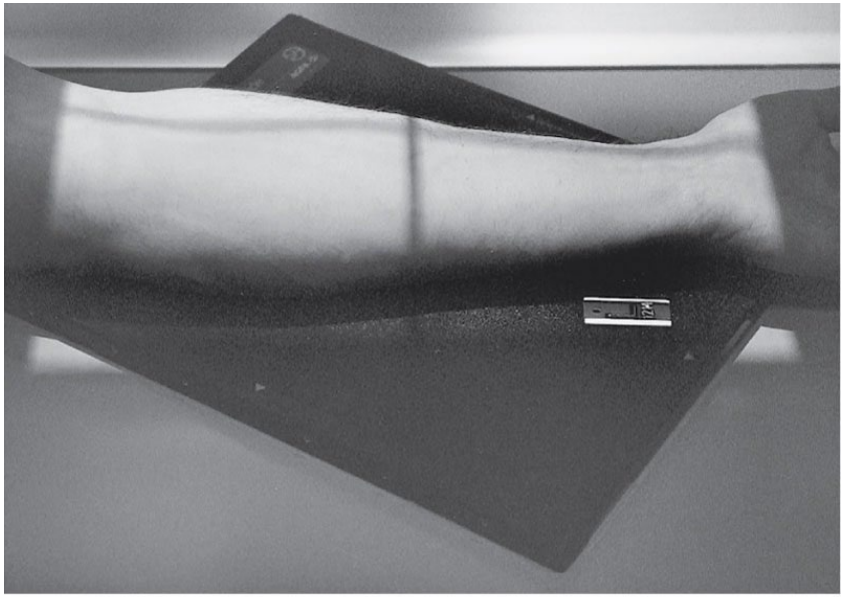
- Patient assessment
- Interpretation of procedure request
- Effective communication
- Selection and orientation of the IR
- Proper alignment of CR, body part, and IR



Copyright © 2013, 2010, 2006, 2002 by Saunders, an imprint of Elsevier Inc.

# Components of a Radiographic Procedure (Cont'd)

- Collimation
- Appropriate radiographic marker placement
- Patient pre- and post-procedure instruction
- Selection of exposure factors
- Evaluation of the radiographic image



Copyright © 2013, 2010, 2006, 2002 by Saunders, an imprint of Elsevier Inc.

# Imaging the Obese Patient

- Large body part diameter, weight approaching or exceeding equipment limits, presence of significant skin/fat folds, and decreased mobility may require changes in the usual procedures
- Imaging of the trunk poses the greatest challenge, because the common positioning landmarks may not be located by palpation
- In addition, proper radiation field collimation is more difficult because of abdomen thickness

# Imaging the Obese Patient (Cont'd)

- Remember that the field light indicating the collimated radiation field will appear small on obese patients
- The field light scales on the x-ray tube collimator must be set to the IR size or desired radiation field size, rather than relying on the visual cues

# Pathology

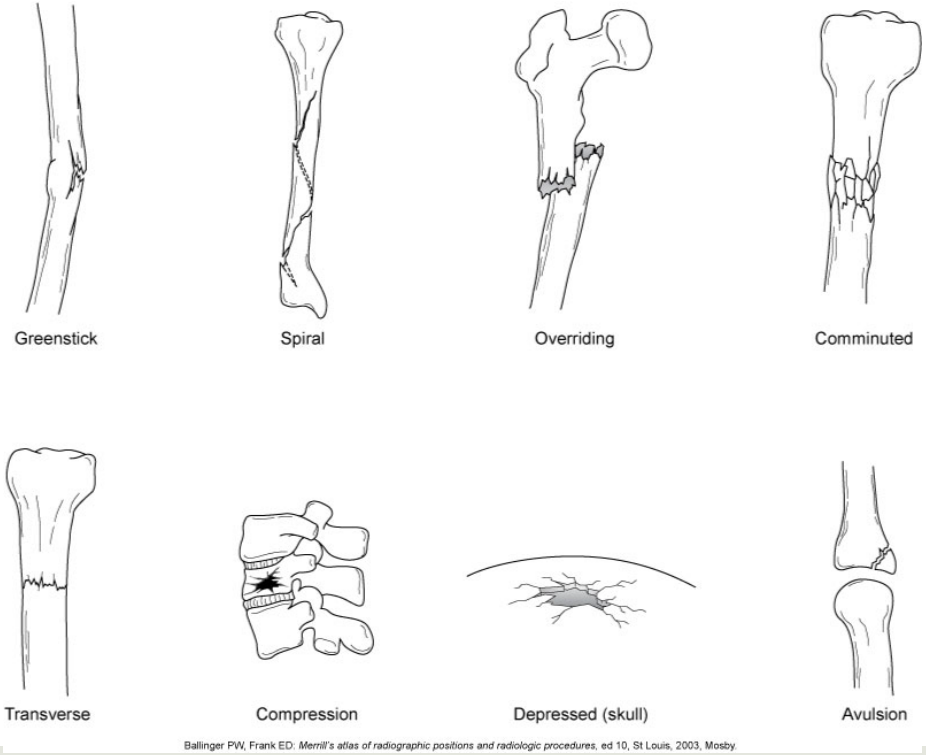
- Study of disease processes that includes:
  - Identification
    - Diagnosis or identification by evaluation of signs and symptoms
    - Prognosis or probable outcome of the disease
  - Classifications
    - Acute (sudden onset) vs. chronic (ongoing)
    - Contagious vs. non-contagious
    - Structural (organic disease involves changes to cells of body) vs. functional (abnormal change in function)
    - Hereditary (caused by genetic makeup of individual) vs. congenital (conditions present at birth)

# Pathology (Cont'd)

- Trauma
  - Physical injury resulting from an object
  - Types of injuries include:
    - Dislocation
    - Sprain – injury to ligament
    - Strain – excessive physical effort
    - Lacerations – cuts and tears through the skin
    - Abrasions - scrapes
    - Contusions – closed wounds that cause bleeding under skin
    - Fractures

# Pathology (Cont'd)

- Fractures
  - Injury in which the bone tissue is broken
  - Termed *compound* when broken bone penetrates the skin
  - Termed *simple* when skin is not penetrated




Ballinger PW, Frank ED: *Merrill's atlas of radiographic positions and radiologic procedures*, ed 10, St Louis, 2003, Mosby.

# Pathology (Cont'd)

- Inflammation
  - Immune system response to cellular injury
  - Characteristics include:
    - Swelling or edema
    - Reddening
    - Heat at infection site
    - Pain
    - Degeneration or further cell and tissue injury when chronic

# Pathology (Cont'd)

- Neoplasms
  - Growths or tumors
    - Benign tumors remain at one body location and have limited growth
    - Malignant cancers invade surrounding tissue and are capable of metastasis, or spreading to other locations

# Summary

- The levels of organization in the body include chemical (atoms and molecules), cells, tissues, organs, and systems
- Body systems include integumentary, muscular, nervous, endocrine, circulatory, lymphatic, respiratory, digestive, urinary, reproductive, and skeletal
- The skeleton contains 206 bones and is divided into axial and appendicular portions

# Summary (Cont'd)

- Bones are classified as long, short, flat, and irregular
- Bone structure includes cortical and cancellous tissue, medullary canal, and periosteum
- Joint classifications are synarthrosis, amphiarthrosis, and diarthrosis

# Summary (Cont'd)

- Types of joint movement include circumduction, rotation, angulation, and gliding
- Anatomic position serves as a point of reference when describing radiographic positions and projections
- Sagittal, coronal, and transverse planes are used to properly position the patient

# Summary (Cont'd)

- Placement of the patient's body may be described as recumbent, supine, prone, or erect
- Body part placement in relationship to the x-ray table and/or IR may be referred to as decubitus, lateral, lordotic, or oblique
- Terms used to describe radiographic projections include AP, PA, lateral, oblique, axial, and tangential

# Summary (Cont'd)

- Components of a radiographic procedure include patient assessment; interpretation of procedure request; communication, selection, and orientation of the IR; alignment of CR, body part, and IR; image labeling; patient instructions; selection of exposure factors; and evaluation of the radiographic image

# Summary (Cont'd)

- The obese patient may present a significant challenge to the limited operator during performance of radiographic procedures. Large body part diameter, weight approaching or exceeding equipment limits, presence of significant skin/fat folds, and decreased mobility may require changes in the usual procedures. Imaging of the trunk poses the greatest challenge, because the common positioning landmarks may not be located by palpation.

# Summary (Cont'd)

- Radiography of the abdomen is most challenging on an obese patient because the pubic symphysis, indicating the inferior aspect of the abdominal cavity, cannot be located easily. In addition, proper radiation field collimation is more difficult because of abdomen thickness.

# Summary (Cont'd)

- Pathology involves identifying and classifying disease processes
- Skeletal trauma may result in compound or simple fractures
- Inflammation is an immune system response to cellular injury characterized by swelling, reddening, heat, and pain
- Neoplasms are tumors that may be benign or malignant