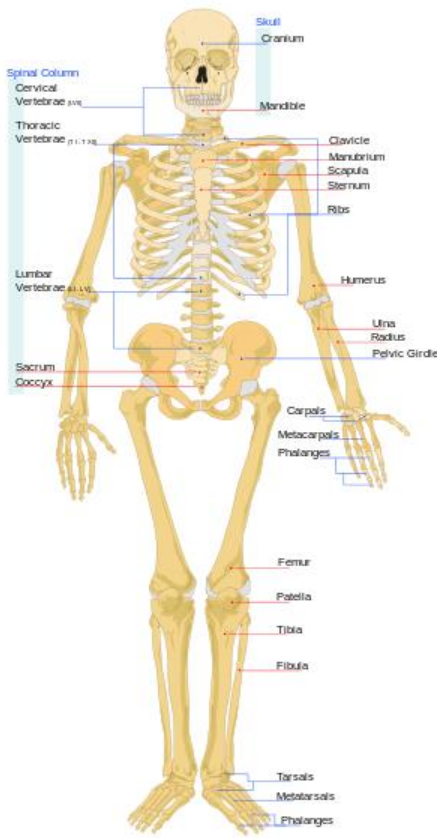


Chapter 7

Anatomy and Terminology

Human skeleton



The **human skeleton** is the internal framework of the body. It is composed of 206 bones. The human skeleton can be divided into the [axial skeleton](#) and the [appendicular skeleton](#). The axial skeleton is formed by the [vertebral column](#), the [rib cage](#) and the [skull](#). The appendicular skeleton, which is attached to the axial skeleton, is formed by the [pectoral girdles](#), the [pelvic girdle](#) and the bones of the upper and lower limbs.

The human skeleton serves six major functions; support, movement, protection, production of [blood cells](#), storage of ions and endocrine regulation.

The human skeleton is not as [sexually dimorphic](#) as that of many other primate species, but subtle differences between sexes in the [morphology](#) of the [skull](#), [dentition](#), [long bones](#), and pelvis exist. In general, female skeletal elements tend to be smaller and less robust than corresponding male elements within a given population. The pelvis in female skeletons is also different from that of males in order to facilitate child birth.

Divisions

Axial skeleton

The axial skeleton (80 bones) is formed by the [vertebral column](#) (32–34 bones; the number of the vertebrae differs from human to human as the lower 2 parts, sacral and coccygeal bone may vary in length), the [rib cage](#) (12 pairs of [ribs](#) and the [sternum](#)), and the [skull](#) (22 bones and 7 associated bones). The upright posture of humans is maintained by the axial skeleton, which transmits the weight from the head, the trunk, and the upper extremities down to the lower extremities at the [hip joints](#). The bones of the spine are supported by many ligaments. The [erectors spinae](#) muscles are also supporting and are useful for balance. A human is able to survive with just the axial portion of their skeleton.

Appendicular skeleton

The appendicular skeleton (126 bones) is formed by the pectoral girdles, the upper limbs, the pelvic girdle or pelvis, and the lower limbs. Their functions are to make locomotion possible and to protect the major organs of digestion, excretion and reproduction.

Functions

The skeleton serves six major functions; support, movement, protection, production of blood cells, storage of minerals and endocrine regulation.

Support

The skeleton provides the framework which supports the body and maintains its shape. The pelvis, associated ligaments and muscles provide a floor for the pelvic structures. Without the [rib cages](#), [costal cartilages](#), and [intercostal muscles](#), the [lungs](#) would collapse.

Movement

The joints between bones allow movement, some allowing a wider range of movement than others, e.g. the ball and socket joint allows a greater range of movement than the pivot joint at the neck. Movement is powered by [skeletal muscles](#), which are attached to the skeleton at various sites on bones. Muscles, bones, and joints provide the principal mechanics for movement, all coordinated by the nervous system.

Protection

The skeleton protects many vital [organs](#):

- The [skull](#) protects the [brain](#), the [eyes](#), and the [middle](#) and [inner ears](#).
- The [vertebrae](#) protect the [spinal cord](#).
- The [rib cage](#), spine, and [sternum](#) protect the [lungs](#), [heart](#) and major [blood vessels](#).
- The [clavicle](#) and [scapula](#) protect the [shoulder](#).
- The [ilium](#) and spine protect the digestive and urogenital systems and the [hip](#).
- The [patella](#) and the [ulna](#) protect the [knee](#) and the [elbow](#) respectively.
- The [carpals](#) and [tarsals](#) protect the [wrist](#) and [ankle](#) respectively.



Blood cell production

The skeleton is the site of [haematopoiesis](#), the development of blood cells that takes place in the [bone marrow](#). In children, haematopoiesis occurs primarily in the marrow of the long bones such as the femur and tibia. In adults, it occurs mainly in the pelvis, cranium, vertebrae, and sternum.^[4]

Storage

The [bone matrix](#) can store [calcium](#) and is involved in [calcium metabolism](#), and [bone marrow](#) can store [iron](#) in [ferritin](#) and is involved in [iron metabolism](#). However, bones are not entirely made of calcium, but a mixture of [chondroitin sulfate](#) and [hydroxyapatite](#), the latter making up 70% of a bone. Hydroxyapatite is in turn composed of 39.8% of calcium, 41.4% of oxygen, 18.5% of phosphorus, and 0.2% of hydrogen by mass. Chondroitin sulfate is a sugar made up primarily of oxygen and carbon.

Endocrine regulation

Bone cells release a hormone called [osteocalcin](#), which contributes to the regulation of [blood sugar](#) ([glucose](#)) and [fat deposition](#). Osteocalcin increases both the [insulin](#) secretion and sensitivity, in addition to boosting the number of [insulin-producing cells](#) and reducing stores of fat.^[5]

Basic Medical Terminology

The foundation for radiographic anatomy and allied subjects is centered primarily in medical terminology. As an X-ray technologist, you should know the meaning of the following general terms:

Science: Systematized and classified knowledge.

-ology: (suffix). A science or branch of knowledge.

Regional or topographical anatomy: The study of separate parts of the body.

A system is a group of organs that work together to perform a function or functions. An example of a system is the skeletal system.

Systemic anatomy: The study of systems and associated parts. Systemic anatomy is divided into these subdivisions:

Osteology - the study of the bones.

Arthrology - The study of the articulations or joints.

Myology - The study of the muscular system.

Neurology - The study of the nervous system.

Angiology - The study of the vascular/lymphatic vessels.

Embryology: The study of the origin of the structures of the body.

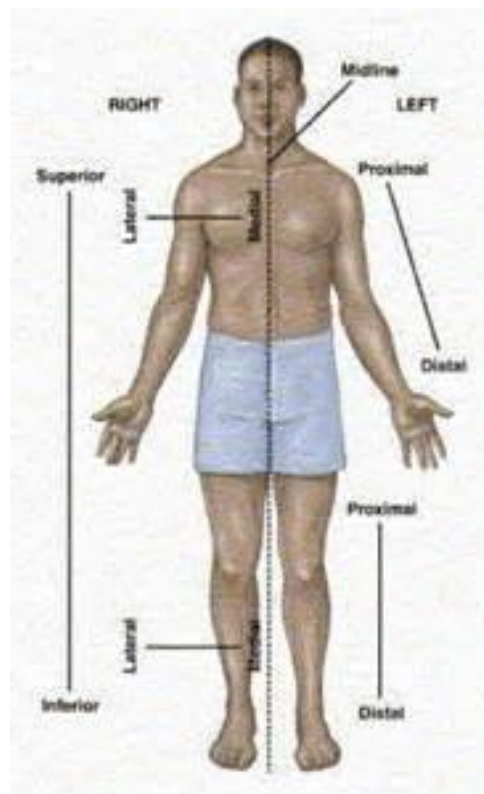
Physiology: The study of the functions and activities of the body.

Pathology: The study of changes in the structures or function of the body caused by disease or trauma.

Radiology: That branch of medical science that deals with the use of radiant energy in the diagnosis and treatment of injuries and diseases.

Anatomical Position

To avoid misunderstanding, a standard position of the human body is arbitrarily taken to be the erect (standing) position with feet flat on the floor, heels together, upper extremities at the sides, and palms, toes, and eyes directed forward. This is the anatomical position.



Terms Dealing with Aspects and Directions

Anterior, frontal, or ventral: The front side of the body.

Posterior or dorsal: The back, or dorsum, of the body.

Median: Pertaining to the midline of the body.

Lateral: Away from the midline or lateral side of the body. In the forearm, the ulna is medial to the radius and the radius is lateral to the ulna. The thumb is on the lateral aspect of the hand.

Proximal: Nearest to a point under consideration or the point of origin. In the case of the extremities, the articulations are considered points of origin

Distal: Remoteness from a point under consideration or the point of origin; the opposite of proximal. In the case of the extremities, joints are considered points of origin.

Superior: Above.

Inferior: Below.

Cephalic: Toward the head.

Caudad: Toward the feet.

Radiographic Usage of Certain Terms

In diagnostic X-ray services, such terms as anteroposterior (AP) or posteroanterior (PA) are frequently used. The prefix indicates the surface from which the central ray (CR) enters the part and the suffix indicates the surface from which the CR emerges.



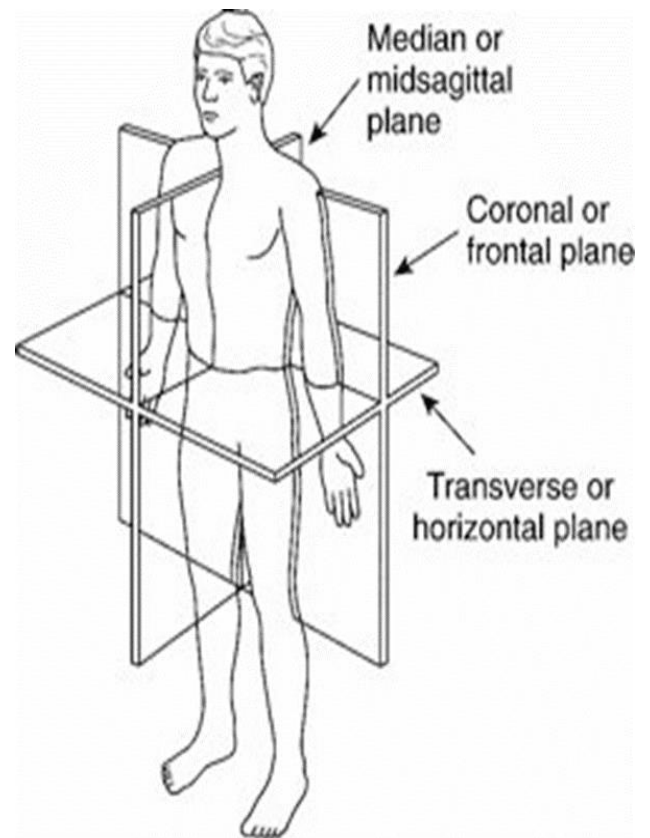
Planes of the Body

Sagittal plane: Any vertical plane that divides the body into right and left unequal portions.

Median or midsagittal plane: The vertical plane that divides the body into right and left halves.

Frontal or coronal plane: Vertical plane that divides the body into front and rear portions.

Transverse or horizontal plane: Any horizontal plane that divides the body into upper and lower portions. The level of this plane must be given.



Surfaces of the Hands and Feet

Palmar surface: Anterior surface (palm) of the hand.

Volar surface: Anterior surface of the hand and forearm (or the sole of the foot).

Plantar surface: Inferior surface (sole) of the foot.

Dorsal surface: Top or superior surface (dorsum) of the foot.

Terminology Relating to the Positions of the Body

Supine: A horizontal position of the body lying flat on the back with no rotation of the trunk.

Prone: A horizontal position of the body lying face and stomach down with no rotation of the trunk.

Lateral recumbent: A horizontal position of the body lying on either side with no rotation of the trunk.

Oblique: A position of the body, or any of its parts, when placed at an inclined angle to the X-ray film.

Erect or vertical: A position of the body either sitting or standing.

External and Internal: These terms are used to describe locations with respect to the surface of the body. Internal means within the body and external means outside the body.

Radiographic Projections

Anteroposterior (AP) The central ray travels in through the anterior aspect and exits the posterior

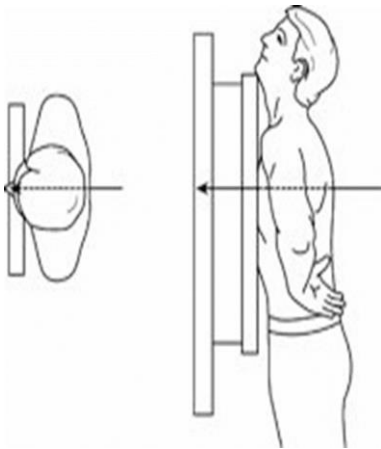
Posteroanterior (PA) The central ray travels in through the posterior aspect and exits the anterior

Oblique neither perpendicular nor parallel: at an angle

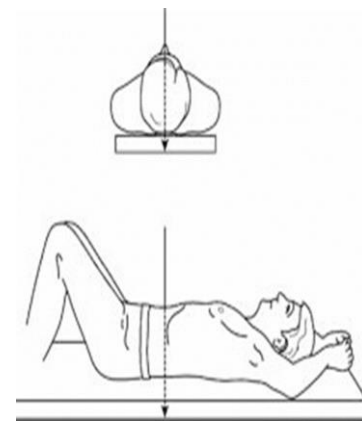
Lateral from the side

Tangential the central ray is skimming the body part

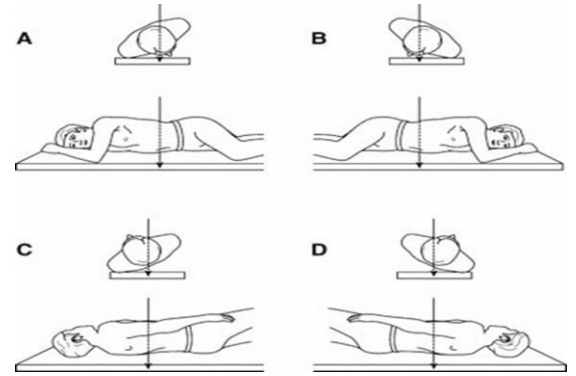
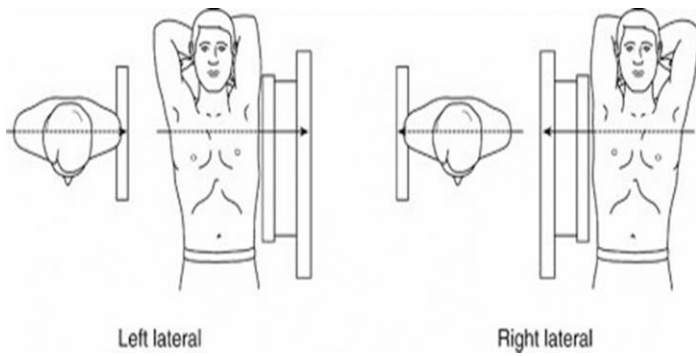
Axial a tilt of greater than 10 degrees is placed on the x-ray tube



Posteroanterior (PA)



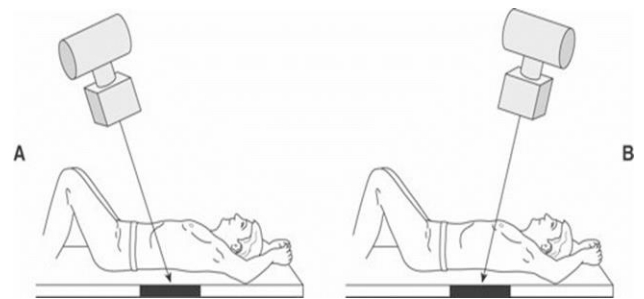
Anteroposterior (AP)



- A. Right Anterior Oblique**
- B. Left Anterior Oblique**
- C. Left Posterior Oblique**
- D. Right Posterior Oblique**



Tangential



Cephalid

Caudal

Body Types

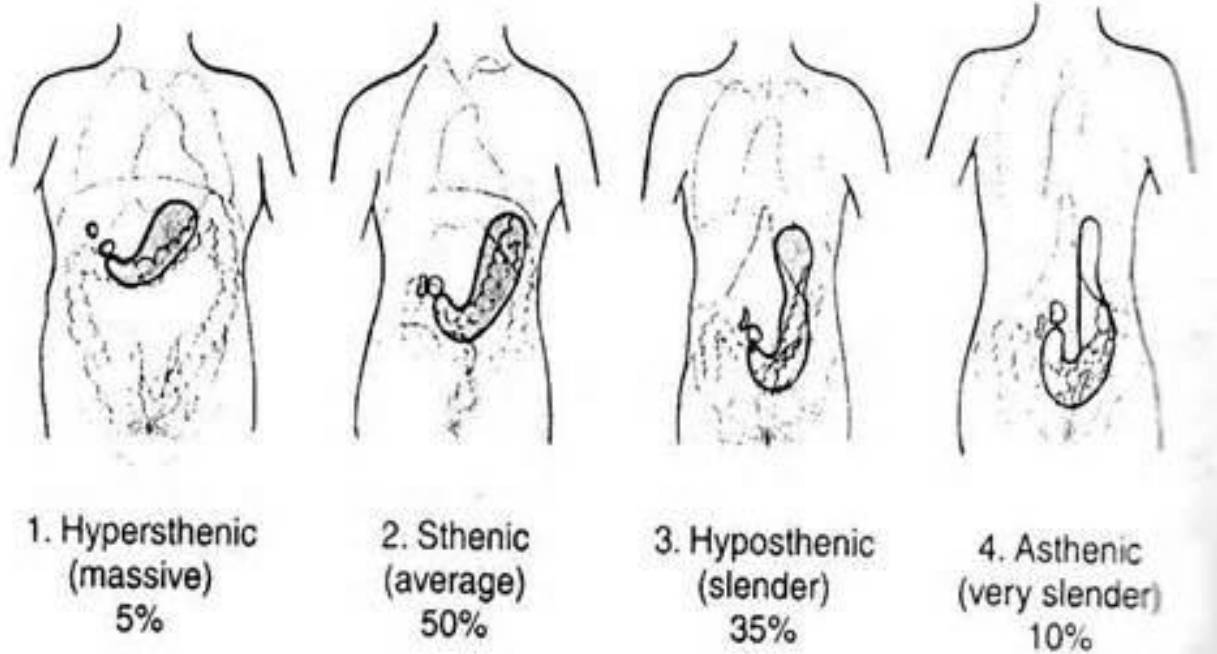
Four terms are generally used to designate the four major types of body habitus. Since the position of certain organs (for example, the gallbladder) can vary as much as 6 to 8 inches between body types, it is essential that the X-ray specialist be familiar with these major body types.

Hypersthenic: The hypersthenic body is of massive build with a broad and deep thorax. The diaphragm is high and the stomach and gallbladder also occupy high positions. An extreme body type, the hypersthenic classification accounts for only about five percent of all people.

Sthenic: Means active or strong. The sthenic body is the one we usually associate with the athletic type. The body is rather heavy with large bones. The sthenic body type is the predominant type, with about half of all people falling into this classification.

Hyposthenic: Slender and light in weight with the stomach and gallbladder situated high in the abdomen. About 35 percent of all people fall into this classification.

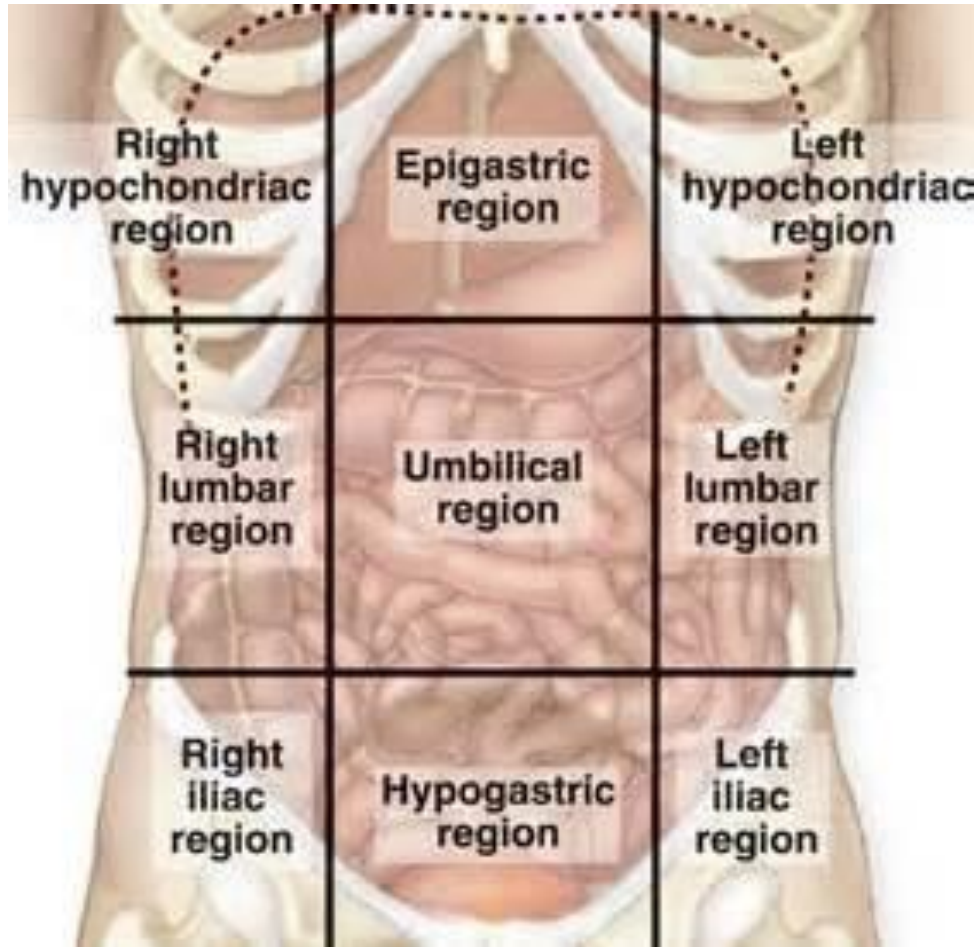
Asthenic: Extremely slender, light build, with a narrow, shallow thorax, and the gallbladder and stomach situated low in the abdomen. An extreme type, the asthenic classification accounts for only about ten percent of all people.



Regions of the Abdomen

The abdomen is that portion of the body that lies between the thorax and the pelvis. It consists of a large cavity, separated from the thoracic cavity by the diaphragm, bounded by muscles and fascia, and partially lined with a serous membrane called the peritoneum.

For purposes of description, the abdomen is divided into nine regions by means of two horizontal and two vertical lines. The upper horizontal line passes through the tenth costal cartilage inferiorly. The lower line passes through the level of the iliac tubercle. Each vertical line passes through the midpoint of a line drawn from the anterior superior iliac spine to the symphysis pubis.



Chapter 7 Quiz

Anatomy and Terminology

1. What is a *system*?
 - A. A similar group of tissues that work together to perform special functions
 - B. The highest level of structural organization of the human body
 - C. The lowest level of structural organization of the human body
 - D. A group of organs that work together to perform complex functions

2. How many bones compose the skeletal system?
 - A. 206
 - B. 412
 - C. 103
 - D. 260

3. What are the two basic divisions of the skeletal system?
 - A. Functional and nonfunctional
 - B. Axial and appendicular
 - C. Moveable and immovable
 - D. Bones and soft tissue

4. Which of the following are parts of the axial skeleton?
 1. Skull
 2. Spine
 3. Shoulders
 - A. 1 and 2 only
 - B. 1 and 3 only
 - C. 2 and 3 only
 - D. 1, 2, and 3

5. Which of the following are parts of the appendicular skeleton?
 1. Skull
 2. Pelvis
 3. Extremities
 - A. 1 and 2 only
 - B. 1 and 3 only
 - C. 2 and 3 only
 - D. 1, 2, and 3

6. Movement of a part away from the central axis of the body is called:
 - A. flexion.
 - B. extension.
 - C. adduction.
 - D. abduction.

7. What term is used to describe a straightened joint?
- A. Abduction
 - B. Adduction
 - C. Extension
 - D. Flexion
8. What does *supination (supine)* mean?
- A. To turn the arm so that the palm of the hand is up
 - B. To turn the arm so that the palm of the hand is down
 - C. To turn the arm so that the palm of the hand faces laterally
 - D. To turn the arm so that the palm of the hand faces medially
9. Which of the following describes anatomic position?
- A. Lying on one's back with arms and legs extended, palms turned outward, and toes facing anteriorly
 - B. Lying on one's back with arms and legs extended, palms turned backward, and toes facing anteriorly
 - C. Standing facing the observer with palms of hands turned forward and toes facing anteriorly
 - D. Standing facing the observer with palms of hand turned backward and toes facing anteriorly
10. What does the term *cephalad* mean?
- A. Toward the head
 - B. Away from the head
 - C. The front part of the body
 - D. The back part of the body
11. The term applied to the back portion of the body or body part is:
- A. anterior.
 - B. posterior.
 - C. cephalic.
 - D. caudal.
12. Which plane divides the body into equal right and left halves?
- A. Midcoronal plane
 - B. Midsagittal plane
 - C. Transverse plane
 - D. Axial plane
13. The midcoronal plane divides the body into:
- A. equal right and left halves.
 - B. equal superior and inferior halves.
 - C. equal anterior and posterior halves.
 - D. equal top and bottom halves.
14. Which body position term indicates that the patient is lying on his or her back?
- A. Supine
 - B. Prone
 - C. Lateral
 - D. Erect

15. When a patient is imaged in the prone position, the patient must be:
- A. standing upright.
 - B. placed in a recumbent position on his or her stomach.
 - C. placed in a recumbent position on his or her back.
 - D. placed in a recumbent position on his or her side.
16. What term is used to describe the path of the CR from the radiographic tube, through the patient, and to the IR?
- A. Position
 - B. Projection
 - C. Tangential
 - D. Image receptor
17. An axial projection is achieved when the:
- A. patient is in a recumbent position.
 - B. CR “skims” the profile of the part.
 - C. CR is angled longitudinally more than 10 degrees.
 - D. CR is horizontal.
18. When the long side of the IR is placed perpendicular to the long axis of the body, then the IR placement is:
- A. lengthwise.
 - B. crosswise.
 - C. incorrect.
19. In radiography, what three items must be precisely aligned?
- A. The x-ray tube, the IR, and the CR
 - B. The CR, the IR, and the collimator field light
 - C. The CR, the body part, and the collimator field light
 - D. The x-ray tube, the IR, and the body part
20. What is indicated by a side marker?
- A. The side of the IR
 - B. The side of the patient
 - C. The side of the x-ray tube
 - D. The side of the collimator field light
21. What is the result of imaging patient motion on a radiograph?
- A. Good image quality
 - B. Increased density
 - C. Decreased density
 - D. Blurring of the