Bone tissue

The hard mineralized tissue of that forms the bones (the organs of skeletal system)

- Bones support the body's weight and protect and anchor organs
- Bone tissue matrix = Mostly calcium phosphate crystalized on collagen fibers
- Compact bone = Dense, solid bone material (few open spaces)
- Spongy bone = Bone with many open spaces inside

Figs 6.9 and 7.2

Ossification

Covering of the embryo's cartilage skeleton with true bone tissue

- Osteoblasts = cells that ossify cartilage
- Medullary cavity = the space in bone where the cartilage template used to be

Figs 6.7, 6.11, and 6.17; Table 6.3

Marrow

The tissue that fills the medullary cavity

- Red marrow = tissue that forms blood cells
- Yellow marrow = adipose tissue

Figs 6.5 and 6.7

Longbones

Bones that with a long tubular shape

- Examples: The bones of the arms and the legs

Figs 6.6 and 6.7

Diaphysis

The shaft of a longbone

- Periosteum = A sheath of dense connective tissue surrounding the diaphysis
- Mostly compact bone

Figs 6.7 and 6.8

Epiphysis

The ends of a longbone

- Mostly spongey bone

Fig 6.7

Epiphyseal plate

An area of hyaline cartilage (between the epiphysis and diaphysis) where the growth of the bone occurs

- Cartilage continuously made and ossified inward (until puberty)
- Increases length of diaphysis
- Epiphyseal line = ossified remnant of epiphyseal plate in adult bone

Figs 6.7 and 6.19

Articulation (joint)

Where bones meet

Articular cartilage

Hyaline cartilage that covers the tip of the epiphysis

- Articular cartilage provides smooth rubbery surface to protect the tips of the bones in the joint

Fig 6.7

Osteon (Haversian system)

Microscopic circular structures that bone tissue is composed of

- Central canal = A canal through the bone that holds blood vessels
- Lamella = The rings of bone tissue that surround the central canal
- Osteocyte = A bone cell inside the bone matrix
  - √ Lacuna = small space where osteocyte is located
- Caniculus = Tiny lateral canals that carry nutrients from the central canal to the osteocytes

Figs 6.12 and 6.13

Osteoclasts

Bone cells that break down bone material to increase calcium level in blood

Fig 6.11 and table 6.3

Bone fractures (broken bones)

When a bone breaks into two or more pieces

- Closed fracture (simple fracture) = Bone pieces remain inside skin
- Open fracture (Compound fracture) = Ends of broken bone pierce skin

Fig 6.20; Table 6.4

Osteoporosis

Thin or fragile bones

- Usually associated with aging (especially in women)
- Other causes:
  - √ Low calcium diet
  - √ Low vitamin D
  - √ Lack of exercise

Fig 6.23; Table 6.5

Rickets

A childhood disease of soft bones

- Leg bones bow outward
- Cause: Low calcium or low vitamin D

Some terms to describe bone structures:

Foramen = An tunnel through a bone (usually to allow passage of blood vessels, nerves, or tendons)

Process = A ridge or projection from a bone (usually an attachment site for muscles)

Head = An round enlargment at the end of a bone (usually where the bone fits into a socket in another bone)

Table 6.2

Human skeleton

The 206 bones in the human body

- Axial skeleton = the bones of the central body axis
- Appendicular skeleton = the bones of the limbs

Fig 7.2

Axial skeleton

The bones of the skull, the vertebral column (spine), and the thorax

Fig 7.2

Skull

The bones of the head (the cranium and facial bones)

Fig 7.3

Cranium bones:

The 8 bones that surround and protect the brain

- Know the names and locations of the 8 cranial bones:

Frontal	Occipital
Parietal (2)	Ethmoid
Temporal (2)	Sphenoid

Fig 7.5, 7.7, 7.8, 7.9, and 7.11

Some features of the temporal bones:

- Zygomatic process = The process that forms the posterior part of the cheeks (it serves as an attachment site for jaw muscles)

- Mastoid process = An attachment site for several neck muscles

- Styloid process = An attachment site for tongue/throat muscles

- External auditory meatus = A hole that leads to the inner ear

Fig 7.5 and 7.7

Some features of other cranial bones:

- Foramen magnum = Opening in the occipital bone that allows the spinal cord to enter the brain

- Sutures = Zig-zag lines that mark the joints between cranial bones

- Fontanels = Unossified areas of the fetal/newborn skull

  √ They allow cranial flexibility for birth and brain growth

Fig 7.5, 7.7, 7.8, 7.9, and 7.33

Facial bones:

The 14 bones that form the face

- Know the names and locations of the 14 facial bones:

Mandible	Palantine (2)
Maxillary (2)	Nasal (2)
Vomer	Inferior nasal concha (2)
Zygomatic (2)	Lacrimal (2)

Fig 7.4, 7.5, 7.8, 7.11, and 7.16

Some features of the skull

- Eye orbits (eye sockets) = The cavities in the skull that house the eyes

- Nasal cavity = The cavity in the skull that houses the nose

- The paranasal sinuses = Hollow spaces inside certain skull bones

Figs 7.4, 7.16, and 7.18

Vertebral column (spine)

The medial bones of the back

- Supports the weight of the upper body
- Protects spinal cord

Fig 7.20

Vertebrae

The individual bones that form the spine

- Body = Solid disc that bears weight (anterior side)
  - √ Intervertebral disc = cartilage disc that separates and cushions neighboring vertebrae
- Vertebral arch = Ring shaped part of vertebrae (posterior side)
  - √ Vertebral foramen = hole that spinal cord passes through
  - √ Vertebral canal = the tube formed by all vertebral foramen together
- Three processes from vertebral arch
  - √ The spinous process points posteriorly
  - √ The two transverse processes point laterally

Figs 7.23, 7.24, and 9.3

Structure of spine:

Fetus has 33 vertebrae

- Superior 24 remain unfused throughout life
- Next lower 5 fuse to form sacrum before birth
- Inferior 4 fuse to form coccyx before birth

The adult spine is subdivided into five regions:

- The cervical vertebrae ($C_1 – C_7$) = The seven superior-most vertebrae (unfused)
  - √ The Atlas = C_1, it articulates with the occipital bone of the skull
  - √ The Axis = C_2, it allows the atlas and skull to rotate (so we can turn our heads left or right)
- The thoracic vertebrae ($T_1 – T_{12}$) = The next twelve vertebrae that are inferior to C_7 (unfused)
  - √ Each thoracic vertebrae attaches to one pair of ribs
- The lumbar vertebrae ($L_1 – L_5$) = The five vertebrae inferior to T_{12} (unfused)
- The sacrum = The spinal bone inferior to L_5. The sacrum is formed from fusion of five fetal vertebrae (25-29)
- The coccyx (tailbone) = The spinal bone inferior to the sacrum. The coccyx is formed from fusion of four fetal vertebrae (30-33)

Figs 7.20, 7.25, 7.26, 7.27, 7.28, and 7.29

The thoracic cage

The sternum, the 12 pairs of ribs, and the 12 thoracic vertebrae

• Protects the organs inside the thoracic cavity

Fig 7.32

Sternum

The bone that forms the front of the thoracic cage and provides the anterior anchoring point for the ribs

• The sternum has three regions (the manubrium, the body, and the xiphoid process) that were three separate bones in the fetus

Fig 7.32

Costal Cartilages

The cartilage at the end of a rib

Fig 7.32

Ribs

The twelve pairs of bones that form the lateral walls of the thorax

• True ribs = the 7 superior rib pairs (their costal cartilages connect directly to the sternum)

• False ribs = the 5 pairs of ribs below the true ribs (their costal cartilages do **not** connect with the sternum)

√ The costal cartilages of the superior 3 false ribs connect to the costal cartilage of lowest true rib

√ The inferior 2 false ribs (the "floating ribs") do not have any anterior connection at all (no costal cartilage)

Fig 7.32

Appendicular skeleton

The bones of the limbs and the girdles (bones between limb bones and axial bones)

Fig 8.2

Shoulder (pectoral) girdles

The bones at the junction of the arm bones and the thorax

- Each shoulder girdle = a clavicle and a scapula

Fig 8.3

Clavicle (collarbone)

A slender bone that articulates with the sternum and the scapula

Fig 8.3

Scapula (shoulder blade)

A triangular bone of the shoulder girdle

- Articulates with clavicle and humerus (arm bone)
- Acromion = A process in the scapula where the clavicle articulates
- The spine = A ridge on the scapula where several muscles attach
- The glenoid cavity = A depression in the scapula where the humerus articulates

Figs 8.3 and 8.4

Humerus

The arm longbone

- Head = rounded proximal end that fits into the glenoid cavity of the scapula

Fig 8.5

Radius and ulna

The two bones of the forearm

- In anatomical position, the ulna is medial and the radius is lateral

√ The distal ends of the bones cross when we turn our palms inward

Fig 8.6

Carpals

The 8 bones of the wrist

Fig 8.7

Metacarpals

The 5 bones of the palm

Fig 8.7

Phalanges

The bones of the fingers

- Each finger has three phalanges (except the thumb, which has two)

Fig 8.7

The pelvis

The two hip bones, the sacrum, and the coccyx

- Shaped like bowl with hole in the bottom
- Supports weight of the spine and protects pelvic organs

Fig 8.12

Hip bones

The pair of bones that form the sides and the front of the pelvis

- The two hip bones are together called the pelvic girdle
- Obturator foramen = A large foramen at the bottom of each hip bone
    - √ Allows blood vessels and nerves to pass into thigh
- Each hip bone is has three regions (the ilium, the ischeum, and the pubis) that were three separate bones in the fetus
- Acetabulum = The depression in the hip bone where the femur articulates
- False pelvis = The diameter across the top of pelvic girdle
- True pelvis = The diameter across the opening at the bottom of the pelvic girdle
    - √ Women have a wider true pelvis than men

Figs 8.12, 8.13, 8.14, and 8.15

Femur

The thigh bone

- Head = rounded proximal end that articulates with the hip bone
- Distal end articulates with patella (kneecap) and tibia (shin bone)

Fig 8.16

Patella (kneecap)

A small bone that articulates with the femur and the tibia

- Protects knee joint

Fig 8.16

Fibula and tibia

The two bones of the leg

- Tibia (shinbone) = The larger and more medial leg bone
- Fibula = The smaller and more lateral leg bone
  - √ Articulates proximally with tibia (**not** with femur or patella)
- The lateral malleolus (on the fibula) and the medial malleolus (on the tibia) = Large knobs at the distal ends of the leg bones
  - √ They form the bulges at the sides of the ankle

Fig 8.18

Tarsals

The 7 bones of the ankle

- The two largest tarsals are the calcaneus (the heel bone) and the talus (the tarsal between the tibia and the calcaneus)

Fig 8.19

Metatarsals

The 5 bones of the sole

Fig 8.19

Phalanges

The bones of the toes

- Each toe has three phalanges (except the big toe, which has two)

Fig 8.19

Articulations (joints)

Where bones meet

- All joints have ligaments and other dense connective tissues on the outside of the joint to hold the bones together

- There are three different kinds of joints (based on the three different materials that can be found between the jointed bones)

  √ Fibrous, cartilaginous, and synovial are the three joint types

Fibrous joints

Bones joined by dense connective tissue

- Usually no mobility

- Example: The cranial bone joints (the sutures)

Figs 9.2 and 9.5

Cartilaginous joints

Joints with a disk of fibrocartilage between the bones of the joint

- Usually a small amount of mobility

- Example: Vertebrae are connected by cartilage discs (the intervertebral discs)

Figs 9.3 and 9.7

Synovial joints

Joints where synovial fluid fills the joint cavity between the bones

- The joint type with the greatest mobility

- The joint cavity is filled with synovial fluid, and surrounded by a synovial membrane, a fibrous capsule, and ligaments

- Example: Shoulder, knee, and hip joints

Fig 9.8

Dislocation

When a bone is forced out of its normal position in a joint

Sprain

When a joint's reinforcing ligaments are torn

Arthritis

Any disease of the joints that causes pain and reduced mobility

- Osteoarthritis = A mild type of arthritis caused by normal "wear and tear" on the articular cartilage
  - √ Bone spurs develop
  - √ Most common in senior citizens
- Rheumatoid arthritis = An autoimmune disease where the immune system destroys the articular cartilage
  - √ Joints may become completely ossified
- Gout = A painful form of arthritis caused by build up of uric acid in the joints
  - √ Gout can immobilize joints if not treated, but there are several drugs that prevent it

Fig 9.11