Biology 109
Lab Handout
Bone Organization and Anatomy

Skeletal Organization

Divisions of the skeleton:

A. *Axial skeleton*

1. Skull- Composed of the cranium (brain case), facial bones and sutural bones.
2. Hyoid bone- Located in the neck between the lower jaw and the larynx. Does not articulate with any other bones in the body. It supports the tongue.
3. Vertebral column- Composed of many vertebrae separated by cartilage disks. Near the bottom, vertebrae fuse to form the sacrum, four rudimentary vertebrae fuse to form the coccyx bone.
4. Thorax- Composed of the ribs and sternum. Protects the thoracic and part of the abdominal cavity.

B. *Appendicular skeleton*- Consists of bones of the upper and lower limbs and those bones that anchor those limbs to the axial skeleton.

1. *Pectoral girdle*- Composed of the scapula and the clavicle. Connects upper limbs to the axial skeleton and aids in upper body movements.

2. *Upper limbs*- Consists of the humerus, ulna, radius, and the hand (carpals, metacarpals, and phalanges).

3. *Pelvic girdle*- Composed of two coxal bones (illium, ischium, pubis), which are attached to the sacrum (part of the axial skeleton). The pelvic girdle connect the bones of the lower limbs to the axial skeleton (the sacrum and coccyx).
**The sacrum, coccyx, and the coxal bones form the pelvis.

4. Lower limbs- Consists of the femur, tibia, fibula, the patella, and the foot (tarsals including calcaneous, talus, & metatarsals, phalanges).

Bone markings (These are here to help you study and understand, you will not be tested on them directly).

A. Depressions and openings
1. Fossa- A shallow depression
2. Sinus- A chamber found within a bone
3. Foramen & canals- A rounded passageway for blood vessels and/or nerves
4. Meatus- Opening of a passageway
5. Fissure- an elongated cleft

B. Projections and processes
1. *Those that fit into joints*
a. Condyle- A smooth rounded process that articulates with another bone
b. Head- The expanded end of an epiphysis, separated from the shaft by a narrower neck
c. Trochlea- A smooth, grooved articular process shaped like a pulley

2. *Those to which tendons and ligaments attach*
    a. Trochanter- A large rough projection
    b. Tuberosity- A smaller, rough projection
    c. Tubercle- A small, rounded projection
    d. Crest- A prominent ridge
    e. Spine- A pointed process

Please know all of the information on the following pages.

Bones and Markings of the Skull

Bones of the Skull *(In Blue)*:

1. Nasal
2. Maxilla
3. Lacrimal
4. Ethmoid
5. Sphenoid
6. Vomer
7. Zygomatic
8. Mandible
9. Palatine
10. Frontal
11. Parietal
12. Occipital
13. Temporal

Bone Markings *(In Green)*:

1. Zygomatic process
2. Foramen magnum
3. Mandibular condyle
4. Mental foramen
5. Mandibular foramen (novacaine goes here)
6. Inferior nasal concha
7. Middle nasal concha
8. Mandibular fossa (found near mandibular condyle)
9. Mastoid process
10. Optic canal
11. Superior orbital fissure
12. Inferior orbital fissure
13. External auditory meatus
14. Styloid process
15. Occipital condyle

You should be able to identify these <u>disarticulated bones</u>: femur, tibia, fibula, humerus, ulna, radius, axis, atlas, any cervical vertebrae, any thoracic vertebrae, any lumbar vertebrae, coxal bone, sacrum, scapula, clavicle, coccyx, calcaneus, mandible, and sternum.

You should be able to decide if the following bones are of the <u>left or right side</u>: humerus, ulna, radius, scapula, coxal, femur, and tibia.

Shoulder Girdle, Pelvic Girdle, Arms, and Legs

Pectoral Girdle (shoulder girdle) Supports upper limbs & provides attachment points for muscles.

A. *two clavicles*

1. "S" shaped bones. It is easily broken, why? (2)
2. The clavicles brace the movable scapulas, holding the shoulders in place.
3. Provides attachment points for muscles of the upper limbs, chest, and back.

B. *two scapulas* - broad, flat, triangular bones.

1. Each scapula has a spine (a bony process that divides the scapula into unequal halves). The spine has a head called the acromion process. The acromion articulates with the acrominal end of the clavicle. The spine also provides attachment points for muscles for the upper limbs and chest.
2. Near the acromion process is a coracoid process. This provides additional attachment points for muscles for the upper limbs and chest.

Upper Limbs

A. *Humerus*

1. head- articulates with the scapula within the glenoid cavity of scapula
2. greater tubercle- attachment points for muscles
3. lessor tubercle- attachment points for muscles
4. deltoid tuberosity- attachment points for the deltoid
5. lateral epicondyle- attachment point for muscles and ligaments of the elbow
6. medial epicondyle- attachment point for muscles and ligaments of the elbow
7. trochlea- articulates the ulna
8. capitulum- articulates with the radius
9. olecranon fossa- receives the olecranon process of ulna when the elbow is straightened
10. coronoid fossa- receives the coronoid process of ulna when the elbow is bent

B. *Ulna*

1. trochlear notch- articulation point for the trochlea of the humerus
2. olecranon process- attachment points for muscles that straighten the limbs. This process fits into the olecranon fossa of humerus
3. coronoid process- attachment points for muscles, it fits into the coronoid fossa of the humerus
4. styloid process- provides attachment points for ligaments of wrist, always medial
5. radial notch- articulates with radial head of radius

C. *Radius*

1. head- articulates with the capitulum of the humerus and the radial notch of ulna
2. radial tuberosity - provides attachment points for muscles
3. styloid process- provides attachment points for ligaments, always lateral

D. Hands- including carpals, metacarpals, and phalanges (proximal, middle, distal).

Pelvic Girdle

A. The pelvic girdle is composed of two coxal bones

1. Each coxal bone is composed of three fused bones, the ischium, ilium, and pubis bones. These bones form a depression called the acetabulum which allows the femur to articulate with each coxal bone.
2. The ilium has a bony prominence called the iliac crest. This provides attachment points for ligaments and is often used as a landmark.
3. The ischium has the ischial tuberosity which supplies attachment points for ligaments and lower limb muscles.
4. The two pubis bones come together to form the pubic arch.
5. Greater and Lesser sciatic notch- nerves and blood vessels through here

B. Differences in the male and female pelvis:

1. the iliac bones in a female are usually more flared, making the hips of a female broader than a male's.
2. If the greater sciatic notch is about 90 degrees, then it probably a female. If the greater sciatic notch is less than 90 degrees, then it is probably male.
3. pelvic brim usually wider
4. Bones of a female are usually lighter, and have less muscle attachments

Lower Limbs

A. *Femur*

1. head- articulates with the acetabulum of the coxal bone
2. neck-
3. greater and lesser trochanter- attachment points for the muscles of the legs and buttocks
4. lateral and medial condyles- articulates with the tibia at the tibial condyles
5. lateral and medial epicondyles- attachment points for muscles and ligaments
6. patellar surface- patella articulates here

B. *Tibia*

1. medial and lateral condyles- articulate with the femur at femural condyles
2. tibial tuberosity- always anterior, provides attachment points for the patellar ligament
3. medial malleolus- attachment points for ligaments and articulates with ankle, always medial

C. *Fibula*- always lateral to tibia

D. Feet

1. Talus- one of the tarsals, articulates with tibia
2. Calcaneous- heel bone
3. Tarsals (talus and calcaneous are considered tarsals as well)- make up some of the ankle bones
4. Metatarsals- make up arch of foot
5. Phalanges- toes
    a. Proximal b. Middle c. Distal Which toe lacks a middle phalange?

The Spinal Column

The vertebral column

A. *Typical vertebrae structure*

1. Body- supports the weight of the trunk
2. Intervertebral disks- made from fibrocartilage, found between vertebrae, used for shock absorbing
3. Transverse and spinous processes- ligaments and muscles are attached here
4. Articulating processes (superior and inferior)- each vertebrae is attached to another by these processes, where the superior of one vertebrae will articulate with the inferior of another
5. Vertebral foramen- the hole through the bone that the spinal cord passes, provides protection

B. Specialized Vertebrae

1. *Cervical vertebrae*- 1-7 vertebrae- most specialized and unique in structure

a. Smallest of the the vertebrae

b. These vertebrae are unique because they have transverse foramina (found within the transverse process), which provide passageways for arteries leading to the brain.

c. Most also have bifed (two forks) spinous process.

d. Vetebra prominens- a process of the 7th vertebrae, used as an enternal landmark

e. atlas- the first vertebrae, superior portion articulates with the occipital condyles of the skull, inferior portion articulates with axis

f. axis- has a process called the dens in which the atlas rotates around when the head is turned from side to side. Forms one of only two pivot joints in the body. Where is the other?

2. *Thoracic vertebrae*- next 12 (8-19)- articulates with all 12 ribs

a. Larger than the cervical vertebrae, but smaller than lumbar

b. most of them have a long spinous process that slopes downward

c. has rib facets on the sides of the body, which articulates with the ribs, each vertebrae will have four total facets, two on the body and two on the transverse processes

3. *Lumbar vertebrae*- next 5 (20-24)

a. Largest and strongest of all the vertebrae (why?)

b. short spinous process is almost hortizontal

4. *Sacrum*- 5 vertebrae that fuse totally between the ages of 18-30

a. These bones are wedged between the coxal bones of the pelvis, and this articulation allows the body's weight to be transmitted to the legs. Together the sacrum and the coxal bones form the pelvis.

5. *Coccyx*- 4 vertebrae that have fused by the age of 25

a. Ligaments attach this bone to the margines of the sacral hiatus of the sacrum

b. Upon sitting the coccyx moves forward acting as shock absorber, can lead to a painful injury.

Thoracic cage

A. Ribs- 12 pairs of ribs that articulate with the 12 thoracic vertebrae

a. First 7 pair are called true ribs, they join directly to the sternum with costal cartilage

b. Last 5 pair are called false ribs because their cartilages do not join the sternum directly while the last two (floating ribs) do not ever join the sternum.

c. Ribs are composed of:

1. shaft
2. the head
3. the tubercle - both the tubercle and head articulate with the thoracic vertebrae at two facets

B. Thoracic vertebrae

C. Sternum

a. attaches to most of the ribs (except floating)

b. Xiphoid process - provides attachment points for abdominal muscles (rectus abdominis)

D. Costal cartilage (hyaline cartilage) that attaches ribs to sternum