Human Functional Anatomy
Musculoskeletal Lab Notes and Guide

Station #1 Vertebral Column
Objectives:
1. Identify the parts of a typical vertebrae
2. Identify cervical, thoracic, lumbar, sacral, coccygeal vertebrae and identify the anatomical differences between the various vertebrae.
3. Demonstrate the movements of the vertebral column. Identify the plane that each movement occurs within.

Bones:
The vertebral column is composed of 33 vertebrae, extending from the base of the skull to the tip of the coccyx. (Not shown on the skeleton are the intervertebral discs and the ligaments which hold the vertebrae together).

With the help of a text or atlas, work together to identify the parts of a typical vertebral segment.
A typical vertebrae is composed of a body and a vertebral arch (neural arch). The vertebral arch and the back of the vertebral body forms the vertebral foramen. The vertebral foramina form the vertebral canal which houses and protects the spinal cord. The vertebral arches are formed by two pedicles and two lamina which unite posteriorly as a spinous process. Notches in the pedicles form the intervertebral foramina through which the roots of the spinal nerves exit the vertebral column. Adjacent vertebrae articulate with each other via the superior and inferior articular facets. Transverse and Spinous processes project from the lateral and posterior aspects of the vertebrae to provide broad attachment points for ligaments and muscle. Intervertebral discs are found between each of the cervical, thoracic, and lumbar vertebrae.

With the help of a text or atlas, work together to identify the regional differences of the cervical, thoracic, lumbar, and sacral vertebrae.
1. Cervical Vertebrae:
There are seven cervical vertebrae. These vertebrae have small bodies and a bifid spinous process. With the exception of the 7th cervical vertebrae, these vertebrae have foramen in the transverse process, the transverse foramen for passage of the vertebral artery. The first cervical vertebra, the atlas lacks a body and spine. It has anterior and posterior arches and two lateral masses. It articulates with the occipital condyles of the skull. The second cervical vertebra, the axis, is characterized by its odontoid process. The odontoid process has anterior and posterior articular facets. A transverse ligament helps hold it in place. The 7th cervical vertebra, the vertebra prominens, is so named for its prominent spine.

2. Thoracic Vertebrae
There are twelve in number. They are characterized by: facet on the vertebral body for head of rib; facet on transverse process for tubercle of rib; long spinous processes which are directed obliquely downwards (orientated like shingles on a roof). Vertebral bodies 1,10,11,12 have circular facets
(whole facets) on the sides of the bodies; the rest of the vertebrae have demifacets on the sides of the bodies.

3. Lumbar Vertebrae
There are five in number. They are characterized by large kidney shaped bodies greater in transverse diameter; and large, oblong, spinous process. A horizontal line drawn from the highest point of the iliac crests runs through the spinous process of L4.

4. Sacral Vertebrae
Five in number and are fused together to form a single piece, the sacrum. The superior end has a “sacral promontory” which articulates the body of L5. It has 4 anterior sacral foramina (analogous to intervertebral foramen) and four posterior sacral foramina for exit of ventral or dorsal rami of the first four sacral nerves. Note the Median crest which is analogous to spinous processes of the upper vertebrae, and the Lateral crests which is analogous to transverse processes.

Work together to describe which plane in which each of the following movements are occurring. Which spinal region is primarily responsible for providing the spinal range of motion required to perform each of the following movements. Why?
1. Performing a shoulder check when driving your car.
2. Golf swing.
3. Sitting up in bed.
Station #2: Upper Extremity

Objectives
1. Name and identify the main bones of the upper extremity.
2. Name and demonstrate the key movements that take place at the major joints of the upper extremity. In which plane does each movement occur.
3. Name, identify, and demonstrate the actions of key muscles of the upper extremity.

Bones of the Upper Extremity:
The pectoral or shoulder girdle is comprised of the clavicle, scapulae and proximal humerus. The pectoral girdle not only serves as an attachment of the upper limb to the axial skeleton, but also serves as a strut placing the upper limb in a position in which it can move freely. The pectoral girdle also transmits forces to the axial skeleton.

With the help of a text or atlas, work together to identify the key features of the following bones.
1. **Scapula**: spine of scapula, the supraspinous and infraspinous fossa, acromion, coracoid process, glenoid cavity, the inferior angle, and the vertebral and lateral borders.
2. **Humerus**: articular head, greater and lesser tubercles, shaft, medial and lateral epicondyles, trochlea and capitulum. Note the groove between the tubercles, the intertubercular groove, also known as the bicipital groove.
3. **Ulna**: olecranon process, head and styloid process.
4. **Radius**: head, neck, and styloid process.
5. **Wrist carpal bones**.
6. **Metacarpals and Phalanges**: base, shaft and head of each

Joints of the Upper Extremity:
On the skeleton, work together to locate the following joints. Name and demonstrate the movements that take place at each joint.
1. **Glenohumeral joint** (shoulder joint): Note that the articular surfaces, the head of the humerus and the glenoid cavity are covered with cartilage.
2. **Elbow joint**: The trochlear notch of the ulna and the head of the radius articulate with the trochlea and capitulum. Note the extensive origins of the muscle. The muscle fibers converge into a tendon which inserts into the humerus. The action of this muscle is to extend, adduct and medially rotate the arm at the shoulder joint.

Muscles of the Upper Extremity:
On a prosected specimen, work together to identify the following muscles of the upper extremity and then demonstrate their actions yourself.
1. Superficial Back and Shoulder
   a. **Trapezius**: it elevates and retracts the scapula (as in shrugging your shoulders); it also helps rotate the scapula during abduction of the arm.
   b. **Deltoid**: note the 3 heads of the deltoid muscle. It abducts / flexes / extends the arm.
   c. **Latissimus dorsi**: Note the extensive origins of the muscle. The muscle fibers converge into a tendon which inserts into the humerus. The action of this muscle is to extend, adduct and medially rotate the arm at the shoulder joint.
2. Muscles of the Pectoral Region  
   a. Pectoralis major: Major actions are to adduct the arm and medially rotate it.

3. Muscles of the Upper Arm  
   a. Biceps brachii: Note that it has two heads of origin from the scapula. It has several actions: 1. It is a flexor of the arm at the shoulder joint; 2. It is a strong flexor of the forearm at the elbow joint; 3. It is a strong supinator of the forearm.  
   b. Triceps: It originates from the scapula and the humerus, inserts into the olecranon process of the ulna, and powers elbow extension.

4. Hand  
   The thenar and hypothenar muscle groups of the hands.
Station #3: Lower Extremity

Objectives
1. Name and identify the main bones of the lower extremity.
2. Name and demonstrate the key movements that take place at the major joints of the lower extremity.
3. Name, identify, and demonstrate the actions of key muscles of the lower extremity.

Bones of the Lower Extremity
The pelvis is comprised of the two hip bones (innominate bones) and sacrum. Each individual innominate bone is comprised of three separate bones (parts): the ilium, the ischium, and the pubis. These three bones come together to form a depression for articulation with the femur, the acetabulum. Note how the head of the femur fits into the acetabulum.

With the help of a text or atlas, work together to identify the key features of the following bones.
1. Femur: head, neck, greater trochanter, lesser trochanter, shaft, medial and lateral condyles.
2. Lower Leg: tibia, fibula, medial and lateral condyles of the tibia, head of the fibula, medial and lateral malleolus of the ankle.
3. Foot: Identify the tarsal, metatarsal and phalanges. Identify the heel bone (calcaneus) and talus specifically.

Joints of the Lower Extremity:
On the skeleton, work together to locate the following joints. Name and demonstrate the movements that take place at each joint.
1. Hip joint (femoral – acetabular joint): Note the congruency of the articular surfaces, and the depth of this ball & socket type synovial joint.
2. Knee joint: Note the large number of ligaments (collaterals/cruciates) involved in stabilizing this condylar joint. Note how the fibro-cartilage (menisci) deepen the contact points for the femur on the tibia, and add to the stability of the joint.
3. Ankle joint: Note how the ankle is comprised of two joints that each have specific functions:
   1. Talo-crural joint (between talus and the medial/lateral malleolus – planter/dorsi flexion)
   2. Sub-talar joint (between talus and calcaneus – inversion and eversion)

Muscles of the Lower Extremity:
On a prosected specimen, work together to identify the following muscles of the lower extremity and then demonstrate their actions yourself.
1. Muscles of the Gluteal Region
   a. Gluteus maximus: Most superficial muscle in buttocks region. It is a powerful extensor of the hip joint and contributes to lateral rotation.
   b. Gluteus medius: Located deep to gluteus maximus. It abducts and medially rotates the thigh. In addition it steadies the pelvis, preventing the pelvis from dropping during walking. (Note: When you lift your right foot off the ground it is the left g. medius that stabilizes the pelvis).
   c. Piriformis: One of the lateral rotators of the thigh. The piriformis muscle is often
described as having a key position in the gluteal region. Many other structures in the area can be identified with respect to the position of the piriformis.

2. Thigh Region (quadriceps, hamstrings & groin muscles)
   a. Iliopsoas: originates in the abdomen and pelvis and is a combination of two muscles: the iliacus and the psoas major. It is a powerful flexor of the thigh.
   b. Quadriceps femoris: This muscle actually consists of 4 separate heads which insert together onto the patella. The four muscles which make up the quadriceps are: rectus femoris, vastus lateralis, vastus intermedius and vastus medialis. It flexes the hip (rectus femoris portion only) and extends the knee joint.
   c. Hamstrings: Located in the posterior compartment of the thigh and is often referred to as the flexor compartment. Consists of three separate muscles: semimembranosus, semitendinosus and the biceps femoris muscle. These muscles function to power flexion at the knee joint and extension of the thigh at the hip joint.
   d. Adductors: The muscles of the medial compartment of the thigh are primarily adductors of the thigh. Hence this compartment is often referred to as the adductor compartment of the thigh. It is comprised of 5 individual muscles: pectineus, adductor brevis, adductor longus, adductor magnus and gracilis.

3. Muscles of the Lower Leg
   a. Anterior Compartment: Muscles of this compartment power dorsi-flexion of the ankle and extension of the toes. The 3 muscles are (moving from medial to lateral): tibialis anterior, extensor hallucis longus, and extensor digitorum longus.
   b. Lateral (Peroneal) Compartment: Includes two muscles: peroneus longus & brevis. These muscles are evertors of the ankle and foot.
   c. Posterior Compartment of the Leg: The function of the muscles in the posterior compartment is plantar flexion of the ankle and flexion of the toes. The compartment can be divided into 2 regions each comprised of 3 muscles: 1. Superficial: Includes what we classically refer to as the calf muscles. They include: gastrocnemius, soleus and plantaris. All insert into the calcaneus via the tendo-calcaneous (or Achilles tendon). 2. Deep: These muscles power eversion of the ankle and flexion of the toes. They include tibialis posterior, flexor hallucis longus and flexor digitorum longus.