The Appendicular Skeleton

A skeletal system lab activity using Visible Body’s Human Anatomy Atlas

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This lab activity is aligned with Visible Body's Human Anatomy Atlas app.

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PRE-LAB EXERCISES

When studying the skeletal system, the bones are often sorted into two broad categories: the axial skeleton and the appendicular skeleton. This lab focuses on the appendicular skeleton, which is formed from the pectoral and pelvic girdles and the upper and lower limbs.

In addition to learning about all the bones of the appendicular skeleton, it is also important to identify some significant bone markings. Bone markings can have many shapes, including holes, round or sharp projections, and shallow or deep valleys, among others. These markings on the bones serve many purposes, including forming attachments to other bones or muscles and allowing passage of a blood vessel or nerve. It is helpful to understand the meanings of some of the more common bone marking terms.

Before we get started, look up the definitions of these common bone marking terms:

**Canal**: a tunnel through a bone

**Condyle**: a rounded projection that articulates with another bone

**Facet**: a flat articular surface that may form a joint with another facet or flat bone

**Fissure**: a long narrow opening that allows for passage of blood vessels or nerves

**Foramen**: (see Module 10.18 Foramina of Skull) a round hole that allows for passage of blood vessels, nerves, muscles, or other structures

**Fossa**: a shallow depression

**Margin**: the edge of a bone

**Process**: a raised area or projection

**Proximal**: closer to the trunk of the body

**Trochanter**: one of two large rough processes on the femur

**Tubercle**: a small rounded process

**Tuberosity**: a rounded prominence

Throughout this exercise, you will notice bold terms. This is meant to focus your attention on these important words. Make sure you pay attention to any bold words and know how to explain their definitions and/or where they are located.

Use the following modules to guide your exploration of the appendicular skeleton. As you explore these bones in Visible Body’s app, also locate the bones and bone markings on any available charts, models, or specimens. You may also find it helpful to palpate bones on yourself or make drawings of the bones with the bone markings labeled. The drawings don’t have to be perfect; just make sure the different bone markings are in the correct locations, relative to each other.

If you have trouble finding a bone or bone marking, you can always type its name into the search bar to get a list of 3D anatomical views where that bone or bone marking is highlighted for you.

To access disarticulated bones with color-coded bone markings, select a bone, and then, in the content box, choose the landmark icon, which shows a bone with pink, yellow, and blue ends.
IN-LAB EXERCISES

Open the Atlas app. From the Views menu, go to System Views to view the Skeletal System Views at the top of the screen.

You are responsible for the identification of all bold terms.

A. Pectoral Girdle

In the Skeletal System Views, select View 15. Shoulder Girdle to identify the clavicles and scapulae.

The clavicles and scapulae make up the pectoral girdle and are responsible for attaching the upper limbs to the skeleton as well as providing attachment points for the shoulder muscles.

In the Skeletal System Views, select View 16. Axillary Region to observe how muscles attach to the clavicles and scapulae.

You can select the systems icons on the left side of the screen to hide blood vessels, lymphatic vessels, and nerves. The shoulder has the largest range of motion of any joint in the body, and the many muscles that attach here stabilize the pectoral girdle to allow for that movement. After identifying the bones and how they function in muscle stabilization, find their bone markings and answer the questions.
1. Scapula

- Coracoid process
- Glenoid cavity
- Neck
- Superior angle
- Medial border
- Subscapular fossa
- Lateral border
- Inferior angle
- Supraspinous fossa
- Acromion
- Scapular spine
- Neck
- Infraspinous fossa
- Medial border
- Lateral border
- Inferior angle
a. Identify the following bone markings:

i. Glenoid cavity

ii. Spine

iii. Acromion

iv. Coracoid process

v. Infraspinous fossa

vi. Supraspinous fossa

vii. Subscapular fossa

viii. Inferior angle

ix. Superior angle

x. Lateral border

xi. Medial border

xii. Neck

xiii. Acromial angle

b. Describe how to determine a right scapula from a left scapula.

Look for conspicuous bone markings. The spine will be on the posterior side. The glenoid cavity will be on the lateral side.
2. Clavicle

a. Identify the following bone markings:

   i. Acromial end
   ii. Sternal end
   iii. Shaft
   iv. Conoid tubercle

b. Describe how the clavicle curves and articulates with other bones.

   The clavicle curves anteriorly (outward) on the medial side, and it curves posteriorly (inward) on the lateral side. The sternal end articulates with the sternum, and the acromial end articulates with the acromion of the scapula.
B. Upper Limb

In the Skeletal System Views, select View 1. Full Skeleton to identify the bones of the upper limb.

The upper limb consists of the bones of the arm, forearm, wrist, and hand. Zoom in on the arm and identify the following bones and bone markings, and then zoom out again to look at the full arm and observe how the individual bones fit together. Note how processes often fit into the fossae of the same name.
1. **Humerus**

- Greater tubercle
- Lesser tubercle
- Intertubercular groove
- Deltoid tuberosity
- Capitulum
- Lateral epicondyle
- Trochlea
- Neck
- Head
- Surgical neck
- Shaft
- Medial epicondyle
- Coronoid fossa

**a. Identify the following bone markings:**

i. **Head**

ii. **Anatomical neck**

iii. **Surgical neck**

iv. **Shaft**

v. **Greater tubercle**

vi. **Lesser tubercle**
vii. Intertubercular groove

viii. Radial groove

ix. Deltoid tuberosity

x. Trochlea

xi. Capitulum

xii. Coronoid fossa

xiii. Olecranon fossa

xiv. Medial epicondyle

xv. Lateral epicondyle

xvi. Radial fossa

b. Describe the difference in position of the anatomical neck and the surgical neck.
The anatomical neck is located immediately distal to the head of the humerus, and it is at an angle. The surgical neck is located distal to the greater and lesser tubercles of the humerus.
2. **Radius**

   a. Identify the following bone markings:

   i. **Head**
   ii. **Neck**
   iii. **Shaft**
   iv. **Tubercle**
   v. **Styloid process**
   vi. **Ulnar notch**
a. Identify the following bone markings:

i. **Coronoid process**

ii. **Olecranon**

iii. **Radial notch**

iv. **Trochlear notch**

v. **Styloid process**

vi. **Head**

vii. **Shaft**
b. How do the bones of the radius and ulna attach to each other?

The tubercle of the radius inserts into the radial fossa of the ulna.

c. Describe how the radius and ulna attach to and rotate around the humerus when the elbow flexes.

- The olecranon process of the ulna inserts into the olecranon fossa of the humerus.
- The trochlear notch of the ulna rotates over the trochlea of the humerus.
- The coronoid process of the ulna inserts into the coronoid fossa of the humerus.
- The head of the radius rotates over the capitulum of the humerus and inserts into the radial fossa of the humerus.
4. Carpus
To see the carpals more clearly, hide some or all of the ligaments on the wrist after you zoom in.

**Carpus (Posterior)**
a. Identify the following carpal bones:

i. **Lunate**

ii. **Scaphoid**

iii. **Trapezium**

iv. **Trapezoid**

v. **Capitate**

vi. **Hamate**

vii. **Triquetral**

viii. **Pisiform**
5. Hand

Note the nomenclature for the bones of the hand. The thumb is considered digit I, while the pinky finger is digit V. The metacarpals and phalanges are numbered accordingly.

- **Metacarpals**
- **Proximal phalanges**
- **Middle phalanges**
- **Distal phalanges**

a. Identify the following hand bones:

   i. **Metacarpals**
   
   ii. **Proximal phalanges**
   
   iii. **Middle phalanges**
   
   iv. **Distal phalanges**

b. List all the bones on your thumb from proximal to distal. Do the same for your pinky finger. What is the difference?

   **Thumb:** metacarpal I, proximal phalanx I, distal phalanx I
   
   **Pinky:** metacarpal V, proximal phalanx V, middle phalanx V, distal phalanx V

   The difference is that the thumb (digit I) has no middle phalanx.
C. Pelvic Girdle

In the Skeletal System Views, select View 11. Pelvic Girdle to identify the ilium, ischium, and pubis.

Just like the pectoral girdle attaches the upper limbs to the skeleton, the pelvic girdle attaches the lower limbs to the skeleton. The pelvic girdle consists of the right and left hip bones and the sacrum that connects the hip bones on the posterior side. You may remember the sacrum from studying the axial skeleton, because it is part of the vertebral column. Each of the hip bones begins as three separate bones: the ilium, ischium, and pubis. These bones eventually fuse together, but bone markings are still considered to belong to one of these three distinct regions. Observe the following bone markings on the ilium, ischium, and pubis, and then try to find the same bone markings on the entire hip bone.
1. Ilium

a. Identify the following bone markings:

i. **Body**

ii. **Iliac crest**

iii. **Iliac fossa**

iv. **Acetabulum**

v. **Anterior inferior iliac spine**

vi. **Anterior superior iliac spine**

vii. **Posterior inferior iliac spine**

viii. **Posterior superior iliac spine**

ix. **Auricular surface**

x. **Greater sciatic notch**
2. Ischium

a. Identify the following bone markings:

i. **Body**

ii. **Ramus**

iii. **Acetabulum**

iv. **Lesser sciatic notch**

v. **Ischial tuberosity**

vi. **Ischial spine**

vii. **Pubic arch**

viii. **Obturator foramen (ischial surface)**
3. Pubis

a. Identify the following bone markings:

i. **Body**
ii. **Acetabulum**
iii. **Superior ramus**
iv. **Inferior ramus**
v. **Pubic arch**
vi. **Pubic crest**
vii. **Pubic tubercle**
viii. **Obturator crest**
ix. **Obturator foramen (pubis surface)**

4. Where does the lower limb attach to the hip bone? Which part of the hip bone is this?
   **The femur inserts into the acetabulum, which is part of all three hip bones (the ilium, ischium, and pubis).**

5. The male and female pelvises have a few differences due to childbearing adaptations. Observe the pelvises by selecting Tours: Pelvis Comparison and answer the following questions.
a. Does the male or female pelvis have more space inside?  
Female

b. Describe what the pelvic brim is.  
The border between the greater pelvis (the flared larger, superior part of the pelvis) and the lesser pelvis (the narrower inferior area)

c. How is the pelvic brim different in males vs. females?  
The pelvic brim is larger and wider in females.

d. Describe what the pubic arch is.  
The angle where the pubis of both hip bones meet

e. How is the pubic arch different in males vs. females?  
The female pubic arch is greater (over 90 degrees), while the male pubic arch is less than 90 degrees.
**D. Lower Limb**

In the Skeletal System Views, select View 1. Full Skeleton to identify the bones of the lower limb.

In addition to their importance in movement, the lower limb bones support the weight of the rest of the body. As a result, they are generally larger and heavier than the bones of the upper limb.
1. **Femur**

- **Head**
- **Neck**
- **Lesser trochanter**
- **Shaft**
- **Greater trochanter**
- **Lateral epicondyle**
- **Medial epicondyle**
- **Medial condyle**
- **Lateral condyle**
- **Patellar surface**

a. Identify the following bone markings:

i. **Head**

ii. **Shaft**

iii. **Greater trochanter**

iv. **Lesser trochanter**

v. **Neck**

vi. **Lateral condyle**

vii. **Lateral epicondyle**

viii. **Medial condyle**
ix. Medial epicondyle
x. Intercondylar fossa
xi. Gluteal tuberosity
xii. Linea aspera
xiii. Patellar surface
xiv. Popliteal surface

b. Describe how you would differentiate between a right femur and a left femur.

Look for conspicuous bone markings. The linea aspera is on the posterior side. The head of the femur is on the medial side.
2. **Tibia**

![Diagram of the Tibia]

a. Identify the following bone markings:

i. **Shaft**

ii. **Medial condyle**

iii. **Lateral condyle**

iv. **Intercondylar area**

v. **Tibial tuberosity**

vi. **Anterior border**

vii. **Medial malleolus**
3. **Fibula**

a. Identify the following bone markings:

   i. **Head**

   ii. **Shaft**

   iii. **Lateral malleolus**
a. Which bones compose the knee joint?

The femur, tibia, fibula, and patella

b. Where do the different bones attach to each other?

The patella attaches to the patellar surface of the femur. The lateral and medial condyles of the femur attach to the lateral and medial condyles of the tibia.
5. **Tarsus**
To see the tarsals more clearly, hide some or all of the ligaments on the wrist after you zoom in.

a. Identify the following tarsal bones:
   i. **Calcaneus**
   ii. **Talus**
   iii. **Medial cuneiform**
   iv. **Intermediate cuneiform**
   v. **Lateral cuneiform**
   vi. **Cuboid**
   vii. **Navicular**

b. Which bone forms the heel of the foot?
   **The calcaneus**
6. Foot

Note that the nomenclature for the toes is the same as for the hand. The big toe is considered digit I, and the pinky toe is digit V.

a. Identify the following foot bones:

i. **Metatarsals**

ii. **Proximal Phalanges**

iii. **Middle Phalanges**

iv. **Distal Phalanges**
1. How is the shape of the glenoid cavity of the scapula different from that of the acetabulum in the hip bone? How do the shapes of these bone markings affect the range of motion at their respective joints? 

The glenoid cavity is shallower, which allows for more freedom of movement and range of motion at the shoulder joint. The acetabulum is a much deeper socket, which somewhat restricts movement at the hip joint.

2. How do the distinct characteristics of the female pelvis make childbirth easier?

There is more space for the baby to sit in the pelvis and then exit through the pelvic outlet.

3. Which bone markings are responsible for making the protrusions of the ankles, just above the feet?

The medial malleolus of the tibia and lateral malleolus of the fibula

4. When someone falls with an outstretched arm, a broken clavicle often results. Physically, how would that person appear afterward? What is the function of the clavicle?

The shoulder with the broken clavicle would be slumped downward. The clavicle braces the arm outward, away from the body.

TIME TO PRACTICE!
GO TO THE SKELETAL SYSTEM QUIZZES AND TAKE QUIZ 7 GIRDLES, QUIZ 8 UPPER LIMB, QUIZ 9 HAND, QUIZ 10 LOWER LIMB, AND QUIZ 11 FOOT
Student Practice

Label the structures in the following figures.
Source: Skeletal System Views: View 15. Shoulder Girdle
Supraspinatus muscle
Infraspinatus muscle
Deltoid muscle (posterior head)

Clavicle
Deltoid muscle (anterior head)
Scapula
Deltoid muscle (middle head)
Scapula (Posterior) Source: Skeletal System Views: View 16: Axillary Region

- Superior angle
- Supraspinous fossa
- Medial border
- Acromion
- Scapular spine
- Neck
- Infraspinous fossa
- Lateral border
- Inferior angle
Clavicle

- Acromial end
- Conoid tubercle
- Shaft
- Sternal end
Humerus

- Greater tubercle
- Lesser tubercle
- Intertubercular groove
- Deltoid tuberosity
- Capitulum
- Lateral epicondyle
- Trochlea
- Medial epicondyle
- Coronoid fossa
- Neck
- Head
- Surgical neck
- Shaft
- Neck
- Head
- Surgical neck
- Shaft
Ulna

- Olecranon
- Trochlear notch
- Coronoid process
- Shafts
- Head
- Styloid process
- Tuberosity
- Radial notch
Radius and Ulna

- Humerus
- Ulna
- Radius
Carpus (Posterior)

- Scaphoid
- Trapezium
- Trapezoid
- Lunate
- Triquetral
- Hamate
- Capitate
Carpus (Anterior)

- Scaphoid
- Lunate
- Triquetral
- Pisiform
- Hamate
- Trapezium
- Capitate
- Trapezoid
- Capitate
- Trapezoid
Hand

Metacarpals

Proximal phalanges

Middle phalanges

Distal phalanges
Ilium

Iliac crest

Posterior superior iliac spine

Posterior inferior iliac spine

Greater sciatic notch

Anterior superior iliac spine

Anterior interior iliac spine
**Ischium**

- Acetabular rim
- Body
- Obturator foramen (ischial surface)
- Ramus
- Ischial spine
- Ischial tuberosity
Pubis

- Body
- Iliopubic eminence
- Acetabular notch
- Obturator foramen, pubis surface
- Superior ramus
- Obturator crest
- Pubic tubercle
- Pubic crest
- Pubic arch
- Inferior ramus
Source: Tours: Pelvis Comparison

Pelvic brim

Pubic arch
Source: Tours: Pelvis Comparison

Pelvic brim

Pubic arch
Source: Skeletal System Views: View 1. Lower Limb
Femur

- Head
- Neck
- Greater trochanter
- Lesser trochanter
- Shaft
- Patellar surface
- Lateral condyle
- Lateral epicondyle
- Medial epicondyle
- Medial condyle
Tibia

- Tibial tuberosity
- Medial condyle
- Lateral condyle
- Intercondylar area
- Anterior border
- Shaft
- Fibular notch
- Medial malleolus
- Tubercles of intercondylar eminence
Fibula

Head

Shaft

Lateral malleolus
Patella

- Patella
- Medial condyle of femur
- Patellar ligament
- Medial condyle of tibia

Femur
- Lateral condyle of femur

Lateral condyle of femur
- Lateral condyle of tibia

Fibula

Tibia
Tarsus

- Tibia
- Fibula
- Talus
- Navicular
- Intermediate cuneiform
- Medial cuneiform
- Calcaneus
- Cuboid
- Lateral cuneiform
Foot

Metatarsals

Proximal phalanges

Middle phalanges

Distal phalanges