Activities in this chapter:

1. **The Axial Skeleton** 32
   - Review Your Key Terms
   - Head and Neck Region
   - Back Region

2. **The Appendicular Skeleton** 36
   - Review Your Key Terms
   - Pectoral Girdle
   - Muscles of the Scapulohumeral Region
   - Upper Limb

3. **Pelvic Girdle**
   - Bones of Lower Limb
   - Muscles of the Lower Limb
   - Joints of the Lower Limb

4. **Check Your Understanding** 51

5. **Chapter Culminating Assignment** 53
4.1.1 Review Your Key Terms

- atlas
- axis
- calvaria
- cervical vertebrae
- coccyx
- costal cartilage
- erector spinae muscles
- external oblique
- false ribs
- floating ribs
- foramen
- frontal bone
- internal oblique
- intervertebral discs
- lacrimal bone
- linea alba
- lumbar vertebrae
- mandible
- manubrium
- maxilla
- nasal bone
- occipital bone
- orbicularis oculi
- orbicularis oris
- parietal bone
- rectus abdominis
- ribs
- sacrum
- sphenoid bone
- sternal body
- sternocleidomastoids
- sternum
- temporal bone
- thoracic vertebrae
- transversus abdominis
- true ribs
- xiphoid process
- zygomatic bone

4.1.2 Head and Neck Region

(A) Anterior and Lateral Views of the Skull

Fill in the appropriate numbers on the figures below using the list of labels provided.

1. frontal bone  
2. lacrimal bone  
3. mandible  
4. maxilla  
5. nasal bone  
6. occipital bone  
7. orbit  
8. parietal bone  
9. sphenoid bone  
10. temporal bone  
11. zygomatic bone

The curved flat bones of the skull form the **calvaria**, which is represented by labels **1, 6, 8, 9, and 10** above. The most fragile of these bones is the **temporal**.
4.1.3 Back Region

(A) Regions of the Spinal Column

In the spaces provided, label the segments of the spinal column indicated on the figure to the right.

1 Cervical vertebrae
2 Thoracic vertebrae
3 Lumbar vertebrae
4 Sacrum
5 Coccyx

The vertebrae that make up the vertebral column are examples of which of the following types of bone (shape)?

☐ Flat ☐ Sesamoid ☐ Long ☑ Irregular ☐ Short

The atlas and axis are the first two cervical vertebrae. Colour them in the figure on the right.

Fill in the appropriate labels below illustrating the structure of a typical thoracic vertebra. Can you locate these structures in the figure on the right?

1 spinous process  3 vertebral body
2 transverse process  4 vertebral foramen

(B) Facial Muscles

Two important facial muscles to remember are the orbicularis oris and the orbicularis oculi, which allow you to blink and chew, respectively.

Label these muscles on the figure to the right.
(B) The Rib Cage

From the list of labels provided, fill in the appropriate numbers on the figures of the rib cage below. The breastbone, represented by labels 5, 6, and 8, is also known as the sternum.

1. costal cartilage  
2. false ribs  
3. floating ribs  
4. intervertebral disc  
5. manubrium  
6. sternal body  
7. true ribs  
8. xiphoid process

(C) Muscles of the Neck and Back

The anterior pair of neck muscles that allows you to flex your head towards your chest is the sternocleidomastoids.

The large muscle mass that spans the back from the skull to the sacrum is called the erector spinae.

Briefly explain why these muscles are important for human movement.

Acting together, the sternocleidomastoid muscles allow you to flex your head towards your chest and to get up from a supine position. Individually, each sternocleidomastoid muscle tilts the face up and towards the opposite side.

The erector spinae muscles allow us to stand erect and walk on two feet – a feature that sets us apart from most other animal species.
Muscles of the Abdomen

Complete the figures of the anterior abdominal wall below using the following labels.

1. external oblique  
2. internal oblique  
3. linea alba  
4. rectus abdominis  
5. rectus sheath  
6. sternal body  
7. tendinous intersections  
8. transversus abdominis  
9. umbilicus  
10. xiphoid process

Which set of muscles would you use for lateral bending and rotation of the trunk? Give an example of an activity that would require these muscles.

The internal and external oblique muscles are important in lateral bending and rotation of the trunk (e.g., in throwing a javelin).

List some exercises you can do to strengthen the abdominal muscles:

- Sit-ups, crunches (flat, incline, medicine ball)
- “Roman chair” leg lifts (pictured on the right)
- Leg lifts (flat, while hanging)
- Bicycle exercise (alternating legs)
- Planks
### 4.2.1 Review Your Key Terms

<table>
<thead>
<tr>
<th>Acetabulum</th>
<th>Humerus</th>
<th>Psoas minor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achilles tendon</td>
<td>Hypothenar muscles</td>
<td>Pubic symphysis</td>
</tr>
<tr>
<td>Acromioclavicular joint</td>
<td>Iliacus</td>
<td>Pubis</td>
</tr>
<tr>
<td>Adductor brevis</td>
<td>Iliopsoas</td>
<td>Quadriceps femoris</td>
</tr>
<tr>
<td>Adductor longus</td>
<td>Iliotibial band</td>
<td>Radiocarpal joint</td>
</tr>
<tr>
<td>Adductor magnus</td>
<td>Ilium</td>
<td>Radius</td>
</tr>
<tr>
<td>Ankle (talocrural) joint</td>
<td>Infraspinatus</td>
<td>Rectus femoris</td>
</tr>
<tr>
<td>Anterior cruciate ligament</td>
<td>Intercarpal joints</td>
<td>Rhomboid muscles</td>
</tr>
<tr>
<td>Biceps brachii</td>
<td>Intermetacarpal joints</td>
<td>Rotator cuff</td>
</tr>
<tr>
<td>Biceps femoris</td>
<td>Interossei muscles</td>
<td>Sacroiliac joint</td>
</tr>
<tr>
<td>Brachialis</td>
<td>Interphalangeal joints</td>
<td>Sartorius</td>
</tr>
<tr>
<td>Brachioradialis</td>
<td>Ischium</td>
<td>Scaphoid</td>
</tr>
<tr>
<td>Calcaneus</td>
<td>Knee (tibiofemoral) joint</td>
<td>Scaphoid</td>
</tr>
<tr>
<td>Capitate</td>
<td>Lateral collateral ligament</td>
<td>Semimembranosus</td>
</tr>
<tr>
<td>Carpals</td>
<td>Lateral malleolus</td>
<td>Semitendinosus</td>
</tr>
<tr>
<td>Carpometacarpal joints</td>
<td>Latissimus dorsi</td>
<td>Serratus anterior</td>
</tr>
<tr>
<td>Carpus</td>
<td>Levator scapulae</td>
<td>Shoulder (glenohumeral) joint</td>
</tr>
<tr>
<td>Clavicle</td>
<td>Lumbrical muscles</td>
<td>Soleus</td>
</tr>
<tr>
<td>Coracobrachialis</td>
<td>Lunate</td>
<td>Sternoclavicular joint</td>
</tr>
<tr>
<td>Cuboid</td>
<td>Medial collateral ligament</td>
<td>Subscapularis</td>
</tr>
<tr>
<td>Cuneiforms</td>
<td>Medial malleolus</td>
<td>Supraspinatus</td>
</tr>
<tr>
<td>Deltoid</td>
<td>Menisci</td>
<td>Talus</td>
</tr>
<tr>
<td>Extensor-supinator group</td>
<td>Metacarpals</td>
<td>Tarsals</td>
</tr>
<tr>
<td>Femur</td>
<td>Metacarpophalangeal (MCP) joints</td>
<td>Tarsus</td>
</tr>
<tr>
<td>Fibula</td>
<td>Metatarsals</td>
<td>Tensor fasciae latae</td>
</tr>
<tr>
<td>Fibularis (peroneus) brevis</td>
<td>Midcarpal joint</td>
<td>Teres major</td>
</tr>
<tr>
<td>Fibularis (peroneus) longus</td>
<td>Navicular</td>
<td>Teres minor</td>
</tr>
<tr>
<td>Flexor digitorum longus</td>
<td>Patella</td>
<td>Thenar muscles</td>
</tr>
<tr>
<td>Flexor hallucis longus</td>
<td>Patellae</td>
<td>Tibia</td>
</tr>
<tr>
<td>Flexor-pronator group</td>
<td>Pectineus</td>
<td>Tibialis anterior</td>
</tr>
<tr>
<td>Gastrocnemius</td>
<td>Pectoral girdle</td>
<td>Tibialis posterior</td>
</tr>
<tr>
<td>Gluteus maximus</td>
<td>Pectoralis major</td>
<td>Transverse tarsal joint</td>
</tr>
<tr>
<td>Gluteus medius</td>
<td>Pectoralis minor</td>
<td>Trapezium</td>
</tr>
<tr>
<td>Gluteus minimus</td>
<td>Pelvic girdle</td>
<td>Trapezius</td>
</tr>
<tr>
<td>Gracilis</td>
<td>Phalanges</td>
<td>Trapezoid</td>
</tr>
<tr>
<td>Hamate</td>
<td>Plissform</td>
<td>Triceps brachii</td>
</tr>
<tr>
<td>Hamstrings</td>
<td>Plantaris</td>
<td>Triquetrum</td>
</tr>
<tr>
<td>Hip (iliofemoral) joint</td>
<td>Popliteus</td>
<td>Ulna</td>
</tr>
<tr>
<td>Hip bone (os coxae)</td>
<td>Posterior cruciate ligament</td>
<td>Vastus intermedius</td>
</tr>
<tr>
<td>Humeral radial joint</td>
<td>Proximal radioulnar joint</td>
<td>Vastus lateralis</td>
</tr>
<tr>
<td>Humeral ulnar joint</td>
<td>Psoas major</td>
<td>Vastus medialis</td>
</tr>
</tbody>
</table>

Can you define most of the key terms listed here? Highlight the key terms you don’t know, and look them up in the chapter or in the glossary at the back of the textbook.
4.2.2 Pectoral Girdle

(A) Bones of the Pectoral Girdle

The collarbone, or *clavicle*, is the only bone connecting the upper limb to the axial skeleton. This bone, plus the *scapula* make up the pectoral girdle.

Identify, label, and colour the bones that make up the pectoral girdle in the figures on the right.

(B) Anterior Muscles of the Pectoral Girdle

In the spaces provided, label the anterior muscles of the pectoral girdle.

1  Humerus
2  Coracoid process
3  Acromion
4  Clavicle
5  Pectoralis major
6  Sternum (sternal body)
7  3rd through 5th ribs
8  Pectoralis minor
9  Coracoid process
10 Acromion
11 Clavicle
12 Serratus anterior
13 Scapula
14 Acromion
15 Coracoid process
16 1st through 9th ribs

Label 5 has two heads: one is attached to the *sternum* and the other is attached to the more superior *clavicle*.
(C) Posterior Muscles of the Pectoral Girdle

Identify the structures below using the labels provided.

1. acromion
2. clavicle
3. deltoid
4. external oblique
5. infraspinatus
6. internal oblique
7. latissimus dorsi
8. levator scapulae
9. rhomboids
10. scapular spine
11. sternocleidomastoid
12. supraspinatus
13. teres major
14. teres minor
15. trapezius, lower fibres
16. trapezius, middle fibres
17. trapezius, upper fibres

The levator scapulae and rhomboid muscles lie deep to trapezius and latissimus dorsi. Which of these muscles is the most superior?

Trapezius (upper fibres)

(D) Joints of the Pectoral Girdle

Fill in the appropriate labels below for the structures and joints of the pectoral girdle.

1. Humerus
2. Glenohumeral joint
3. Coracoid process
4. Subacromial space
5. Acromion
6. Acromioclavicular joint
7. Scapulothoracic joint
8. Clavicle
9. 1st rib
10. Sternoclavicular joint
11. Manubrium (sternum)
4.2.3 Muscles of the Scapulohumeral Region

(A) Anterior, Superior, and Posterior Groups

Identify the structures of the scapulohumeral region below using the labels provided. Then indicate which view is anterior and which is posterior.

1. acromion  
2. coracoid process  
3. humerus  
4. infraspinatus  
5. subscapularis  
6. supraspinatus  
7. teres minor

Anterior view

Posterior view

Use the same numbered labels from above to label the image below. Are there any structures that can't be seen in this image?

You can't see the coracoid process, humerus, or subscapularis in the image provided.

What muscles make up the rotator cuff of the shoulder? What is their primary role?

The rotator cuff muscles of the shoulder (abbreviated SSIT) include the supraspinatus, subscapularis, infraspinatus, and teres minor. Collectively, these muscles act mainly as stabilizers, allowing full use of the upper limb and preventing instability and dislocations.
(B) Lateral Group

Complete the statements below by filling in the blanks. Then label the structures in the figures below using some of the words you filled in.

The lateral group of the scapulohumeral region is composed of the *deltoid* muscle, which has three functional groups of fibres. The *anterior* fibres flex and medially rotate the upper limb; the *middle* fibres abduct the upper limb; and the *posterior* fibres extend and laterally rotate the upper limb. All three groups insert into the *deltoid tuberosity* of the *humerus*.

1. scapula
2. deltoid, posterior fibres
3. deltoid, middle fibres
4. acromion
5. clavicle
6. deltoid, anterior fibres
7. deltoid tuberosity
8. humerus
9. scapular spine

Can you think of a few examples of actions or activities you might use these muscles for?

*Examples include paddling sports (kayaking, canoeing), tennis or volleyball serve, jumping jacks, and so on.*
4.2.4 Upper Limb

(A) Bones of the Upper Limb

Identify the structures below and label them with the appropriate numbers. Then colour the most lateral bone of the forearm in each image. [The most lateral bone of the forearm is the radius.]

1 acromion
2 arm
3 carpals
4 clavicle
5 coracoid process
6 fifth metacarpal
7 first metacarpal
8 first proximal phalanx
9 forearm
10 fourth distal phalanx
11 hand
12 humerus
13 metacarpals
14 radius
15 scapula
16 second distal phalanx
17 second proximal phalanx
18 third proximal phalanx
19 ulna
(B) Bones of the Hand and Wrist

The wrist, or carpus, is formed by two rows of four bones called carpal. The distal row joins with the five metacarpals bones of the hand, which articulate with the fingers, or phalanges. Identify the structures on the figure below and indicate which view is illustrated.

(C) Muscles of the Hand

The two largest muscle groups of the hand are the thenar (palm) group and the hypothenar (little palm) group. Between these groups lie the interossei and lumbrical muscles, which are referred to collectively as the intrinsic muscles of the hand.

Label the muscles illustrated on the figure to the right. What action do these muscles allow you to perform?

Together the thenar and hypothenar muscles allow you to cup your hand as in holding a ball. They allow you to abduct, flex, and oppose the thumb tip to the digits.
**D) Muscles of the Arm and Forearm**

Identify the structures below and label them with the appropriate numbers. Then circle the structure that serves as the common head of the flexors of the wrist and digits.

Muscles of the limbs are primarily flexors or extensors. In the upper limb, the **flexors** are on the anterior surface of the arm, forearm, and hand, and the **extensors** are on the posterior surface.

Which images depicted here illustrate the extensors of the upper limb? Can you think of exercises that can be done to develop the extensors? The flexors?

*Extensors are depicted on the images to the right (posterior view). Exercises to develop these muscle would include dips, push-ups, bench press, etc. Exercises to develop the flexors would include pull-ups, biceps curls, and so on.*
The shoulder joint, or *glenohumeral* joint, is classified as a *ball and socket* joint. The integrity of the joint depends on the SSIT, or *rotator cuff*, muscles that hold the head of the humerus against the *glenoid fossa* of the scapula.

There are actually three joints at the elbow. Identify and label the structures below, and then circle and name the three joints at the elbow. How do you know which view is anterior and which is posterior?

**Anterior view**

1. **Radius**
2. **Ulna**
3. **Radiocarpal joint**
4. **Carpometacarpal joint**
5. **Metacarpophalangeal (MCP) joint**
6. **Proximal interphalangeal (PIP) joint**
7. **Distal interphalangeal (DIP) joint**

**Posterior view**

- The larger and longer ulna is medial to the radius; the olecranon process of the ulna is only visible posteriorly; the capitulum and trochlea are only visible anteriorly.

In the spaces provided, label the structures and joints of the wrist and hand indicated in the figure on the left.

- **Metacarpophalangeal joints**
4.2.5 Pelvic Girdle

(A) Bones and Joints of the Pelvic Girdle

Identify the structures of the pelvic girdle below. Then circle and label the sacroiliac and pubic symphysis joints.

![Diagram of the pelvic girdle showing bones and joints]

(B) Muscles of the Pelvic Girdle

Identify the structures below using the labels provided.

1. femur
2. gluteus maximus
3. gluteus medius
4. iliacus
5. iliotibial band
6. psoas major
7. psoas minor
8. pubic symphysis
9. tensor fasciae latae

Labels 4 and 6 unite to form the iliopsoas muscle, the primary flexor of the hip.

List the three muscles that make up the gluteals from the most superficial layer to the deepest layer. Which of these layers cannot be seen in the images depicted here?

*Most superficial layer: Gluteus maximus*

*Middle layer: Gluteus medius*

*Deepest layer: Gluteus minimus*

Gluteus minimus is not visible in the image.

The deepest layer of six little muscles work to laterally rotate the hip. Which of the following muscles is not included in this group of muscles? Check all that apply.

- [ ] Gemellus inferior
- [ ] Gluteus medius
- [ ] Obturator internus
- [ ] Piriformis
- [ ] Gemellus superior
- [ ] Iliacus
- [X] Pectineus
- [ ] Quadratus femoris
4.2.6 Bones of the Lower Limb

Identify the structures below and label them with the appropriate numbers. Then colour the structure that is classified as a sesamoid bone. [The patella is classified as a sesamoid bone.]

1. 1st digit distal phalanx
2. 1st metatarsal
3. 2nd digit proximal phalanx
4. 3rd digit proximal phalanx
5. 4th digit middle phalanx
6. 5th digit proximal phalanx
7. 5th metatarsal
8. calcaneus
9. cuboid
10. femur
11. fibula
12. hip bone
13. intermediate cuneiform
14. lateral condyle
15. lateral cuneiform
16. lateral malleolus
17. leg
18. medial condyle
19. medial cuneiform
20. medial malleolus
21. metatarsals
22. navicular
23. patella
24. phalanges
25. talus
26. tarsals
27. thigh
28. tibia

The patella is classified as a sesamoid bone.
4.2.7 Muscles of the Lower Limb

(A) Muscles of the Anterior and Posterior Compartments of the Thigh

Identify the structures below and fill in the spaces. Then colour the most lateral muscle of the anterior compartment of the thigh and the muscle that attaches distally to the fibula in the posterior compartment of the thigh.

[The most lateral muscle of the anterior thigh is the vastus lateralis. The muscle that attaches distally to the fibula in the posterior thigh is the biceps femoris.]

Collectively, the anterior muscles of the thigh are referred to as the **quadriceps**.

What type of action does this muscle group perform? What are some examples of exercises that can be used to strengthen these muscles?

*The anterior group of thigh muscles form the extensor group, which serve to extend the knee. Exercises that can be used to strengthen these muscles include squats, leg extensions, and lunges (any exercise where knee extension occurs).*

Collectively, the posterior muscles of the thigh are referred to as the **hamstrings**.

What type of action do these muscles perform? What exercises can be used to strengthen this muscle group?

*The posterior group of thigh muscles serve to flex the knee and extend the hip (along with gluteus maximus). Exercises that can be used to strengthen these muscles include leg curls, dead lifts, and lunges (any exercise where knee flexion or hip extension occurs).*
(B) Muscles of the Medial Compartment of the Thigh

Fill in the appropriate labels for the structures of the medial compartment of the thigh.

1. Pectineus
2. Adductor brevis
3. Adductor longus
4. Gracilis
5. Adductor magnus
6. Femur
7. Patella
8. Tibia
9. Fibula

This group of medial thigh muscles has one primary action – that is, to **adduct** the thigh towards the midline.

(C) Muscles of the Leg

Fill in the appropriate labels for the structures below.

1. Achilles tendon
2. Extensor digitorum longus
3. Extensor hallucis longus
4. Femur
5. Fibula
6. Fibularis brevis
7. Fibularis longus
8. Gastrocnemius
9. Lateral malleolus
10. Medial malleolus
11. Plantaris
12. Soleus
13. Tibia
14. Tibialis anterior

Which of the muscles above would be used primarily to

(a) stand on the toes?  (a) **gastrocnemius; soleus**
(b) evert the foot?  (b) **peroneus longus; peroneus brevis**
(c) dorsiflex the foot?  (c) **tibialis anterior**
4.2.8 Joints of the Lower Limb

(A) The Hip Joint

The hip joint is also known as the iliofemoral joint. Label the bones involved in the hip and circle the joint on the figure to the right.

Based on shape, the hip is classified as a ball and socket joint, which provides the greatest range of motion and mobility of any joint type. List the types of movements that can occur at the hip.

- flexion–extension
- abduction–adduction
- circumduction
- rotation

(B) The Knee Joint

Complete the figure of the right knee below using the labels provided. The knee joint is classified as a hinge joint, and the primary action performed here is flexion–extension, such as when performing a squat.

- anterior cruciate ligament
- femur
- fibula
- lateral collateral ligament
- lateral condyle
- lateral meniscus
- medial collateral ligament
- medial condyle
- medial meniscus
- patella
- patellar ligament
- posterior cruciate ligament
- tibia

How do you know which view is anterior and which is posterior?

The image on the left depicts the knee from an anterior view and the image on the right from a posterior view. Many clues give this away: the fibula is lateral to the larger tibia; the knee is flexed slightly in the left diagram, which clearly shows the articulation between the tibia and femur; the patella can only be seen anteriorly; the medial and lateral femoral condyles can only be seen posteriorly.
(C) Ankle and Foot Joints

Identify and label the two major ankle and foot joints below.

1. **Talocrural joint**
2. **Transverse tarsal joint**

The ankle joint is made up of several bones. Which of the following is **not** part of this joint? Check all that apply.

- [x] Calcaneus
- [ ] Lateral cuneiform
- [ ] Navicular
- [x] Cuboid
- [x] Lateral malleolus
- [ ] Talus
- [ ] Fibula
- [ ] Medial malleolus
- [ ] Tibia
Multiple Choice

1. Which of the following is not a facial bone:
   A) zygomatic
   B) maxilla
   C) sphenoid
   D) mandible
   E) lacrimal
   Answer: C

2. The false ribs:
   A) attach directly to the sternum
   B) are ribs 7 to 10
   C) articulate with the thoracic vertebrae
   D) are ribs 10 to 12
   E) do not attach to the sternum
   Answer: C

3. Which of the following is not a posterior muscle of the pectoral girdle:
   A) latissimus dorsi
   B) trapezius
   C) levator scapulae
   D) teres major
   E) none of the above
   Answer: E

4. Which of the following is not a bone of the upper limb:
   A) phalanx
   B) metacarpal
   C) pisiform
   D) lunate
   E) cuboid
   Answer: E

5. Which of the following is not a muscle of the pelvic girdle:
   A) gluteus maximus
   B) psoas major
   C) iliacus
   D) gluteus minimus
   E) sartorius
   Answer: E

Fill in the Blanks

Fill in the blanks for the following statements using words from the word bank. Place the corresponding letter from the word bank in the blank spaces provided.

1. An opening in bone through which an anatomical structure can pass is a/an foramen.

2. The erector spinae muscles allow us to stand straight and walk on two feet.

3. At the pectoral girdle, the lateral end of the clavicle joins with the acromion process of the scapula.

4. The triceps brachii extends the elbow joint, while the biceps brachii flexes the elbow joint.

5. The major anterior compartment muscle of the lower leg is tibialis anterior.

Word Bank

a. acromion process e. erector spinae i. manubrium
b. biceps f. fibularis j. orbit
c. clavicle g. foramen k. tibialis
d. coracoid process h. levator scapulae l. triceps

True or False

Indicate whether each statement is true (T) or false (F). If the statement is false, provide the correct answer.

1. The head sits on the first cervical vertebra, called the atlas.
   Answer: true; true

2. The anterior abdominal wall is formed by the external oblique, internal oblique, and rectus abdominis muscles.
   Answer: false (Correct: transversus abdominis)

3. The subscapularis is one of the rotator cuff muscles.
   Answer: true

4. Each finger has two metacarpophalangeal joints.
   Answer: false (Correct: interphalangeal)

5. The tibiofemoral joint is more commonly known as the ankle.
   Answer: false (Correct: knee)
Think and Link

1. Match each of the following bones with its corresponding location.

<table>
<thead>
<tr>
<th>Bone</th>
<th>Answer</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xiphoid process</td>
<td>C</td>
<td>A) Skull</td>
</tr>
<tr>
<td>Ilium</td>
<td>F</td>
<td>B) Face</td>
</tr>
<tr>
<td>Fibula</td>
<td>G</td>
<td>C) Chest</td>
</tr>
<tr>
<td>Sphenoid</td>
<td>A</td>
<td>D) Pectoral girdle</td>
</tr>
<tr>
<td>Talus</td>
<td>G</td>
<td>E) Upper limb</td>
</tr>
<tr>
<td>Manubrium</td>
<td>C</td>
<td>F) Pelvic girdle</td>
</tr>
<tr>
<td>Ulna</td>
<td>E</td>
<td>G) Lower limb</td>
</tr>
<tr>
<td>Cuboid</td>
<td>G</td>
<td></td>
</tr>
<tr>
<td>Scapula</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>Metatarsal</td>
<td>G</td>
<td></td>
</tr>
<tr>
<td>Trapezium</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>Zygomatic</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>Lunate</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>Clavicle</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>Parietal</td>
<td>A</td>
<td></td>
</tr>
</tbody>
</table>

2. Discuss the anterior and posterior muscle groups of the thigh, identifying the muscles in each group and the role they play.

   The anterior group of thigh muscles is commonly called the quadriceps. The quadriceps muscles are rectus femoris, vastus lateralis, vastus intermedius, and vastus medialis. Their role is to extend the knee. The posterior group of thigh muscles is commonly called the hamstrings. The hamstring muscles are semitendinosus, semimembranosus, and biceps femoris. Their role is to flex the knee and extend the hip with the gluteus maximus.

3. Select one upper body and one lower body region in the chapter and describe all aspects of its anatomy: the bones and muscles involved, up to three joints involved, and the types of movements that can occur there. Remember to use relevant directional terms and anatomical terminology whenever possible.

<table>
<thead>
<tr>
<th>Body Region</th>
<th>Bones</th>
<th>Muscles</th>
<th>Joints</th>
<th>Movements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper body:</td>
<td>• humerus</td>
<td>• biceps brachii</td>
<td>• humeroradial</td>
<td>• flexion–extension</td>
</tr>
<tr>
<td>Example: Elbow</td>
<td>• radius</td>
<td>• brachialis</td>
<td>• humeroulnar</td>
<td>• pronation–supination at the radioulnar joint</td>
</tr>
<tr>
<td></td>
<td>• ulna</td>
<td>• brachioradialis</td>
<td>• radioulnar</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• triceps brachii</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower body:</td>
<td>• femur</td>
<td>• quadriceps (rectus femoris; vastus medialis, intermedius, and lateralis)</td>
<td>• tibiofemoral</td>
<td>• primarily flexion–extension</td>
</tr>
<tr>
<td>Example: Knee</td>
<td>• tibia</td>
<td>• sartorius</td>
<td>• many ligaments for structural support, including patellar, anterior cruciate, posterior cruciate, medial collateral, lateral collateral</td>
<td>• medial and lateral rotation also possible when knee is flexed</td>
</tr>
<tr>
<td></td>
<td>• fibula</td>
<td>• hamstrings (biceps femoris; semitendinosus; semimembranosus)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Case Study: Focus on the Road

It was a sunny afternoon, and Alyssa and Victoria were having fun on the street in their quiet residential neighbourhood. Alyssa was doing cartwheels, and Victoria was skipping rope. In the distance, a high school student named Knowshon and his friend Robert were speeding at approximately 80 km/h in the 50 km/h zone.

Knowshon was sending text messages on his cell phone as he was driving. Robert noticed the kids on the street, and he screamed at his friend to pay attention. As Knowshon swerved to avoid hitting the girls, he lost control of his Civic and hit a tree. Because he was not wearing a seat belt, he was ejected from the car.

The initial impact resulted in multiple fractures of the lower mandible and skull. Knowshon was treated quickly for a suspected epidural haemorrhage but miraculously was still conscious. He also fractured his coccyx, ilium, and the distal end of his left fibula as well as dislocating his right patella.

Robert, who was wearing his seat belt, fractured his clavicle and ribs 5 and 6 on the right side. Because he tried to grasp the dashboard before the crash, Robert suffered additional fractures of the radius and scaphoid.

As the victims were being transferred to the ambulance, Knowshon reported intense pain when trying to extend his right leg from the knee and complained of tenderness of the thigh muscles. Robert reported extreme pain and stiffness in the cervical region resulting from severe whiplash.

Considering all this information, complete the following statements.

While doing cartwheels in the street, Alyssa was performing actions in the **frontal** plane, and Victoria was performing actions in the **sagittal** plane as she skipped rope.

When Knowshon was ejected from the car through the windshield, he rolled forward several times. Rolling forward is an example of a **sagittal** plane movement.

When Knowshon slammed on the brakes, he had to quickly **plantar flex** his foot. The muscles that allowed him to perform this action include the gastrocnemius and **soleus**.

Knowshon fractured his lower mandible, ilium, and coccyx and dislocated his patella. In layperson’s terms, he broke his **jaw**, **pelvis (hip bone)**, and **tail bone** and dislocated his **knee cap**.

Robert fractured his scaphoid and radius and suffered severe whiplash in his cervical region. In layperson’s terms, he broke his **wrist** and **forearm** and severely strained his **neck** muscles.
Knowshon also suffered multiple fractures of the skull, and based on the suspected epidural haemorrhage, the *temporal* bone was likely one of them. If the anterior aspect of his skull made first impact, he may have also fractured the *frontal* bone.

Robert’s fractured ribs are part of the upper pairs of ribs called *true* ribs.

Knowshon fractured the distal end of the fibula; therefore, he fractured his *ankle* joint.

Knowshon’s thigh tenderness and inability to straighten his leg are most likely related to the bruising impact on his *quadriceps* muscles and the dislocation of his patella, which is a *sesamoid* type of bone.

As the emergency (EMS) personnel lifted the stretchers into the ambulance from a squatting position, they had to *extend* their knees using primarily the *quadriceps* muscles.

When the attendant pushed the doors of the ambulance closed, she had to *extend* her elbow using her *triceps* muscles.

It was later determined that Knowshon’s ilium was also dislocated from his upper thigh bone. This type of joint is a *ball and socket* joint, and it connects the *head of the femur* to the *os coxae (hip bone)*. In this type of joint, rotation in *all* planes of movement is possible.

Robert’s fractured clavicle was a nuisance when attempting rehabilitation of his whiplash, as the clavicle has two joints in which movement was severely hindered. Name those two joints: *acromioclavicular* and *sternoclavicular*.

What life lessons can be learned from this fictional case study scenario?

*Answers will vary.*

1) *Don’t text while driving*
2) *Be aware of your speed and your surroundings*
3) *Wear your seatbelt*