Pelvic Girdle and Lower Limb

Purpose of the Exercise
To examine the bones of the pelvic girdle and lower limb, and to identify the major features of these bones.

Learning Outcomes
After completing this exercise, you should be able to
1. Locate and identify the bones of the pelvic girdle and their major features.
2. Differentiate a male and female pelvis.
3. Locate and identify the bones of the lower limb and their major features.

Materials Needed
- Human skeleton, articulated
- Human skeleton, disarticulated
- Male and female pelves

Pre-Lab
Carefully read the introductory material and examine the entire lab. Be familiar with the pelvic girdle and the lower limb bones from lecture or the textbook. Answer the pre-lab questions.

Pre-Lab Questions: Select the correct answer for each of the following questions:

1. The two hip bones articulate anteriorly at the
   a. acetabulum.
   b. pubic arch.
   c. sacroiliac joint.
   d. pubic symphysis.

2. Anatomically, leg refers to
   a. the lower limb.
   b. hip to knee.
   c. knee to ankle.
   d. hip to ankle.

3. The ______ is the largest portion of the hip bone.
   a. acetabulum
   b. ilium
   c. ischium
   d. pubis

4. The ______ is the lateral bone in the leg.
   a. tibia
   b. fibula
   c. femur
   d. patella

5. Which of the following bones is not a tarsal bone?
   a. metatarsal
   b. talus
   c. calcaneus
   d. cuboid

6. The ilium, ischium, and pubis are separate bones in a young child.
   True ___ False ______

7. Ischial spines, ischial tuberosities, and iliac crests are closer together in a pelvis of a female than in a pelvis of a male.
   True _____ False ___

8. Each digit of a foot has three phalanges.
   True _____ False ___
The pelvic girdle includes two hip bones that articulate with each other anteriorly at the pubic symphysis. Posteriorly, each hip bone articulates with a sacrum at a sacroiliac joint. Together, the pelvic girdle, sacrum, and coccyx comprise the pelvis. The pelvis, in turn, provides support for the trunk of the body and provides attachments for the lower limbs. The pelvis supports and protects the viscera in the pelvic region of the abdominopelvic cavity. The pelvic outlet, with boundaries of the coccyx, inferior border of the pubic symphysis, and between the ischial tuberosities, is clinically important in females. The pelvic outlet must be large enough to successfully accommodate the fetal head during a vaginal delivery. Each acetabulum of a hip bone articulates with the head of the femur of a lower limb. The hip joint structures provide a more stable joint compared to a shoulder joint.

The bones of the lower limb form the framework of the thigh, leg, and foot. (Anatomically, thigh represents the region from hip to knee, leg is from knee to ankle, and foot includes the ankle to the end of the toes.) Each limb includes a femur in the thigh, a patella in the knee, a tibia and fibula in the leg, and seven tarsals, five metatarsals, and fourteen phalanges in the foot. These bones and large muscles are for weight-bearing support and locomotion and thus are considerably larger and possess more stable joints than those of an upper limb.

Procedure A—Pelvic Girdle

The pelvic girdle supports the majority of the weight of the head, neck, and trunk. Each hip bone (coxal bone) originates in three separate ossification areas known as the ilium, ischium, and pubis. These are separate bones of a child but fuse into an individual hip bone. All three parts of the hip bone fuse within the acetabulum, and the ischium and pubis also fuse along the inferior portion of the obturator foramen. The acetabulum is a well-formed deep socket for the head of the femur. The obturator foramen is the largest foramen in the skeleton; it serves as a passageway for blood vessels and nerves between the pelvic cavity and the thigh.

Several of the bone features (bone markings) of the pelvis can be palpatated because they are located near the surface of the body. The medial sacral crest is near the middle of the posterior surface of the pelvis, somewhat superior to the coccyx. The ilium is the largest portion of the hip bone, and its iliac crest can be palpatated along the anterior and lateral portions. By following the anterior portion of the iliac crest, the anterior superior iliac spine can be felt very close to the surface.

1. Examine figures 9.1 and 9.2.
2. Observe the bones of the pelvic girdle and locate the following:

   **hip bone (coxal bone; pelvic bone; innominate bone)**
   - ilium
     - iliac crest
     - anterior superior iliac spine
     - anterior inferior iliac spine
     - posterior superior iliac spine
     - posterior inferior iliac spine
     - greater sciatic notch—portion in ischium
     - iliac fossa

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**Figure 9.1** Bones of the pelvis (anterosuperior view).

![Bones of the pelvis (anterosuperior view)](image-url)
FIGURE 9.2 Right hip bone (a) lateral view (b) medial view. The three colors used enable the viewing of fusion locations of the ilium, ischium, and pubis of the adult skeleton.
- ischium
  - ischial tuberosity—supports weight of body when seated
  - ischial spine
  - ischial ramus
  - lesser sciatic notch
- pubis
  - pubic symphysis—cartilaginous joint between pubic bones
  - pubic tubercle
  - superior pubic ramus
  - inferior pubic ramus
  - pubic arch—between pubic bones of pelvis
- acetabulum—formed by portions of ilium, ischium, and pubis
- obturator foramen—formed by portions of ischium and pubis

3. Observe the male pelvis and the female pelvis. Use table 9.1 as a guide as comparisons are made between the pelves of males and females.


Procedure B—Lower Limb

The femur of the lower limb is the longest and strongest bone of the skeleton. The neck of the femur has somewhat of a lateral angle and is the weakest part of the bone and a common fracture site, especially if the person has some degree of osteoporosis. This fracture site is usually called a broken hip; however it is actually a broken femur in the region of the hip joint. Often this fracture is attributed to a fall causing the fracture, when many times the fracture occurs first, followed by the fall. The greater trochanter can be palpated along the proximal and lateral region of the thigh about one hand length below the iliac crest. The medial and lateral epicondyles can be palpated near the knee.

Large muscles are positioned on the anterior and posterior surfaces as well as the lateral and medial surfaces of the femur and the hip joint region. The thigh can be pulled in any direction depending upon which muscle group is contracting at that time. The large anterior muscles of the thigh (quadriiceps femoris) possess a common patellar tendon with an enclosed sesamoid bone, the patella. The muscle attachment continues distally to the tibial tuberosity.

2. Observe the bones of the lower limb and locate each of the following:
   - femur
     - proximal features
       - head
       - fovea capitis
       - neck
       - greater trochanter
       - lesser trochanter
     - shaft
       - gluteal tuberosity
       - linea aspera
   - distal features
     - lateral epicondyle
     - medial epicondyle
     - lateral condyle
     - medial condyle
   - patella
   - tibia
     - medial condyle
     - lateral condyle
     - tibial tuberosity
     - anterior border (crest; margin)
     - medial malleolus

### Table 9.1 Differences Between Male and Female Pelves

<table>
<thead>
<tr>
<th>Structure of Comparison</th>
<th>Male Pelvis</th>
<th>Female Pelvis</th>
</tr>
</thead>
<tbody>
<tr>
<td>General structure</td>
<td>Heavier thicker bones and processes</td>
<td>Lighter thinner bones and processes</td>
</tr>
<tr>
<td>Sacrum</td>
<td>Narrower and longer</td>
<td>Wider and shorter</td>
</tr>
<tr>
<td>Coccyx</td>
<td>Less movable</td>
<td>More movable</td>
</tr>
<tr>
<td>Pelvic outlet</td>
<td>Smaller</td>
<td>Larger</td>
</tr>
<tr>
<td>Greater sciatic notch</td>
<td>Narrower</td>
<td>Wider</td>
</tr>
<tr>
<td>Obturator foramen</td>
<td>Round</td>
<td>Triangular to oval</td>
</tr>
<tr>
<td>Acetabula</td>
<td>Larger; closer together</td>
<td>Smaller; farther apart</td>
</tr>
<tr>
<td>Pubic arch</td>
<td>Usually 90° or less; more V-shaped</td>
<td>Usually greater than 90°</td>
</tr>
<tr>
<td>Ischial spines</td>
<td>Longer; closer together</td>
<td>Shorter; farther apart</td>
</tr>
<tr>
<td>Ischial tuberosities</td>
<td>Rougher; closer together</td>
<td>Smoother; farther apart</td>
</tr>
<tr>
<td>Iliac crests</td>
<td>Less flared; closer together</td>
<td>More flared; farther apart</td>
</tr>
</tbody>
</table>
FIGURE 9.3 The features of (a) the anterior surface and (b) the posterior surface of the right femur. The anterior and posterior views of the patella are included in the figure.

FIGURE 9.4 Features of the right tibia and fibula (anterior view).

FIGURE 9.5 Superior surface view of right foot. The proximal group of tarsals are colored yellow and the distal group of tarsals are colored green.

fibula
- head
- lateral malleolus
tarsal bones
- talus
- calcaneus
- navicular
- cuboid
- lateral cuneiform
- intermediate (middle) cuneiform
- medial cuneiform
metatarsal bones
phalanges
- proximal phalanx
- middle phalanx—absent in first digit
- distal phalanx

Critical Thinking Activity

Compare the size and depth of an acetabulum of a hip bone to the glenoid cavity of the scapula. How do these socket differences between the hip joint and the shoulder joint relate to strength and mobility?

Critical Thinking Activity

As a review of the entire skeleton, use the disarticulated skeleton and arrange all of the bones in relative position to re-create their normal positions. Work with a partner or in a small group and place the bones on the surface of a laboratory table. Check your results with the articulated skeletons.
Pelvic Girdle and Lower Limb

**Part A Assessments**

Complete the following statements:

1. The pelvic girdle consists of two _________________________. A
2. The head of the femur articulates with the ______________ acetabulum of the hip bone. A
3. The __________ ilium __________ is the largest portion of the hip bone. A
4. The distance between the __________ ischial spines __________ represents the shortest diameter of the pelvic outlet. A
5. The pubic bones come together anteriorly to form a cartilaginous joint called the ________ pubic symphysis __________. A
6. The __________ iliac crest __________ is the superior margin of the ilium that causes the prominence of the hip. A
7. When a person sits, the __________ ischial tuberosity __________ of the ischium supports the weight of the body. A
8. The angle formed by the pubic bones below the pubic symphysis is called the ________ pubic arch __________. A
9. The ________ obturator foramen ________ is the largest foramen in the skeleton. A
10. The ilium joins the sacrum at the ________ sacroiliac ________ joint. A

**Critical Thinking Assessment**

Examine the male and female pelves. Look for major differences between them. Note especially the flare of the iliac bones, the angle of the pubic arch, the distance between the ischial spines and ischial tuberosities, and the curve and width of the sacrum. In what ways are the differences you observed related to the function of the female pelvis as a birth canal? A

All of the features examined are wider in the female pelvis which results in a larger pelvic cavity. The pelvic cavity and the pelvic outlet must be large enough to accommodate a vaginal delivery.

**Part B Assessments**

Match the bones in column A with the features in column B. Place the letter of your choice in the space provided. A

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Femur</td>
<td>e</td>
</tr>
<tr>
<td>b. Fibula</td>
<td>a</td>
</tr>
<tr>
<td>c. Metatarsals</td>
<td>g</td>
</tr>
<tr>
<td>d. Patella</td>
<td>a</td>
</tr>
<tr>
<td>e. Phalanges</td>
<td>f</td>
</tr>
<tr>
<td>f. Tarsals</td>
<td>f</td>
</tr>
<tr>
<td>g. Tibia</td>
<td>b</td>
</tr>
<tr>
<td></td>
<td>f</td>
</tr>
<tr>
<td></td>
<td>b</td>
</tr>
<tr>
<td></td>
<td>d</td>
</tr>
<tr>
<td></td>
<td>c</td>
</tr>
<tr>
<td></td>
<td>12. Five bones that form the instep</td>
</tr>
</tbody>
</table>
Part C  Assessments

Identify the bones and features indicated in the radiographs of figures 9.6, 9.7, and 9.8.

**FIGURE 9.6** Identify the bones and features indicated on this radiograph of the anterior view of the pelvic region, using the terms provided.  

**FIGURE 9.7** Identify the bones and features indicated in this radiograph of the right knee (anterior view), using the terms provided.
FIGURE 9.8 Identify the bones indicated in this radiograph of the right foot (medial side), using the terms provided.

Navicular
Medial cuneiform
Metatarsal
Proximal phalanx
Distal phalanx
Sesamoid bone

4 Tibia
5 Talus
6 Calcaneus

Terms:
Calcaneus
Distal phalanx
Metatarsal
Proximal phalanx
Talus
Tibia

Part D Assessments
Identify the bones of the foot in figure 9.9 and the features of a femur in figure 9.10.

FIGURE 9.9 Identify the bones indicated on this superior view of the right foot, using the terms provided.

Distal phalanges
Proximal phalanges
Metatarsals
Medial cuneiform
Intermediate cuneiform
Lateral cuneiform
Navicular
Talus

1 Distal phalanges
2 Proximal phalanges
3 Metatarsals
4 Medial cuneiform
5 Intermediate cuneiform
6 Lateral cuneiform
7 Navicular
8 Talus
9 Middle phalanges
10 Cuboid
11 Calcaneus

Terms:
Calcaneus
Cuboid
Distal phalanges
Intermediate
cuneiform
Lateral cuneiform
Medial cuneiform
Metatarsals
Middle phalanges
Navicular
Proximal phalanges
Talus
FIGURE 9.10  Label the anterior features of a right femur.

1. Fovea capitis
2. Head
3. Neck
4. Greater trochanter
5. Lesser trochanter
6. Shaft
7. Medial epicondyle