

The Human Skeleton

Biology 104

Objectives:

1. Know anatomical directions.
2. Know the bones of the skeleton.
3. Recognize the differences in the skulls and pelvises of males and females.
4. Be able to describe the specific differences between the bones of males and females using proper terminology.
5. Estimate height using one bone.

Introduction: The bones of the skeleton provide support and attachment sites for muscles that move the body, protection for internal organs, and the manufacture of blood cells.

I. In this part of the exercise you will be expected to learn some of the major bones of the body. **LABEL** the following structures in Figures 1 and 2 and 3, as much as possible, as you read through this. The skeleton is subdivided into three regions: the skull, the axial skeleton, and the appendicular skeleton.

Skull

The human skull consists of 28 bones, some of which cannot be seen from the outside. Many fit tightly together along thin, often irregular, lines called **sutures**; others become completely fused in the course of development. The skull itself is subdivided into 2 areas, the cranium and the facial area. The **cranium** of the skull contains the brain and inner and middle ears. On each side of the cranium is a small hole into the skull. This hole is the **auditory canal**, which connects the fleshy outer ear to the middle and inner ears. Look on the ventral surface of the cranium for a hole about the size of a quarter, the **foramen magnum**, (= big hole), through which the spinal cord passes from the cranium into the neck.

The **facial area** of the skull contains the eyes, nose and mouth. The **orbits**, which house the eyes, are composed of a number of facial bones. The bone that contains the upper teeth is the **maxilla**. The lower teeth are in the **mandible**.

Adult humans have a maximum of 32 teeth. Find on the skeleton and on yourself the following teeth; starting at the midline of the mandible and proceeding laterally: 2 **incisors**, 1 **canine**, 2 **premolars**, and 2-3 **molars**. If you only have 2 molars, then your "wisdom tooth" (third molar) is either still embedded in your jaw below your gums, or it didn't form, or it was surgically removed. Notice that the incisors are chisel-shaped and slide past each other: good for biting and slicing. The more conical canines are better for tearing. The premolars and molars are grinding teeth in humans. Notice how they are wider than the other teeth, and that their grinding surfaces meet when the jaw is closed.

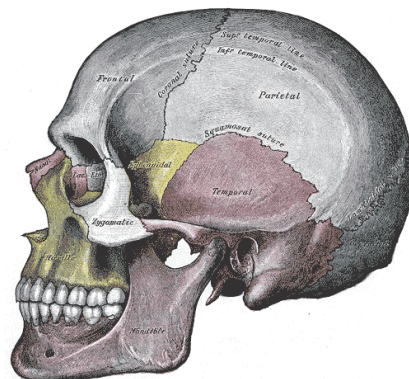


Figure 1: Lateral view of skull
Gray's anatomy

Axial Skeleton

The **axial skeleton** consists of the vertebral column, ribs, and sternum. The human **vertebral column** must be rigid enough to protect the delicate spinal cord and support the entire upper body, but flexible enough to permit a wide range of movements. To get an idea of how that is accomplished, examine a single **vertebra** (Fig. 2). On the ventral side is the large, thick, disk-like **centrum**. The centra stack like coins to form a column that supports the body. Between the centra are intervertebral discs of cartilage that are compressible and absorb the shock of the vertebrae moving against each other. When these are not in their normal place it's called a slipped disc. Dorsal to the centrum is the **neural arch**. The many neural arches of successive vertebrae make a flexible, but protective, bony tube for the spinal cord. Between successive neural arches are lateral holes for the spinal nerves to exit their bony sheath and fan out to parts of the body. Atop the neural arch is a **neural spine** for attachment of muscles that move the parts of the body.

The vertebral column is considered to have 5 regions. The **cervical vertebrae** in the neck support the head but allow for considerably more movement than would be possible if they had ribs. The first cervical vertebra is the **atlas**. Why is this name appropriate?

The second cervical vertebra is the **axis**. Examine these two vertebrae closely and decide which allows you to nod your head "yes" and which permits you to shake your head "no".

The **thoracic vertebrae** are those that articulate with the ribs. Next are the **lumbar vertebrae**, which lie between the thoracic vertebrae and the pelvic region. The lumbar vertebrae lack ribs, a condition that allows flexibility in the lower back. The **sacral vertebrae** are those that articulate with the pelvis. In humans they are fused into a single bone, the **sacrum**. The **caudal vertebrae** are those following the sacrum (caudal = tail). In humans the caudals are reduced to a few small, partially fused bones collectively called the **coccyx**. How many vertebrae of each type do humans have?

Cervical _____ Thoracic _____ Lumbar _____ Sacral _____ Caudal _____

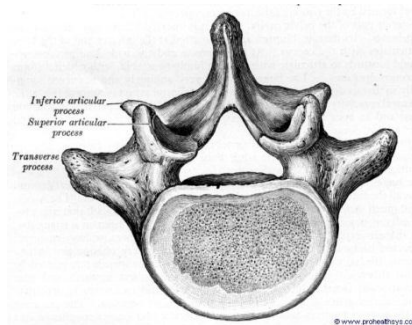


Figure 2: Lumbar vertebra,
From *Gray's Anatomy*

Both male and female humans have 12 pairs of **ribs**. All articulate with the thoracic vertebrae, and most attach via cartilage to the **sternum** (breastbone). What is an advantage of having a flexible rather than a rigid connection between the ribs and the sternum? _____

The **floating ribs** do not attach to the sternum. How many pairs of floating ribs does a human have? _____

Return your attention to the neck region. Note that in the human skeleton there is a bone, the **hyoid bone**, in the throat region, which is not articulated with any other bones. This hyoid bone helps support the larynx and is an attachment site for muscles of the larynx and tongue.

Appendicular Skeleton

The appendicular skeleton consists of the bones of the appendages, plus the pectoral and pelvic girdles. The **pectoral girdle** is the set of bones that supports the arms and helps hold them onto the skeleton. It consists of two flat, triangular **scapulas** ("shoulder blades") on the dorsal surface of the ribs, and two rod-like **clavicles** ("collar bones") on the ventral surface that articulate rigidly with the sternum. Together, these bones, plus muscles and tendons, provide a flexible attachment of the arms to the axial skeleton.

Articulating with the scapula is the **humerus**, the bone of the upper arm. The humerus articulates at its distal end with the **ulna** in a hinge-like joint at the elbow. Lateral to the ulna is the **radius**. Does the radius articulate with the humerus? _____ The eight gravel-shaped bones of each wrist are the **carpals**. The **metacarpals** are the long bones of the palm of the hand. How many metacarpals are there in each hand? _____ The **phalanges** are the bones of the digits (fingers and thumb).

How many phalanges are there in each hand? _____

Show your math here: _____

The **pelvic girdle** provides a rigid attachment of the legs to the body, and in humans must support the entire weight of the trunk and head. Each side of the pelvic girdle consists of 3 bones that fuse during development: the large fan-shaped **ilium**; the **ischium**, on which you sit; and the **pubis**, anterior to the ischium. The 2 pubic bones of each side meet at the **pubic symphysis**, but are separated by a pad of cartilage. The ilia attach broadly and rigidly to each side of the sacrum. The large knobby processes which make contact with a seat when humans sit are the ischial tuberosities.

The cylindrical hole in the center of the pelvis, through which an infant passes at birth, is known as the **true pelvis**. Its size and shape vary, depending on whether the bony pelvis is from a male or female. On the medial edge of the ischium, and projecting medially into the true pelvis, are the **ischial spines**.

The socket in each side of the pelvis is the **acetabulum**, which receives the head of the **femur** and forms a ball-and-socket joint with it. Each femur articulates with the large **tibia**. The **patella** (kneecap) covers this joint. Articulating with the tibia laterally is the slender **fibula**. Does the fibula articulate with the femur? _____ Distal to the tibia and fibula are the **tarsals**, the largest of which is the **calcaneus** ("heelbone") to which the Achilles tendon attaches. The **metatarsals** are in the "arch" of the foot, and the **phalanges** are in the toes.

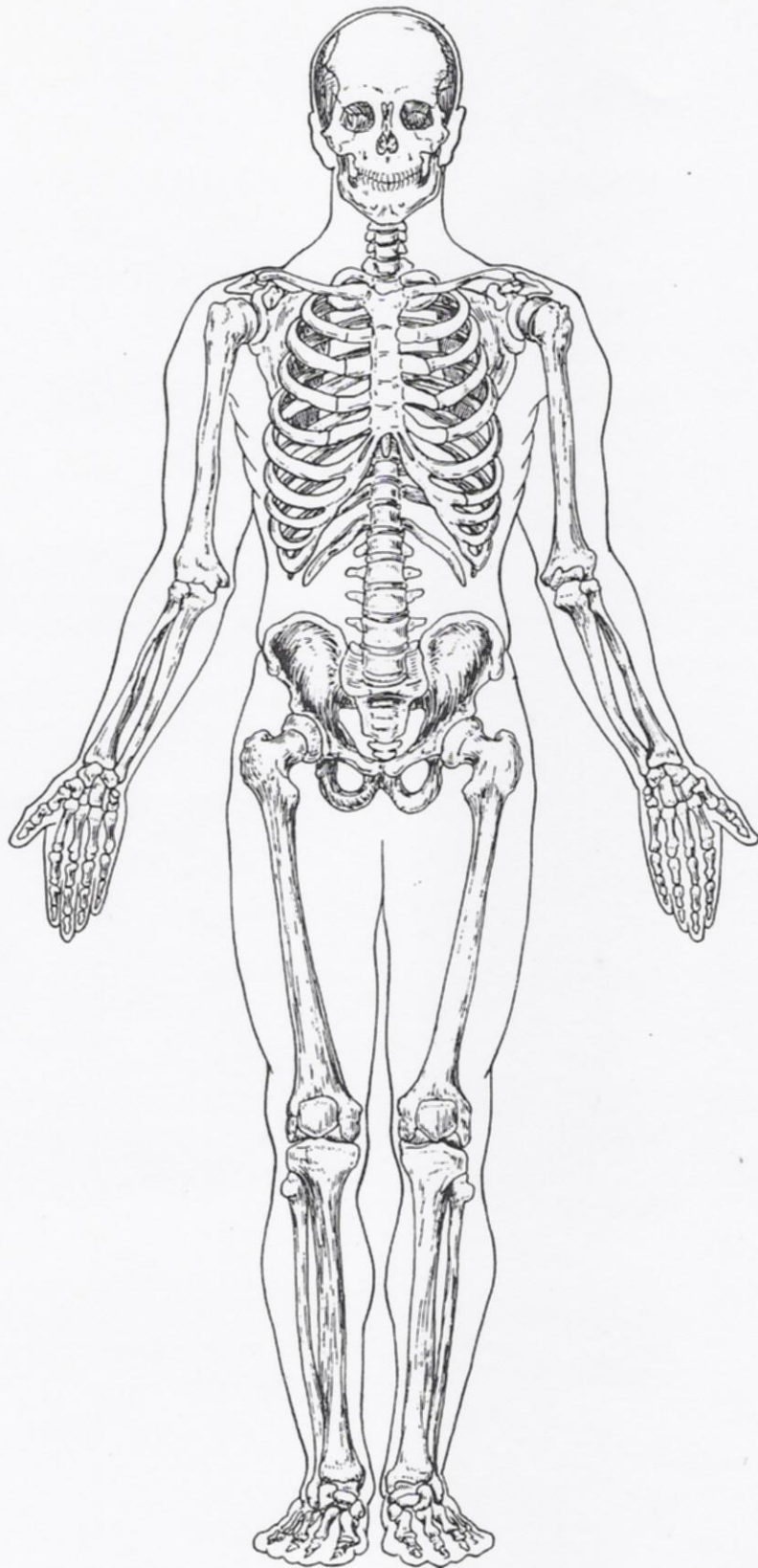


Figure 3: Anterior view of skeleton

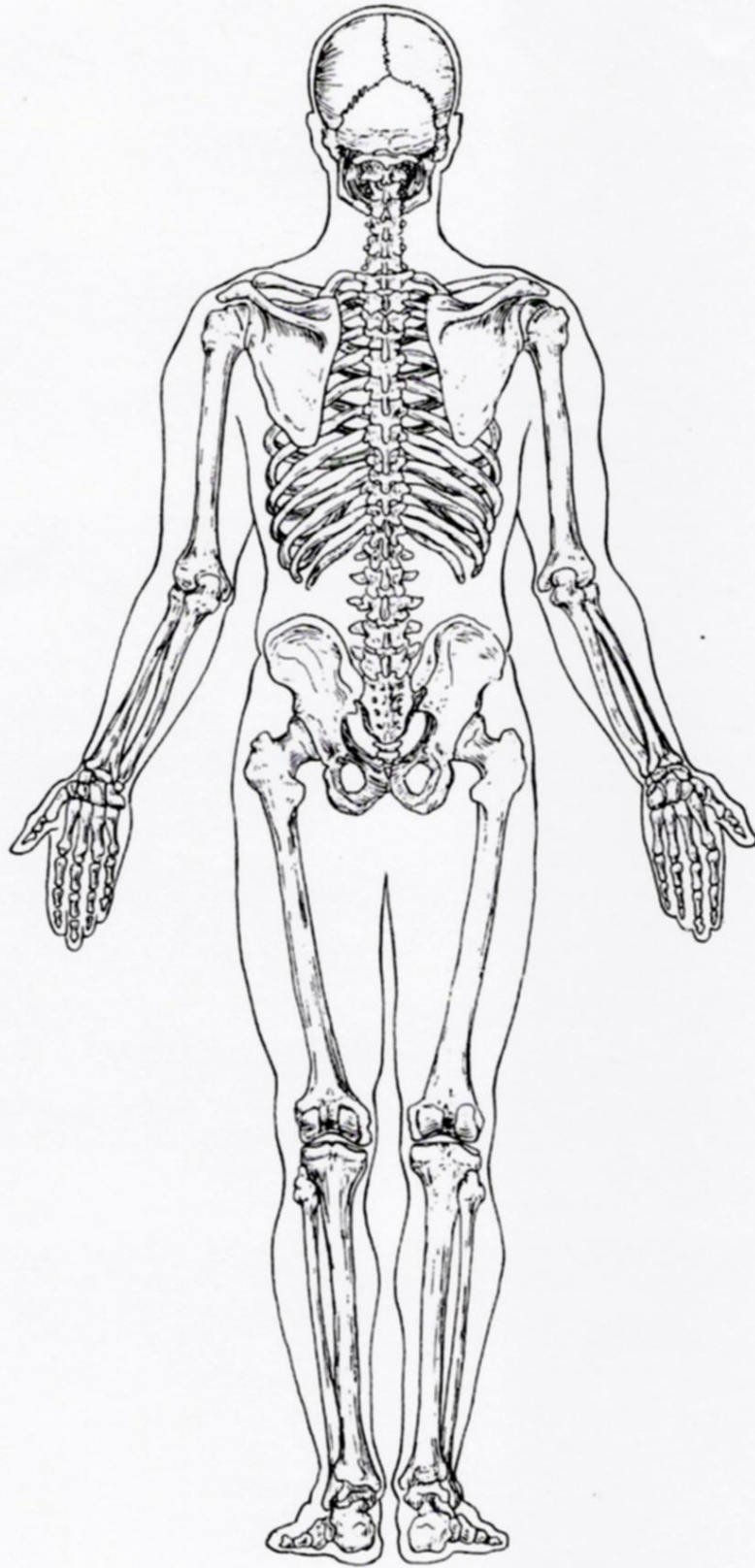


Figure 4: Posterior view of skeleton

II. It is sometimes necessary to identify a person from skeletal remains. Determining the sex of a person based on skeletal elements is sometimes required. Estimating the height of the living person, based on a single bone, is also sometimes required. Forensic anthropologists or forensic osteologists are often called upon to do such work. A fictional osteologist is Dr. Temperance Brennan of the television show “Bones.”

A. Use the skeletal parts at your table to answer the following questions.

1. Examine the skull on your table. The skull is from a person of which sex? What evidence do you have? How sure are you?
2. Examine the pelvis on your table. Is the pelvis on your table from a male or a female? What evidence do you have? How sure are you?

Table 1. Differences in the skull between male and female. In general the male skull is larger, and has more angular processes. The skull of the female is smaller and smoother.

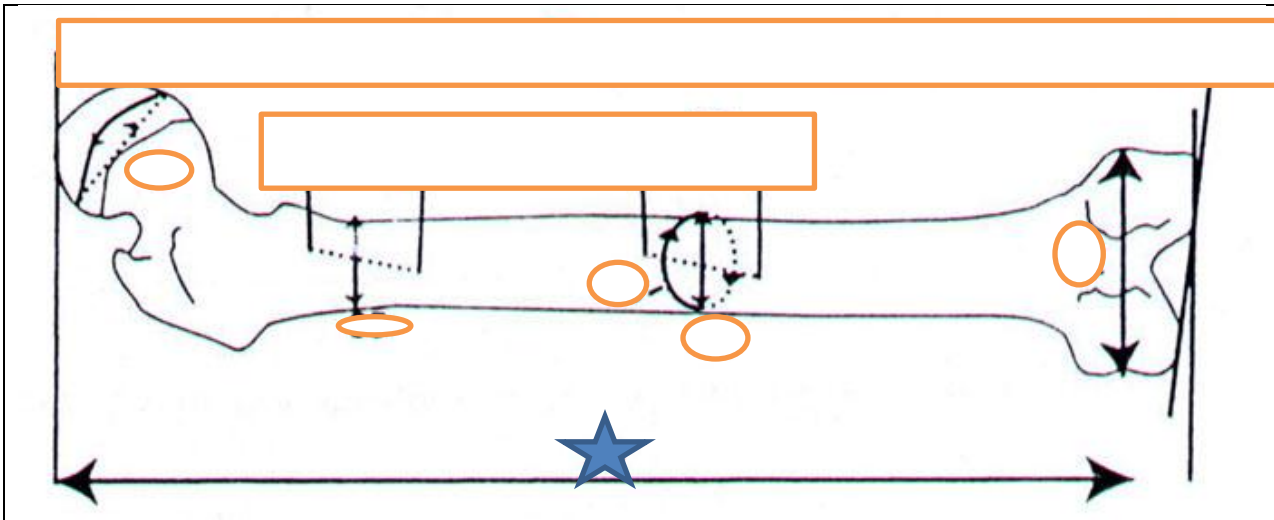
Males	Females
Larger occipital protuberance	Small or no occipital protuberance
Larger brow ridges	Small or no brow ridges
Anterior mandible rectangular	Anterior mandible pointed
Larger overall size, e.g. cranium circumference	Smaller overall size
Forehead is sloping	Forehead more vertical
Orbits rectangular, relatively small	Orbits circular, relatively large

Table 2. Differences in the pelvis between male and female. The pelvis in females is modified for childbirth. Thus, the true pelvis is wider and less obstructed in a female than in a male. E.g., the sacrum extends posteriorly in the female, which makes the true pelvis deeper. The ischial spines are more blunt in the female, which makes the passage of the newborn’s skull during childbirth easier. An obstetrician might measure the distance between the ischial spines in order to gauge relative difficulty of a natural childbirth.

Males	Females
Pubic arch forms an acute angle	Pubic arch forms an obtuse angle, or a broad curve
Sacrum does not extend posteriorly	Sacrum extends posteriorly
True pelvis circular, as broad as deep	True pelvis oval, broader than deep
Ischial spines sharper, with less distance between them	Ischial spines blunt, with greater distance between them
Iliac do not project laterally	Iliac project farther laterally
Narrower pelvic inlet	Wider pelvic inlet

III. Forensic anthropologists can estimate the height of individuals by measuring specific bones. These formulae are based on the study of hundreds of skeletons. Measure the length of the femur in your selection of bones and, using the height estimation data given below, provide a range of estimated height for the individual whose skeleton contained this femur.

Height estimation in cm using the femur (+/- 4 cm)	
Formula for male	$2.27 (\text{femur length}) + 68$
Formula for female	$2.375 (\text{femur length}) + 57$



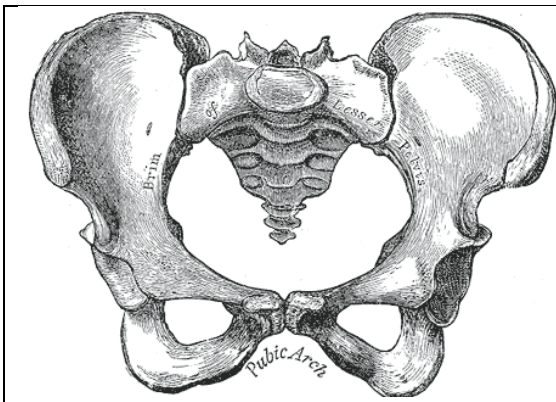
Measuring the length of a femur -- measure the maximal length, as shown by line labeled with a STAR (the line should extend, but does not, to the vertical line on the far right.)

(drawing from Garwin, April. Social Sciences Department. College of the Redwoods. From: ANTH 6- Forensic Anthropology, Measuring Adult Human Remains.

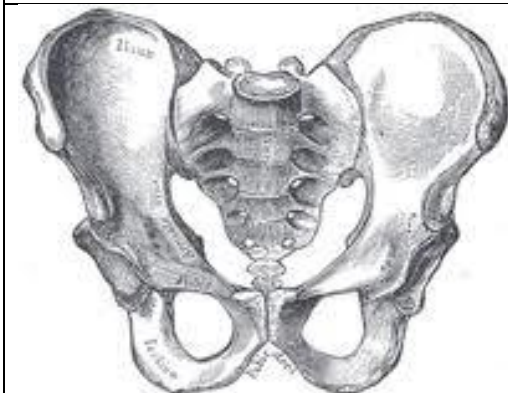
http://www.redwoods.edu/instruct/agarwin/anth_6_measurements.htm

Review:

1. Could you estimate a person's height based on some measurement of the skull? Explain how you could do it or why you couldn't do it.



2. Is this from the skeleton of a male or a female? How do you know?



3. Is this from the skeleton of a male or a female? How do you know?