Human Anatomy Lab #1:
Human Anatomy in Perspective

Lab #1 Table of Contents:
• Expected Learning Outcomes . . . . 1
• Introduction . . . . . . . . 2
• Station 1: Anatomical Terms . . . . 2
• Station 2: Comparison of Cat, Monkey, & Human 4
• Station 3: Comparison of Chimp & Human . 6
• Station 4: Comparison of Fossil & Modern Skulls 8
• Station 5: Sex Differences in the Skeleton . 11
• Station 6: Variation Due to Age . . . . 13

Expected Learning Outcomes
At the end of this lab, you will be able to
• define and use common anatomical terms;
• explain the similarities and differences between humans, other mammals, and other primates;
• describe major trends in human evolution over the past 5 million years; and
• identify features of the skeleton that vary with sex and age.

Fig. 1.1 Human Skeleton
**Introduction**

Welcome to Anatomy! Today’s activities were designed to introduce you to commonly used vocabulary and give you the opportunity to observe and discuss the functions of anatomical features. Humans share much of our anatomy with other vertebrates; for example, all vertebrates have a skull, vertebral column, and four limbs. Mammals are a type of vertebrate. We share anatomical features with other mammals, especially other primates, as you will see. Our unique human journey has shaped and differentiated our anatomy from even our closest relatives, the chimpanzees. In sum, this lab will offer you the opportunity to explore features of human anatomy within the context of human function.

**Station 1: Building Anatomical Vocabulary**

In anatomy, precise terms are necessary for clear communication; one does not want a surgeon who cuts on the “whatchamacallit” in the “whatever” area. The following are common terms, and we expect you to be able to use them accurately, starting today.

Divide into groups of two to three people. Each group should define half of the terms using your books or resources provided by instructors. Then share your definitions with the other half of your group.

**Terms to Know**

- Superior
- Inferior
- Medial
- Lateral
- Proximal
- Distal
- Anterior
- Posterior
- Superficial
- Deep
- Dorsal
- Ventral
- Anatomical Position
- Sagittal (Plane & Section)
- Frontal (Coronal)
- Transverse (Horizontal)
- Axial
- Appendicular
Check Your Understanding

Try to answer the following questions without looking at your notes.
1. List the opposite term for each of the following (a) posterior, (b) lateral, (c) inferior.
2. (True/False) In the anatomical position, the dorsal surface of the hand faces anteriorly.
3. (True/False) The wrist is proximal to the elbow.

Station 2: Comparison of Cat, Monkey, and Human

Humans are classified as **primates**, one of the orders of mammals that diversified after the extinction of the Dinosaurs 65 million years ago. Living primates include **prosimians** (for example, the ring-tailed lemur), **monkeys** (examples are baboons and macaques), **apes** (such as chimpanzees and gorillas), and **humans**. Primates are characterized by grasping hands and feet (except humans no longer have grasping toes!) with **opposable thumbs**, a reliance on vision with forward facing eyes and ability to see color, and large brains. The large brains provide the opportunity for learning, behavioral flexibility, and complex social interactions. Primates live in social groups and offspring take a long time to reach independence.

Comparison of a cat, a monkey, and a human highlights features shared by all mammals, features shared by primates, and features unique to humans.

In your groups, examine the cat, monkey, and human skeletons and answer the following questions.

Identify the following regions on each of the skeletons and answer questions regarding each.

**Skull**

List a similarity between the skulls, and then a difference.

**Similarity:**

______________________________

**A Difference:**

______________________________

**Vertebral Column**
Identify the following regions.

- **Cervical Region**
- **Thoracic Region**
- **Lumbar Region**
- **Sacral Region**
- **Coccygeal Region (Coccyx)**

1. How many cervical vertebrae do the cat, monkey, and human have?

2. List one difference in the thoracic region between the cat and the human.

3. What is a difference in the coccygeal region of the species?

**Pelvis**

Identify the following regions of the pelvis.

- **Ilium**
- **Ischium**
- **Pubis**

1. Which two have the most similar pelvic shape?

Give a functional explanation for the unique human pelvis. (Hint: Think about locomotor behavior; how the animals move.)

**Hands and Feet (or Paws)**

Examine the hands and feet. What is one difference between the cat and the others?
How does the difference relate to the animal’s way of life?

Fig. 1.2 Cat Skeleton

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Check Your Understanding

Try to answer the following questions without looking at your notes. Circle the Statements that are False, and explain why they are not True.

1. Cats have opposable thumbs.
2. Monkeys have more cervical bones than cats.
3. Cats have adaptations for a carnivorous diet.
4. Cats and humans are more similar in their vertebral column anatomy, than are monkeys and humans.

Station 3: Comparison of Human and Chimpanzee

Chimpanzees are more closely genetically related to humans than any other living creature. Molecular and fossil evidence indicate that humans and chimpanzees diverged from a common ancestor 5 to 6 million years ago. At that time, humans took a unique evolutionary path; our anatomy especially reflects the divergence in locomotor styles. When chimpanzees travel in forests and woodlands of Africa, they knuckle-walk, supporting part of their weight with their strong upper limbs. Their hands are positioned like a football player at the scrimmage line, with their middle phalanges contacting the ground. Humans, in contrast, move **bipedally**, an uncommon form of locomotion for mammals.
1. Define Bipedal.

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**Skull Comparisons**

List a difference between the chimpanzee and human skulls.

Give a brief functional explanation for the difference.

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**Postcranial Comparison**

**Limb Proportions**

How do Upper and Lower Limb Proportions differ?

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What is the functional reason for the difference?

**Upper Limbs**

Which species has more robust upper limbs? (Hint: Observe the bumps on the bones such as the *supracondylar ridge* and the *deltoid tuberosity*. These serve as muscle attachments.)

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What does the comparison indicate about the way the upper limbs are used by each species?

- Hands
  Note the length of the components of the hands (*metacarpals, phalanges*). Describe the difference between humans and chimpanzees.
Lower Limbs

• Pelvis
  What is different in the pelves of chimpanzees and humans?
  ________________________________________________________

  Provide a brief functional explanation for the difference.

• Feet
  Which species has an opposable big toe?
  ________________________________________________________

Check Your Understanding

Try to answer the following questions without looking at your notes.
Circle the Statements that are False, and explain why they are not True.

5. Humans have more robust upper limbs than chimpanzees.
6. Chimpanzees have longer lower limbs than upper limbs.
7. Humans have large canine teeth.
8. Chimpanzees have an elongated, narrow pelvis compared to humans.

Station 4: Comparison of Fossil and Modern Skulls

Fossils consist mainly of bones and teeth. Spectacular finds in recent decades have provided information about where early humans lived (Africa), what they looked like, what they ate, and how they moved.

Fossils are interpreted in the context of comparative anatomy. For example, the first humans looked similar to chimpanzees but were unique in their locomotion. All hominins (modern humans and our upright ancestors and cousins) walk on two legs; they are bipedal. Bipedality profoundly shaped human anatomy and behavior, for example, freeing the hands for uses other than supporting body weight.

In addition to many new fossil finds, current techniques have yielded precise dates for fossils and provide a chronology for events in human evolution. Together, the evidence indicates that humans shared a common ancestor with chimpanzees some 5 to 6 million years ago. Then we set out on our own unique human journey.

A variety of hominin species lived between 5 to 6 million years ago up to the origin of our own species, Homo sapiens, which appeared
approximately 200 thousand years ago. One of the most challenging tasks is to assign the fossils (which are usually fragmentary) to an appropriate taxonomic category (e.g. genus and species). Variation in anatomical features such as tooth shape or facial configuration is usually due to species differences; variation in size may be due to differences between males and females or species differences. Scientists use information from comparative anatomy to try to group the fossils in genera and species.

**Genus Australopithecus**
Examine the *Australopithecus* fossil casts.

Early fossils are usually assigned to the genus *Australopithecus* (“Southern Ape”). Within the genus there are several species. In general, these early hominids had a brain size comparable to apes; their dentition suggests that they ate mostly plant foods; and they had adaptations in the pelvis and lower limb for bipedality.

Australopithecines are extremely varied. Australopithecine fossils had small cranial capacities (400-500 cubic centimeters compared to 350-400ccs for chimpanzees). They had large back teeth compared to later humans, suggesting they were adapted for grinding plant food. Fossils from East Africa and Southern Africa show two distinct forms of Australopithecines, the Gracile and Robust. Gracile Australopithecines had more delicate faces and smaller molars. Robust forms had flaring cheek bones a sagittal crest for chewing muscle attachment, and enormous molars, bigger than your thumbnail! The australopithecines persisted in Africa until about 1 million years ago. Populations of Australopithecines gave rise to later species of hominids.

**Genus Homo**
Examine the *Homo ergaster* skull.

This cast represents part of a nearly complete 1.6 million year old skeleton found near Lake Turkana in Kenya. It is sometimes called the “Turkana Boy” because it is an adolescent. It is a member of the species *Homo ergaster* (but is sometimes assigned to *Homo erectus*). Despite its antiquity, it exhibits modern proportions with long legs, short arms, and tall stature. The presence of immature teeth and unfused ends of bones indicate that the individual had not yet achieved adult size.
Examine the Neandertal (*Homo neandertalensis*) skull.

Neandertals (also called Neanderthals) lived in Europe and probably appeared about 500,000 years ago (based on mitochondrial DNA analysis). Their scientific name is *Homo neandertalensis*. They migrated south to the Middle East by about 60,000 years ago and coexisted (and perhaps interbred) for several thousand years in the same areas as modern humans, *Homo sapiens*. Neandertals had a different skull shape than our own species, and, on average, had even larger brain size. They were robust and well-muscled, used sophisticated stone tools, and there is evidence that they cared for elderly members of their groups. The last Neandertal disappeared about 35,000 years ago. The reason for their extinction remains a mystery.

Questions:

Look at the australopithecines and *Homo* specimens. What trends do you observe from the Australopithecine skulls to modern skulls?

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**Check Your Understanding**

Answer the following questions based on your observations of the skulls and information in the preceding paragraphs.

Determine which of the following statements is/are false, and explain why.

1. Neandertals have smaller brain size than humans, but have a similar shape to their skulls.
2. Australopithecines had a brain size similar to chimpanzees.
3. Australopithecine skulls show that they were adapted to eat meat.
5. *Homo ergaster* had modern body proportions.
6. Modern humans (*Homo sapiens*) originated in Asia 500,000 years ago.
The skeleton varies between men and women. Variation due to sex and age is used by experts to identify skeletal remains. If a skeleton is found in the Santa Cruz mountains, for example, the first thing forensic scientists will do is try to determine whether the individual was male or female, and whether he/she was a child or an adult.

The main functions of the skeleton are support and locomotion. A question you may ask is why there would be sex differences, if both men and women have to haul their carcasses around? Women do something that men don’t—they become pregnant and give birth. The female pelvis has to accommodate locomotor and reproductive demands. The woman’s pelvis is wider and has modifications to allow the large-brained human baby to get through the birth canal.

There are less marked sex differences in other parts of the skeleton. Testosterone in males enhances growth of skeletal muscles, which pull on bones and produce more prominent ridges and bumps compared to females. These features of the skull can be used to distinguish males from females.

**Sex Differences and the Skeleton**

Examine the pelvis bones in front of you. How can the pelvis be modified to make the outlet bigger in women? After examination, determine the sex of the bones in front of you. Use the terms below to guide your analysis. Draw a simple diagram of the pelvis and label these features.
• Subpubic Angle
• Sciatic Notch
• Bending of the Sacrum to the Coccyx
• Width of the Ischial Spines

Circle the sex of the pelves that are in front of you.

a. Male/Female
b. Male/Female

Examine the skulls. There are differences in men and women that relate to musculature and size. Identify the features listed below and try to figure out whether the skulls on the table are male or female.

• Supraorbital Ridges
• Chin
• Nuchal Crest
• Mastoid Process
Station 6: Variation Due to Age

The skeleton changes dramatically as one grows from a fetus, to an infant, through childhood to adulthood and old age. There are various ways that experts can determine age in a skeleton. The best estimates of age are in young people for two reasons. First, there is a specific pattern of eruption of baby and adult dentition. Stages of tooth development are compared to established charts. Second, the ends of long bones such as the femur and humerus are separated from the shaft at birth by a cartilaginous plate; fusion of the shaft and ends occurs in a specific pattern at known ages.

Bones growth at the epiphyses (ends) is thoroughly documented. For example, the iliac crest, the upper edge of the pelvic bone, is completely fused by age 23. Before the 20’s, age can be established by tooth development and bone fusion. Once individuals reach age 25 or older, the estimates become less exact, and are based on degenerative changes such as tooth wear, arthritis, and fusion of sutures in the skull.

Examine the fetal skull. What is the name for the areas between the skull bones that are not fully bony yet (commonly called “soft spots”)?

What is the function (or functions) of these non-bony areas in the fetal skull?

List a difference between the adult skull and the baby skull.

1. ___________________________________________________________________________

Look at the fetal skull, 6-year old skull, adult skull, and old age skull. What do you notice that is different in the elderly skull?

_____________________________________________________________________________

Examine the long bones. Identify one that has a fully fused epiphysis and one that does not. Where does bone growth occur?
Check Your Understanding

Try to answer the following questions without looking at your notes.

1. What are the two main sources of variation in human skeletons?
2. When hiking in the Santa Cruz mountains, you find a human skeleton. What part of the skeleton would you examine to determine whether it was male or female?
3. Why is it easier to determine the age of a younger individual compared to someone who is middle-aged?
4. List two specific features you would use to determine sex of a skull.