“There is a brief but very informative biography of an individual contained within the skeleton, if you know how to read it . . .”

—Clyde Snow, forensic anthropologist
Objectives

You will understand:

How anthropologists can use bones to determine:

- Whether remains are human
- Gender
- Age
- Sometimes race
- Estimated height
- When the death occurred.
Objectives, continued

You will be able to:

Distinguish between a male and a female skeleton.

Give an age range after examining unknown remains.

Describe differences in skull features among the three major racial categories.

Estimate height by measuring long bones.
Forensic Anthropology

Forensic anthropology is a type of applied anthropology that specializes in the changes and variations in the human skeleton for the purpose of legal inquiry.
Forensic Anthropology, continued

A forensic anthropologist may provide basic identification information on skeletonized or badly decomposed remains.
From a whole bone or part of a bone, the scientist may be able to determine:

• An age range
• Sex
• Race
• Approximate height
• Cause of death, disease, or anomaly
Osteology

Osteology is the study of bones.

There are 206 bones in an adult human.

Function of bones:

- Provide structure and rigidity
- Protect soft tissue and organs
- Serve as an attachment for muscles
- Produce blood cells
- Serve as a storage area for minerals
- Can detoxify the body by removing heavy metals and other foreign elements from the blood
Estimation of Height

The height of a person can be calculated by measuring the length of certain long bones, including the femur, tibia, humerus, and radius. Below are the equations used to determine average measurements for both male and female. (All measurements are in centimeters.)

<table>
<thead>
<tr>
<th>Male Height, ( H )</th>
<th>Female Height, ( H )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( H = \text{femur} \times 2.23 + 69.08 )</td>
<td>( H = \text{femur} \times 2.21 + 61.41 )</td>
</tr>
<tr>
<td>( H = \text{tibia} \times 2.39 + 81.68 )</td>
<td>( H = \text{tibia} \times 2.53 + 72.57 )</td>
</tr>
<tr>
<td>( H = \text{humerus} \times 2.97 + 73.57 )</td>
<td>( H = \text{humerus} \times 3.14 + 64.97 )</td>
</tr>
<tr>
<td>( H = \text{radius} \times 3.65 + 80.40 )</td>
<td>( H = \text{radius} \times 3.87 + 73.50 )</td>
</tr>
</tbody>
</table>
Age Determination

Most accurate estimations are made from:

- Teeth
- Epiphyses or growth plates
- Pubic symphysis
- Cranial sutures: The three major cranial sutures appear as distinct lines in youth and gradually close from the inside out.

Investigators *always* use an *age range* because of the variation in people and how they age. The investigator does not want to eliminate any possibilities for identification.
Age Determination Using Cranial Sutures

Sagittal suture completely closed
- Male—26 or older
- Female—29 or older

Sagittal suture completely open
- Male—less than 32
- Female—less than 35

Complete closure of all three major sutures
- Male—over 35
- Female—over 50
Age Determination Using Basilar Suture

Basilar suture
Technically known as the synchondrosis spheno-occipitalis, closes in females as young as 14 and in males as young as 16. If the suture is open, the individual is generally considered to be 18 or younger.
Age Determination

In long bones, the *diaphysis*, or shaft, makes up most of the bone’s length. The *epiphyses* are found at the ends of the bones; their function is to allow for growth. The epiphyses are good places to look for changes in estimating age. Though all people are different and grow at different rates, there are *similarities that allow for generalizations* in estimating age.
Definitions

Stage 1: no epiphysis (the growth plate has not formed yet)
Stage 2: non-union; the epiphysis and bone are separate
Stage 3: partial union; the epiphysis is attached, but a line is visible
Stage 4: complete union; the epiphysis is attached and a line is *not* visible
The Medial Clavicle in Stages 1–4
### Age Determination Using Epiphysis

<table>
<thead>
<tr>
<th>Stage of Union of Medial Clavicle</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-union without separate epiphysis</td>
<td>21 or younger</td>
<td>20 or younger</td>
</tr>
<tr>
<td>Non-union with separate epiphysis</td>
<td>16–21</td>
<td>17–20</td>
</tr>
<tr>
<td>Partial union</td>
<td>17–30</td>
<td>17–33</td>
</tr>
<tr>
<td>Complete union</td>
<td>21 or older</td>
<td>20 or older</td>
</tr>
</tbody>
</table>
Gender Differences in Bones

Determination of sex is crucial to the analysis of unidentified human remains. The pelvis offers the most definitive traits. Comparison of three characteristics of the os pubis gives the information used to identify sex.
Gender Identification

A. The female (top) has a wider pubic body than the male (bottom).

B. The female has a wider subpubic concavity or subpubic angle.
Gender Identification, *continued*

C. Most females have a ventral arc present.
Human Remains

**Subpubic Angle**

Male

Female

Subpubic Angle
Determine which are male and which are female.
Gender Differences

The rib cage and shoulders of males are generally *wider* and *larger* than those of females. In addition, about one person in 20 has an extra rib. This is more common in males than in females.
Gender Differences, continued

In males, the index finger is sometimes shorter than the third finger. In females, the index finger is sometimes longer than the third finger. This is not often used as an indicator of gender, as there are many exceptions.

Is this a male or female hand according to the above rule?
Race

Race is difficult to determine from most skeletal remains, especially since pure races are becoming uncommon. An experienced forensic anthropologist can generally place skulls into one of three groups:

- **Caucasoid**—European, Middle Eastern, and Indian descent
- **Negroid**—African, Aborigine, and Melanesian descent
- **Mongoloid**—Asian, Native American, and Polynesian descent
Race Characteristics

**Caucasoids**—have a long, narrow nasal aperture, a triangular palate, oval orbits, narrow zygomatic arches, and narrow mandibles.

**Negroids**—have a wide nasal aperture, a rectangular palate, square orbits, and more pronounced zygomatic arches. The long bones are longer, and have less curvature and greater density.

**Mongoloids**—have a more rounded nasal aperture, a parabolic palate, rounded orbits, wide zygomatic arches, and more pointed mandibles.
What differences do you notice among these three skulls? Can you determine race?
Odontology
The Study of Teeth

The identity of an individual can be determined by comparing a person’s teeth to his or her dental records. Unusual features including the number and types of teeth and fillings, the spacing of the teeth, and/or special dental work (bridges, false teeth, root canals) help to make a positive identification.
Odontology and Identification

Teeth are often used for body identification because:

They are the hardest substances in the body (they do not readily decompose).

They are unique to the individual.

X rays are a good record of a person’s teeth, giving them a unique identity.
Facial Restoration

After determining the sex, age, and race of an individual, facial features can be built upon a skull to assist in identification. Erasers are used to make tissue depths at various points on the skull. Clay is used to build around these markers, and facial features are molded.
Steps in Facial Reconstruction

*With a skull:*
- Establish age, sex, and race.
- Plot landmarks for tissue thickness.
- Plot origin and insertion points for muscles.
- Plot landmarks for facial features.
- Select a dataset and mount markers for tissue thickness.
- Mount the eyes.

- Model muscles on skull.
- Add fatty tissue around eyes and lacrimal glands.
- Add eyelids.
- Add the nose.
- Add the parotid gland.
- Add the ears.
- Cover all with layers of skin.
- Detail the face.
Case Study: Facial Reconstruction

John List killed his entire family, moved to a new town, and assumed a new identity. Seventeen years later, Frank Bender reconstructed what he believed List would look like. The reconstruction was shown on America’s Most Wanted, and he was turned in by the viewers almost immediately . . . looking very much like the reconstruction.

Check out more about this story on truTV’s Crime Library:

www.crimelibrary.com/notorious_murders/family/list/1.html
People in the News

Bill Bass is a forensic anthropologist who has assisted law enforcement with hundreds of cases. He established the world’s first and only laboratory devoted to the study of human decomposition at the University of Tennessee’s Anthropology Research Facility.

It is known as “The Body Farm.”
The Body Farm

The Body Farm is the nickname of a two-and-a-half-acre research facility in Tennessee developed in 1980 by Bill Bass where bodies are placed in various conditions and allowed to decompose. Its main purpose is to observe and understand the processes and timetable of postmortem decay. Over the years it has helped to improve the ability to determine “time since death” in murder cases.

*Hic locus est ubi mortui viveuntes docent.*

“This is the place where the dead teach the living.”
Anthropologist at Work

This anthropologist is hard at work dusting away material from these embedded bones.

Picture taken at Chicago’s Museum of Natural History
More Applications

Forensic experts may be called upon to give information on the life and death of humans and animals in unique circumstances, including:

Mass murder (Oklahoma bombing, plane crashes, World Trade Center)
Earlier man (mummies, Iceman, Lindow Man)
Historical significance (Holocaust, uncertain death of famous people)
Prehistoric animals (dinosaurs)
Animal Facial Restoration

Determining what *T. Rex* looked like using the bone formation.

From this:       To this:
More Information

For additional information on Bill Bass and the Body Farm:

On forensic artists: