LAB #9: FORENSIC ANTHROPOLOGY

Objectives: To become familiar with the methods physical and forensic anthropologists use to identify an individual's sex, race, age, and stature by looking at skeletal remains. Employing common osteometric techniques, you will analyze four different elements from a single skeleton including the pelvis (for sex and age), skull (sex, race, age), femur (sex, race, age, height), and humerus (sex, age, height).

Reading: Chapter 12 in Lab Manual and Workbook for Physical Anthropology.

Procedure
The procedure you will follow is outlined in the following pages. You will be working in groups of two or three for this lab exercise. You and your partner(s) will be working with one of three sets of skeletal materials.

Your work must be presented in the following order:

- Title Page (be sure to indicate what individual you are analyzing)
- Tables 1-10 (pp. 10-14 in this lab packet)
  - Be sure your handwriting is clearly legible
- All tables are available in electronic format on Blackboard
- Exercise 12.1 in the lab manual
Introduction

Imagine that you are hiking in the woods when suddenly you stumble upon what appears to be a human skull. Upon closer inspection, you notice some other bones in the area. The authorities are called and immediately begin to investigate the scene. You may wonder whose job it is to identify the remains you have just found and how they even go about doing just that.

In this case, a forensic anthropologist would be called on to assess the bones and make that determination. Through careful observations and measurements of key bones, these experts are able to suggest the sex, race, height, and age of the skeleton at the time of death. They may also learn about the deceased's medical history and sometimes even the cause of death. They are able to accomplish all of this by taking advantage of their knowledge of the many bone changes that occur throughout a person's lifetime, including growth, repair, and maturation.

Forensic anthropologists use both metric and non-metric data to assess bones. Most commonly however, they rely on metric data when studying a skeleton. Usually, these experts use costly precision instruments such as sliding calipers, spreading calipers, and osteometric boards to make measurements of the skull and long bones. Non-metric traits are those that are purely observational in nature. These traits are examined and compared on the basis of frequency of occurrence within certain populations. Due to its inherent subjectivity, the data collection of non-metric traits is not as definitive as metric data collection. However, it is still considered to be a very useful tool in the assessment of skeletal remains.

The job of identifying skeletal remains is, of course, made much easier if the entire skeleton is present. However, many times this is not the case and the scientists must make their assessment based on only a few bones. This will be the case with today's lab activity. You will be examining the fragmentary remains of an individual. You are the forensic anthropologist assigned to the case and it's up to you to determine as much information as possible about these bones to help identify the individual represented. Good luck!

Sex Determination

A number of skeletal indicators are used to determine sex. The more indicators used, the more accurate the results will be. However, it is important to note that there is very little sexual dimorphism in preadolescent skeletons, which makes sex determination in them very difficult.

The pelvis is considered to be the best bone with which to estimate sex. This is mainly due to the fact that the female's pelvis is designed to allow for the passage of a child. Consequently, the pelvis of a female is generally larger and wider than that of a male. These differences can be observed in figures 2-5.

The skull is the second most commonly used bone to determine sex. Many of the skull traits related to sexing are most easily observed when directly compared to a skull of the opposite sex. This is why one's ability to sex a skull, and a skeleton for that matter, improves with experience. Observe the differences between a male and a female skull in figures 9-12.

Normally, the long bones alone are not used to estimate gender. However, if these bones are the only ones present, there are characteristics that can be used for sex determination.
**Race Determination**

It can be extremely difficult to determine the true race of a skeleton. This is due to several factors: First, forensic anthropologists generally use a three-race model to categorize skeletal traits: Caucasoid (European), Mongoloid (Asian/Amerindian), and Negroid (African). Although there are certainly some common physical characteristics of these groups, not all individuals have skeletal traits that are completely consistent with their geographic origin. Additionally, there is the issue of racial mixing to consider. Often times, a skeleton exhibits characteristics of more than one racial group and does not fit neatly into the three-race model. Also, the vast majority of the skeletal indicators used to determine race are non-metric, which, as stated earlier, can be highly subjective. Despite these drawbacks, race determination is viewed as a critical part of the overall identification of an individual's remains.

The skull is considered to be the most important bone for race determination because without it, the origin of race cannot accurately be determined. Forensic anthropologists use lengths, widths, and shapes of skull features along with population-specific dental traits to aid them in reaching a conclusion. Compare the skulls in figures 16-21 to assess the racial variation between them. The femur bone can also be used to aid in the race determination of a skeleton but is only used to eliminate either the Caucasoid or Negroid race.

**Height Determination**

The height, or stature, of a skeleton is most commonly determined by examining the long bones of that individual (femur, tibia, fibula, humerus, ulna, and radius). If a complete set of these bones is not available, the accuracy in height determination is improved if two or more bones are used. The femur and the humerus bones are excellent skeletal indicators for height when used together.

**Age Determination**

The best bone to use in determining a person's age at the time of death is the pelvis. Many changes can be observed on the face of the pubic symphysis and the auricular surface of the ilium over time that are good indicators of a person's age. The extent of suture closure on the skull can also be used as an indicator. However, these changes are best viewed on a natural skeleton rather than on a plastic one.

For this lab you will look at another indicator of age known as epiphyseal union. At birth, humans have about 450 bones. These bones will eventually fuse together to form just 206 adult bones. During the course of development, the articular end of the bone, or epiphysis, is separated from the shaft of the bone, or diaphysis, by a layer of cartilage. This cartilaginous layer remains throughout the bone's development and forms a very distinct line in the bone. This line becomes increasingly faint until the bone becomes completely ossified and the line is altogether obliterated. Because this line remains for a definite amount of time, it is a useful trait in aging individuals, especially juveniles.
Materials Needed Per Group
1 Vernier Caliper
1 Large Caliper
1 Protractor
1 Metric Ruler
1 Bone (rotate through the following in any order: skull, humerus, pelvis, or femur)
1 Packet of Figures

Key Directional Terms
Anterior (ventral) - Situated in front of; the front of the body
Posterior (dorsal) - Situated in back of; the back of the body
Superior - Toward the head; relatively higher in position
Inferior - Away from the head; relatively lower in position
Medial - Toward the midline of the body
Lateral - Away from the midline of the body
Proximal - Closer to any point of reference on the body
Distal - Farther from any point of reference on the body

How to Use Your Vernier Caliper
You will be asked to use a vernier caliper to obtain metric data in this lab. All measurements, with the exception of one, will be made from the outside of the bone, using the outside measuring scale. This means that you will use the inside of the movable portion of the caliper to lightly squeeze the bone you are measuring and then read the outside scale located at the top of the caliper. Only the nasal cavity will be measured from inside the cavity, using the inside measuring scale. The whole number is read at the "0" of the appropriate scale (outside or inside) and the decimal reading is made at the point at which the appropriate scale lines match up exactly with a millimeter mark in the center of the caliper. For example, in Figure 1 below, the outside measurement reads 12.5 mm, whereas the inside measurement reads 25.1 mm. Be sure not to read the inside scale when taking an outside measurement.
Procedure
In this lab you will learn to recognize and assess a number of skeletal indicators located on the pelvis, skull, femur, and humerus. You will then determine the sex, race, height, and approximate age of an individual at the time of death based on those skeletal indicators.

PART I - PELVIS
Refer to Figures 2-8 when assessing the pelvis.

Sex Determination
1. Determine the sub-pubic angle (Fig. 6, no. 1) by using the following method: Place the pelvis anterior-face down on a white sheet of paper. Trace the sub-pubic angle onto a piece of paper. Using the straight edge of your ruler, go over the lines you have just made to make them as straight as possible and extend the lines until they meet to form an angle. Measure this angle using your protractor. Record your results in Table 1.

2. Use the Vernier Caliper to measure the pubis body width (Fig. 6, no. 10). Start at the middle of the lateral edge of the pubic symphysis and measure across to the medial edge of the obturator foramen (Fig. 6, no. 6). Record your result in Table 1.

3. Locate the greater sciatic notch (Fig. 8, no. 11) and use the following method to measure its angle: Place the pelvis posterior-side down on a piece of paper and turn it in such a way that the greater sciatic notch is closest to the paper. Trace the angle of the sciatic notch onto the piece of paper. Use the straight edge of your ruler to go over the lines you have just made and extend those lines until they meet to form an angle. Use your protractor to measure the angle you have just drawn. Record your result in Table 1.

4. Locate the sacrum and the coccyx (Figs. 7 and 8, nos. 8 and 9, respectively). Hold the pelvis in such a way that the pubic symphysis (Fig. 6, no. 2) is facing down and parallel to the tabletop (as shown in Figure 7). Hold the pelvic cavity (Fig. 7, no. 12) at eye level in order to observe its shape properly. Is the opening circular and wide, showing mainly the coccyx (as shown in Fig. 5), or is it more heart-shaped, showing a large portion of the sacrum and the coccyx (as shown in Fig. 3)? Record your result in Table 1.

Age Determination
1. Refer to Table 8 in the analysis section to determine the approximate age when each bone will have fused and/or completely ossified (i.e., there is no evidence of an epiphysis or cartilaginous line).

2. Inspect the entire pelvis carefully. Pay close attention to any evidence of epiphyseal unions. In Table 8, draw a circle around each age or age group in which the specified developmental occurrence has already taken place.
PART II - SKULL
Refer to Figures 9-24 when assessing the skull. Note that when you view the skull from the front or side, always have the skull oriented so that it is anatomically correct, i.e., the eye sockets should be parallel to the table top as shown in Figures 10 and 12, and not directed upwards. This is known as the Frankfort Horizontal Plane.

Sex Determination
1. Run your finger over the upper edge of the eye orbit (Fig. 13, no. 13). Is it rounded or sharp? Record your result in Table 2.
2. Observe the shape of the eye orbit. Is it closer to being square or circular? Record your result in Table 2.
3. Locate the zygomatic process (Fig. 14, no. 15). Is this ridge expressed beyond the external auditory meatus (Fig. 14, no. 16)? Record your results in Table 2.
4. Observe the occipital region of the skull (Fig. 14, no. 17). The nuchal crest is a ridge that runs along the base of the occipital bone (Fig. 15, no. 18). Is this area smooth (similar to the rest of the skull) or rough and bumpy? Record your result in Table 2.
5. Is there a single bump, known as the external occipital protuberance, present in this region? (Fig. 15, no. 19). Record your result in Table 2.
6. Observe the frontal bone from the side (Fig. 14, no. 20). Is it low and slanting (as in Fig. 10) or rounded and globular (as in Fig. 12)? Record your result in Table 2.
7. Observe the mandible from the inferior view (as shown in Fig. 15, no. 21). Does it look squared and U-shaped or rounded and V-Shaped? Record your result in Table 2.
8. Observe the ramus of the mandible (Fig. 14, no. 22). Draw an imaginary vertical line down from the external auditory meatus (Fig. 14, no. 16) to the floor. Be sure to keep the skull in the Frankfort Horizontal Plane. Is this line fairly parallel with the ramus, indicating that it is straight, or does the ramus slant away from the imaginary line as your eye moves down it? Record your result in Table 2.

Race Determination
1. Using your Vernier caliper, determine the nasal width by taking an inside measurement of the widest portion of the nasal cavity (Fig. 13, no. 23). Determine the nasal height by placing one end of your caliper on the nasion (Fig. 13, no. 24) and the other end on the nasal spine (Fig. 13, no. 25). Determine the nasal index by dividing the nasal width by the nasal height and record your result in Table 5.
2. To demonstrate racial differences among skulls, use your metric ruler to determine the nasal width and height of each of the skulls in Figures 22, 23, and 24. Record this information in the space provided below Table 5.
3. The nasal spine is located medially at the base of the nasal cavity (Fig. 14, no. 25). To assess the prominence of this protrusion, rest your pencil, sideways, across the maxilla (Fig. 13, no. 27). Try to run the pencil gently onto the nasal cavity. Is the nasal spine so prominent that it
completely blocks your pencil from reaching the nasal cavity, or does your pencil run over the small protrusion in order to reach the cavity, or is the spine so small that your pencil can easily glide into the opening? Record your result in Table 5.

4. Feel the base of the nasal cavity, on either side of the nasal spine (Fig. 13, no. 26). Do you feel sharp ridges (nasal silling), rounded edges, or no ridges at all (nasal guttering)?

5. A jaw is considered to be prognathic if it juts out away from the face. To assess prognathism, hold your pencil in a vertical position against the nasal spine (Fig. 14, no. 25) and lower the pencil towards the face and attempt to touch the chin. Does the pencil touch, or come close to touching, both the anterior nasal spine and the chin at the same time or does the pencil angle out too far due to a protruding jaw? Record your results in Table 5. See Figures 17, 19, and 21 to compare prognathism between races.

6. Observe the shape of the eye orbits (Fig. 13, no. 13). Are they rounded and somewhat square, rounded and circular, or fairly rectangular? Record your result in Table 5.

PART III - FEMUR
Refer to Figures 25-26 when assessing the femur.

Sex Determination
1. Using your Vernier Caliper, measure the vertical diameter of the femoral head (Fig. 26, no. 35) and record your result in Table 3.

2. Using your Vernier Caliper, determine the bicondylar width by measuring the distance from the most lateral portion of the internal condyle (Fig. 25, no. 34) and the most lateral portion of the external condyle (Fig. 25, no. 33). Record your result in Table 3.

3. Using your large caliper, obtain the maximum length of the femur by measuring from the most superior portion of the femoral head (Fig. 25, no. 28) to the most inferior portion of the internal condyle (Fig. 25, no. 34). Record your result in Table 3 and in the space provided above Table 6.

Race Determination
1. Lay the femur down on the table in such a way that the lesser trochanter is closest to the table. Place the palm of your hand flat on the table and try sliding your fingers underneath the curvature of the shaft (Fig. 25, no. 32). Do they fit? If so, the Negroid race can be eliminated. If they do not fit underneath the shaft, the Caucasoid race can be eliminated.

Age Determination
1. Refer to Table 9 to determine the approximate age when each bone initially appears or joins the shaft of the femur.

2. Inspect the femur carefully. In Table 9, draw a circle around each age or age group in which the specified developmental occurrence has already taken place.
PART IV - HUMERUS
Refer to Figures 27-29 when assessing the humerus.

Sex Determination
1. With your Vernier Caliper, measure the transverse diameter of the humeral head (Fig. 29, no. 43) and record your result in Table 4.

2. With your Vernier Caliper, measure the vertical diameter of the humeral head (Fig. 28, no. 44) and record your result in Table 4.

3. Using your large caliper, obtain the maximum length of the humerus by measuring from the most superior portion of the humeral head (Fig. 27, no. 36) to the most inferior portion of the trochlea (Fig. 27, no. 40). Record your result in Table 4 and in the space provided above Table 7.

4. Using your Vernier Caliper, obtain the epicondylar width by measuring from the most lateral portion of the internal condyle (Fig. 27, no. 39) to the most lateral portion of the external condyle (Fig. 27, no. 42). Record your result in Table 4.

Age Determination
1. Refer to Table 10 in the analysis section to determine the approximate age when each bone joins or unites with the shaft of the humerus.

2. Inspect the humerus carefully. In Table 10, draw a circle around each age or age group in which the specified developmental occurrence has already taken place.

PART V - CALCULATIONS
1. Plug your data for the maximum length of the femur into each regression formula in Table 6 and calculate. Record your answer to the right of each formula in the space provided.

2. Plug your data for the full length of the humerus into each regression formula in Table 7 and calculate. Record your results to the right of each formula in the space provided.
PART VI - FINAL DETERMINATIONS

Note: Remember that all of the bones used to assess any given trait should be looked at as a whole. For example, if the majority of the bones used to determine the sex indicate that the individual was male, then your final determination of sex should be male.

1. Based on your results entered in Tables 1-4, make a final determination as to the sex of this individual. Write this answer in the space provided below Table 4.

2. Based on your results entered in Table 5 and the results of the femur curvature test, make a final determination as to the race of this individual. Write this answer in the space provided below Table 5.

3. Now that you have determined the sex and race of this individual, you should circle the heights in Tables 6 and 7 that correspond to your determinations. Combine this information in order to write down a final height determination of this individual in the space provided below Table 7. Express the individual's height as a range, from the height determined by the femur and the height determined by the humerus.

4. Based on the ages circled in Tables 8, 9, and 10, determine the minimum age of this individual at the time of death. Write this answer in the space provided below table 10.

5. In the spaces provided on the final page of this lab indicate the Sex, Race, Height, and Age of the individual.

References


SEX DETERMINATION

**TABLE 1 - PELVIS**

<table>
<thead>
<tr>
<th>Trait</th>
<th>Result</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-Pubic Angle</td>
<td>&gt; 90 degrees</td>
<td>&lt; 90 degrees</td>
<td></td>
</tr>
<tr>
<td>Pubis Body Width</td>
<td>40 mm</td>
<td>25-30 mm</td>
<td></td>
</tr>
<tr>
<td>Greater Sciatic Notch</td>
<td>&gt; 68 degrees</td>
<td>&lt; 68 degrees</td>
<td></td>
</tr>
<tr>
<td>Pelvic Cavity Shape</td>
<td>Circular and Wide showing mainly coccyx</td>
<td>Heart-Shaped showing sacrum and coccyx</td>
<td></td>
</tr>
</tbody>
</table>

**TABLE 2 - SKULL**

<table>
<thead>
<tr>
<th>Trait</th>
<th>Result</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Edge of Eye Orbit</td>
<td>Sharp</td>
<td>Blunt</td>
<td></td>
</tr>
<tr>
<td>Shape of Eye Orbit</td>
<td>Round</td>
<td>Square</td>
<td></td>
</tr>
<tr>
<td>Zygomatic Process</td>
<td>Not expressed beyond external auditory meatus</td>
<td>Expressed beyond external auditory meatus</td>
<td></td>
</tr>
<tr>
<td>Nuchal Crest (Occipital Bone)</td>
<td>Smooth</td>
<td>Rough, Bumpy</td>
<td></td>
</tr>
<tr>
<td>External Occipital Protuberance</td>
<td>Generally Absent</td>
<td>Generally Present</td>
<td></td>
</tr>
<tr>
<td>Frontal Bone</td>
<td>Round, Globular</td>
<td>Low, Slanting</td>
<td></td>
</tr>
<tr>
<td>Mandible Shape</td>
<td>Rounded, V-Shaped</td>
<td>Square, U-Shaped</td>
<td></td>
</tr>
<tr>
<td>Ramus of Mandible</td>
<td>Slanting</td>
<td>Straight</td>
<td></td>
</tr>
</tbody>
</table>
### TABLE 3 - FEMUR

<table>
<thead>
<tr>
<th>Trait</th>
<th>Result</th>
<th>Female</th>
<th>Intermediate Sex</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical (Maximum) Diameter of Femoral Head (mm)</td>
<td>&lt; 43.5</td>
<td>43.5 - 44.5</td>
<td>&gt; 44.5</td>
<td></td>
</tr>
<tr>
<td>Bicondylar Width (mm)</td>
<td>&lt; 74</td>
<td>74 - 76</td>
<td>&gt; 76</td>
<td></td>
</tr>
<tr>
<td>Maximum Length (mm)</td>
<td>&lt; 405</td>
<td>405 - 430</td>
<td>&gt; 430</td>
<td></td>
</tr>
</tbody>
</table>

### TABLE 4 - HUMERUS

<table>
<thead>
<tr>
<th>Trait</th>
<th>Result</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transverse Diameter of Humeral Head (mm)</td>
<td>37.0 - 39.0</td>
<td>42.7 - 44.7</td>
<td></td>
</tr>
<tr>
<td>Vertical Diameter of Humeral Head (mm)</td>
<td>42.7</td>
<td>48.8</td>
<td></td>
</tr>
<tr>
<td>Maximum Length (mm)</td>
<td>305.9</td>
<td>339.0</td>
<td></td>
</tr>
<tr>
<td>Epicondylar Width (mm)</td>
<td>56.8</td>
<td>63.9</td>
<td></td>
</tr>
</tbody>
</table>

FINAL SEX DETERMINATION _________________________
RACE DETERMINATION

TABLE 5 - SKULL

Nasal Width _______ mm
Nasal Height _______ mm

<table>
<thead>
<tr>
<th>Trait</th>
<th>Result</th>
<th>Caucasian</th>
<th>Mongoloid</th>
<th>Negroid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nasal Index</td>
<td>&lt; .48</td>
<td>.48 - .53</td>
<td>&gt; .53</td>
<td></td>
</tr>
<tr>
<td>Nasal Silling/Guttering</td>
<td>Sharp Ridge (Silling)</td>
<td>Rounded Ridge</td>
<td>No Ridge (Guttering)</td>
<td></td>
</tr>
<tr>
<td>Prognathism</td>
<td>Straight</td>
<td>Variable</td>
<td>Prognathic</td>
<td></td>
</tr>
<tr>
<td>Shape of Orbital Openings</td>
<td>Rounded, Somewhat Square</td>
<td>Rounded, Somewhat Circular</td>
<td>Rectangular or Squared</td>
<td></td>
</tr>
</tbody>
</table>

Measurements From Figures 22, 23, and 24
Caucasoid Skull (Figure 22):
Nasal Width _______ mm ÷ Nasal Height _______ mm = Nasal Index _______

Mongoloid Skull (Figure 23):
Nasal Width _______ mm ÷ Nasal Height _______ mm = Nasal Index _______

Negroid Skull (Figure 24):
Nasal Width _______ mm ÷ Nasal Height _______ mm = Nasal Index _______

FEMUR
Caucasoid - Fingers can fit under curvature of femur.
Negroid - Fingers cannot fit under curvature of femur.

FINAL RACE DETERMINATION ____________________________
HEIGHT DETERMINATION

TABLE 6 - FEMUR

Maximum Length of Femur (MLF) = __________ cm

<table>
<thead>
<tr>
<th>Population</th>
<th>Male Regression Formula</th>
<th>Height (cm)</th>
<th>Confidence Interval</th>
<th>Height Range (cm)</th>
<th>Female Regression Formula</th>
<th>Height (cm)</th>
<th>Confidence Interval</th>
<th>Height Range (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caucasian</td>
<td>2.32 x MLF + 65.53</td>
<td>±3.94</td>
<td></td>
<td>2.47 x MLF + 64.10</td>
<td>±3.72</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mongoloid</td>
<td>2.15 x MLF + 72.57</td>
<td>±3.80</td>
<td></td>
<td>2.38 x MLF + 56.93</td>
<td>±3.57</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negroid</td>
<td>2.10 x MLF + 72.22</td>
<td>±3.91</td>
<td></td>
<td>2.28 x MLF + 59.76</td>
<td>±3.41</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TABLE 7 - HUMERUS

Maximum Length of Humerus (MLH) = __________ cm

<table>
<thead>
<tr>
<th>Population</th>
<th>Male Regression Formula</th>
<th>Height (cm)</th>
<th>Confidence Interval</th>
<th>Height Range (cm)</th>
<th>Female Regression Formula</th>
<th>Height (cm)</th>
<th>Confidence Interval</th>
<th>Height Range (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caucasian</td>
<td>2.89 x MLH + 78.10</td>
<td>±4.57</td>
<td></td>
<td>3.36 x MLH + 57.97</td>
<td>±4.45</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mongoloid</td>
<td>2.68 x MLH + 83.19</td>
<td>±4.16</td>
<td></td>
<td>3.22 x MLH + 61.32</td>
<td>±4.35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negroid</td>
<td>2.88 x MLH + 75.48</td>
<td>±4.16</td>
<td></td>
<td>3.08 x MLH + 64.67</td>
<td>±4.25</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Minimum value = _______ cm ÷ 2.54 = _______ inches = ______ feet ______ inches

Maximum value = _______ cm ÷ 2.54 = _______ inches = ______ feet ______ inches

FINAL HEIGHT DETERMINATION (Range) _____________________________
## AGE DETERMINATION

### TABLE 8 - PELVIS

<table>
<thead>
<tr>
<th>Approximate Age/Age Range</th>
<th>Developmental Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>7-8</td>
<td>The pubis bone and ischium are almost completely united by bone (Fig. 6).</td>
</tr>
<tr>
<td>13-14</td>
<td>The ilium, ischium, and pubis bones are joined together (Fig. 6).</td>
</tr>
<tr>
<td>18</td>
<td>The two lowest segments of the sacral vertebrae become joined together (Fig. 8).</td>
</tr>
<tr>
<td>20 - 25</td>
<td>The ilium, ischium, and pubis bones become fully ossified with no evidence of epiphyseal unions (indicated by cartilaginous lines).</td>
</tr>
<tr>
<td>25 - 30</td>
<td>All segments of the sacrum are united with no evidence of epiphyseal unions.</td>
</tr>
</tbody>
</table>

### TABLE 9 - FEMUR

<table>
<thead>
<tr>
<th>Approximate Age/Age Range</th>
<th>Developmental Occurrence</th>
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</thead>
<tbody>
<tr>
<td>4</td>
<td>The greater trochanter first appears.</td>
</tr>
<tr>
<td>13-14</td>
<td>The lesser trochanter first appears.</td>
</tr>
<tr>
<td>18</td>
<td>The head, greater trochanter, and lesser trochanter first join the shaft.</td>
</tr>
<tr>
<td>20</td>
<td>The condyles first join the shaft.</td>
</tr>
</tbody>
</table>

### TABLE 10 - HUMERUS

<table>
<thead>
<tr>
<th>Approximate Age/Age Range</th>
<th>Developmental Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>The head and tuberosities join to become a single large epiphysis.</td>
</tr>
<tr>
<td>16 - 17</td>
<td>The radial head, trochlea, and external condyle blend and unite with the shaft.</td>
</tr>
<tr>
<td>18</td>
<td>The internal condyle unites with the shaft.</td>
</tr>
<tr>
<td>20</td>
<td>The upper epiphysis unites with the shaft.</td>
</tr>
</tbody>
</table>

**FINAL AGE DETERMINATION (Range) _________________________**

**SEX ________________________                  HEIGHT ____________________**

**RACE _______________________   AGE ____________________**