Name ______________________________ Period _______ Date _______

Sherlock Bones: Identification of Skeltal Remains
Student Data/Analysis Sheet

SCENARIO

Your local police department has been searching for three individuals who have been reported missing within the last two years. Recent news of the discovery of human bones in the area has given rise to new hope of identifying one of these individuals. As Sherlock Bones, the lead forensic anthropologist on the case, it is your job to provide the authorities with a physical description of the individual. Good Luck!

background

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 nearly impossible.

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 towards the end of this guide.

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

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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: European, Asian, and African. Although there are certainly some common physical characteristics among 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 traits, 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 European or African 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 at least 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 of age. However, these changes are best viewed on a natural skeleton rather than on a plastic one.

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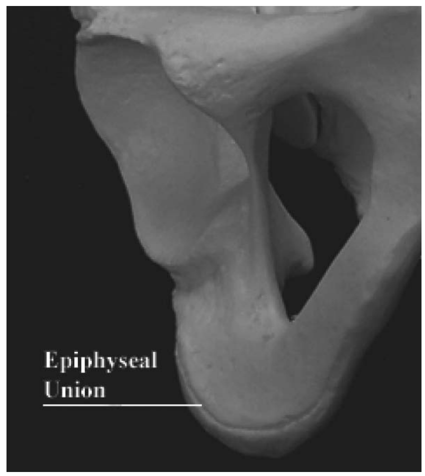
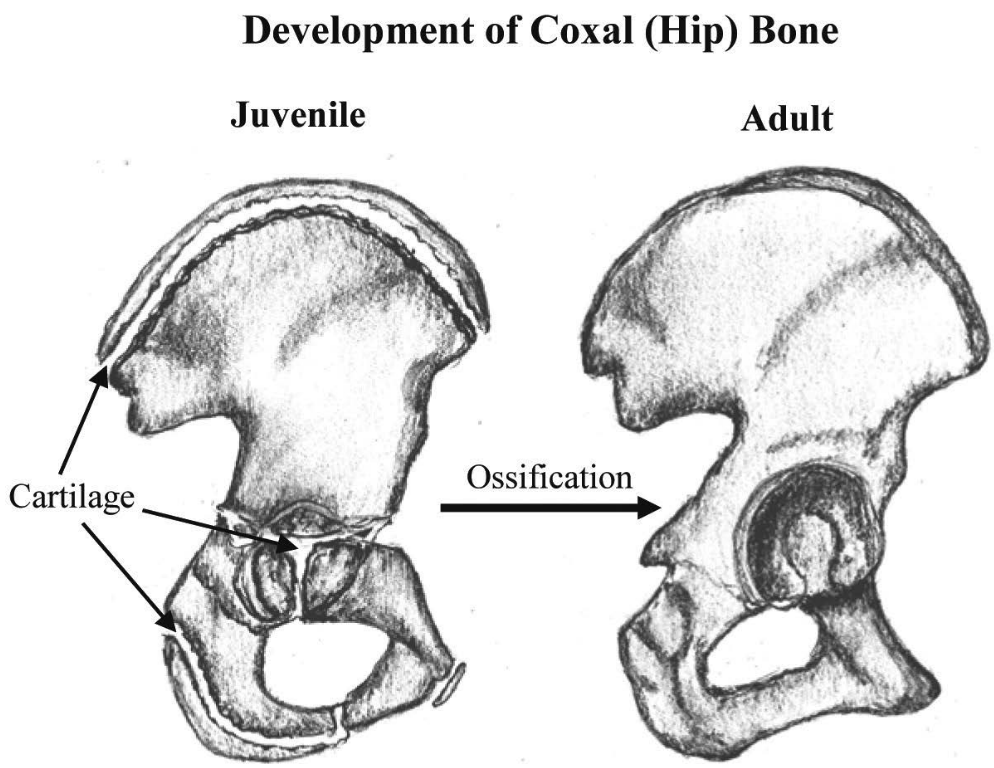
background

For this lab, we will look at another indicator of age, the process 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 ends of each bone are separated from the shaft by a layer of cartilage (as seen in the illustrations below). This layer of cartilage emains throughout the bone's development and forms a very distinct line of fusion in the bone. This line becomes increasingly faint until the bone is fully formed (ossified) and then completely disappears. Because the lines created by epiphyseal unions remain for a definite amount of time, they are a useful trait in aging bones, especially juveniles.





SEX DETERMINATION:

Table 1: Pelvis

Trait	Result	Female	Male
Sub-Pubic Angle		>90°	<90°
Pubis Body Width		~40 mm	25-30 mm
Greater Sciatic Notch		>68°	<68°
Pelvic Cavity Shape		Circular and wide, showing mainly coccyx	Heart-shaped, showing sacrum and coccyx

Table 2: Skull

Trait	Result	Female	Male
Upper Edge of Eye Orbit		Sharp	Blunt
Shape of Eye Orbit		Round	Square
Zygomatic Process		Not expressed beyond external auditory meatus	Expressed beyond external auditory meatus
Nuchal Crest (Occipital Bone)		Smooth	Rough and bumpy
External Occipital Protuberance		Generally absent	Generally present
Frontal Bone		Round, globular	Low, slanting
Mandible Shape		Rounded, V-shaped	Square, U-shaped
Ramus of mandible		Slanting	Straight

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Skeletal ID # ______

Table 3: Use the appropriate table for the femur or the tibia.

Femur

Measurement	Result	Female	Indeterminate Sex	Male
Vertical (Maximum) Diameter of Femoral Head (mm)		<43.5	43.5-44.5	>44.5
Bicondylar Width (mm)		<74	74-76	>76
Maximum Length (mm)		<405	405-430	>430

Femur Curvature Test
European: fingers can fit under curvature of femur
African: fingers cannot fit under curvature of femur

Tibia

Measurement	Result	Average Female	Average Male
Maximum Epiphyseal Breadth of Proximal Tibia (mm)		70.26	79.40
Maximum Epiphyseal Breadth of Distal Tibia (mm)		46.31	52.48

Table 4: Humerus

Measurement	Result	Average Female	Average Male
Transverse Diameter of Humeral Head (mm)		37.0-39.0	42.7-44.7
Vertical Diameter of Humeral Head (mm)		42.7	48.8
Maximum Length (mm)		305.9	339.0
Epicondylar Width (mm)		56.8	63.9

Final sex determination: ________________________________

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Skeletal ID # ______

RACE DETERMINATION:

Table 5: Skull

Nasal width_____________mm
Nasal height_____________mm

Trait	Result	European	Asian	African
Nasal Index		<.48	.48-.53	>.53
Nasal Spine		Prominent spine	Somewhat prominent spine	Very small spine
Nasal Silling/Guttering		Sharp ridge (silling)	Rounded ridge	No ridge (guttering)
Prognathism		Straight	Variable	Prognathic
Shape of Orbital Openings		Rounded, somewhat square	Rounded, somewhat circular	Rectangular or squared

European skull:
Nasal width_________mm ÷ Nasal height_________mm = Nasal index ____

Asian skull:
Nasal width_________mm ÷ Nasal height_________mm = Nasal index _____

African skull:
Nasal width_________mm ÷ Nasal height_________mm = Nasal index ___

Are the nasal indexes of each racial group close to the ones that appear in Table 5?
If not,what could account for this inconsistency?

Final race determination ________________

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Skeletal ID # ______

results and analysis

HEIGHT DETERMINATION:

Table 6 for Femur

Maximum Length of Femur (MLF)________________mm =________________cm

	Male			
	Regression formula	**Height (cm)**	**Confidence interval**	**Height range (cm)**
European	2.32 (MLF) + 65.53		± 3.94	
Asian	2.15 (MLF) + 72.57		± 3.80	
African	2.10 (MLF) + 72.22		± 3.91	

	Female			
	Regression formula	**Height (cm)**	**Confidence interval**	**Height range (cm)**
European	2.47 (MLF) + 54.10		± 3.72	
Asian	2.38 (MLF) + 56.93 **		± 3.57	
African	2.28 (MLF) + 59.76		± 3.41	

** Practitioners' formula extrapolated from European and African regression formulae for females.

Table 6 for Tibia

Maximum Length of Tibia (MLT)____ mm = ____ cm

	Male			
	Regression formula	**Height (cm)**	**Confidence interval**	**Height range (cm)**
European	2.42 (MLT) + 81.93		± 4.00	163.84 to 171.84
Asian	2.39 (MLT) + 81.45		± 3.27	163.03 to 169.57
African	2.19 (MLT) + 85.36		± 3.91	159.20 to 167.02

	Female			
	Regression formula	**Height (cm)**	**Confidence interval**	**Height range (cm)**
European	2.90 (MLT) + 61.53		± 3.66	160.82 to 168.14
Asian	2.68 (MLT) + 67.05 **		± 3.68	158.33 to 165.69
African	2.45 (MLT) + 72.56		± 3.70	159.03 to 166.43

** Practitioners' formula extrapolated from European and African regression formulae for females.

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Table 7: Humerus

Maximum Length of Humerus (MLH)__________mm =____________cm

	Male			
	Regression formula	**Height (cm)**	**Confidence interval**	**Height range (cm)**
European	2.89 (MLH) + 78.10		±4.57	
Asian	2.68 (MLH) + 83.19		±4.16	
African	2.88 (MLH) + 75.48		±4.23	

	Female			
	Regression formula	**Height (cm)**	**Confidence interval**	**Height range (cm)**
European	3.36 (MLH) + 57.97		±4.45	
Asian	3.22 (MLH) + 61.32 **		±4.35	
African	3.08 (MLH) + 64.67		±4.25	

Minimum value = __________ cm ÷ 2.54 = __________ in. = __________ ft. __________ in.

Maximum value = __________ cm ÷ 2.54 = __________ in. = __________ ft. __________ in.

**To convert your answers to feet and inches: assign the "feet" value according to the chart on the right, then subtract the appropriate whole number (in inches) from your answer to calculate the "inches" portion of the number (e.g., 63.78 in. is >60 in. therefore, the person is at least 5 ft. tall; 63.78 - 60 = 3.78 in. to give a final answer of 5'3.78" tall.

≥ 24 in. = 2 ft.
≥ 36 in. = 3 ft.
≥ 48 in. = 4 ft.
≥ 60 in. = 5 ft.
≥ 72 in. = 6 ft.

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AGE DETERMINATION:

Table 8: Pelvis

Developmental Occurrence	Approximate Age
The pubis bone and ischium are almost completely united by bone (Figure 6)	7-8
The ilium, ischium, and pubis bones are joined together (Figure 6)	13-14
The two lowest segments of the sacral vertebrae become joined together (Figure 8)	18
The ilium, ischium, and pubis bones become fully ossified with no evidence of epiphyseal unions (indicated by cartilaginous lines)	20-25
All segments of the sacrum are united with no evidence of epiphyseal unions	25-30

Table 9: Femur

Developmental Occurrence	Approximate Age
The greater trochanter first appears	4
The lesser trochanter first appears	13-14
The head, greater trochanter, and lesser trochanter first join the shaft	18
The condyles first join the shaft	20

Table 9: Tibia

Developmental Occurrence	Approximate Age
The lower epiphysis joins the shaft	18
The upper epiphysis joins the shaft	20

Table 10: Humerus

Developmental Occurrence	Approximate Age
The head and tuberosities join to become a single large epiphysis	6
The radial head, trochlea, and external condyle blend and unite with the shaft	16-17
The internal condyle unites with the shaft	18
The upper epiphysis unites with the shaft	20

Final minimum age determination (range) _____________ years

Name ___________________________________ Period _______ Date ___________

QUESTIONS

Skeletal ID _________

1. What did you determine the sex, race, height, and age of the skeleton to be?

   Sex –

   Race –

   Height Range –

   Age (minimum age) –

2. What factor sex, race, height, or age was the hardest to determine? Why?

3. What factor was the easiest to determine? Why?

4. In a real-life situation, what additional information could be gained from the bones besides sex, race, height, and age? How could this information be helpful in finding the identity of the person?

5. Can you determine which side of the body the humerus came from? How?

6. What bones are best for determining the height of an individual?

7. Why is it difficult to determine the true race of a skeleton and which bone is normally used to do so?

8. Which is the most common bone used to determine the sex of a skeleton and why?

9. How is the age of an individual determined from the bones?