Name ______________________________ Period ______ Date ___________

Sherlock Bones: Identification of Skeletal 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!

SEX DETERMINATION

A number of skeletal indicators are used to determine sex. **The more indictors used, the more accurate the results will be.** However, it is important to note that there is very little difference in the skeletal structure of preadolescents, making sex determination in them nearly impossible.

The pelvis is considered 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.

The skull is the second most commonly used bone to determine sex. Many of the skull traits related to sexing are 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.

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

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.

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), Mongloid (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 traits, which, 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 the most important bone for race determination. 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.

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, which occur 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 a plastic one.

For this lab, we 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 thin 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.

Skeletal ID #-__________
SEX DETERMINATION

Pelvis

Table 1

Trait	Result	Female	Male
Sub-Pubic Angle		>80°	<80°
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

greater than >
less than <

Skull

Table 2

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, 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

Femur **Table 3**

Trait	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

Tibia **Table 3b**

Measurement	Result	Average Female	Average Male
Maximum Width of Proximal Tibia (mm)		70.26	79.4
Maximum Width of Distal Tibia (mm)		46.31	52.48

Humerus **Table 4**

Trait	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 ______________

RACE DETERMINATION

Skull

Nasal width _______ mm
Nasal height _______ mm

Table 5

Trait	Result	Caucasoid	Mongoloid	Negroid
Nasal Index		< .48	.48 - .53	> .53
Nasal Spine		Prominent spine	Not so 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	Rounded, circular	Rectangular

Caucasoid skull:
Nasal width _____mm ÷ Nasal height _____mm = Nasal index _____

Mongoloid skull:
Nasal width _____mm ÷ Nasal height _____mm = Nasal index _____

Negroid 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_________________________

HEIGHT DETERMINATION

Femur

Maximum Length of Femur (MLF) _____mm = _____ cm

Table 6

	Male				Female			
	Regression formula	Height (cm)	Confidence interval	Height range (cm)	Regression formula	Height (cm)	Confidence interval	Height range (cm)
Caucasoid	2.32 (MLF) + 65.53		±3.94		2.47 (MLF) + 54.10		±3.72	
Mongoloid	2.15 (MLF) + 72.57		±3.80		2.38 (MLF) + 56.93		±3.57	
Negroid	2.10 (MLF) + 72.22		±3.91		2.28 (MLF) + 59.76		±3.41	

Tibia

Maximum Length of Tibia (MLT) _____mm = _____cm

Table 6(b)

	Male				Female			
	Regression formula	Height (cm)	Confidence interval	Height range (cm)	Regression formula	Height (cm)	Confidence interval	Height range (cm)
Caucasoid	2.42 (MLT) + 81.93		± 4.00		2.90 (MLT) + 61.53		± 3.66	
Mongoloid	2.39 (MLT) + 81.45		± 3.27		2.68 (MLT) + 67.05 **		± 3.68	
Negroid	2.19 (MLT) + 85.36		± 3.91		2.45 (MLT) + 72.56		± 3.70	

** Practitioners' formula extrapolated from Caucasoid and Negroid regression formulae for females.

Humerus

Maximum Length of Humerus (MLH) _____mm = ______cm

Table 7

	Male				Female			
	Regression formula	**Height (cm)**	**Confidence interval**	**Height range (cm)**	**Regression formula**	**Height (cm)**	**Confidence interval**	**Height range (cm)**
Caucasoid	2.89 (MLH) + 78.10		±4.57		3.36 (MLH) + 57.97		±4.45	
Mongoloid	2.68 (MLH) + 83.19		±4.16		3.22 (MLH) + 61.32		±4.35	
Negroid	2.88 (MLH) + 75.48		±4.23		3.08 (MLH) + 64.67		±4.25	

Minimum value = ______cm ÷ 2.54 = ______ inches = ___feet ______inches

Maximum value = ______ cm ÷ 2.54 = ______ inches = ___feet ______inches

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

**To convert your answers to feet and inches: assign the "feet" value according to the chart that follows, 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.

Final determination of height range ________________

AGE DETERMINATION

Pelvis **Table 8**

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

Femur **Table 9**

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

Humerus **Table 10**

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

Final minimum age determination ______________

FURTHER INVESTIGATION

For the more advanced student, you may determine the age at death of a natural skeleton by examining the surface of the pubic symphysis. Using the methods outlined by Todd (1920) and/or Suchey & Brooks (1990), one can determine which of the ten phases of symphyseal development or degeneration that an individual was in at the time of death. Diagrams of each of these methods have been adapted from Buikstr and Ubelaker (1994).

Name ________________________________ Period ______ Date __________

QUESTIONS

Skeleton 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?