

Investigation: Can You Estimate a Person's Height from the Length of their Bones?

At a nearby construction zone, workers have made a startling discovery. They uncovered several bones that look like they were buried some time ago. You are part of a team of forensic anthropologists who have been called in to analyze these bones. Unfortunately, the bones were heavily damaged by the construction equipment. The bones have all been mixed up, and several have been crushed. However, you think you can use the bones that are left to determine the number of bodies and the height of each individual.

When a body is discovered, it is important to learn as much as possible from the remains.

Forensic anthropologists use mathematical formulas to estimate someone's height from the lengths of certain bones in their body.

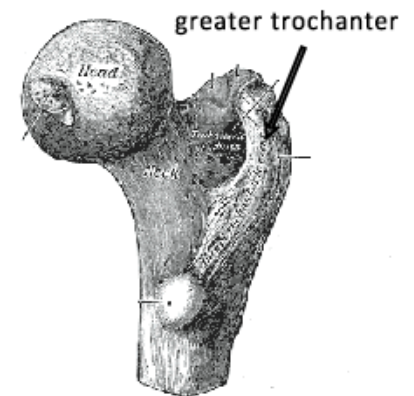
1. Using a ruler or tape measure, measure the length of your femur in **centimeters**. This is the large bone that runs from your hip socket to your knee cap. The bone that sticks out near your hip is part of the femur and is called the greater trochanter. Record this information in the table below for you and your lab partners. Gather data from at least three people in your class.

*Use the femur length and the chart to calculate your height and compare that to your actual height. If your race isn't listed, you can find more formulas online.

2. Next, measure the length of your tibia. Start at the tibial tuberosity (bump on your shin) to the medial malleolus, the bump on your ankle. Use the chart to calculate your height based on the tibia.

3. Finally, measure your ulna length by bending your arm and measuring from the proximal end of the ulna (elbow bump) to the distal end, the styloid process of the ulna. The styloid process is visible as a bump near your wrist. Use the chart to calculate your height based on the ulna.

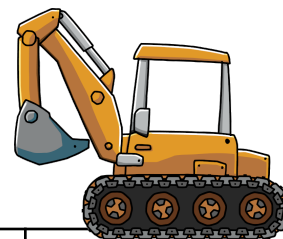
4. Complete the table for at least 3 members in your group or class.



Name:				
Actual Height (cm)				
Femur Length (cm)				
Calculated Height (cm)				
Tibia Length (cm)				
Calculated Height (cm)				
Ulna Length (cm)				
Calculated Height (cm)				

Construction Site

The following bones were recovered from the construction site. A fellow forensic anthropologist has already classified the bones by sex and race. **Using the mathematical formulas, calculate the approximate height of each individual.**



Bone #	Bone Type	Length (cm)	Race	Sex	Calculated Height (cm)
1	Humerus	38.2	Caucasian	Male	
2	Femur	44.0	African-American	Female	
3	Ulna	25.4	Caucasian	Male	
4	Femur	52.4	Caucasian	Male	
5	Femur	43.9	African-American	Female	
6	Tibia	45.7	Caucasian	Male	

Discussion Questions:

1. Is it possible that any of the bones came from the same person? Which bones do you think might be the same person and provide an explanation for WHY you think so.

2. What is the minimum number of bodies buried at this site? What is the maximum number of bodies buried at this site? Explain your reasoning.

3. Consider a case where two females have the same femur length. Would you expect those females to be the exact same height? Why or why not?

4. On the formula table, there is a symbol shown as $\pm$. What does this symbol mean?

5. Consider your calculated heights and your actual height. Are they within the range that was expected? Suggest a reason for why a person's calculated height might not be accurate.

Formulas for Calculating Height			
	Race	Male Equation	Female Equation
Femur	Caucasian	$2.32 \times \text{femur} + 65.53 \pm 3.94 \text{ cm}$	$2.47 \times \text{femur} + 54.10 \pm 3.72 \text{ cm}$
	African-American	$2.10 \times \text{femur} + 72.22 \pm 3.91 \text{ cm}$	$2.28 \times \text{femur} + 59.76 \pm 3.41$
	Asian	$2.15 \times \text{femur} + 72.57 \pm 3.80 \text{ cm}$	$2.15 \times \text{femur} + 72.57 \pm 3.80 \text{ cm}$
Tibia	Caucasian	$2.42 \times \text{tibia} + 81.93 \pm 4.00 \text{ cm}$	$2.90 \times \text{tibia} + 61.53 \pm 3.66 \text{ cm}$
	African-American	$2.19 \times \text{tibia} + 85.36 \pm 3.96 \text{ cm}$	$2.45 \times \text{tibia} + 72.56 \pm 3.70 \text{ cm}$
	Asian	$2.39 \times \text{tibia} + 81.45 \pm 3.24 \text{ cm}$	$2.39 \times \text{tibia} + 81.45 \pm 3.24 \text{ cm}$
Ulna	Caucasian	$3.76 \times \text{ulna} + 75.55 \pm 4.72 \text{ cm}$	$4.27 \times \text{ulna} + 57.76 \pm 4.30 \text{ cm}$
	African-American	$3.20 \times \text{ulna} + 82.77 \pm 4.74 \text{ cm}$	$3.31 \times \text{ulna} + 75.38 \pm 4.83 \text{ cm}$
	Asian	$3.48 \times \text{ulna} + 77.45 \pm 4.66 \text{ cm}$	$3.48 \times \text{ulna} + 77.45 \pm 4.66 \text{ cm}$
Humerus	Caucasian	$2.89 \times \text{humerus} + 78.10 \pm 4.57 \text{ cm}$	$3.36 \times \text{humerus} + 57.97 \pm 4.45 \text{ cm}$
	African-American	$2.88 \times \text{humerus} + 75.48 \pm 4.23 \text{ cm}$	$3.08 \times \text{humerus} + 64.67 \pm 4.25 \text{ cm}$
	Asian	$2.68 \times \text{humerus} + 83.19 \pm 4.16 \text{ cm}$	$2.68 \times \text{humerus} + 83.19 \pm 4.16 \text{ cm}$

Activity Adapted from: http://forensics.rice.edu/en/materials/activity_nine.pdf