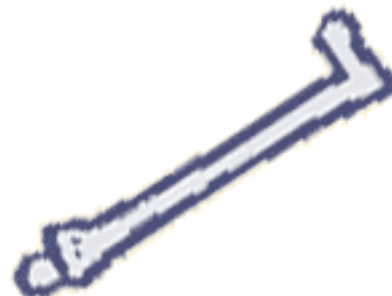


Dead Men's Tales

Activity 2: Grades 5-8 Inferring Height from Bone Length

In this show, you observed how forensic scientists use various clues to construct the identity of deceased individuals. By analyzing skeletal remains, scientists can infer all sorts of traits. For example, there is a link between the length of certain bones and height of an individual. This connection (also known as a regression) is consistent enough to allow a person's height to be inferred from just a few bones.



Inferring Height

Your upper leg contains a large, single bone called the femur. This long bone stretches from the hip (pelvis) socket to the kneecap (patella). The length of this bone can be used to roughly estimate a person's height. To increase accuracy of this bone-to-height relationship, you will also need to know both the gender and race of the individual. These factors affect the relationship between long bone length and the individual's height.

OBJECTIVE

This activity page will offer an experience in:

- Metric measurement
- Obtaining lengths of body parts
- Inferring height from various long bone lengths
- Developing bone/height relation charts

MATERIALS

- Metric ruler or tape measure

PROCEDURE

Part 1-Inferring Height from Femur Length

1. Work with a partner. Identify the placement of your partner's femur bone. It is the single large bone that extends from the hip socket to the kneecap.
2. Use a meter stick or measuring tape to determine the approximate length of this bone (in centimeters).
3. Multiple the length of the femur by 2.6.
4. Add 65 to this number to arrive at the approximate height of your partner in centimeters.
5. Use a metric ruler to obtain the actual height of your partner in centimeters.
6. If you'd like to see these two numbers in inches, convert this metric measurement by dividing by 2.54.
7. Switch roles.

Analyzing Your Results

1. How accurate were you in inferring height from femur length? Explain.
2. Were factors such as gender and race taken into account in this computation? Explain.
3. How might the accuracy of this calculation be improved?

Part 2-Inferring Height from Humerus Length

1. Work with a partner. Identify the placement of your partner's humerus bone. It is the single large bone that extends from the elbow to the shoulder socket.
2. Use a meter stick or measuring tape to determine the approximate length of this bone (in centimeters). If the bone comes from a female subject, go to step 3, If the bone comes from a male subject, go to step 5.
3. If the bone comes from a male subject, go to step 5. 3. If the bone comes from a female, multiply the measured length in centimeters by 3.06.
4. Add 64.26 to this number. This final number is the approximate height of the female based upon her humerus length.
5. If the bone comes from a male, multiply the measured length in centimeters by 32.69.
6. Add 59.41 to this number. This final number is the approximate height of the male based upon his humerus length.
7. Again, if you'd like to convert this numbers into inches, divide the result by 2.54.
8. Switch roles.

Analyzing Your Results

1. How accurate were you in inferring height from humerus length? Explain.

2. Were factors such as gender and race taken into account in this computation? Explain.
3. How might the accuracy of this calculation be improved?

Part 3-Inferring Height from Tibia Length

1. Work with a partner. Identify the placement of your partner's tibia bone. It is the larger central bone of the lower leg, extending from just below the kneecap to the ankle.
2. Use a meter ruler or measuring tape to determine the approximate length of this bone (in centimeters).
3. Use the chart below to estimate the height of your partner based upon the tibia length. This regression chart uses only three racial stocks, Caucasoid, Negroid and Mongoloid.

Caucasoid male	(2.42)	(tibia length in centimeters) + 81.93
Caucasoid female	(2.90)	(tibia length in centimeters) + 61.53
Negroid male	(2.19)	(tibia length in centimeters) + 85.36
Negroid female	(2.45)	(tibia length in centimeters) + 72.56
Mongoloid male	(2.39)	(tibia length in centimeters) + 81.45
Mongoloid female	not available	

NOTE: Mongoloid is the major ethnic group that includes Chinese, Japanese, Eskimos, Native Americans, Siberians, Malaysians, and Mongolians.

Analyzing Your Results

1. What was an advantage in using the tibia method for determining height?
2. What were the disadvantages for using the tibia method for determining height?
3. Were factors such as gender and race taken into account in this computation? Explain.

EXTENSIONS

Two Bones Better Than One?

Here's another equation that can be used to infer height:

$$\text{Height} = 1.31 (\text{length of femur in centimeters} + \text{length of fibula in centimeters}) + 63.05$$

As you can see, this calculation requires two bone length measurements, the femur (upper leg bone) and the fibula (lower leg bone), to arrive at this value. Compare and contrast the use of this calculation with your previous estimation techniques.

Wrapping It Up

Create lyrics to a song or rap that describes the relationship between long bone length and height. Make sure that the words include the names of specific bones and the calculations needed to arrive at a height inference.

Compose Your Own Regression

Select easily measured structures of your body (such as lower arm, fingers, foot). Then compose a calculation that could be used to infer a person's height from the length of these body parts. Compare and contrast your regression to those given for femur and humerus. Which is more accurate or consistent in obtaining heights from part length?

WEB CONNECTION

[University of North Texas Criminal Justice Department](http://www.unt.edu/cjus/forensic.htm)

<http://www.unt.edu/cjus/forensic.htm>

Forensic Links

[Age and Stature Estimation](http://www.wku.edu/~appleda/forensic/lab5.html)

<http://www.wku.edu/~appleda/forensic/lab5.html>

A wonderful site offered by Western Kentucky University that offers all sorts of bone data regressions.

[Introductory Anatomy: Bones](http://www.leeds.ac.uk/chb/lectures/anatomy3.html)

<http://www.leeds.ac.uk/chb/lectures/anatomy3.html>

An introduction to bones and anatomy with application to forensics.

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Dead Men's Tales

Activity 2: Grades 5-8

Inferring Height from Bone Length

ANSWERS

Part 1-Inferring Height from Femur Length

Analyzing Your Results

1. How accurate were you in inferring height from femur length? Explain.
(Answers will vary but expect a variance of up to 5 cm)
2. Were factors such as gender and race taken into account in this computation? Explain.
(No. Only a single computation that did not include gender or race differences was used in estimating height)
3. How might the accuracy of this calculation be improved?
(The calculation used was most likely developed for white males. So although it can be used for other groups, it may not be accurate across the range. In order to increase the accuracy of individual measurements, one would need to develop custom equations for each sex and race (as seen later in the exercise.))

Part 2-Inferring Height from Humerus Length

Analyzing Your Results

1. How accurate were you in inferring height from humerus length? Explain.
(Answers will vary but should have less of a variance than observed in previous exploration)
2. Were factors such as gender and race taken into account in this computation? Explain.

(Only a subject's gender was taken into consideration when estimating height)

3. How might the accuracy of this calculation be improved?
(As with the previous exercise, one would need to develop additional computations that include anatomical variance based upon race)

Part 3-Inferring Height from Tibia Length

Analyzing Your Results

1. What was an advantage in using the tibia method for determining height?
(Variances for both gender and races were included in the computation)
2. What were the disadvantages for using the tibia method for determining height?
(The tibia may be more difficult to measure. Data was not given for the Mongoloid female computation. There were only three racial categories from which to select.)
3. Were factors such as gender and race taken into account in this computation? Explain.
(Yes - However, the races were limited to three stocks and no data was offered for the Mongoloid female computation.)

Compose Your Own Regression

Select easily measured structures of your body (such as lower arm, fingers, foot). Then compose a calculation that could be used to infer a person's height from the length of these body parts. Compare and contrast your regression to those given for femur and humerus. Which is more accurate or consistent in obtaining heights from part length?

(Measuring the length of bones in the hands and feet is not as effective in inferring height as leg and arm bone length. Though related, the former is much more variable.)