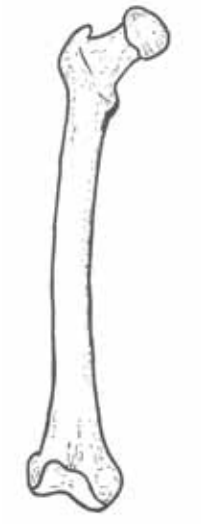
Bones Can Tell Us More

Compiled By: Nancy Volk

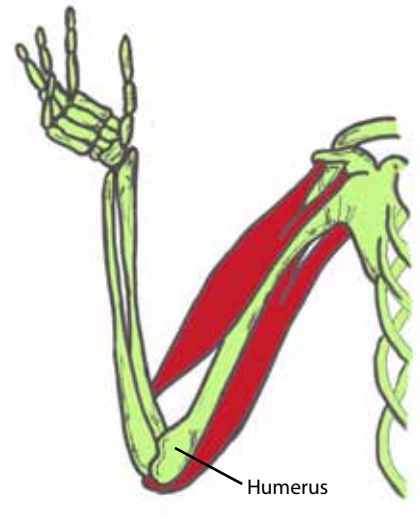
Strong Bones

Sometimes only a few bones are found in a location in an archeological dig. A few bones can tell about the height of a person. This is possible due to the ratios of the bones. It has been determined that there are relationships between the femur, tibia, humerus, and radius and a person's height.

Here is a little help to identify these four bones and formulas to assist with determining the height of a person based on bone length.

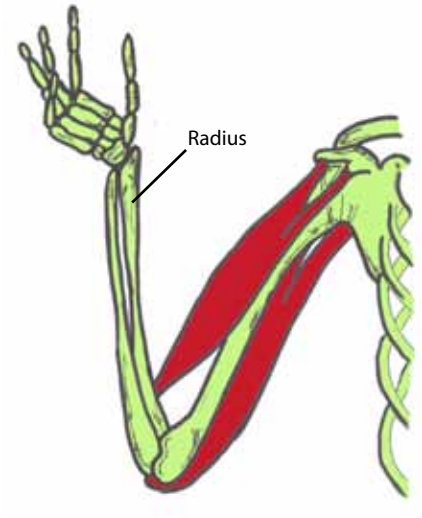


Femur:
The thigh is the region of the femur. From the hip bone to the knee bone.



Humerus:
The arm bone most people call the upper arm. It is found from the elbow to the shoulder joints.

Tibia:
The larger and stronger of the two bones in the leg below the knee bone.
In vertebrates It is recognized as the strongest weight bearing bone in the body.



Radius:
The bone found in the forearm that extends from the side of the elbow to the wrist.

MOST*

VOCABULARY

Femur

Humerus

Radius

Tibia

Inside This Packet

New York State Standards

Middle School

Standard 4: Living Environment
Idea 1: 1.2a, 1.2b, 1.2e, 1.2f

Activity: Bone Relationships

MATERIALS NEEDED

Skeleton

Tape Measure

Directions and formulas

Calculator

Students should be able to:

Identify and measure the length of a major bone

Determine the height of person using a formula and the bone length

Convert centimeters to feet

Formulas:

Bone relationship is represented by the following formulas:

P represents the person's height. The last letter of each formula stands for the known length of the bone (femur, tibia, humerus, or radius) through measurement.

Femur:
P = 61.412 + 2.31F

Tibia:
P = 72.572 + 2.533T

Humerus:
P = 64.977 + 3.144H

Radius:
P = 73.502 + 3.876R

Helpful Conversions:

Centimeters (cm) x 0.3937 = inches (in)

Meters (m) x 3.281 = feet (ft)

Try this:

The tibia of a 22-year-old female measured 31.5 cm.
How tall was she?

P = 72.572 + 2.533(31.5cm)
152.36cm x .3937 = 59.98 in
59.98in/12in = 4.99ft

Activity: Bone Relationships

Name: _____ *Date:* _____

Name of bone measured: _____

Calculations for the height of the body:

The class will share the following information with each other.

Femur length in cm: _____

Tibia length in cm: _____

Humerus length in cm: _____

Radius length in cm: _____

Height of skeleton based on class calculations:

Height of skeleton using the femur: _____

Height of skeleton using the tibia: _____

Height of skeleton using the humerus: _____

Height of skeleton using the radius: _____

Measure the skeleton's height in cm: _____

Which bone appears most accurate? _____

How close were your estimates based on calculations? _____

What are possible sources of error in this process? How could you get better results?

_____

_____

Do we need bones or can we use measurements from living people?

_____

_____

Does this work for children/youth/young adults or just fully grown people?

_____

_____

How could you test the above two ideas?

_____

_____

Activity: Bone Relationships

Name: _____ *Date:* _____

Extending the Problem:

Can you use the same measuring method to determine the height of individuals not fully grown?

Prediction (Hypothesis):

_____

_____

_____

_____

_____

_____

Procedure: Include variable and controls.

_____

_____

_____

_____

_____

_____

Testing Data: Organize your measurements into a chart or form to share.

Calculations:

Activity: Bone Relationships

*Name:*_____ *Date:*_____

Conclusions:

Questions:

Sources of Error: How can you improve on the data collection process?

Accept or Reject Hypothesis: Provide reasons why.

Data for the MOST Skeleton:

The samples are completed below for the skeleton at the museum.

Femur: 40cm
61.412 + 2.317(40) = 154cm **or 154 x .3937/12 = 5.05 ft**

Tibia: 34cm
72.572 + 2.533(34cm) = 158cm **or 158 x .3937/12 = 5.18 ft**

Radius: 24.5 cm
73.502 + 3.876(24.5cm) = 168.5cm **or 168.5 x .3937/12 = 5.53 ft**

Humerus: 27cm **or 149.9 x .3937/12 = 4.92**
64.977 + 3.144(27) = 149.9 cm

Total height of the skeleton by measuring is 165cm.

165cm x .3937 = 64.96 in /12 = 5.41 ft

Percent error for the above data:

Femur: I165-154I/165 x 100 =6.7%

Tibia: I165—158I/165 x 100 = 4.24%

Radius: I168.5-165I/165 x 100 = 2.12%

Humerus: I165-149.9I/165 x 100 = 9.2%

Source Material

Marilyn Fenichel, educational writer; Wendy Goldfein, sixth-grade teacher, Fairfax County School District, Virginia
http://school.discovery.com/lessonplans/programs/forensics/

Patricia Roberto's "Forensic Science in the Middle School Math Classroom." Roberto is a math teacher at Rogers Middle School (Pittsburgh Public Schools).