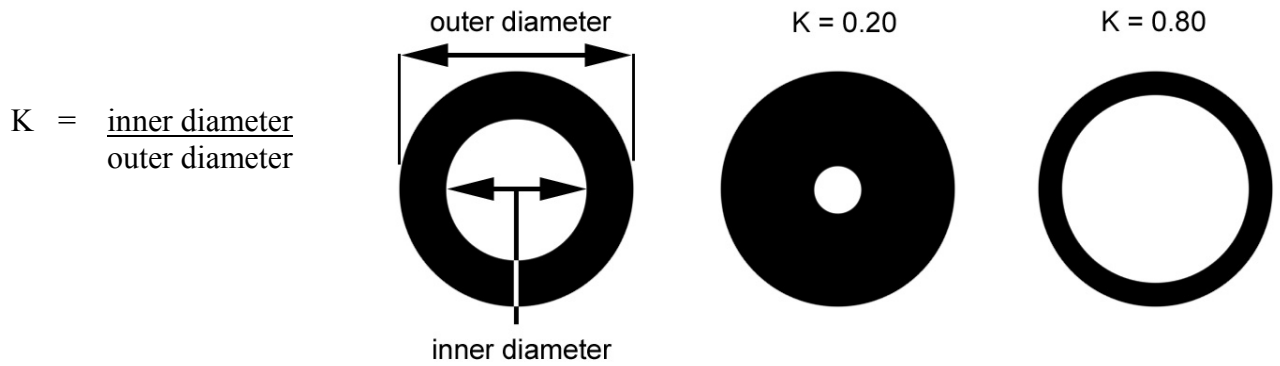


**Part I.** In general, bones with thicker walls are stronger and heavier, and bones with thinner walls are lighter and weaker. In this exercise we will measure the wall thickness of the limb bones in 5 animals: alligators, chickens, cows, humans, and the giant dinosaur *Stegosaurus*. To remove the effects of scale, we'll make our comparisons using a measure of **relative thickness**, called the **K value**.



1. Could a bone ever have a K value of zero? What would such a bone look like in cross-section?
  
2. Could a bone ever have a K value of 1.0? What would such a bone look like in cross-section?
  
3. Hypothesis time. Rank the five animals in this study according to the K values you expect to find. The five animals are: alligator, chicken, cow, human, *Stegosaurus*

Thickest walls, lowest K value \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Thinnest walls, highest K value \_\_\_\_\_

4. Take a minute to explain your predictions from question 3. What factors of these animals , lives do you think are most important for determining the thickness of their bones? State each one as a hypothesis and **use complete sentences**. For example: “*I hypothesize that because it needs to run fast to catch its prey, the cheetah has lightweight bones with thin walls.*”

Alligator

Chicken

Cow

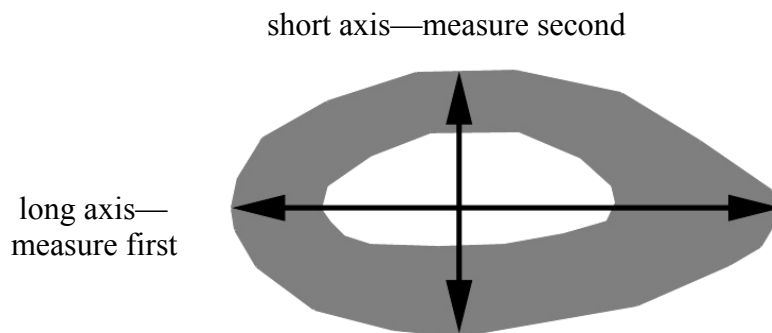
Human

*Stegosaurus*

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Part II. Measure the bones and calculate the K values. You will be given actual bone samples for the cow and the chicken. For the alligator, human, and *Stegosaurus*, use the printed outlines. Use the worksheet on the next page to record your data and calculate the K values. When you're done, answer the questions.

One potential problem is that most bones are not perfectly round, and measuring in different directions will give you different K values. To get around this, we will measure each specimen in two directions and average the results. Take your first measurements along the long axis of the section. Take the next set at right angles to the first.



Make all measurements in millimeters. Calculate K values to two decimal places.

**Alligator (printed cross-sections)**

Long Axis

Short Axis

1. Inside diameter = \_\_\_\_\_  
Outside diameter = \_\_\_\_\_  
K value = \_\_\_\_\_

- Inside diameter = \_\_\_\_\_  
Outside diameter = \_\_\_\_\_  
K value = \_\_\_\_\_

2. Inside diameter = \_\_\_\_\_  
Outside diameter = \_\_\_\_\_  
K value = \_\_\_\_\_

- Inside diameter = \_\_\_\_\_  
Outside diameter = \_\_\_\_\_  
K value = \_\_\_\_\_

Find the average of the four K values. This is the average K for alligator: \_\_\_\_\_

**Chicken (actual specimens)**

Long Axis

Short Axis

1. Inside diameter = \_\_\_\_\_  
Outside diameter = \_\_\_\_\_  
K value = \_\_\_\_\_

- Inside diameter = \_\_\_\_\_  
Outside diameter = \_\_\_\_\_  
K value = \_\_\_\_\_

2. Inside diameter = \_\_\_\_\_  
Outside diameter = \_\_\_\_\_  
K value = \_\_\_\_\_

- Inside diameter = \_\_\_\_\_  
Outside diameter = \_\_\_\_\_  
K value = \_\_\_\_\_

Average K for the chicken: \_\_\_\_\_

Make all measurements in millimeters. Calculate K values to two decimal places.

**Cow (actual specimens)**

Long Axis

Short Axis

1. Inside diameter = \_\_\_\_\_

Inside diameter = \_\_\_\_\_

Outside diameter = \_\_\_\_\_

Outside diameter = \_\_\_\_\_

K value = \_\_\_\_\_

K value = \_\_\_\_\_

2. Inside diameter = \_\_\_\_\_

Inside diameter = \_\_\_\_\_

Outside diameter = \_\_\_\_\_

Outside diameter = \_\_\_\_\_

K value = \_\_\_\_\_

K value = \_\_\_\_\_

Average K for the cow: \_\_\_\_\_

**Human (printed cross-sections)**

Long Axis

Short Axis

1. Inside diameter = \_\_\_\_\_

Inside diameter = \_\_\_\_\_

Outside diameter = \_\_\_\_\_

Outside diameter = \_\_\_\_\_

K value = \_\_\_\_\_

K value = \_\_\_\_\_

2. Inside diameter = \_\_\_\_\_

Inside diameter = \_\_\_\_\_

Outside diameter = \_\_\_\_\_

Outside diameter = \_\_\_\_\_

K value = \_\_\_\_\_

K value = \_\_\_\_\_

Average K for humans: \_\_\_\_\_

Make all measurements in millimeters. Calculate K values to two decimal places.

**Stegosaurus (printed cross-sections)**

	Long Axis	Short Axis
1.	Inside diameter = _____ Outside diameter = _____ K value = _____	Inside diameter = _____ Outside diameter = _____ K value = _____
2.	Inside diameter = _____ Outside diameter = _____ K value = _____	Inside diameter = _____ Outside diameter = _____ K value = _____

Average K for *Stegosaurus*: \_\_\_\_\_

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Part III. Answer the following questions about your findings and the results of the study.

5. Rank the five animals by the K values you found in the study. Include the average K value for each one.

	Animal	K value
Thickest walls, lowest K value	_____	_____
	_____	_____
	_____	_____
	_____	_____
Thinnest walls, highest K value	_____	_____

6. Have a look back at your hypotheses from question 4. Which ones were supported by your findings, and which were not? Explain your answers and **use complete sentences**.

Alligator

Chicken

Cow

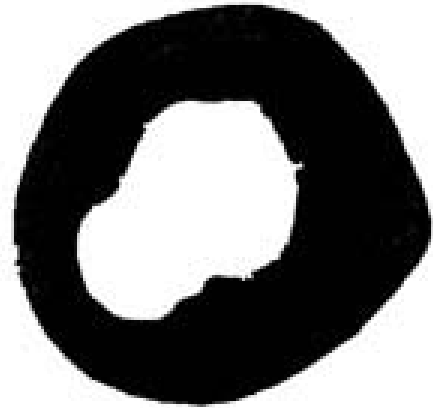
Human

*Stegosaurus*

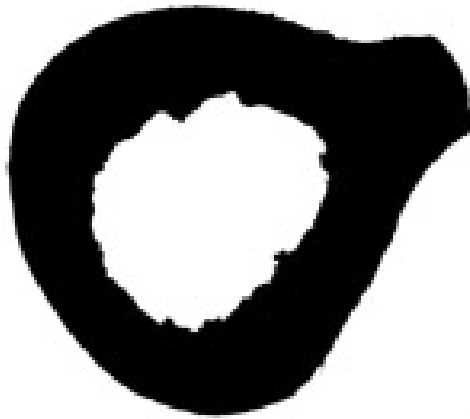
7. Do you think the results of the study are accurate? If you had more time and resources, what would you do differently to improve the study? Give at least three suggestions, and explain your answer **using complete sentences**.

## Bone Cross-Sections

**Alligator**



**Human**



***Stegosaurus***

