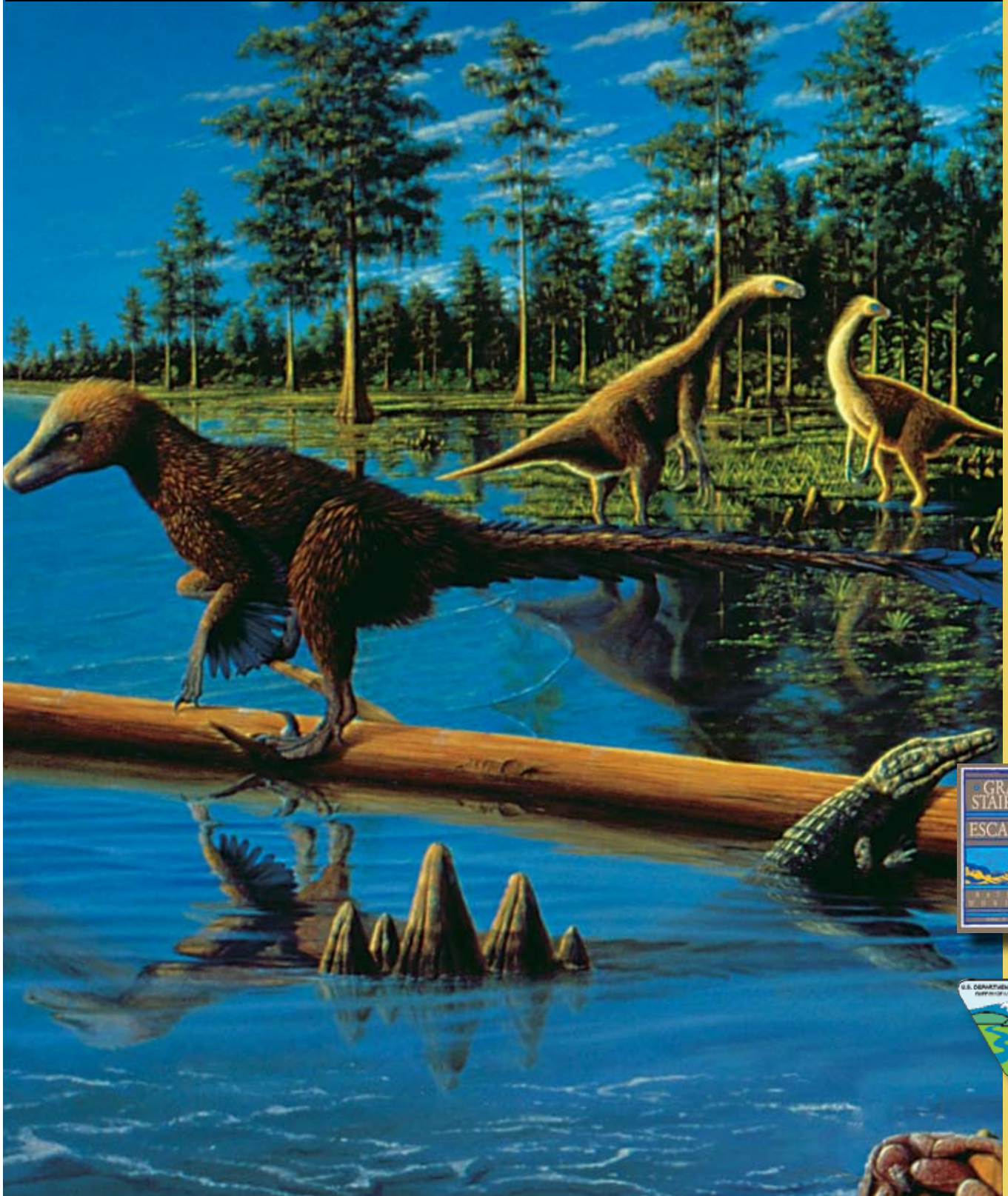


# Sizing Up Cretaceous Critters

## Student Activity



Grand Staircase-Escalante National Monument

BLM



# Sizing Up Cretaceous Critters

In the 1800's scientists knew that many of the fossils they studied were quite different than most living organisms. In 1842 Sir Robert Owen, a British comparative anatomist, coined the name "dinosauria" meaning "fearfully great lizard." For the next 150 years or so it was generally accepted that dinosaurs were giant, *cold-blooded*, small-brained, green swamp dwellers that were all extinct.

This description has changed radically in recent years due to some amazing discoveries in places like Grand Staircase-Escalante National Monument.

Today paleontologists know that dinosaurs came in all sizes, lived in many different habitats, and were not all cold-blooded. Many dinosaurs were smart, agile, active, and even good parents. Some were feathered, raising a debate about whether dinosaurs are actually extinct or simply ancestors to modern day birds.

In this activity you will measure, calculate, and *extrapolate* data about dinosaurs to evaluate their actual size and possible metabolic requirements.

**If you are using *scale* drawings follow Procedure A**  
**If you are using dinosaur replicas use Procedure B**

## Procedure A: For Scale Drawings of Cretaceous Critters

### Materials:

- *Scale Drawings of Cretaceous Critters*
- *Table of Cretaceous Critter Calculations*
- String
- Scissors
- Ruler (U.S. and/or metric markings)
- Calculator
- Long tape measure (U.S. and/or Metric markings)

### Step 1: Measure and record data from *Scale Drawings of Cretaceous Critters*

- I. Choose scale drawings for measurement.
  - A. Select one animal from each page of the *Scale Drawings of Cretaceous Critters* to measure.
  - B. Record animal names on the *Table of Cretaceous Critter Calculations*.
- II. Take measurements and record data.
  - A. Measure the length of scale drawings.
    1. Lay a piece of string along the length of the animal from its nose to the tip of its tail. Follow the backbone, and curve the string along any bends in the neck, body, and tail.

2. Stretch the string out, and measure its length with a ruler in inches or centimeters.
  3. Record measurements on the *Table of Cretaceous Critter Calculations*.
- B.** Measure the height – for some scale drawings.
- Not all scale drawings allow for height measurement. Check with your instructor if you have a question.
1. If the animal has all four legs on the ground measure height from the ground to the top of its hind hip.
  2. If the animal has only two legs on the ground, measure height from the ground to the top of its head.
  3. Use the string again to measure the animal’s height in inches or centimeters.
  4. Record measurements on the *Table of Cretaceous Critter Calculations*. Be sure to record the unit of measurement.

## Step 2: Calculate the life-size dimensions of Cretaceous Critters

- I. Calculate life-size dimensions by multiplying string measurements by the scale used for drawings.
  - A. Cretaceous Critters were drawn the 1/50<sup>th</sup> scale so you would multiply measurements by 50.  
Example: Gryposaurus length = 13.3 cm x 50 = 665 cm
  - B. Record life-size measurements on the *Table of Cretaceous Critter Calculations*. Be sure to include the unit of measurement.
- II. Convert life-size dimensions to meters.
  - A. To convert inches to centimeters use the following conversion:  
1 inch = 2.54 centimeters **OR** 1 centimeter = 0.39 inches
  - B. To convert centimeters to meters use the following conversion:  
100 centimeters = 1 meter
  - C. Record life-size measurements, in meters, on the *Table of Cretaceous Critter Calculations*.

When you have finished Step 2, skip Procedure B and move on to “Visualizing the Actual Size of Cretaceous Critters”.

## Procedure B: For Dinosaur Replicas

### Materials:

- Dinosaur replicas (preferably 1/40<sup>th</sup> scale)
- *Table of Cretaceous Critter Calculations*
- String
- Scissors
- Ruler (U.S. and/or metric markings)
- Calculator
- Weight scale

- Long tape measure (U.S. and/or metric markings)

### Step 1: Measure and record data for dinosaur replicas

- I. Choose dinosaur replicas for measurement and determine the scale used for each replica.
  - A. Choose at least three dinosaur replicas to measure.
  - B. Record dinosaur names on the *Table of Cretaceous Critter Calculations*.
  - C. Determine the scale used for each replica being measured. Many replicas are made using 1/40<sup>th</sup> scale.
- II. Take measurements and record data.
  - A. Measure the length of dinosaur replicas.
    1. Lay a piece of string along the length of the dinosaur from its nose to the tip of its tail. Follow the backbone, and curve the string along any bends in the neck, body, and tail.
    2. Stretch the string out and measure its length with a ruler in inches or centimeters.
    3. Record measurements on the *Table of Cretaceous Critter Calculations*. Be sure to record the unit of measurements.
  - B. Measure the height of dinosaur replicas
    1. If the animal has all four legs on the ground measure height from the ground to the top of its hind hip.
    2. If the animal has only two legs on the ground, measure height from the ground to the top of its head.
    3. Record measurements in the *Table of Cretaceous Critter Calculations*. Be sure to record the unit of measurement.
  - C. Measure the width of dinosaur replicas.
    1. Measure the greatest width of the replica with the string.
    2. Record measurements on the *Table of Cretaceous Critter Calculations*. Be sure to record the unit of measurement.
  - D. Measure the weight of dinosaur replicas.

Many dinosaur replicas are made from a flexible plastic that's nearly the same density as animal flesh. This makes it possible to make a reasonable estimate of the real-life weight of the dinosaur. Individual dinosaurs of the same species would vary in weight so there is some margin for error.

    1. Weigh the replicas on a scale in pounds or grams.
    2. Record the weights on the *Table of Cretaceous Critter Calculations*. Be sure to record the unit of weight.

### Step 2: Calculate and record life-size dimensions of dinosaur replicas

- I. Calculate life-size dimensions by multiplying string measurements for length, height, and width by the scale for each replica.
  - A. If scale is 1/40<sup>th</sup>, multiply measurements by 40.

Example: Gryposaurus length =  $13.3 \text{ cm} \times 40 = 532 \text{ cm}$

**B.** Record life-size measurements on the *Table of Cretaceous Critter Calculations*. Be sure to record the unit of measurement again.

**II.** Convert life-size dimensions of dinosaur replicas to meters.

**A.** To convert inches to centimeters use the following conversion:

$1 \text{ inch} = 2.54 \text{ centimeters}$  **OR**  $1 \text{ centimeter} = 0.39 \text{ inch}$

**B.** To convert centimeters to meters use the following conversion:

$100 \text{ cm} = 1 \text{ meter}$

**C.** Record life-size measurements in meters on the *Table of Cretaceous Critter Calculations*.

**III.** Convert the weight of the replica to that of a full-size dinosaur.

At first it probably seems like you could multiply the replica's weight by its scale to find the weight of a full size dinosaur. But weight is related to volume and volume is length x width x height. Volume isn't a linear dimension though, it's a cubic dimension!

**A.** To expand the model to the 3-D size of a real dinosaur, take the weight of the replica and multiply it x 40 x 40 x 40. (If the replica's scale is 1/40<sup>th</sup>)

**B.** If your weight measurement was made in grams, convert to kilograms and then to pounds using the following conversions:

$1000 \text{ grams} = 1 \text{ kilogram}$

$1 \text{ kilogram} = 2.2 \text{ pounds}$  **OR**  $1 \text{ pound} = 0.454 \text{ kilograms}$ .

**C.** If the weight from your last calculation is more than 2000 pounds, convert the large number of pounds to tons.

**1.** To convert pounds to U.S. tons use the following conversion:

$2000 \text{ pounds} = 1 \text{ U.S. ton}$

**2.** To convert kilograms to metric tons use the following conversion:

$1000 \text{ kilograms} = 1 \text{ metric ton}$

**D.** Record the estimated weights on the *Table of Cretaceous Critter Calculations*.

Be sure to record the unit of weight.



Question 1

Table of Cretaceous Critter Calculations

Name of Cretaceous Critter	String Measurement	Life-Size Dimension <sup>◇</sup>	Life Size Dimension in Meters	Estimated Weight <sup>□</sup>
	L	L	L	
	H	H	H	
	W	W	W	
	L	L	L	
	H	H	H	
	W	W	W	
	L	L	L	
	H	H	H	
	W	W	W	
	L	L	L	
	H	H	H	
	W	W	W	
	L	L	L	
	H	H	H	
	W	W	W	
	L	L	L	
	H	H	H	
	W	W	W	
	L	L	L	
	H	H	H	
	W	W	W	

Remember to include **units** of measurement!

<sup>◇</sup> Formula for Life Size Dimensions = Length, Height or Width X Scale

<sup>□</sup> Formula for weight = Replica weight x scale x scale x scale

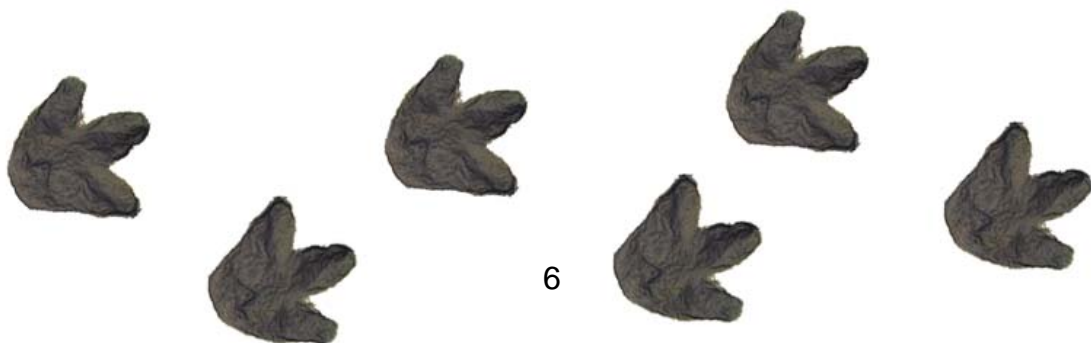
## Visualize the Actual Dimensions of Cretaceous Critters

Depending on the size of the animals chosen this may need to be done outside.

- I. Select three Cretaceous Critters that were measured and recorded previously.
- II. Measure and mark the lengths of Cretaceous Critters on the ground.
  - A. Place one person at the starting point.
  - B. Measure the full length of each animal on the ground using the Life-Size length(s) from the *Table of Cretaceous Critters*. Choose one of the following methods to measure this distance:
    1. Stretch a long tape measure to the animal’s full length on the ground.
    - OR**
    2. Step off the distance by measuring your walking stride and determining how many steps you need to take to reach the animal’s full length on the ground.
  - C. Place another person at the end.
- III. Visualize the heights of Cretaceous Critters
  - A. Measure the height of one of the people standing at either end of your measurement. Determine the proportional difference between this person’s height and that of the Cretaceous animal by dividing the smaller measurement into the larger. The full-size measurement of your animal is in the *Table of Cretaceous Critter Calculations*.
  - B. Be sure you use the same unit of measurement.
- IV. Compare the actual size of Cretaceous Critters to everyday objects
  - A. Look at the actual length and height of the Cretaceous animal you measured. What do these dimensions compare to? A car? A truck? A mailbox? Use your imagination and come up with a good comparison of your own.
  - B. Write your comparisons in the table below

### Question 2

Name of Cretaceous Critter	Actual length of Cretaceous Critter (meters)	Actual height of Cretaceous Critter (meters)	Item(s) of comparable size to Cretaceous Critter



## Extrapolate Daily Caloric Requirements of Cretaceous Critters

It's difficult to estimate how many calories Cretaceous Critters would need per day. We can't measure the energy needs of organisms that no longer exist, but we can extrapolate, or use known facts to draw conclusions.

The number of calories an organism needs per day relates directly to its size, diet, and activity level. A large *herbivore* would probably require massive quantities of vegetation on a daily basis. How much would depend on factors like whether it grazed peacefully or used a lot of energy searching for food and running from predators. Big *carnivores* would have to hunt for their prey, but how often they hunted would affect the amount of energy required. If the prey available were small, low calorie insects or rodents, more energy would probably be needed than if the prey were large and plentiful so one kill would last for days.

Since there are so many unknowns involved in determining the caloric requirements of Cretaceous Critters we'll use some facts and figures that we do know...human caloric requirements!

### Step 1

Choose three animals from the *Table of Cretaceous Critter Calculations* to analyze for metabolic requirements. Record names below.

### Step 2

Calculate caloric requirements for the three Cretaceous Critters based on human energy needs.

- I. Most humans need about 2000 calories of food per day to maintain their body's *metabolism*.
- II. Average human length is (height) is 5.6 feet, or 1.7 meters
- III. Use the table below to calculate the approximate number of calories your Cretaceous animals would require per day.

### Question 3

Name of Cretaceous Critter	Length of animal (meters)	Divided by average human size	Size difference	Multiplied by daily human caloric requirement	Approximate daily caloric requirement
		÷1.7 meters	=	X 2,000	
		÷1.7 meters	=	X 2,000	
		÷1.7 meters	=	X 2,000	

**Step 3**

Calculate the number of jelly donuts each Cretaceous Critter would need per day to meet its approximate daily caloric requirements.

- I. Use the same three Cretaceous Critters as you did in the last step and record their names below.
- II. Record the approximate daily caloric requirements for each Critter below. (This information is in the previous table.)
- III. Record the number of jelly donuts each Critter would need per day using the following nutritional information obtained from the internet:  
Jelly-Filled Donut = 210 calories per donut
- IV. Determine the number of jelly-filled donuts each Cretaceous Critter would need per day by dividing the approximate caloric requirements by the number of calories in one jelly donut.
- V. Complete the table below with your calculations.

*Question 4*

Name of Cretaceous Critter	Approximate daily caloric requirements	Number of Jelly Donuts per day

Obviously, Cretaceous Critters didn't eat jelly donuts. But it's not a bad way to illustrate the relationship between size and calories, is it?

## Vocabulary

*Carnivore*

An animal that eats other animals

*Cold-blooded*

Term used to describe an animal that maintains its body temperature by absorbing heat from its environment. The terms “ectotherm” and “poikilotherm” are more frequently used by scientists.

*Cretaceous*

The Cretaceous Period is one of the subdivisions of the Mesozoic Era and lasted from 144 mya to 65 mya. The Cretaceous Period is best known by its huge diversity of dinosaur species.

*Extrapolate*

Using known facts as the basis for drawing inferences or conclusions about something unknown.

*Herbivore*

An animal that feeds on plants

*Metabolism*

The chemical reactions that occur in living organisms that provide energy needed to sustain life.

*Scale*

A ratio representing the size of an object as represented by an illustration, model, or map.