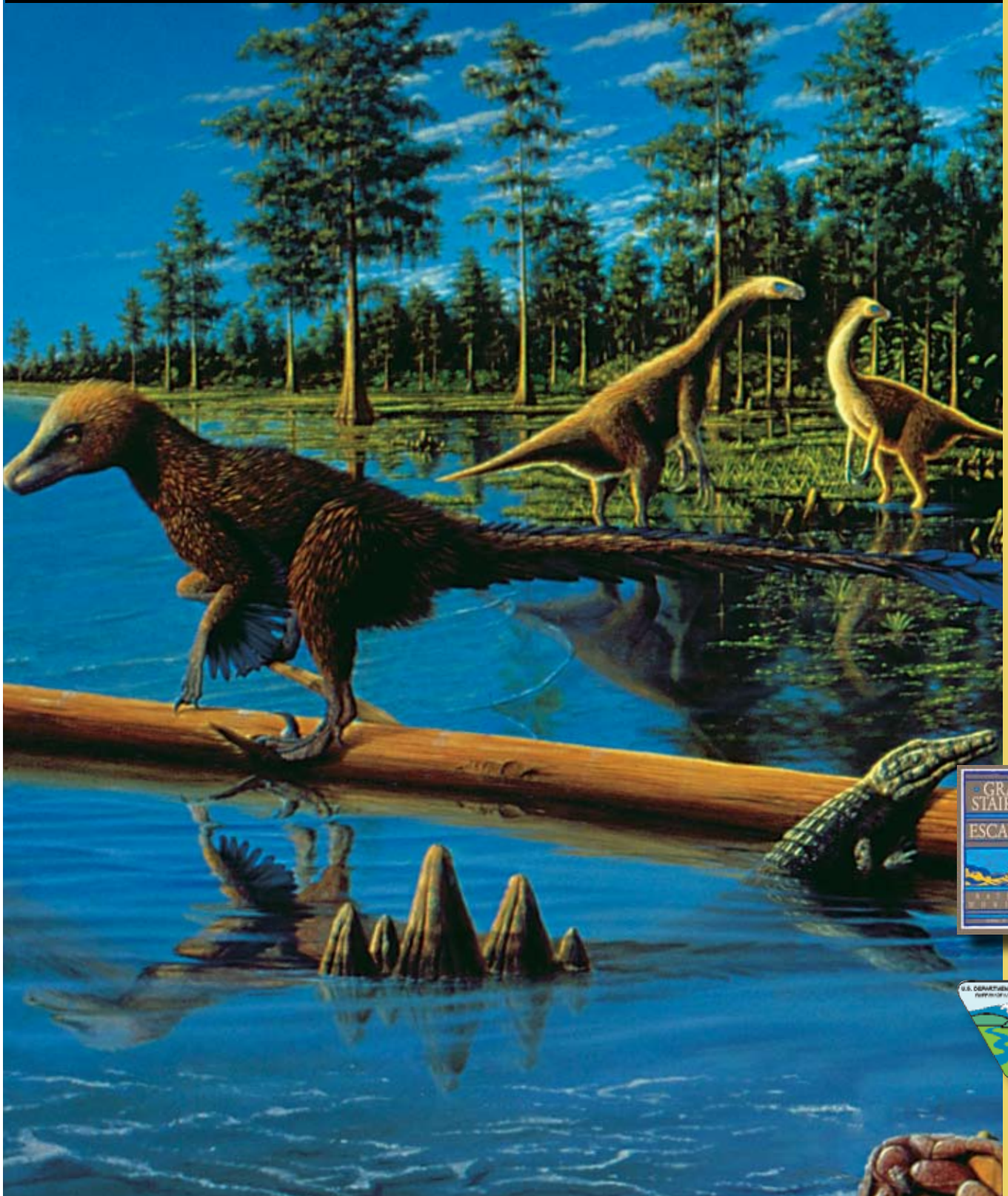


# Sizing Up Cretaceous Critters

## Teacher Guide

BLM

Grand Staircase-Escalante National Monument



## Sizing Up Cretaceous Critters

### Grade Level

9-12

### Duration

90 minutes

### Description

Students measure scale drawings (or replicas) of animals from the Cretaceous Period, calculate and visualize their actual dimensions, and extrapolate the number of jelly donuts it would take to meet the animal's daily caloric requirements.

### Goals

- Measure scale drawings or models and calculate their actual dimensions
- Convert calculations between U.S. and metric systems of measurement.
- Compare the actual size of Cretaceous animals to everyday objects.
- Extrapolate the caloric requirements of Cretaceous animals from human data.

### Academic Content Standards

The following standards are drawn from *Content Knowledge*<sup>1</sup>.

#### Math Standard 4

Understands and applies basic and advanced properties of the concepts of measurement.

##### Level IV (Grades 9-12)

##### Benchmark 4

Solves real-world problems involving three-dimensional measures (e.g., volume, surface area)

##### Benchmark 5

Uses unit analysis to solve problems involving measurement and unit conversion (e.g., between metric and U.S. customary systems, foreign currency conversion.)

#### Math Standard 9

Understands the general nature and uses of mathematics

##### Level IV (Grades 9-12)

##### Benchmark 1

Understands that mathematics is the study of any pattern or relationship, but natural science is the study of those patterns that are relevant to the observable world.

##### Benchmark 6

Understands that science and mathematics operate under common principles: belief in order, ideals of honesty and openness, the importance of review by colleagues, and the importance of imagination.

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<sup>1</sup> *Content Knowledge: A Compendium of Standards and Benchmarks for K-12 Education: 4<sup>th</sup> Edition*, Mid-Continent Research for Education and Learning in Aurora, Colorado. <http://www.mcrel.org/standards-benchmarks/>

Nature of Science Standard 11

Understands the nature of scientific knowledge

Level IV (Grade 9-12)Benchmark 3

Understands how scientific knowledge changes and accumulates over time (e.g., all scientific knowledge is subject to change as new evidence becomes available; some scientific ideas are incomplete and opportunity exists in these areas for new advances; theories are continually tested, revised, and occasionally discarded)

Benchmark 4

Knows that from time to time, major shifts occur in the scientific view of how the world works, but usually the changes that take place in the body of scientific knowledge are small modifications of prior knowledge.

Nature of Science Standard 13

Understands the scientific enterprise

Level IV (Grade 9-12)Benchmark 6

Knows that creativity, imagination, and a good knowledge base are all required in the work of science and engineering.

**Materials**

- *Scale Drawings of Cretaceous Critters* or Dinosaur Replicas
- String
- Scissors
- Ruler (U.S. or metric markings)
- Calculator
- Weight Scale
- Long tape measure (U.S. or metric markings)
- Video or DVD *Traces in Time*, produced by GSENM

**Objectives**

1. Measure scale drawings or replicas to calculate the real-life dimensions of animals that lived during the Cretaceous Period.
2. Visualize the actual dimensions of Cretaceous Critters and identify objects or organisms of comparable size.
3. Extrapolate daily caloric requirement for Cretaceous Critters and the number of jelly donuts they would need per day to meet their caloric needs.

**Procedures**

This activity has been designed for small groups or teams of students. If you assign drawings or replicas to different groups it is helpful to duplicate Cretaceous Critters so students can compare their calculations at the end of the activity. The video or DVD *Traces in Time* is a great way to introduce students to the Grand Staircase-Escalante National Monument.

1. Step 1 (pages 1-5) has two different procedures, one for use with *Scale Drawings of Cretaceous Critters* (included in activity) or Procedure B for use with Dinosaur Replicas. Scale drawings only allow for length and height measurements while dinosaur replicas can be measured for length, height, width, and weight.

#### Procedure A – For Scale Drawings of Cretaceous Critters

Students measure the length and height of seven Cretaceous animals using a string and ruler. Life-size dimensions are calculated using the drawing scale (1/50<sup>th</sup>) and recorded on the *Table of Cretaceous Critter Calculations*. Not all drawings are measured for height. You may need to help students discern which are and are not. If students use U.S. measurements they will need to convert to metric. You can decide whether your students need more practice in making measurements using the metric system or in converting U.S. to metric.

#### Procedure B – For Dinosaur Replicas

Students measure the length, height, and width of model dinosaurs using a string and ruler. Life-size dimensions are calculated using the replica scale (usually 1/40<sup>th</sup>) and recorded on the *Table of Cretaceous Critter Calculations*. Weight measurements will probably need to be made using lab scales. Students estimate the actual weights of Cretaceous Critters by using the scale x scale x scale (discussion of volume and cubic measurement is included). Students can use either metric or U.S. measurements.

#### About Dinosaur Replicas

Students may have model dinosaurs at home that could be used in this activity. If the scale is unknown, you can quickly determine scale by measuring the model and dividing that into the actual length of the dinosaur. A good source for dinosaur lengths (and other data) online is the Natural History Museum of London. (<http://www.nhm.ac.uk>)

Dinosaur replicas are available for use at the Grand Staircase-Escalante National Monument Visitor Center in Big Water, Utah.

Dinosaur replicas can be purchased at many sites online including the Carnegie Museum of Natural History in Pittsburgh, PA ([www.naturalhistorystore.com](http://www.naturalhistorystore.com))

2. Step 2 - *Visualize the Actual Size of Cretaceous Critters* (page 6), requires at least three students and will probably need to take place in a large space. Parking lots are good because students measure the actual length of three Cretaceous Critters on the ground, estimate their height, and then make comparisons to everyday objects. Cars and trucks make good comparisons.

3. Step 3 - *Extrapolate Daily Caloric Requirements* (pages 7-8), uses the daily human caloric recommendation of 2,000 calories as the basis for determining the approximate daily caloric requirement for Cretaceous Critters. Step 3 converts this daily caloric requirement into jelly donuts. The math is simple and can be done by students in the classroom or at home. Jelly donuts are good to have on hand to help visualize the quantity of food Cretaceous Critters might need on a daily basis.

### Adaptations

This activity can be finished in 45 minutes if the number of Cretaceous Critters measured is decreased. Groups of three students can measure one or two scale drawings, or one dinosaur replica and work through the objectives relatively quickly. Objective 3 can be completed at home, though it's more fun to share jelly donuts with the class at the end.

### **Extensions**

Students can go online to BBC's *Walking With Dinosaurs* and play a game that simulates the metabolic requirements for a baby Allosaurus growing to maturity. This interactive game is based on actual dinosaur data like: feeding strategy, maternal instincts, ferocity, size, environment, nutritional value of food items, and energy used to search for food.

[http://www.bbc.co.uk/sn/prehistoric\\_life/games/big\\_al/](http://www.bbc.co.uk/sn/prehistoric_life/games/big_al/)

### **References**

#### Websites

Natural History Museum of London

<http://www.nhm.ac.uk/>

Jurassic Park Institute

<http://yahooligans.yahoo.com/content/science/dinosaurs/start.html>

Dinosauria.com

<http://www.dinosauria.com/dml/dmlf.htm>

Northern Arizona University's Global Paleogeographic Views of Earth's History

<http://jan.ucc.nau.edu/~rcb7/globaltext2.html>

National Geographic News - August 23, 2005

[http://news.nationalgeographic.com/news/2005/08/0823\\_050823\\_dinolava.html](http://news.nationalgeographic.com/news/2005/08/0823_050823_dinolava.html)

University of California Berkeley

<http://www.ucmp.berkeley.edu/diapsids/extinction.html>

Geo Times

[http://www.agiweb.org/geotimes/feb05/feature\\_25years.html](http://www.agiweb.org/geotimes/feb05/feature_25years.html)

BBC's Walking With Dinosaurs – An interactive game requiring knowledge and skill

<http://www.bbc.co.uk/dinosaurs/bigalgame/bigal.pl>

Discovery Channel's Dinosaur Viewer

<http://dsc.discovery.com/convergence/dinosaurplanet/interactive/interactive.html>

Discovery Channel's Beasts in Your Back Yard

<http://dsc.discovery.com/convergence/dinos/lookup.html>

Discovery Channel's Go Back in Time

<http://dsc.discovery.com/convergence/dinos/timetravel.html>

### Assessment

Observe students as they measure drawings or replicas and check the *Table of Cretaceous Critter Calculations* at the end of Objective 1 before they begin Objective 2. When the class has completed the activity have them share their comparisons to everyday objects and the number of jelly donuts their Cretaceous Critters would need to satisfy their daily caloric needs. Obviously dinosaurs didn't eat jelly donuts, but is a way to illustrate the relationships between size and calories. Consider Paleontology Unit 1: *How Dinosaurs Tell Time in GSENM* to learn more about dinosaurs and to speculate on what they really ate.

### Answer Key:

#### Question 1

Table of Cretaceous Critter Calculations (Scale Drawings)			
Name of Cretaceous Critter	String Measurement	Life Size Dimension	Life Size Dimension in Meters
Avisaurus	L 3 centimeters H	L 150 centimeters H	L 150 meters H
Brachauchenius	L 22.9 cm H 10.8 cm	L 1145 cm H 540 cm	L 11.45 m H 5.4 m
Brachylophosaurus	L 24.7 cm H 9.8 cm	L 1253 cm H 490 cm	L 12.35 m H 4.9 m
Cimolomys	L 2.8 cm H .7 cm	L 140 cm H 35 cm	L 1.4 m H .35 m
Cretoxyrhina	L 14.6 cm H	L 730 cm H	L 7.3 m H
Daspletosaur	L 18 cm H 5.5 cm	L 900 cm H 275 cm	L 9 m H 2.75 m
Dromaeosaurid	L 4.5 cm H 1.5 cm	L 215 cm H 75 cm	L 2.15 m H .75 m
Euoplocephalus	L 12.2 cm H 4.5 cm	L 610 cm H 225 cm	L 6.1 m H 2.25 m
Gryposaurus	L 13.8 cm H 4.1 cm	L 690 cm H 205 cm	L 6.9 m H 2.05 m
Hagryphus	L 5 cm H 2.6 cm	L 250 cm H 130 cm	L 2.5 m H 1.3 m
Hesperornid	L 4.4 cm H 2.2 cm	L 220 cm H 110 cm	L 2.2 m H 1.1 m

Neurankylus	L	2.9 cm	L	145 cm	L	1.45 m
	H	1 cm	H	50 cm	H	.5 m
Nothronychus	L	19.4 cm	L	970 cm	L	9.7 m
	H	12.2 cm	H	610 cm	H	6.1 m
Parasaurolophus	L	20.5 cm	L	1025 cm	L	10.25 m
	H	7.9 cm	H	395 cm	H	3.95 m
Placenticerias	L	1.9 cm	L	95 cm	L	.95 m
	H		H		H	
Pterosaur	L	3.8 cm	L	190 cm	L	1.9 m
	H	1 cm	H	50 cm	H	.5 m
Saurornitholestes	L	4.6 cm	L	230 cm	L	2.3 m
	H	1.9 cm	H	95 cm	H	.95 m
Stegoceras	L	5.5 cm	L	275 cm	L	2.75 m
	H		H		H	
Struthiomimus	L	7.6 cm	L	380 cm	L	3.8 m
	H	5.9 cm	H	295 cm	H	2.95 m
Utahceratops	L	19.7 cm	L	985 cm	L	9.85 m
	H	6 cm	H	300 cm	H	3 m
Zuniceratops	L	7.7 cm	L	385 cm	L	3.85 m
	H	2.7 cm	H	135 cm	H	1.35 m

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
<i>Example:</i> Nothronychus	9.25 meters	5.39 meters	Semi truck and trailer

Question 3

Daily Caloric Requirements of Cretaceous Critters					
Name of Cretaceous Critter	Length of animal (meters)	Divided by average human size	Size Difference	Multipled by daily human caloric requiremnt	Approxiamate daily caloric requirement
Avisaurus	1.5 m	1.7 meters	0.88	2,000	1,760
Brachauchenius	11.45 m	1.7 meters	6.74	2,000	13,480
Brachylophosaurus	12.35 m	1.7 meters	7.26	2,000	14,520
Cimolomys	1.4 m	1.7 meters	0.82	2,000	1,640

Cretoxyrhina	7.3 m	1.7 meters	4.29	2,000	8,580
Daspletosaur	9 m	1.7 meters	5.29	2,000	10,580
Dromaeosaurid	2.15 m	1.7 meters	1.26	2,000	2,520
Euoplocephalus	6.1 m	1.7 meters	3.59	2,000	7,180
Gryposaurus	6.9 m	1.7 meters	4.066	2,000	8,120
Hagryphus	2.5 m	1.7 meters	1.47	2,000	2,940
Hesperornid	2.2 m	1.7 meters	1.29	2,000	2,580
Neurankylus	1.45 m	1.7 meters	0.85	2,000	1,700
Nothronychus	9.7 m	1.7 meters	5.71	2,000	11,420
Parasaurolophus	10.25 m	1.7 meters	6.03	2,000	12,060
Placenticerias	.95 m	1.7 meters	0.56	2,000	1,120
Pterosaur	1.9 m	1.7 meters	1.12	2,000	2,240
Saurornitholestes	2.3 m	1.7 meters	1.35	2,000	2,700
Stegoceras	2.75 m	1.7 meters	1.62	2,000	3,240
Struthiomimus	3.8 m	1.7 meters	2.24	2,000	4,480
Utahceratops	9.85 m	1.7 meters	5.79	2,000	11,580
Zuniceratops	3.85 m	1.7 meters	2.26	2,000	4,520

## Question 4

Number of Jelly Donuts Per Day		
Name of Cretaceous Critter	Approximate daily caloric requirements	Number of Jelly Donuts per day
Avisaurus	1,760	8.38 or 9
Brachauchenius	13,480	64.19 or 65
Brachylophosaurus	14,520	69.14 or 70
Cimolomys	1,640	7.81 or 8
Cretoxyrhina	8,580	40.86 or 41
Daspletosaur	10,580	50.38 or 51
Dromaeosaurid	2,520	12
Euoplocephalus	7,180	34.19 or 35
Gryposaurus	8,120	38.67 or 39
Hagryphus	2,940	14
Hesperornid	2,580	12.21 or 13
Neurankylus	1,700	8.1 or 9
Nothronychus	11,420	54.38 or 55
Parasaurolophus	12,060	57.43 or 58
Placenticerias	1,120	5.33 or 6

Pterosaur	2,240	10.67 or 11
Saurorntholestes	2,700	12.86 or 13
Stegoceras	3,240	15.43 or 16
Struthiomimus	4,480	21.33 or 22
Utahceratops	11,580	55.14 or 56
Zuniceratops	4520	21.52 or 22

## Vocabulary

<b>Carnivore</b>	An animal that eats other animals
<b>Cold-blooded</b>	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.
<b>Cretaceous</b>	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.
<b>Extrapolate</b>	Using known facts as the basis for drawing inferences or conclusions about something unknown.
<b>Herbivore</b>	An animal that feeds on plants
<b>Metabolism</b>	The chemical reactions that occur in living organisms that provide energy needed to sustain life.
<b>Scale</b>	A ratio representing the size of an object as represented by an illustration, model, or map.