HOW BIG?
Activity Overview

BIG IDEA
The immensity of Sauropods and T. rex can often fool us into thinking all dinosaurs were giants. However, in reality, dinosaurs varied greatly in size. In the second part of this activity, students will brainstorm inherent advantages of large and small dinosaurs.

OBJECTIVE
Students will compare the weights of various dinosaurs to familiar items to understand the wide variation in size.

BACKGROUND
Dinosaurs varied greatly in size and structure. The heaviest dinosaur known was Argentinosaurus, weighing in at 60-100 tons! At only 13 inches long and weighing under a quarter of a pound, Anchiornis huxleyi was the smallest known non-avian dinosaur. Both large and small dinosaurs had unique advantages that helped them to survive. For example, large dinosaurs, like sauropods had long necks which gave them a better view of their surroundings and any approaching danger. Small dinosaurs were typically lighter and could move faster and hide more easily to escape larger predators. Encourage students to brainstorm other advantages dinosaurs may or may not have had because of their size.

To include the scientific method, have students think of modern animal behavior they have observed. Based on their observations of both small and large animals, have them create hypotheses about dinosaur behavior. For example: “The mouse is a small animal and has to be very fast to escape predators like cats. Therefore, smaller dinosaurs were probably faster so they could escape larger dinosaurs that may try to eat them.”

EXTENSION
Have students compare the weights of the dinosaurs in the activity by using <, >, and = between the pictures of the dinosaurs. To further incorporate Number and Operations in Base 10, have students write the dinosaurs’ weights in scientific notation.
HOW BIG?
Museum Instructions

MATERIALS
Student activity sheets, clipboards, pencils (Pens, crayons, and markers are not allowed in exhibit spaces)

ACTIVITY TIME
30 Minutes

LOCATION
Find a space in the Dinosaurs Under the Big Sky exhibit at MOR.

INSTRUCTIONS
This activity can be used to explore the sizes of dinosaurs. Students can travel throughout the exhibit to estimate sizes of animals on display, however, the best place to introduce the topic is under the Diplodocus neck, in the Dinosaurs Under the Big Sky exhibit, just after the viewing lab.

Tell your students that the branch of paleontology that is studied here at the museum is ontogeny, which is the science of how things change as they grow. Throughout the Dinosaurs Under the Big Sky exhibit, you'll see growth series of different dinosaurs – Diplodocus, Maiasaura, Triceratops, Pachycephalosaurus, and Tyrannosaurus. While this might give the idea that dinosaurs were all truly giants, there were actually many smaller species of dinosaur. The average size of a dinosaur was about the same size as a sheep. We can use the activity guide to compare these animals and think about why they might have been such different sizes.

After working through the activity, have your students explore the Dinosaurs Under the Big Sky exhibit. Use the skeletons to make estimations and observations about the sizes of the dinosaurs on display. Using paces to estimate is fine. What are the largest and smallest dinosaurs on full display at the museum?
HOW BIG?
Classroom Instructions

MATERIALS
100’ Tape Measure, masking tape, any open area 100 feet long, dinosaur toys (optional) sidewalk chalk (optional)

ACTIVITY TIME
15-30 Minutes

INSTRUCTIONS
This activity can be used as a math lesson and to support the sizes of dinosaurs, which can be an abstract concept for students.

Providing a visual reference for the sizes of various dinosaurs can really help with the sense of scale of these extinct animals, some of whom grew to extraordinary sizes. Go out to a hallway or other open area and explain to your students that we will be measuring dinosaurs today. Establish a “starting line” or point from where the measurements will be starting.

First, have your students line up at the starting line. The first dinosaur we’re going to measure today will be Deinonychus, who was 12 feet long. Have students walk out to where they think 12 feet is. Then, measure it, see who was closest, and mark the spot with a piece of tape or a dinosaur toy.

Repeat the procedure for Triceratops (30 feet long), and Tyrannosaurus (45 feet long).

Lastly, tell them about Diplodocus, which is the longest dinosaur at Museum of the Rockies, and the longest type of dinosaur found in Montana. Diplodocus was a long-necked dinosaur about 90 feet long. Have students walk out to where they think 90 feet is, and then measure it again. High school basketball courts typically measure 84 feet long (though they can vary a bit in size). Next, we should divide the Diplodocus into thirds. The neck was about 30 feet long, the body another 30 feet, and the remainder is the tail. You can have students stand at each of these divisions to more clearly mark it. Note that the neck of the Diplodocus is just as long as a whole Triceratops!

You could also trace an outline of each of these dinosaurs on a basketball court, sidewalk, or other pavement.

For a math extension have students compare the lengths of each of these dinosaurs to each other, or measure and compare other large objects in the area, like cars, busses, trees, bridges, and so on.
How Big?

We’re familiar with the idea that dinosaurs were some of the largest creatures to walk the Earth, but just how big were they?

- **Argentinosaurus**
  - Weighs 70 tons or 140,000 pounds
  - Measures 130 ft long

- **Diplodocus**
  - Weighs 15 tons or 30,000 pounds
  - Measures 90 ft long

- **Triceratops**
  - Weighs 9 tons or 18,000 pounds
  - Measures 30 ft long

- **T. rex**
  - Weighs 9 tons or 18,000 pounds
  - Measures 45 ft long

- **Einiosaurus**
  - Weighs 1.3 tons or 2,600 lbs
  - Measures 15 ft long

- **Deinonychus**
  - Weighs 0.08 tons or 160 lbs
  - Measures 12 ft long

- **Gallon of Milk**
  - Weighs 0.004 tons or 8 lbs
  - Measures ½ foot long

- **Average Adult**
  - Weighs 160 lbs
  - Measures 5.5 feet long

- **Bison**
  - Weighs 0.7 tons or 1,400 lbs
  - Measures 11 feet long

- **Elephant**
  - Weighs 7 tons or 14,000 lbs
  - Measures 24 feet long

- **School Bus**
  - Weighs 18 tons or 36,000 lbs
  - Measures 45 feet long

- **Boeing 737**
  - Weighs 38 tons or 76,000 lbs
  - Measures 138 feet long
1. How many gallons of milk are equal to the weight of Argentinosaurus?

2. What modern object shown on the worksheet is closest in weight to Triceratops? Einiosaurus?

3. Diplodocus weighs about as much as _______ Elephants.

4. A Boeing 737 is about as long as which dinosaur?

5. How much longer is a Tyrannosaurus than a school bus?

6. How much longer is a Triceratops than a bison? How much heavier?
How Big? (Cont.)

_Troodon_ and _Daspletosaurus_ were two theropods who lived at the same time in Montana. Besides their sizes, they had a rather similar body structure, with two legs, two arms with sharp claws, a stout muscular head, and sharp teeth. What do you suppose these two animals ate?

What is one reason they might be different size animals?

What advantages do you think a small predator like _Troodon_ had in its environment?

What advantages do you think a large predator like _Daspletosaurus_ had in its environment?
How Big? (cont.)

Buff Or Slim?

Paleontologists have actually calculated a range of sizes for most dinosaurs. For instance, Tyrannosaurus is estimated to be between 7 tons and 12 tons. Why do you think paleontologists are unsure to what Tyrannosaurus’ true weight might have been?

More Modern Creatures

Can you think of a group of animals that have the same essential body structure, but are different sizes? List three examples here. Research one of your sets of animals, and find the largest and smallest members of that animal “family.”
How Big?

We’re familiar with the idea that dinosaurs were some of the largest creatures to walk the Earth, but just how big were they?

- **Argentinosaurus**: 70 tons or 140,000 pounds, 130 ft long
- **Diplodocus**: 15 tons or 30,000 pounds, 90 ft long
- **Triceratops**: 9 tons or 19,000 pounds, 30 ft long
- **Einiosaurus**: 1.3 tons or 2,600 lbs, 15 ft long
- **Deinonychus**: 0.08 tons or 160 lbs, 12 ft long
- **T.rex**: 9 tons or 18,000 pounds, 45 ft long
- **Gallon of Milk**: 0.004 tons or 8 lbs, ½ foot long
- **Average Adult**: 160 lbs, 5.5 feet long
- **Bison**: 0.7 tons or 1,400 lbs, 11 feet long
- **Boeing 737**: 38 tons or 76,000 lbs, 138 feet long
- **School Bus**: 18 tons or 36,000 lbs, 45 feet long
- **Elephant**: 7 tons or 14,000 lbs, 24 feet long
- **Bison**: 0.7 tons or 1,400 lbs, 11 feet long
How Big? (Cont.)

1. How many gallons of milk are equal to the weight of Argentinosaurus?

\[
140,000 / 8 = 17,500 \text{ gallons of milk}
\]

2. What modern object shown on the worksheet is closest in weight to Triceratops? Einiosaurus?

- Triceratops is closest to an elephant in weight.
- Einiosaurus is closest to a bison in weight.

3. Diplodocus weighs about as much as ___2___ Elephants.

\[
15 \text{ tons} / 7 \text{ tons} = 2.1
\]

4. A Boeing 737 is about as long as which dinosaur?

- Argentinosaurus

5. How much longer is a Tyrannosaurus than a school bus?

- They are about the same length.

6. How much longer is a Triceratops than a bison? How much heavier?

- Triceratops is 19 feet longer than a bison (or about 3 times as long).
- Triceratops weighs about 178,600 more pounds than a bison (or over 100 times heavier).
How Big? (Cont.)

*Troodon* and *Daspletosaurus* were two theropods who lived at the same time in Montana. Besides their sizes, they had a rather similar body structure, with two legs, two arms with sharp claws, a stout muscular head, and sharp teeth. What do you suppose these two animals ate?

**Meat because of their sharp teeth and claws.**

What is one reason they might be different size animals?

**Specialize in hunting different size mammals. Large predators eat larger prey and small predators eat smaller prey. Other reasonable answers may be correct.**

What advantages do you think a small predator like *Troodon* had in its environment?

**Smaller predators can be faster than larger predators. Smaller animals can more easily conceal themselves for hunting or defense.**

What advantages do you think a large predator like *Daspletosaurus* had in its environment?

**Large predators can attack large prey. Large predators can’t be attacked by smaller animals as easily, making it easier to defend a kill or scare away other predators from a kill.**
How Big? (Cont.)

Buff Or Slim?

Paleontologists have actually calculated a range of sizes for most dinosaurs. For instance, *Tyrannosaurus* is estimated to have been between 7 tons and 12 tons. Why do you think paleontologists are unsure to what *Tyrannosaurus*’ true weight might have been?

All we have are their bones, and very few skin impressions. We can't be sure just how muscular or fat they may have been.

More Modern Creatures

Can you think of a group of animals that have the same essential body structure, but are different sizes? List three examples here. Research one of your sets of animals, and find the largest and smallest members of that animal “family.”

- **Dogs/Canines** - Chihuahua, Labrador, St. Bernard
- **Cats/Felines** - House Cat, Bobcat, Lion
- **Deer** - Whitetail, Mule Deer, Elk
- **Whale** - Beluga, Humpback, Blue Whale

Other appropriate and well thought answers are acceptable.