Design a Dinosaur Bone Exhibit

Number and Operations—Fractions

Grade 3

45 Min. or

CCSS MATH
3.NF.A.2, 3.NF.A.3.A–B

TEKS MATH
3.3.A, 3.3.F

QSC
QSC116

LESSON OBJECTIVE
Use models to generate equivalent fractions.

LANGUAGE OBJECTIVES
Understand the words *equivalent*, *fossil*, *fraction*, and *shelf* and apply them in context.

PREREQUISITE SKILLS
Decompose fractions into unit fractions and compose fractions using unit fractions with denominators of 2, 3, 4, 6, and 8.

LESSON OVERVIEW
Students organize dinosaur bones based on fractional lengths. They design exhibits of 4 rows with 3 bones on each row. They identify 2 equivalent fractions in each row and analyze their findings.

MATERIALS
- Fraction bars
- Vocabulary Knowledge Rating Sheet

Science Background

A dinosaur bone is an example of a fossil. Fossils are the remains of an organism, such as a dinosaur, that have been preserved as rock. What is an organism? It could be an animal or a plant or even bacteria. Every living thing is an organism. People are organisms. When organisms die, their remains turn into fossils over a very long period of time.

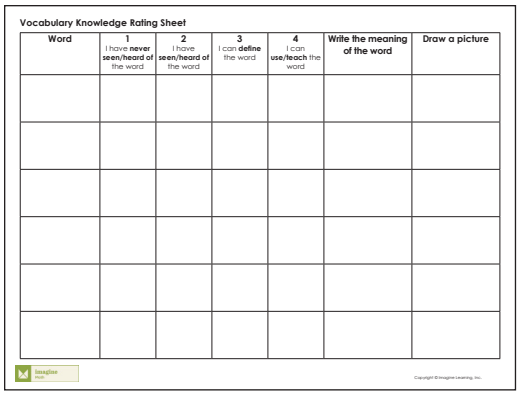
Fossils provide evidence about ancient life—including plants, not just animals. Everything that scientists know about dinosaurs comes from studying their fossils. For example, scientists can tell what dinosaurs ate by looking at their teeth.

Dinosaur exhibits at museums attract many visitors each year. For example, in the Dinosaur Wing at the American Museum of Natural History in New York City, visitors can view reconstructed models or "mounts" of dinosaurs such as *Tyrannosaurus rex*, *Stegosaurus*, and *Triceratops*.

Vocabulary Knowledge Rating

Before students begin the task, pre-assess student knowledge of words used in the task. Write the words *equivalent*, *fossil*, *fraction*, and *shelf* for students to see. Ask students to individually say the word and then write the word on a Vocabulary Knowledge Rating Sheet using the ratings from 1–4 as shown. Once students have self-assessed, ask students to write what they think the word means, in their own words, on their rating sheet. Then, ask them to draw a picture of the word.

Throughout the task, students should discuss the meanings of the words within the context of the situation. At the end of the task, ask students to reassess their word knowledge using the same four-point scale.



Vocabulary Knowledge Rating Sheet

Word	1 I have never seen/heard of the word	2 I have seen/heard of the word	3 I can define the word	4 I can use/teach the word	Write the meaning of the word	Draw a picture

Task Application

In the context of designing an exhibit of dinosaur bones for a museum, students understand relationships between fractions and how to recognize equivalent fractions. Students represent and identify equivalent fractions on number lines, and they use visual fraction models (fraction bars) to check their answers for reasonableness.

In ***section A***, students fill in equivalent fractions on number lines, and they write number sentences to express equivalence. Students who need help recognizing the equivalent fractions may benefit from using visual fraction models such as fraction circles or bars.

In ***section B***, students organize the fractions in 4 rows of 3 fractions each, with each row containing at least 2 equivalent fractions. Remind students to circle the equivalent fractions in each row.

In ***section C***, students select one of their designs as the exhibit, and they analyze relationships between equivalent fractions in the display.

In ***section D***, students use fraction bars to check that the fractions circled in each row are equivalent. If students have difficulty understanding fraction equivalence, reinforce visual understanding by using other visual models such as fraction circles or blocks.

Watch Out: Common Misconceptions

Museum exhibits in the United States often express lengths in customary units such as inches and feet because these units are familiar to many museum visitors. In most scientific fields such as paleontology, however, measurements are expressed in metric units such as millimeters, centimeters, and meters.

Customary rulers are usually divided into eighth inches, with locations marked for $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{3}{4}$ inches. Encourage students to focus on equivalent fraction relationships involving halves, fourths, and eighths.

Sample Rubric

Score	Criteria
3	Students accurately complete the number lines and number sentences in section A, and in section B they develop four accurate designs for a display of dinosaur bones based on equivalent fractions. Their answers in sections C and D accurately apply math concepts.
2	Students complete the number lines and number sentences in section A with one or two errors, and in section B they develop at least two accurate designs for a display of dinosaur bones based on equivalent fractions. Their answers in sections C and D apply math concepts with no more than one minor error.
1	Students complete the number lines and number sentences in section A with seven or fewer errors, and they develop at least one accurate design in section B for a display of dinosaur bones based on equivalent fractions. Their answers in sections C and D are mostly inaccurate statements and demonstrate a poor understanding of math concepts.
0	Students present a very limited or rudimentary response to the assignment. They complete less than half of the number lines and number sentences in section A accurately, make inaccurate designs or no designs for a display of dinosaur bones based on equivalent fractions, and include very general or incomplete answers to the questions.

STEM Activity Suggestions

NGSS SCIENCE	SCIENCE AND ENGINEERING PRACTICE	MATHEMATICAL PRACTICE
NGSS 3-LS4-1	SEP4	MP4

STEM OBJECTIVE Connect the sizes of fossils to the sizes of the organisms they belong to.

1. **Build Background** Ask students to investigate the relationship between the size of a fossil and the size of the organism the fossil came from. Guide students to compare the sizes of fossils used to construct the skeletons of large dinosaurs, such as *Apatasaurus*, to those of smaller dinosaurs, such as *Compsognathus*. For example, a $\frac{1}{4}$-inch fossil recently discovered in England is the neck bone of an adult dinosaur estimated to be no more than $15\frac{2}{3}$ inches long, making it the second smallest known feathered dinosaur after *Anchiornis*, which has an estimated length of 13 inches.

2. **Introduce the STEM Activity** Present a scenario that involves a backyard discovery of a dinosaur bone that measures less than 1 inch long. Have students work in groups to research small dinosaur species and to consider how they used their size and other physical attributes to defend themselves from larger predators. Then have students create a life-sized drawing of the new smallest dinosaur represented by the new fossil. They should present their life-size drawing to their class, explaining how they used mathematical reasoning to create their drawings of their dinosaur's physical attributes.

3. **Guide Teams** Encourage students to draw the fossil bone first, measuring with a ruler to make sure it is the correct length before drawing the rest of the dinosaur in the available space. Students should measure and add labels for lengths of various bones and for the length of the entire dinosaur as well. Remind students to cite any sources that helped them create their drawing.

4. **Assess Results** Evaluate student drawings and presentations based on the scientific and mathematical reasoning behind their reconstructions (**NGSS 3-LS4-1, SEP4**) as well as the accuracy of their labeled measurements (**MP4**).

Answer Key

APPLICATION TASK | **Design a Dinosaur Bone Exhibit**

Name: _____

Goal
Use models to generate equivalent fractions.

Why Study Dinosaur Bones?
Dinosaur bones may provide clues about why dinosaurs suddenly disappeared 65 million years ago.

Connect to Reading

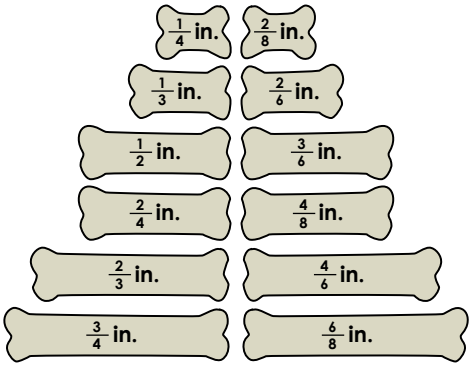
She Sold Seashells and Fossils, Too!

Digging for Dinos

Essential Question **How can we tell if two fractions are equivalent?**

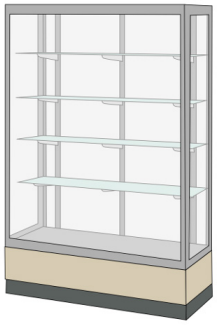
In this task, you are designing a dinosaur bone exhibit. You will create four different designs using the 12 bones here and then select one of the designs as your solution.

The display case has four shelves. Each shelf holds 3 bones and at least 2 equal-length bones should be on each shelf.



SAMPLE EXHIBIT DESIGN

Shelf 1	$\frac{1}{2}$	$\frac{3}{6}$	$\frac{1}{4}$
Shelf 2	$\frac{2}{4}$	$\frac{4}{8}$	$\frac{2}{8}$
Shelf 3	$\frac{2}{3}$	$\frac{4}{6}$	$\frac{1}{3}$
Shelf 4	$\frac{3}{4}$	$\frac{6}{8}$	$\frac{2}{6}$

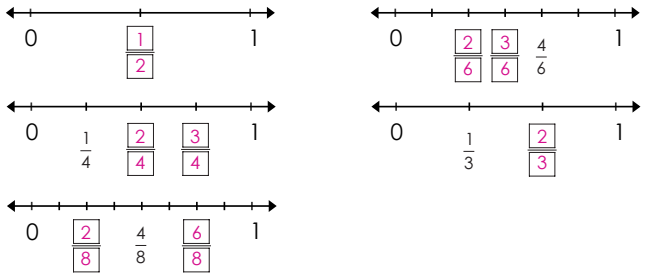


Did You Know? **Sometimes a scientist can tell what a dinosaur looked like by studying a single bone.**

A | Understand

Name: _____

To help you find equal-length bones, find equivalent fractions on a number line. The marks on the number line represent the lengths of dinosaur bones in inches. Label each of the marks that have blank fractions.



Think about It Use vocabulary words to complete the sentences.

Two fractions are equivalent if they are the same point on a number line.

Explain It Write the equivalent fractions shown on the number lines from section A. How can you tell that these fractions are equivalent?

$\frac{1}{2} = \frac{2}{4} = \frac{3}{6} = \frac{4}{8}$ $\quad \frac{1}{3} = \frac{2}{6}$ $\quad \frac{1}{4} = \frac{2}{8}$ $\quad \frac{2}{3} = \frac{4}{6}$ $\quad \frac{3}{4} = \frac{6}{8}$

Sample answer: These fractions are equivalent because they represent the same location on the number lines.

Talk about It Talk about how to solve this problem with a partner. Discuss how the number lines in ***section A*** help you meet the requirements of the task.

ACADEMIC AND MATH VOCABULARY

Read each definition. Use these words in discussions and responses to thinking questions.

denominator: the number below the fraction bar in a fraction that shows the number of equal-sized parts the whole has been divided into

eighth: one of eight equal parts

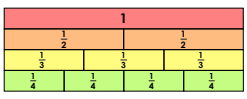
equivalent: equal in value

fossil: the preserved remains of a plant or animal from the past

fourth: one of four equal parts

fraction: part or portion of the whole

fraction bars: visual aids to represent fraction relationships



B | Organize

Name: _____

Design four different displays. Each shelf of the display case holds 3 bones, and at least 2 of the bones must have the same length. For each design, use the fractions from the number lines for the lengths of the dinosaur bones on each shelf of the display case. Circle two equivalent fractions in each row. The first row of Design 1 is completed for you.

Design 1

Shelf 1	(2/8)	(1/4)	2/4
Shelf 2	(2/6)	(1/3)	1/2
Shelf 3	(2/3)	(4/6)	3/6
Shelf 4	(3/4)	(6/8)	4/8

Design 2

Shelf 1	(2/4)	(1/2)	3/6
Shelf 2	4/8	(1/3)	(2/6)
Shelf 3	(6/8)	4/6	(3/4)
Shelf 4	2/3	(1/4)	(2/8)

Design 3

Shelf 1	(4/6)	(2/3)	1/4
Shelf 2	2/8	(2/4)	(3/6)
Shelf 3	(4/8)	(1/2)	1/3
Shelf 4	(6/8)	(3/4)	2/6

Design 4

Shelf 1	(3/6)	(4/8)	4/6
Shelf 2	(1/4)	1/3	(2/8)
Shelf 3	(1/2)	(2/4)	2/3
Shelf 4	(3/4)	2/6	(6/8)

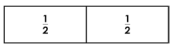
Explain It

Is it possible for a row to have three equivalent fractions?

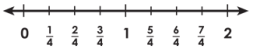
Sample answer: Yes, the top row in Design 2 has three equivalent fractions, $\frac{1}{2}$, $\frac{2}{3}$, and $\frac{3}{6}$, although only two of the equivalent fractions are circled.

ACADEMIC AND MATH VOCABULARY *(continued)*

half: one of two equal parts



number line: a line where each point represents a location

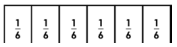


Example: The number line is divided into $\frac{1}{4}$ parts.

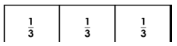
numerator: the number written above the fraction bar in a fraction that shows how many parts are being considered out of the number of equal-sized parts indicated by the denominator

shelf: a thin slab of wood, metal, or plastic used to hold objects

sixth: one of six equal parts



third: one of three equal parts



C | Solve

Name: _____

Select one of your designs as your solution. Enter your fractions into the table.

Solution

Shelf 1	2/8	1/4	2/4
Shelf 2	2/6	1/3	1/2
Shelf 3	2/3	4/6	3/6
Shelf 4	3/4	6/8	4/8

Explain It

What patterns do you notice in your design?

Sample answer: The fraction in each row that is not equivalent to the other two fractions is equivalent to a fraction in another row.

CONNECT TO SCIENCE

Scientists who study fossils are called paleontologists.

Are dinosaur bones fossils?

Sample response: Yes, minerals in the bones are replaced by other minerals over time producing rock-like copies of the original bones.

What are some reasons to display bones of the same length on the same shelf?

Sample responses: To make it easier to compare the bones; to make the exhibit look good.

What other types of dinosaur fossils are there besides bones?

Sample responses: claws, teeth, eggs, nests

Extend Design an exhibit so that the total length of the bones on each shelf is 1 inch.

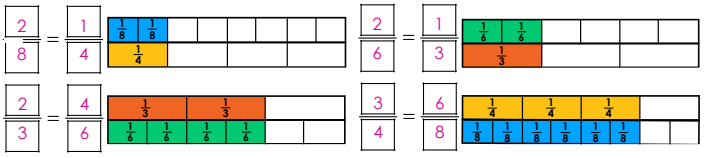
How many shelves are needed? 6

How many bones are on each shelf? 2

Shelf 1	1/2	3/6
Shelf 2	2/4	4/8
Shelf 3	2/3	1/3
Shelf 4	4/6	2/6
Shelf 5	3/4	1/4
Shelf 6	6/8	2/8

D | Check

Draw fraction bars to check that two fractions in each row are equivalent. Then, write the equivalent fractions on both sides of the equals signs.



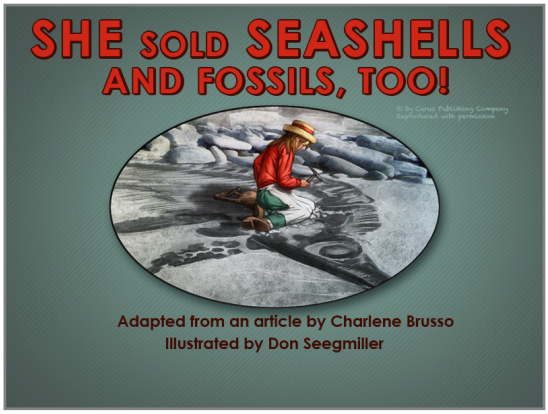
Explain It

How can using fraction bars show that two fractions are equivalent?

Sample answer: If the two wholes are the same size, then equivalent fractions are also the same size. They show equal parts of the same whole.

Name: _____

She Sold Seashells and Fossils, Too!



Adapted from an article by Charlene Russo
Illustrated by Don Seegmiller
Lexile®: 640L, 416 words

She sells seashells on the seashore.

The shells she sells are seashells, I'm sure.

For if she sells seashells on the seashore,

Then I'm sure she sells seashore shells.

English songwriter Terry Sullivan wrote this tongue twister in 1908. But most of the world had forgotten Mary Anning, the girl he was writing about. After all, she had been dead for 61 years.

When Mary was born, girls usually did not go to school and almost never studied science. But Mary was an expert fossil hunter. Fossils are the remains of plants and animals that lived millions of years ago.

Mary was born in 1799, in the village of Lyme Regis. Lyme Regis is on the coast of England. The cliffs there were famous for their strangely shaped stones. Some looked like shells. Others looked like bones and teeth. The "stones" were actually fossils. When Mary was young, scientists were just beginning to study fossils. Most people had no idea what they were. Tourists often bought the mysterious stones.

Mary's family was poor. Her father was a carpenter who collected fossils in his spare time. Mary loved to climb the cliffs with him to find new fossils. But the cliffs were dangerous. When Mary was ten, her father slipped and fell more than 100 feet. He never completely recovered from the fall. When he died a few months later, Mary's family became even poorer.

Mary continued to go fossil hunting whenever she could. One day, she sold a beautiful shell to a tourist for half a crown. That was enough money to feed her whole family for a week! After that, Mary spent all her time collecting fossils. She would study and sell the fossils.

Name: _____

Mary found the fossilized skeleton of a strange creature when she was 12. It looked like it was half fish and half lizard. The fossil was 17 feet long. It was the first complete Ichthyosaurus skeleton ever found. Scientists later figured out that it was more than 165 million years old!

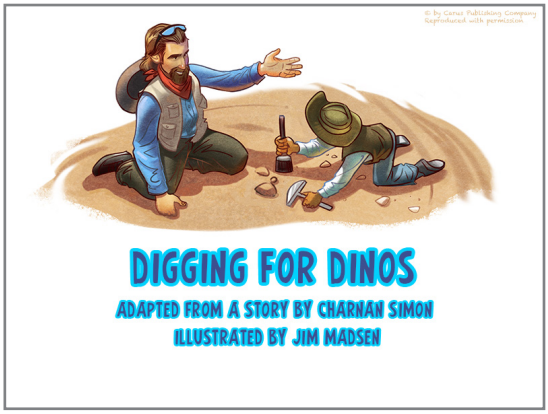
Years later, Mary discovered the bones of a Plesiosaurus. This was a long-necked sea reptile with flippers. She also found England's first pterosaur.

Mary became famous for her fossils. She studied books on geology and animal biology. People came from all over to talk with her and see her fossils. Many of her discoveries are displayed in museums and collections today.

Terry Sullivan's song was only partly correct. Mary did sell seashells on the seashore, fossil seashells, and ancient reptile bones, too.

Name: _____

Digging for Dinos



Adapted from an article by Charnan Simon
Illustrated by Jim Madsen
Lexile®: 660L, 491 words

Digging for dinosaurs was hard work. When Mom and Dad told Benny they were going on a dinosaur dig for their vacation, Benny couldn't stop smiling. He bragged to his friends that he would discover a brand new species of dinosaur. He'd call it the Benosaurus.

But when Benny got to the real dig, he found out no one was even digging. "No shovels," Dave, the paleontologist in charge, told them. "Any dinosaur bones buried here should be only a couple of feet under the surface. We don't want to risk breaking any of them."

Then Dave handed out ice picks and paint brushes. He showed everyone how to chip and brush away sand and dirt, slowly and carefully, a little bit at a time.

"The most important thing is knowing where to look," Dave said. "Some rocks aren't old enough to have dinosaur bones. Other rocks are too old. We found some fossils in this area, so maybe you'll find some too!"

Well, that was two days ago, and so far the most exciting thing Benny had found was that his tooth was loose. He wiggled it now. If he couldn't find any dinosaur bones, at least he could show his friends back home that he'd lost another tooth.

Dave crouched beside Benny. "How's it going?" he asked.

"I haven't found anything," Benny said. "I bet a shovel would make this go a lot faster."

Dave laughed. "Yep, it's hard work. But we want to keep the bones safe. Sometimes paleontologists and fossil hunters look for weeks without finding anything. Don't give up. Today might be your lucky day!"

Benny bent over his patch of rocky ground and carefully cleared away the sand and gravel. When he needed a break, he wiggled his loose tooth while the

Name: _____

sun climbed higher and hotter into the sky. Every time Benny swept away dirt he just found more dirt, not bones.

But then Benny found something that wasn't just dirt. "My tooth!" Benny dropped his tools in surprise.

Benny's parents looked up from their pit. "My tooth!" Benny repeated, pointing at the ground in front of him.

Dad walked over to Benny and asked, "Did you lose your tooth in the dirt? Do you need me to help you find it?"

"MY TOOTH!" Benny whooped. "My dinosaur tooth! I found a real, live dinosaur tooth!"

Dave hurried over to look. "Well, I'll be!" he said. "It's a dinosaur tooth all right!"

"What kind is it?" Benny asked excitedly. "Is it from a T-rex? Apatosaurus? Triceratops?"

Dave laughed, but he kept studying the fossil in the ground. "Well, Ben," he finally said, "I've seen a lot of dinosaur teeth, but this one's different. I think you may have found one we haven't seen before. Good job!"

"Wow," Benny said softly. Digging for dinosaurs was such an amazing experience. Now Benny could not wait until his friends back home heard about his tooth!