MATH Literacy

Toolkit

Ratio & Unit Rates Toolkit

SNIPPETS FROM THE LESSON

ProActiveEd

proactiveEd.net | info@proactiveEd.net

State Standards

- ☑ TEKS 6.4B
- ☑ TEKS 6.4C
- ☑ TEKS 6.4E
- ☑ TEKS 6.5A

NCTM Process Standards

Problem Solving	Build new mathematical knowledge through problem solving. Solve problems that arise in mathematics and in other contexts. Apply and adapt a variety of appropriate strategies to solve problems. Monitor and reflect on the process of mathematical problem solving.
Reasoning and Proof	Make and investigate mathematical conjectures. Select and use various types of reasoning and methods of proof.
Communication	Organize and consolidate student mathematical thinking in written and verbal communication. Communicate mathematical thinking clearly to peers, teachers, and others. Use the language of mathematics to express mathematical ideas precisely
Connections	Recognize and use connections among mathematical ideas. Understand how mathematical ideas interconnect and build on one another to produce a coherent whole. Recognize and apply mathematics in contexts outside of mathematics.
Representations	Create and use representations to organize, record, and communicate mathematical ideas. Select, apply, and translate among mathematical representations to solve problems. Use representations to model and interpret physical, social, and mathematical phenomena.

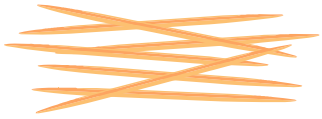
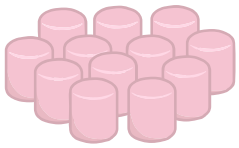
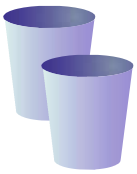
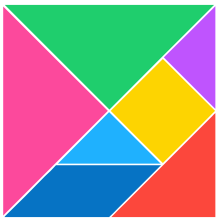
Learning Objectives

Students develop an understanding of proportional relationships by applying qualitative and quantitative reasoning to solve prediction and comparison of real-world problems involving ratios and rates. They also give examples of ratios as multiplicative comparisons of two quantities describing the same attribute. Students represent ratios and percents with concrete models, fractions, and decimals. They also represent mathematical and real-world problems involving ratios and rates using scale factors, tables, graphs, and proportions.

Toolkit Materials

Concrete Representations

- ☑ Sticks
- ☑ Marshmallows
- ☑ Cups
- ☑ Tangrams

Blackline Masters

- ☑ Ratio Table
- ☑ Unit Rate Table

Triangle to Square	5	2	5 to 2
Square to Triangle		5	2 to 5
3 Sided Shape to 4 Sided Shape	5		
	2	5	
Square to all Shapes			2 to 7
All Shapes to Triangles		5	

Birds to wings	1 bird	2 wings	1 to 2
Wings to birds	2 wings	1 bird	2 to 1
Horse to legs			
	4 legs	1 horse	
Triangle to sides			
Sides to triangle			
			10 to 1
Eyes to Toes			

Not Included

- ❒ Scissors

Literacy Guide

Academic Discourse	Engage in conversations about the big ideas
Conceptual Understanding	Explore the math using hands-on materials
Informational Text	Read and write about concepts and problem solving strategies
S.T.E.A.M. Connections	Investigate science, technology, engineering and art topics using the math
Technical Writing	Present and write about the S.T.E.A.M. Connections

Recommended Intervention Toolkit

Evaluating Linear and Exponential Functions Toolkit

Recommended Acceleration Toolkit

Building Radical, Rational, and Composite Functions Toolkit

Teacher Tips

Anchor 1: Academic Discourse

- ☑ Use games like a scavenger hunt to help students see the mathematics in the universe that surrounds them.
- ☑ Connect prior learning to make real-world connections to the learning goal.
- ☑ Reduce the barrier of academic vocabulary by focusing on big ideas and real world representations.

Anchor 2: Conceptual Understanding

- ☑ Use concrete realia or virtual manipulatives to represent the learning objective.
- ☑ Use hand-on manipulatives and student created pictures before transitioning to abstract concepts and standard algorithms.
- ☑ Use laboratory procedures that follow a constructivist approach to investigate the topic and learn key concepts.
- ☑ Communicate learning experiences through academic dialogue
- ☑ Write expository pieces to demonstrate conceptual understanding of the learning topic.

Anchor 3: Informational Text

- ☑ Use informational text to investigate the topic and learn key terms.
- ☑ Use reading strategies like previewing, chunking, annotating, and text dependent questioning to help students process the density text.
- ☑ Encourage reading and English teachers to utilize informational text about mathematics in their classroom settings.
- ☑ Communicate learning experiences through academic dialogue
- ☑ Write expository pieces to analyze the concepts and strategies presented in the text.

Anchor 4: S.T.E.A.M. Connections

- ☑ Use research, context clues, and access student schema to comprehend the given scenario
- ☑ Investigate invented strategies and standard algorithms to determine potential successes and failures.
- ☑ Design a prototype that satisfies the criteria outlined in the project before creating the final product.
- ☑ Collaborate with others to share strategies, critique reasoning, and justify methods.

Anchor 5: Technical Writing

- ☑ Write paragraphs that summarize the S.T.E.A.M. scenario. Be sure to include the criteria and scoring guide.
- ☑ Write paragraphs that describes the steps that will be used to address the scenario. Be careful to use numbers with a description of the role those numbers play in those steps.
- ☑ Write paragraphs that incorporates the steps used to address the scenario into actual calculations that include graphs, charts, diagrams and other representations as deemed appropriate
- ☑ Write paragraphs that investigate alternative problem solving strategies as a means for verifying the accuracy and validity of solutions
- ☑ Write paragraphs that reflect on strengths, misconceptions, and potential future applications of the concepts that were addressed and the strategies that were used.

Scavenge for Comparisons

Math describes the world around us and ratios are no different. A ratio is a mathematical way to compare two or more different things. When shopping for a cell phone, you may compare the features offered with each phone. At the ice cream store, you may compare each size cone. At school you may compare seating options for lunch. Just like these comparisons, ratios compare two or more things.

Stop here and write down as many other comparisons you can think of:

SETUP AND PLAY THE GAME

Step 1: Take out your pile of tangrams.
Step 2: Sort your tangrams into piles with a common feature. For example, you might group your tangrams by color.
Step 3: After sorting, explain your common feature in the table below. The first example has been done for you.
Step 4: Reset the timer for 2 minutes and repeat Steps 2 and 3.
Step 5: Continue playing for a total of 15 minutes.

	Description of Common Feature
1.	I sorted all my tangrams by color.
2.	
3.	
4.	
5.	
6.	
7.	

What's Old?

In math we are often comparing and finding a relationship between numbers. You have previously learned to compare numbers with fractions. For example, if you eat ½ a cookie, you can say that you have eaten 1 out of 2 equal pieces of cookie. A ratio is another way to compare values.

Stop and Think: What are some strategies you need when comparing fractions?

Recall: The numerator is always written on the top of the fraction and the denominator is located at the bottom of the fraction. The bar between the numerator and denominator can be read as "out of". So, ¾ can be read as 3 out of 4.

What's New?

Now you will learn new ways to compare numbers. You will use ratio language to describe the relationship between quantities using words and math symbols. When we use fractions to compare numbers, we are comparing values of the same thing, such as a cookie. However, when we compare numbers using ratios we can also compare the values of two (or more!) different things.

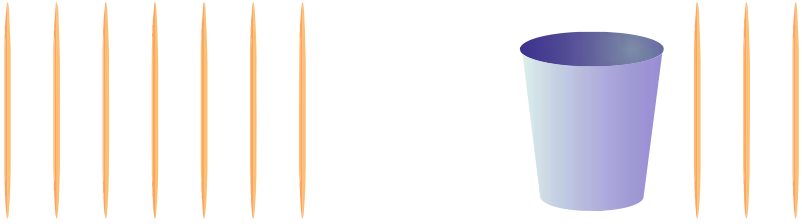
Try it!

In the past you have used fractions to make comparisons of equal parts. For example, fractions can tell you a portion of a whole or multiple wholes.

Stop and Think: Your job is to compare parts of a whole using fractions.

Try it 1:

Step 1: Count out 10 toothpicks.
Step 2: From the 10 toothpicks, separate a small group of 3 toothpicks and set them into a paper cup.
Step 3: Write the fraction to represent the number of toothpicks in the paper cup.

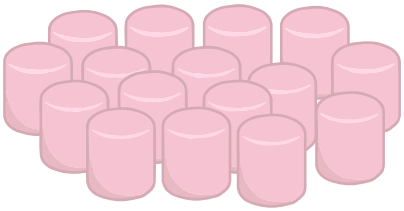


Explore

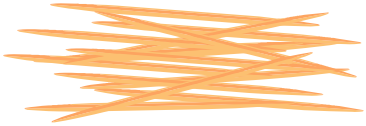
Reading and Writing Ratios Warm-Up:

Step 1: Gather your marshmallows and toothpicks.

Step 2: Make a pile of marshmallows.



Step 3: Make a pile of toothpicks.



Step 4: Close your eyes and take a handful of marshmallows.

How many marshmallows did you pick up? _____

Step 5: Close your eyes and use your fingers to pick up a "pinchful" of toothpicks.

How many toothpicks did you pick up? _____

Step 6: Fill in the blanks below.
Since we want to compare marshmallows to toothpicks, complete the following statement:

I picked up _____ marshmallows and _____ toothpicks.
The ratio is: _____ marshmallows to _____ toothpicks.

DRAW your ratio here: marshmallows to toothpicks.

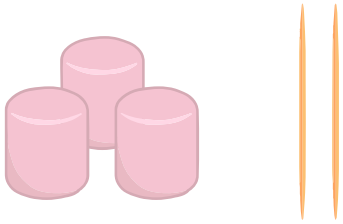
Hint: The number of marshmallows and toothpicks drawn should be the SAME as how many you picked up.

Using the same numbers, I can also compare toothpicks to marshmallows.

I picked up _____ marshmallows and _____ toothpicks.
The ratio is: _____ marshmallows to _____ toothpicks.

DRAW your ratio here: marshmallows to toothpicks.

In math, we like to use symbols to shorten our words. For ratios, we replace the word "to" with a colon. Let's go back to our original example.



Note: When we read a ratio that has a colon, we replace the colon with the word to.

The ratio of marshmallows to toothpicks is 3 to 2.
The shorthand notation is 3:2.

Ratio Using the Word To	Ratio Using a Colon	Reading a Ratio	Pictorial
3 to 2	3:2	Three to Two	

Step 7: Using your numbers from Step 6 above, write your ratios using the colon notation
in the spaces below.

For every _____ marshmallows there are _____ toothpicks.
The ratio of marshmallows to toothpicks is: _____.

: *complete your ratio using pictures*

Let's Compare!

Reading and Writing Ratios

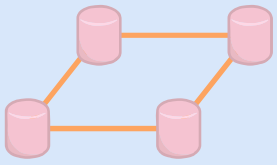
We compare things to each other every day and math is no different. In math, we can use fractions to compare parts of a whole. Making a comparison using fractions was reviewed in the "try it" exercise. You were able to show how many toothpicks were in or out of the cup and used that information to create a fraction. You recognized that the numerator represents the portion value while the value representing the whole is the denominator.

One out of two pieces of cookie or 1/2 of the cookie was eaten.

In your first warm up, you learned that we can use ratios to compare two different things. This was unlike the "try it" exercise where you were only comparing a set number of toothpicks. This time, you were comparing toothpicks to something else (marshmallows). You learned that it is necessary to write your ratio in a particular order. That is, that the digit representation in your ratio needs to be in the same order as the word description. For example, when comparing marshmallows to toothpicks, since you are describing marshmallows first, you must write the number of marshmallows first.

In the second warm up, you continued to explore ratios using its mathematical symbol, the colon (:). You replaced the word "to" with ":". Not only can you replace words with a symbol, you can also use the symbols to write words. When reading the : symbol, for example, we use the word to.

For every 2 toothpicks Tim needed to build his square, he used 1 marshmallow.
2 toothpicks to 1 marshmallow.
2:1



In the last warm up you learned how to calculate unit rates using ratios. A unit rate is the value of something for 1 unit. Division can help us calculate the unit rate as long as the denominator is not equal to 0.

Child's Play

You work for the City of Bullins as an engineer. The city has just set aside some land to develop a new park. As one of the town's engineers, you have been asked to design a new climbing structure for the park's playground. Your first task in this process is to make a model of your design. This model will help the town decide how much land is needed for the structure and calculate its cost to build.

Using your understanding of ratios, you will build a free standing, 3-dimensional structure out of mini marshmallows and toothpicks. You can choose to design your structure in any way, but it must be able to stand on its own and be at least 10" tall.

Once your building is complete, you will need to submit your ratio to the town for inspection. Remember to write your ratio in TWO different ways.

S.T.E.A.M. Presentation

Use your climbing structure model to create a presentation to the City of Bullins. On a separate sheet of paper, create five sections as shown below. Then, write a 5-paragraph essay analyzing this scenario, explaining your strategies, and justifying your recommendation.

Paragraph 1: Summary

Use complete sentences to restate the project in your own words, identifying important information in the project. Use numbers with units in your description of any quantities.

Paragraph 2: Strategy

Use complete sentences and academic vocabulary to write the steps you would take to solve the problem. Do not use any numbers or computations in your description.

Paragraph 3: Solution

Use complete sentences, an organized presentation of mathematical computations (e.g. graphs, tables, equations, etc.), and your strategy to demonstrate the solution to the problem.

Paragraph 4: Justification

Use complete sentences and flexible problem solving strategies to construct viable arguments that demonstrate the accuracy of your solution.

Paragraph 5: Reflection

Use complete sentences and academic vocabulary to reflect on what you did well, what you did not do well, and what will you do differently next time to fix any errors.