ENDCAP DESIGN PROJECT
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Unit Overview
In this 10-day, integrated unit plan, students learn about rates and ratios. Students first learn how to identify and write ratios, then they learn how to solve equivalent ratios and measurement conversions, and have the opportunity to apply them to a real-world situation. In the latter part of the unit, the class receives a fictional request from a European client in which they must design a store endcap. In the process, they will apply their ratio, rate, and conversion knowledge to design the endcap for the European market.

Standards Addressed
1. **MGSE6.RP.1:** Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.

2. **MGSE6.RP.2:** Understand the concept of a unit rate a / b associated with a ratio a: b with b ≠ 0 (b not equal to zero), and use rate language in the context of a ratio relationship.

3. **MGSE6.RP.3:** Use ratio and rate reasoning to solve real-world and mathematical problems utilizing strategies such as tables of equivalent ratios, tape diagrams (bar models), double number line diagrams, and/or equations.

4. **MGSE6.RP.3a:** Make tables of equivalent ratios relating quantities with whole-number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios.

5. **MGSE6.RP.3b:** Solve unit rate problems including those involving unit pricing and constant speed.

6. **MGSE6.RP.3d:** Given a conversion factor, use ratio reasoning to convert measurement units within one system of measurement and between two systems of measurements (customary and metric); manipulate and transform units appropriately when multiplying or dividing quantities.

7. **ELAGSE6RI10:** By the end of the year, read and comprehend literary nonfiction in the grades 6-8 text complexity band proficiently, with scaffolding as needed at the high end of the range.

8. **ELAGSE6SL5:** Include multimedia components (e.g., graphics, images, music, sound) and visual displays in presentations to clarify information.

9. **ELAGSE6W1:** Write arguments to support claims with clear reasons and relevant evidence.

10. **ELAGSE6W6:** Use technology, including the Internet, to produce and publish writing as well as to interact and collaborate with others.

11. **MSENGR-EET-1:** Students will examine the nature of engineering & technology.

12. **MSENGR-EET-4:** Students will demonstrate an understanding for a technological world through hands-on projects.

13. **MSENGR-EET-6:** Students will examine and research careers in fields related to engineering & technology.

14. **VA6PR.1:** Understands and applies media, techniques, and processes.

15. **VA6PR.3:** Incorporates an understanding of the language of art (elements and principles of design) to develop and organize own ideas, resolve specific visual arts problems, and create works of art.

Day 1 – Ratios in the Real World

Standards Addressed: 3, 4

Essential Question: How do I write and calculate ratios?

1. Ask students to work with a partner for the activity. Begin the lesson by providing students with plastic bags of various shapes, including hexagons, rhombi, triangles, squares, and trapezoids (shapes from a math manipulative kit or you can use die cut shapes). Use slide 4 of the **Ratios Slideshow.**

2. Give students about 10 minutes to use the shapes to do the following:
    a. Count the number of each shape in the bag; and
    b. Answer the questions:
        i. How can you compare the types of shapes in your bag?
        ii. Are there other ways to compare the types of shapes in your bag?
        iii. How would you write these comparisons?

3. After 10 minutes, regroup the class and ask students to share out their findings.

4. Use slides 5 – 6 of the **Ratios Slideshow** to provide a brief lesson on ratios. During the lesson, students should take notes in their math journals. Using slide 6, have students practice writing ratios.

5. Using slides 7 – 8, relate ratios to real-world situations (Builders & Contractors and Power Outage in Duluth). Have students practice determining and writing ratios with the Power Outage in Duluth slide (slide 8).

6. Provide students with **The Cajun Chili Caper** activity sheet. Either as a class, in small groups, or independently, read the case of the Cajun Chili Caper. After the reading, direct students to solve the mystery in small groups, in partners, or independently. Tell them to use the space below the word problem to show their work. Collect the mystery activity at the end of class to review their progress and provide feedback.

7. Ticket out the door: Display the Ticket out the door on slide 10. Direct students to grab an index card from the center of the table and answer the questions about the image on the slide.

Day 2 – Equivalent Ratios in the Real World

Standards Addressed: 1, 13

Essential Question: How do I write and calculate equivalent ratios**?**

1. Begin the lesson by showing the class a short video about **Equal Ratios** (slide 13). Following the video, ask the class to discuss their thoughts.

2. Use slides 14 – 16 of the **Ratios Slideshow** to provide a brief lesson on equivalent ratios. During the lesson, students should take notes in their math journals. Using the examples on slides 17 – 18 to have students practice solving equivalent ratios. Use the examples on slide 19 to practice as a class. Give the class a few minutes to solve the ratio, then invite students to complete the work on the board.

3. Use slide 21 – 22 to provide a brief lesson on how to scale to find equivalent ratios. Using the examples on slides 23 – 24 to have students practice solving equivalent ratios.

4. Provide students with **The Mystery of Pirate Ringold's Lost Treasure** activity sheet. Either as a class, in small groups, or independently, read the case of the mystery. After the reading, direct students to solve the mystery in small groups, in partners, or independently. Tell them to use the space below the word problem to show their work. Collect the mystery activity at the end of class to review their progress and provide feedback.

5. Ticket out the door: Have students practice real-world ratios with the example on slide 26.

Day 3 – Rates & Unit Rate

Standards Addressed: 2-5, 14, 15

Essential Question: How do I describe the difference between rate and unit rate?

1. Begin the lesson by having students practice the problem on slide 29.

2. Use slides 30 – 34 of the **Ratios Slideshow** to provide a brief lesson on rates and unit rates. During the lesson, students should take notes in their math journals. Use the example on slide 35 to have students practice solving unit rates. Give the class a few minutes to solve the ratio, then invite students to complete the work on the board.

3. Provide students with **Best Buy** activity sheet. As a class, complete page two of the activity sheet. Invite students to complete the work on the board. Then, in small groups or independently, direct students to complete the activity sheet by determining the best buy for each of the featured items. Collect the activity at the end of class to review their progress and provide feedback.

4. Use slides 36 – 40 of the **Ratios Slideshow** to give students a short lesson on the Golden Ratio. At the end of the lesson, provide students with the **Golden Rectangle** activity sheet. Direct students to create a work of art within the guidelines of the Golden Rectangle. They can use any medium they choose (pencil, pen/ink, pastel, watercolor, marker, colored pencils, etc.). Collect student art and display in classroom.

Day 4 – Graphing Equivalent Ratios & Introduction to the Engineering Design Process

Standards Addressed: 2-4

Essential Question: How do I graph equivalent ratios?

1. Begin the lesson on slide 44 of the **Ratios Slideshow**. As a class, go through the questions.

2. Continue with the lesson on slide 45 – 47 of the **Ratios Slideshow.** Students should take notes in their math journals. Briefly discuss different ways that ratios are written (horizontal ratios, vertical ratios, bar diagrams, number lines, and graphs). Model how to graph ratios using the problem on slide 47. As a class, solve the problems about saving money. Give the class a few minutes to work in pairs to complete the graph for the scenario on slide 48. Then have volunteers complete the work on the board. Give the students a few minutes to individually complete a graph for the scenario on slide 49. After five minutes, ask for a couple of volunteers to complete it on the board.

3. Display slide 50, which has information about the Mini Engineering Design Project. Next, tell students that they will have the 20 minutes to use the Engineering Design Process to build a structure that will support a stress ball. Students will work in groups of three or four. Tell students that you will provide them with a bag containing the following materials, which are the only materials that may be used to complete the task: 20 mini marshmallows and 15 pieces of spaghetti.

4. Reading from the slide, tell students that they will develop their design by first discussing their ideas using the following protocol:
    a. Each group member will silently think of design ideas.
    b. Then each person has one minute to share their idea while the other group members listen quietly.
    c. Finally, after each group member has shared their ideas, the group will decide which ideas are best for the first design.

5. Once the groups have completed this process, they will sketch the design. Tell students that before they begin engineering the structure, they must get teacher approval for the design. While students sketch the structure, walk around and provide

A NOTE FROM THE TEACHER

The Engineering Design Process are steps that students can use to effectively carry out an engineering project. Here are the steps:

1. *Identify the Need*
2. *Research the Problem*
3. *Develop Possible Solutions*
4. *Select the Best Solution*
5. *Build a Prototype*
6. *Test and Evaluate the Solution*
7. *Redesign the Solution, where needed.*

guidance, where needed. Remind students how much time they have left to complete the structure.

6. Once students get approval on the design, they may begin building the structure. Walk around the class and provide guidance to groups as they build. Emphasize that groups whose design failed should redesign their structure, rebuild, and retest.

7. Once all groups have built and tested the structure at least twice, regroup the class. Discuss the outcomes of the mini engineering design project.

Day 5 – Measurement Conversions Using Ratios

Standards Addressed: 6

Essential Question: How do I use ratios to convert measurements?

1. Begin the lesson by displaying the problem on slide 51 of the **Ratios Slideshow**. Ask a volunteer to read the problem. As a class, discuss some possible solutions to Mr. Barnes' problem. Encourage students to be creative in their answers.

2. Continue the lesson on slide 54. First, explain how to use ratios to convert measurements using the instructions on the slide. Students should take notes in their math journals. Then, model the steps using the gallons to quarts example.

3. Using the example on slide 55, give students a few minutes to solve the problem in their math journals. After a few minutes, ask a volunteer to solve the problem on the board.

4. Instruct students to work independently to solve the problem on slide 56. Walk around the room to gauge the class' understanding of the content. After a few minutes, ask a volunteer to solve the problem on the board.

5. Next, divide the class based on their grasp of the content students. One group of students should continue to work with the teacher. You may consider using online resources to practice conversion with students. Consider using MathGames.com, Quizlet.com, or Quizziz.com.

6. Students who have a strong grasp of the content will complete the activity on slide 58. Hand out one piece of copy paper per student. Provide students with the square footages for rooms in a house. Ask students to draw a floor plan (the design is up to them), where one foot equals half an inch. Then, instruct them to convert the measurements of the room into centimeters, where one inch = 2.54 centimeters. Collect the blueprints at the end of class. This activity will be homework for the group that needed extra guidance with the content.

7. Regroup the class. Instruct students answer on an index card the ticket out the door on slide 59. Collect the responses as students leave the class.

Day 6 - 7 – Measurement Conversions Using Ratios

Standards Addressed: 3, 6, 7, 12, 13

Essential Question: How do I use ratios in the real world?

1. Begin the lesson by displaying the problem on slide 62 of the **Ratios Slideshow**. Ask students to independently answer the problem. After a few minutes, ask a volunteer to solve the problem on the board.

2. Next, introduce the project. First, read the fictional letter from the French client. See the teacher's note for more details. Then provide students with a copy of the **Foreign Client Letter** and the **Endcap Design Project** information sheet. The spec sheet details the endcap dimensions and the dimensions of a variety of energy conserving products in customary units along with their prices in dollars. As a class, provide a brief overview of the project.

> **A NOTE FROM THE TEACHER**
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> *This part of the unit is most effective if you can make it as realistic as possible. Consider asking a colleague to bring the letter in at a scheduled time. Arranging the letter handoff ahead of time will give the students the impression that this is a legitimate request.*

3. Engage the class in a discussion about what an endcap is. Instruct students to turn-and-talk with their elbow partner/table partners to discuss what an endcap might be. Ask for students to share out their thoughts on the definition. After a brief discussion, display photographs of endcaps from a variety of large building supply stores (you can easily search for these photos online).

4. Then, pass out laptops. Provide students with an electronic copy (or hard copy if laptops not available) of the Retail Endcap Design and Display and How to Write an Effective and Compelling Business Proposal articles. Instruct students to read the articles to gain additional knowledge about people who design endcaps for a career and how to write a proposal. Students should also take notes about both articles in their math journals.

5. Once students have read both articles, explain in detail the requirements of the project using slides 65 – 67. Explain that students will have the choice to work individually or in pairs. Students will apply what they have learned about endcap design, design proposals, and measurement conversions to begin their design for the endcap and their business proposal recommending their design to the European building supply company.

6. Circulate the room and provide feedback as students design their endcap designs.

7. On day seven, students continue to work on their designs and begin writing their business proposal. Continue to provide feedback. On this day, students will select the three products they want to display on their endcap. They must complete the measurement conversion chart and price conversions for each product they choose.

Day 8 – Continuing the Endcap Design Project

Standards Addressed: 3, 6, 8, 12

Essential Question: How do I use ratios in the real world?

1. Students continue working on their endcap design for the first 10 minutes of class. Circulate the room and provide feedback as students design their endcap designs.

2. Then, students will prepare for a gallery walk/peer review of their designs. Explain the Gallery Walk instructions:
    a. Step 1: Students will hang their designs on the classroom wall or bulletin board using tape, tacks, or staples.
    b. Step 2: Students have nine minutes give feedback to three other individuals/pairs using post-it notes. Give students three minutes at each design to provide feedback. Use a timer to manage rotations. Tell students to post feedback to each design according to the following rules:
        i. Feedback should be constructive.
        ii. Give at least one "I wonder…." feedback statement. (Ex: I wonder if you have considered turning the product package a different direction.)
        iii. Give at least one "I like…" feedback statement. (Ex: I like how you put your larger products on the bottom shelf.)
    c. Step 3: Students retrieve their own designs and feedback to review and revise if needed.

Day 9 - 10 – Continuing the Endcap Design

Standards Addressed: 3, 6, 8, 9, 10, 12

Essential Question: How do I use ratios in the real world?

1. Students continue to work on their designs and the proposals. Continue to provide feedback.

2. By day 10, students should complete and submit the designs and the proposals, inclusive of peer feedback.

3. Use the **Endcap Design Project Rubric** to grade the designs.