Brandy New

Space Ratios
6th grade, up to 6 class periods of approximately 45 minutes each.

Standards
KY.6.RP.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. MP.2, MP.6

KY.6.RP.2 Understand the concept of a unit rate a/b associated with a ratio a:b with B ≠ 0 and use rate language in the context of a ratio relationship. MP.2, MP.6

KY.6.RP.3 Use ratio and rate reasoning to solve real-world and mathematical problems. a. 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. *b. Solve rate problems including those involving unit pricing and constant speed. c. Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities. MP.1, MP.4, MP.7*

Statement of Purpose
The unit will have a space theme to bring in science, while asking students to perform hands-on math tasks to explore and form an understanding of ratios. It is appropriate for 6th grade students because most will not have had direct instruction on ratios in 5th grade, because it is not elementary content in Ky. Starting with exploration will allow them to see the uses for ratio and build their own process for finding and using them.

Students will make sense of problems and preserve in solving them in both the space model activity when using pennies to find scale, and when finding the perfect amount of ovaltine powder to use. Both activities will also have student attend to precision. Students will also construct a model with math whole making the scale for the space model.

Process and product will be differentiated. Students will work in mixed ability groups during the creation of the space scale model. This will allow for differentiation, and also there is one right answer but multiple ways for students to explain how they get the answer. Similarly, during the ovaltine task, students can have multiple right answers but will have to explain their thinking using written or spoken words, and mathematical expressions or models.

Essential questions

How can you represent a relationship between two quantities?

How can you write a ratio to represent a situation, and what does that ratio mean?

What is a unit rate?

How do you use ratios and unit rates in the real world?

Day 1-3 (45 minute class periods)	from JPL: How Far Away is Space? (NASA JPL, n.d.)
Engage day 1	**Procedure:** Show video https://youtu.be/DMZ5WFRbSTc, then ask: How far would we have to travel from the surface of the Earth to reach space? What are some places on Earth that are that far away from us in Etown? Facilitate whole group discussion Hand out maps, rulers, pennies. Say, "It is very difficult for students to understand distance, more so vertical than horizontal." Then clarify their groups task by giving them the following statement, "We as teachers will create a vertical model of how far space is from Earth along with a verbal explaiantion of how we made the model, so that we can help students visualize the distance from Earth to space." **Teacher:** Pose questions above, facilitate discussions, hand out materials, clarify their group task. **Student:** Answer questions by thinking alone first and then sharing with whole and small group. **Standards Addressed:** KY.6.RP.1 (MP.2, MP.6) Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. I can write or say a sentence that describes a ratio. I can say words and numbers in the correct order to accurately describe a ratio. I can explain what the word "per" means. **Formative/Summative Assessments:** Partners will discuss answers to 2 opening questions in Think-Pair-Share. Teacher will facilitate and check for participation, not accuracy. **Materials:** Ky road maps maps, rulers, pennies

Explore day 1	**Procedure:** Students will be put in groups of 4.First, groups will complete a chart of what they KNOW and WHAT THEY NEED TO KNOW, to complete the above task. Then groups will determine next steps to be taken. Last, students will solve the problem by creating models individually or with others in the group. Each individual may have a different method, which is fine and they will work to explain that and verbalize their thinking in the next step. Once all individuals have an answer and explanation the group can move onto Explain.

Teacher: Will circulate to probe for more things students know and need to know to complete task. Once students begin work, teacher will circulate to ensure that all students are activity trying a way to solve the problem. Anticipated misconceptions would be measuring errors, so teacher can check for those and give reminders on how to use ruler when needed. Once, students have the model they will likely not know how to write ratio, so teacher will ask them to think of a way they could express what they found in terms of math or science. Teacher will also use knows and needs to knows chart to draw students back to task at hand, and refocus when needed. Teacher will also insure that each member of the group can explain how they or someone else completed the task by having groups to share amongst themselves.

Student: Will participate in knows and needs to knows with group. Then, students will work with pennies, rulers, and maps to design model alone or with others from the group. Then, each student will explain how they got their model and why its accurate to the group. Each groups member must have a t least one way they can explain to solve the problem, and once they do the group will consider that completion.

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I can write or say a sentence that describes a ratio.

I can say words and numbers in the correct order to accurately describe a ratio.

I can explain what the word "per" means.

Formative/Summative Assessments: Participation in knows and needs to knows. Students will be watched to see who is actively trying to solve problem and participate in task.

Materials: chart paper, markers |
| Explain day 2 | **Procedure:** After models are created teacher will guide students to explain the ratio of pennies to cm with the word "per". Teacher will have groups share out multiple explanations and models for their process. This will ensure that all students have some udersadning of the concept and can explain it verbally first, and then in writing if possible. |

	Teacher: Have groups share with the goal of highlighting the use of the word per. Teacher will explain what the assessment will be so students know how to phrase answers and what they are aiming for in their explanations to the class. Teacher will then explain and model the correct use of the word per and order in which words are used both verbally and in writing on board.

Student: Explain their thinking to their group, possible share with whole class, and listen to others. Each student should have heard multiple ways to solve the problem and have formed or burrowed their own to explain how the ratio was discovered.

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Formative/Summative Assessments: Students can write on exit slips in words, models, equations, or submit video to Flipgrid explaining the following, which will be posted for them so they clearly understand their assessment.

Explain how you created your model with including of the following:

I can write or say a sentence that describes a ratio.

I can say words and numbers in the correct order to accurately describe a ratio.

I can use the word "per" correctly.

Materials: have flipgrid grid up and ready for submission, paper for exit slips |
| Elaborate day 2-3 | **Procedure:** After looking t day 2 exit slip, teacher coulda address any misconceptions at this point. Students will continue to have access to pennies and other materials to solve these problems with their groups. Some group members may choose to use the math rather than the pennies already.

Teacher: Call upon the way the first models were create, the use fo the word per, and the order of the words used to explain their models, then show students sign : used to show ratio. Talk about scale and similarities and where students have seen these used. Then teacher will pose addition questions to groups one at a time to solve, so that students get further practice with concept.

So space was about 60 miles away, and that was _ pennies. Additional questions:

Ask students to make a stack of coins reaching the altitudes of the following objects orbiting Earth: |

	International Space Station: 250 miles (400 km)

Hubble Space Telescope: 340 miles (550 km)

Ask students to determine how high a stack of coins would need to be to represent the distance from Earth's surface to the Moon, which orbits 238,855 miles (384,400 kilometers) away.

Student: Participate in modeling of additional problems while working in proximity of group whether working alone or with others. Students will be asked to explain how they are forming answers to each questions to the group as they proceed through questions.

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Formative/Summative Assessments: Actively participate in answering and explaining, as well as listening to others.

Materials: |
| Evaluate day 3 | **Procedure:** Present one question which must be answered and explained by all students individually.

Teacher: Pose question and provide accommodations to those who might need them while assessing. Pennies can be available for those who are still creating ratios at concrete level.

"If we think back to the map and look at the map scale in the corner, could you talk about it in a different way? Pick a place outside of Kentucky that you would like to visit in the United States. Using the map scale and centimeters write an explanation fo the map scale using what you know about ratios. Then use the specific place you want to visit to as an example with a ratio of the distance from where we are now in Ky.

Student: Answer question individually and explain using ratio and explanation of that ratio.

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I can write or say a sentence that describes a ratio.

I can say words and numbers in the correct order to accurately describe a ratio. |

	I can explain what the word "per" means. **Formative/Summative Assessments:** Students will write a ratio as _:_, and explain using the word per why the ratio is expressed as such on an exit slip that is either totally written or submitted to Flipgrid. **Materials:** larger United States map
Day 4-6	Making the Perfect Ovaltine
Engage day 4	**Procedure:** Show videos https://www.youtube.com/watch?v=TWghCdIqedA https://www.youtube.com/watch?v=BJorUKAIECA. To engage students in the idea of astronauts drinking powered drink mixes in space. Ask them why they did this. What do you know about space that would make these work, and not soda? After discussion, tell students they will be trying to make the perfect Ovaltine or Tang by creating their own mixtures. **Teacher:** Put students in pairs and have them form a plan for how much is they think they will need per 1 cup of liquid. Have them read directions on packages, and decide if they are going to use that ratio or not. Discuss what the 2 different drinks suggest as the ratio by using what students know about ratios so far. Write ratios on the board. Tangh is expressed as tablespoons on the package so the class will have to convert that to cups. Point out that liquid and solids are different but that both can be measured in the cup because both measure volume, although many bakers prefer to weight dry ingredients for precision. Both ratios aret in a fraction of a cup of dry to 1 cup of solid on the package. Use this opportunity to create a Tchart with students and multiply the amounts till the dry measurements are at 1 cup. Students will follow along and make their own Tcharts, as they start to get that concept stop, and let them fill in next sections on their own. This will get them expose them to putting ratios in Tcharts to create plots to point which is next in the unit progression and standards. Explain to students that this would be a unit rate because 1 cup of liquid would equal the other ingredient. Ask why the unit rate would be important to know? They will likely draw the connection to mixing ingredients in cooking, mixing gas for weedeaters, speed, and other things they know. **Student:** Pairs will explore packing directions to find and create ratios of ingredients. They will also participate in this whole class discussion about the 2 ratios. Then students will follow along while making of multiples and progress to fill in Tchart with their own methods once ready. Students may repeatedly add fractions, or multiply depending on their level. **Standards Addressed:** KY.6.RP.1 (MP.2, MP.6) Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.

	KY.6.RP.2 (MP.2, MP.6)Understand the concept of a unit rate a/b associated with a ratio a:b with B ≠ 0 and use rate language in the context of a ratio relationship. I can describe the relationship between two quantities using ratio language. I can write or say a sentence that describes a ratio. I can say words and numbers in the correct order to accurately describe a ratio. I can explain what the word "per" means. **Formative/Summative Assessments:** Teacher will circulate to see how students are using vocabulary to describe ratios, specifically looking for the word "per". **Materials:** milk, water, ovaltine, tang, measuring cups, and measuring spoons
Explore day 5	**Procedure:** Students will make the perfect mix of Ovaltine or Tang with their partners. Through trial and error students will measure and mix ingredients according to package and then then can try out more or less dry mix to find a ratio of mix to liquid they like better. **Teacher:** Will prep materials so students have access. Teacher will refer beach to last class and theT chart the class created. Students will be directed to create another Tchart to record their trials as they mix today and try to create what they think is the perfect mixture. **Student:** With a partner students will mix and then taste drinks. As they try different mixtures other than the directions suggest, they will record those ratios on a Tchart. Each individual will explain what they think is the perfect mix as an exit ticket. **Standards Addressed:** KY.6.RP.1 (MP.2, MP.6) Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. KY.6.RP.2 (MP.2, MP.6)Understand the concept of a unit rate a/b associated with a ratio a:b with B ≠ 0 and use rate language in the context of a ratio relationship. I can describe the relationship between two quantities using ratio language. I can write or say a sentence that describes a ratio. I can say words and numbers in the correct order to accurately describe a ratio. I can explain what the word "per" means. **Formative/Summative Assessments:** Students will explain what they think is the perfect ratio for their drink using the word per and also showing the ratio. **Materials:** milk, water, ovaltine, tang, measuring cups, and measuring spoons

Explain day 6	**Procedure:** Students will do the as a whole class, so that teacher can guide discussion as they proceed. **Teacher:** Watch the video. Then discuss what Dan did wrong. Use pacing to restrict students to Screens 1–2. These screens are designed to set the context for the activity. Then highlight several student responses to show the class. How can Dan fix the glass on the right so that it has the right balance of milk and chocolate?Highlight several student responses to show the class. Start with informal math language and reasoning. Then move to more formal responses. On scene 3 The teacher will explain that one way to represent Nana's recipe is to use a table. Another way is to use a double number line. Press "Stir" to see how the table and the double number line are connected. Then allow students to press stir on their own and talk about the number lines to a partner. The goal for this screen is to establish connections between the table, the double number line, and the contents of the glass. Use pacing to restrict students to Screens 3–5 to prevent them from seeing the "reveal" on Screen 6. **Student:** Scene 1 - Students will see that Dan used too much chocolate. Scene 2 -Students will ultimately come up with that Dan needs to add more milk and chocolate so the balance matches Nana's `1`-cup-of-milk to `4`-scoops-of-chocolate ratio. Scene 3 - explore after teacher explains double number line representation. **Standards Addressed:** KY.6.RP.1 (MP.2, MP.6) Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. KY.6.RP.2 (MP.2, MP.6)Understand the concept of a unit rate a/b associated with a ratio a:b with B ≠ 0 and use rate language in the context of a ratio relationship. I can describe the relationship between two quantities using ratio language. I can write or say a sentence that describes a ratio. I can say words and numbers in the correct order to accurately describe a ratio. I can explain what the word "per" means. **Formative/Summative Assessments:** Responses on scene 1-2 are written and will be checked for understanding before the next day by teacher. If a student is not understanding teacher will pull them during bell work next class to clarify. **Materials:** [Desmos activity](#)

Elaborate 6	**Procedure:** Students will work through scenes 5-6 on their own. **Teacher:** Circulate and help students who are not able to complete it on their own. Ask students to explain why they put what they did in the chart and explain with double number line. **Student:** Fill in chart on 5 and mix to find Dan's problem. Explain to teacher what Dan was doing wrong and point to double number line to show how they know this. **Standards Addressed:** KY.6.RP.1 (MP.2, MP.6) Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. KY.6.RP.2 (MP.2, MP.6)Understand the concept of a unit rate a/b associated with a ratio a:b with B ≠ 0 and use rate language in the context of a ratio relationship. I can describe the relationship between two quantities using ratio language. I can write or say a sentence that describes a ratio. I can say words and numbers in the correct order to accurately describe a ratio. I can explain what the word "per" means. **Formative/Summative Assessments:** Explain verbally to teacher what the double number reflects. **Materials:** Desmos activity
Evaluate day 6	**Procedure:** Have students who gave different solutions to gather in groups and explain their thinking to each other. Then have student complete scene 7 to explain multiple solutions. **Teacher:** In how many different ways can we solve Dan's problem? Have students work in groups to explain multiple answers to each other, then complete scene 7. Many students do not like the sketch tool, so they can explain on paper. Students will be expected to write answers in words using per, and explain their thinking using a double number line, or a chart. **Student:** Answer question individually, then share and listen to other explanations. Complete scene 7. They may use paper instead of Desmos to explain. **Standards Addressed:** KY.6.RP.1 (MP.2, MP.6) Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. KY.6.RP.2 (MP.2, MP.6)Understand the concept of a unit rate a/b associated with a ratio a:b with B ≠ 0 and use rate language in the context of a ratio relationship. I can describe the relationship between two quantities using ratio language.

	I can write or say a sentence that describes a ratio.
	I can say words and numbers in the correct order to accurately describe a ratio.
	I can explain what the word "per" means.
	Formative/Summative Assessments: [Student rubric](#)
	Materials: Desmos activity

I was able to help plan facilitate parts of the chocolate milk activities in a 6th grade classroom this year. Linked [here](#) is the site with students work and full plans. The plans, along with the Desmos activity were taken from New Tech Network, which is a PBL partner we are working with for PD and resources as a district. I modified it to include a space flare to fit the unit. Also, I put the chocolate milk activity first, and added another CRA lesson first because of the gaps in understanding we saw when using the Chocolate Milk activity first in the classroom. Students did not have even enough background knowledge to make the connection to ratios without some context first. I shared the first activity, How Far Away is Space?, with the teacher who did the Chocolate Milk activity in hopes it will help him next year to be more successful in building vocabulary and concept of ratio before the Chocolate Milk activity.

References

Desoms.com. (n.d.). *Nana's Chocolate Milk • Activity Builder by Desmos*. Teacher Desmos. Retrieved July 13, 2022, from https://teacher.desmos.com/activitybuilder/custom/59c49dee312da862ad688b9c

NASA JPL. (n.d.). Educator Guide: How Far Away Is Space? Retrieved July 11, 2022, from https://www.jpl.nasa.gov/edu/teach/activity/how-far-away-is-space/