Skittles in 60 Seconds

Lesson Focus	Students will collect data to find unit rates, and determine proportionality using the relationships between graphs and tables.	***PLC Notes***
Lesson Purpose	Students will identify characteristics of proportional and non-proportional relationships by making connections between unit rates, tables, graphs and equations.	
Content Standards	**Ratios and Proportional Relationships** 7.RP **Analyze proportional relationships and use them to solve real-world and mathematical problems.** 1. Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. *For example, if a person walks 1/2 mile in each 1/4 hour, compute the unit rate as the complex fraction ½/¼ miles per hour, equivalently 2 miles per hour.* 2. Recognize and represent proportional relationships between quantities. a. Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin. b. Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships. c. Represent proportional relationships by equations. *For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as t = pn.* d. Explain what a point *(x, y)* on the graph of a proportional relationship means in terms of the situation, with special attention to the points (0, 0) and (1, *r)* where *r* is the unit rate.	
Practice Standards	☒ Make sense of problems and persevere in solving them. ☒ Reason abstractly and quantitatively. ☒ Construct viable arguments and critique the reasoning of others. ☐ Model with mathematics. ☐ Use appropriate tools strategically. ☒ Attend to precision. ☒ Look for and make use of structure. ☒ Look for and express regularity in repeated reasoning.	
Introduce **Materials** *Handouts* *Skittles* *Stopwatches* **<u>Timeline:</u>** Day 1 – Data Collection Day 2 – Analyze Data in table and find unit rates Day 3 – Analyze un-labeled graph Day 4 – Analyze labeled graph and write	**POSE THE PROBLEM**: How many skittles do you think you can eat in one minute? Give a reason for your estimation. While students are answering the question, pass out the scenario cards. Keep them face down on each table. Then have students share out their estimations. Next have students randomly choose a scenario card. Follow the scenario card for each person. Students should write the scenarios at the top of their data table in the space provided. **NOTICE and WONDER** with Scenario cards. Predict how many you will have by end of one minute. Make a class list somewhere of all of the notice and wonders. **Want students to notice that some people already get to start with some before the time starts and that some people get to eat more. This will later be related to the graph.* Go over Roles (while keeping scenario cards face down). Recorder: Writes down time and total number of Skittles consumed at each elapsed number of seconds.	Problem adapted & modified from https://johnberray.wordpress.com/2012/10/23/marshmallow-minute/ By John Berray

	Skittle consumer: Ingests Skittles with given scenario, without fail. Timer: Yells out “Now” or “Go” or “Eat some” every so many seconds. Back-up Recorder: Helps the Recorder verify the numbers are correct. Explain that roles will rotate after each member has lived their Skittle minute. Then based upon the scenario, students will need to decide how the table should be labeled and how they might organize the date they collect. Now the fun begins. When each person’s minute is up, everyone records the data that the Recorder has jotted down until all scenarios are complete.	***Possible modification: Make Person A start with 14 and eat 4 Skittles every 5 seconds. Make Person B start w/6. Lead to does eating the fastest also mean you ate the most?***
Investigate **<u>Materials</u>** *Handouts* *Skittles* *Stopwatches*	**TABLE TALK**: • **1)** Looking at the data, who ate the most after one minute? How do you know? (*in the y column, scenario B will have the highest value of 62)* **2) POSE THE PROBLEM:** Which person will eat the most Skittles in one second? What to look for: ➢ Students who find Seconds per Skittle instead of Skittle per Second. ➢ If they only use division ask… ➢ “How can we write this another way?” (*we want them to write ratios and see if they are equivalent)* ➢ Scenarios A and B are not proportional, so every time they divide, they will have different unit rates or ratios that are not equivalent. For these scenarios if they only chose one point ask them, “*Will that always work?*” **This could be easily monitored and sequenced as not all students choose the same points. So you can easily compare points from the same scenario and students will notice that they got different answers.** So why would person A and person B have different unit rates for each point if they are eating the same amount of Skittles consistently for the same amount of time? Next give students the graph of the data. Have them **NOTICE and WONDER** about the graph… ➢ 3) What do you notice about the graph? (*have students write down their noticing on the graph. You want them to make connections to the first time they did noticing with the scenario cards.* ➢ “__________ noticed some people start with Skittles, where do you see this on the graph?” *(You want them to talk about the y-intercept but proper use of vocabulary is not the goal at this point). It would be great if they identified the unit rate on the graph through noticing. If not it will be addressed later.* ➢ Based on the graph, who takes the longest to eat? *(Ideally they would be talking about slope but proper use of the term is not the goal here. Accept terms like steepness, more flat etc.)*	***This took 2.5 days!!!!!!*** ***Maybe change the question to, ”Who eats the fastest?”*** ***Other questions to ask:*** ***Why are they all decimals?*** ***What does that mean in regards to Skittles and seconds?*** ***Why are we even dividing?*** ***Can we multiply? What would that look like?***

- Which line do you think belongs to each person? Label your graph and be ready to justify your reasoning. *(Students may talk about unit rate here, if not be sure to ask next question).*
- Where do you see the unit rate on the graph? How can this help us determine which line belongs to each person? *(We want them to look around the point (1,y) or where x = 1 so see how many skittles each person can eat in one second however it will not be labeled so it will be hard to determine the unit rate from the graph).*
- Even though the unit rate isn't clearly labeled, how can we be sure that we have correctly labeled each line? *(Students can use the unit rates and try to predict how the unit rate relates to the steepness. Eating more skittles per second would mean the line is more steep because it would take someone eating less skittles longer to catch up making their line not as steep)*

Once students have correctly identified which line belongs to which person, give them the labeled graph and the close up the graph. **NOTICE and WONDER** with the new graph. You want students to see that now they can identify the unit rate on the graph? If no one notices it…

- Where can we see the unit rates on the graph? *(1, y)*
- How would we write that? *(1, .75) and (1, .67) etc.*
- If they write the unit rates for A and B as (1, 6.6) and (1, 14.8) see if they can see what is similar and different about those points? *(You want them to see that person C and D have a 1 for the x, and the unit rate for the y. Although A and B also have a 1 for the x, the <u>y-value</u> is <u>not the unit rate</u>.)*
- Do you see the unit rate anywhere in the points for person A and B? How do we explain the discrepancy between scenario A and B and the unit rate? What makes those people different than the others? *(Some may notice that the graphs start at different places. You want them to notice that the two graphs that started at (0,0) had a consistent unit rate. The other two did not, but you can find out many skittles they ate at one second by looking at the graph. It would be awesome if the could see that the amount the started with, plus the unit rate makes up the y value at x=1 for persons A and B).*
- 4) How many Skittles can person C eat in 5 minutes? *(.75 Skittles × 60 sec = 45 Skittles in one minute × 5 minutes = 225 Skittles.)*
- How can we represent that as an equation? *(y=.75x where x = seconds and y = skittles therefore 5 minutes = 300 seconds and .75(300) = 225)*
- 5) Can we use a similar equation for person D? How will it be the same or different? *(Person D consumes a different amount of Skittles per second but everything else will be the same. So it would be y=.67x or y=2/3x)*
- Will this same equation work for A and B? *(Hopefully they will say that the y=kx equation will not work, and that it has to do with the fact that they already consumed Skittles before time started)*

Equations they came up with:

Person A:
$y=(42-6)x + 6$
$= 36x + 6$
$= .6x + 6$ (sec)

Person B:
$y=(62-14)x + 14$
$= 48x + 14$
$= .8x + 14$ (sec)

Person C:
$y= 45x$ (min)
$y= 0.75x$ (sec)

Person D:
$y=40x$ (min)
$y=2/3x$ (sec)

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<td>Summarize

Materials List</td>
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What is the relationship between the unit rate and the equation(s)? Unit rate and table? Unit rate and Graph? (the unit rate is the number that multiples the x to get y, which is called the constant of proportionality and the slope of the line).
Which lines do you think have a proportional relationship between amounts of skittles eaten as compared to seconds? List characteristics (without having a formal definition of what it means to be a proportions, they may just list characteristics about what they see, what worked and didn’t work). Want to try to develop ideas and definitions for what it means to be a proportion.

<table>
<tr><th>Proportional</th><th>Non-Proportional</th></tr>
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Can make equivalent ratios from the table which will give us the Unit Rate (constant).
Only contains multiplication in the equation.
Straight line that must start at the origin (0, 0).
As one quantity changes the other changes at a constant rate.

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No equivalent ratios.
Have something being added to the equation (i.e. starting with Skittles).
Line doesn’t start at the origin.

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<td>Homework</td>
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At the conclusion of each day, assign one (or let students choose from a list you have already selected) of the reflection questions below…

Homework Reflection Questions
Your responses to the question(s) chosen should be <u>VERY detailed</u>! Please write in complete sentences and be ready to share your responses in class the next day.

What were the main mathematical concepts or ideas that you learned today or that we discussed in class today?
What questions do you still have about________? If you don’t have a question, write a similar problem and solve it instead.
Describe a mistake or misconception that you or a classmate had in class today. What did you learn from this mistake or misconception?
How did you or your group approach today’s problem or problem set? Was your approach successful? What did you learn from your approach?
Describe in detail how someone else in class approached a problem. How is their approach similar or different to the way you approached the problem?

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<td>Reflection questions taken from Jo Baoler Mathematical Mindsets (2016)</td>
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6) What new vocabulary words or terms were introduced today? What do you believe each new word means? Gives an example/picture of each word.

7) What was the big mathematical debate about in class today? What did you learn from the debate?

8) How is ___________ similar or different to _________?

9) What would happen if you change ____________?

10) In what situations could I used the knowledge I learned today?

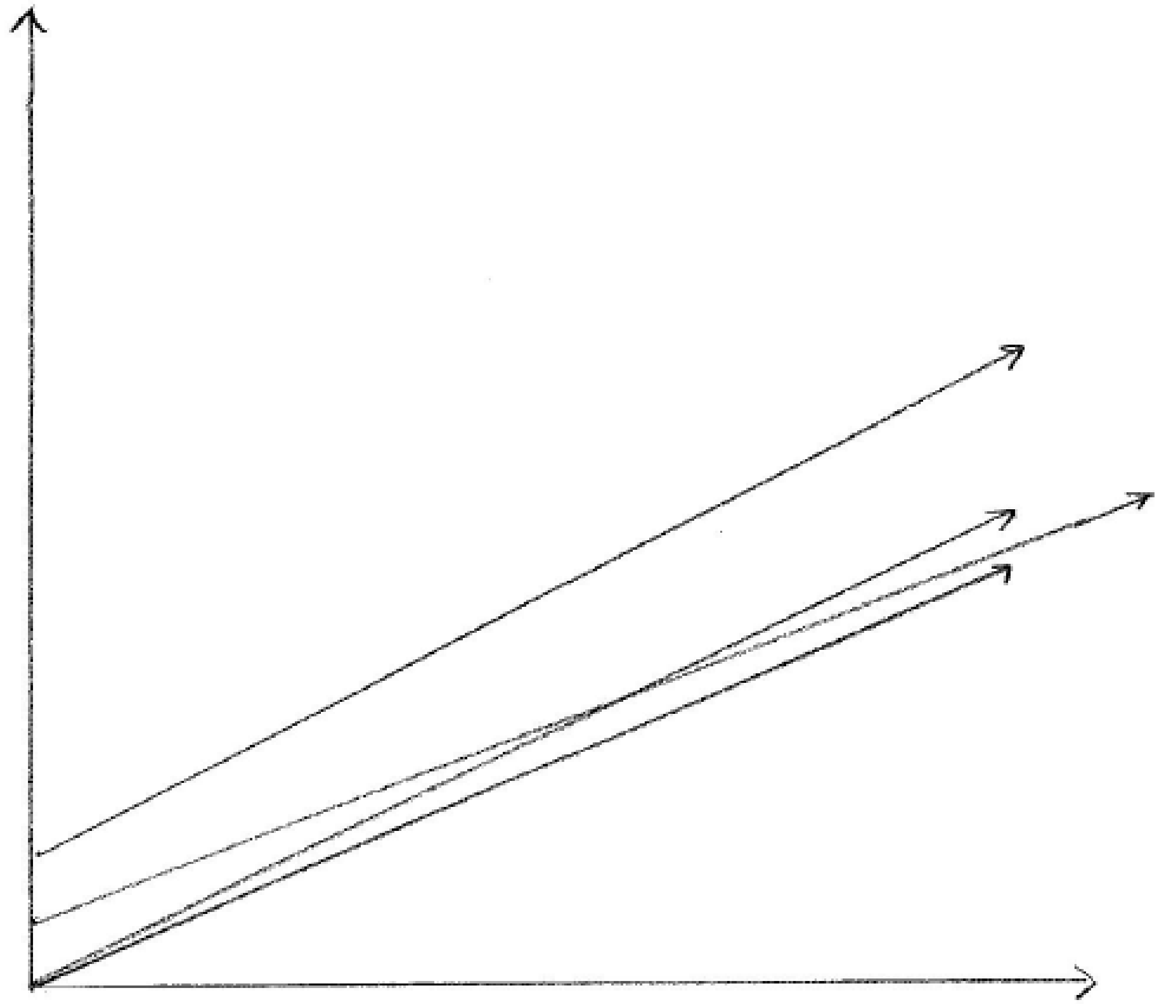
11) What new ideas do I have that this lesson made me think about?

12) What were some of your strengths and weaknesses in this unit? What is your plan to improve in your areas of weakness?

A **Start with 6. Eat 3 Skittles every 5 seconds. End at 60 seconds.**	**B** **Start with 14. Eat 8 Skittles every 10 seconds. End at 60 seconds.**
C **Start with none. Eat 3 Skittles every 4 seconds. End at 60 seconds.**	**D** **Start with none. Eat 10 Skittles every 15 seconds. End at 60 seconds.**

Skittles in Sixty Seconds

A:		B:		C:		D:	
Description		Description		Description		Description	



1) Who will eat the most over the course of one minute? How do you know?

2) Who will eat the most in one second?

Seconds

4) How many Skittles can Person C eat in 5 minutes?

5) Can we use a similar equation for Person D? How will it be the same or different?

6) Will this same type of equation work for Persons A and B?

Proportion	*Not Proportion*