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Please enjoy this complimentary excerpt from *Classroom-Ready Rich Math Tasks, Grades 4-5* by Beth McCord Kobett, Francis (Skip) Fennell, Karen S. Karp, Delise Andrews, and Sorsha-Maria T. Mulroe.

LEARN MORE about this title!

Task 11

Ryan and Rachel's Debate

Visualize the difference between adding n and multiplying by n

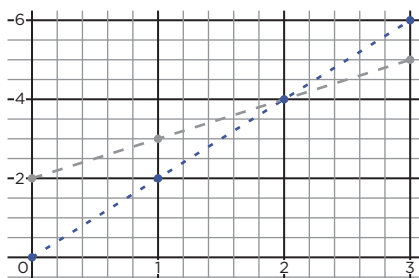
TASK

Ryan and Rachel's Debate

Ryan and Rachel were exploring number patterns. They were looking at the rule $y = x + 2$ and the rule $y = x \times 2$. They organized their patterns in tables, and then they graphed both rules on a coordinate grid. Ryan graphed his points in gray, and Rachel graphed her points in blue. Figure 6.3 shows their work.

Figure 6.3 Ryan and Rachel's graphs

Rule: $y = x + 2$		Rule: $y = x \times 2$	
x	y	x	y
0	2	0	0
1	3	1	2
2	4	2	4
3	5	3	6



Ryan made a conjecture that adding 2 was not much different from multiplying by 2 because the y value was increasing with both kinds of rules. Rachel says multiplying by 2 is different from adding 2 because the y values changed more. Ryan and Rachel are both a little unsure, so they need your help to continue their exploration.



ACCESS AND EQUITY

The use of a technology-based tool like Desmos will enable students to quickly generate appropriately scaled graphs in order to engage in the reasoning and sense-making central to this task.

Mathematics Standard

- Generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs consisting of corresponding terms from the two patterns, and graph the ordered pairs on a coordinate plane.

Mathematical Practices

- Construct viable arguments and critique the reasoning of others.
- Look for and make use of structure.

Vocabulary

- conjecture
- rule
- ordered pair
- coordinate plane
- graph
- point
- function table
- input
- output

Materials

- sticky notes
- T-chart (on poster paper or on the board)
- student devices with access to <https://www.desmos.com/calculator>
- Rule Cards
- Function Table pages

TASK PREPARATION

- Organize students into heterogeneous groups of 3 or 4. Provide each group with a device and access to Desmos or another digital graphing tool.
- Prepare student rule cards. Be sure that only one group gets the card labeled J ($n = 1$), half of the remaining groups get whole number cards (A–I), and the rest get fraction cards (K–P).
- Consider how you will share student graphs with the rest of the class. Can they be displayed on the class projector? Can they export graphs and share them to a class website? Can they print the graphs out?



ALTERNATE LEARNING ENVIRONMENT

The web-generated graphs could be shared by asking students to share their screens, copying and pasting the graphs to a shared googleslides presentation or googledoc.

LAUNCH

1. Bring the whole class together for a quick discussion around the task.
2. Display only the image from the task at first. Facilitate a quick *See, Think, and Wonder*. Have students *Pair-to-Pair Share*; then elicit and record ideas from the whole class.
3. **Show Me.**
 - » Point to a row in one of the tables: “Show me where this part of the pattern is represented on the graph.”
 - » Point to a point on the graph: “Show me where this point is represented in one of the tables.”
 - » Indicate the point (2,4) on the graph: This point looks like it is both on the blue line and on the gray line! What does this mean?”
4. After students have made connections between the tables and the graph, show them the entire task.
5. Ask students to *Turn-and-Learn* what their partner is thinking about Ryan’s conjecture. Then give each student a sticky note and have them write a justification to add to a class T-chart like the one shown in Figure 6.4.

PRODUCTIVE STRUGGLE

Students should have ready access to this poster throughout the task and be encouraged to come up and edit or move their sticky note as their thinking develops.

Figure 6.4 Class T-Chart

I agree with Ryan's conjecture because . . .	I disagree with Ryan's conjecture because . . .

Sticky note source: freesvg.org

FACILITATE

1. Tell students they will have an opportunity to explore some more rules like the ones Ryan and Rachel were exploring. Say, “Together as a class, we will try to help Ryan and Rachel be able to justify their thinking and revise their conjectures if needed.”
2. Organize the students into small groups. Each group should have a computer or other tool for generating graphs (see materials), a rule card, and one function table handout. Be sure that only one group has the card labeled J (add 1, multiply by 1).
 - » Say, “Each group is going to get a different set of rules—one with addition and one with multiplication. You will work with your group to complete a table for each of your rules. Then you will graph the ordered pairs you generate.”
 - » Direct all groups to graph their points from the addition rules in red and their points from the multiplication rules in blue (as indicated on their rule cards). This will help facilitate the whole-group discussion at the conclusion of the task.
3. **Interview/Show Me.** Conduct interviews with each small group. Ask the following:
 - » How are you finding the y values for your tables?
 - » What are you noticing about the y values for the addition rule compared to the y values for the multiplication rule?
 - » **Show me** which points on your graph represent your addition rule. Which ones represent your multiplication rule? How do you know?
4. As groups finish with each set of rules, let them know how you want them to share their graphs with the rest of the class.
5. Consider partnering early finishers with another small group to compare and discuss their graphs.

CLOSE: MAKE THE MATH VISIBLE

1. Bring the class together and revisit the T-chart made during the Launch phase of the task. Encourage students to share how their thinking may have changed or been refined during the exploration.
2. Select and Sequence students to share their results based on your interviews with the small groups. Encourage students to use the graphs and tables they and other groups have made to justify their thinking.
3. As students look at the various graphs each group has made, the following ideas should be highlighted:
 - » When the number we are adding to x or multiplying by x is greater than 1, a value generated by the multiplication rule will increase more quickly than a value generated by the addition rule.
 - » In the graph that shows $x + 1$ and $x \cdot 1$, the lines are parallel and increase at the same rate.
4. Ask students to think about ways they can justify why these observations are true. Revisit the initial task and ask, “What is another way we can explain why the graph for $y = x \cdot 2$ increases more quickly than the graph for $y = x + 2$?”



STRENGTHS SPOTTING

When students articulate how their thinking has changed or grown, focus on the strengths they share by naming the strength. For example, perhaps they tried multiple solution pathways. When students understand how they used their strengths to revise learning or build new learning, they are more likely to exhibit this behavior again.

Task 11: Rule Cards for $y = x + n$ and $y = x \times n$

A. Graph these two rules: RED: $y = x + 2$ BLUE: $y = x \times 2$	B. Graph these two rules: RED: $y = x + 3$ BLUE: $y = x \times 3$
C. Graph these two rules: RED: $y = x + 4$ BLUE: $y = x \times 4$	D. Graph these two rules: RED: $y = x + 5$ BLUE: $y = x \times 5$
E. Graph these two rules: RED: $y = x + 6$ BLUE: $y = x \times 6$	F. Graph these two rules: RED: $y = x + 7$ BLUE: $y = x \times 7$
G. Graph these two rules: RED: $y = x + 8$ BLUE: $y = x \times 8$	H. Graph these two rules: RED: $y = x + 9$ BLUE: $y = x \times 9$
I. Graph these two rules: RED: $y = x + 10$ BLUE: $y = x \times 10$	J. Graph these two rules: RED: $y = x + 1$ BLUE: $y = x \times 1$
K. Graph these two rules: RED: $y = x + \frac{1}{2}$ BLUE: $y = x \times \frac{1}{2}$	L. Graph these two rules: RED: $y = x + \frac{1}{4}$ BLUE: $y = x \times \frac{1}{4}$
M. Graph these two rules: RED: $y = x + \frac{3}{4}$ BLUE: $y = x \times \frac{3}{4}$	N. Graph these two rules: RED: $y = x + \frac{1}{8}$ BLUE: $y = x \times \frac{1}{8}$
O. Graph these two rules: RED: $y = x + \frac{1}{10}$ BLUE: $y = x \times \frac{1}{10}$	P. Graph these two rules: RED: $y = x + \frac{1}{100}$ BLUE: $y = x \times \frac{1}{100}$

Task 11: Function Table Student Page

Rule: $y =$ _____	
x	y
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Rule: $y =$ _____	
x	y
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	