Rich Mathematical Task – Grade *5* – *Room for Shoes*

Task Overview/Description/Purpose:

- In this task, students will investigate a variety of ways of multiplying a decimal and a whole number.
- The purpose of this task is for students to use their knowledge of base-ten relationships and procedures developed for whole number computation and apply it to decimal computation, giving careful attention to the placement of the decimal point. Students will be able to use a calculator for this standard but must show and justify their thinking using pictures, words, and symbols.
- This task is meant to serve as an introduction to determining the product of practical problems involving decimals by building off of students' prior knowledge of multiplication of whole numbers and decimal addition.

Standards Alignment: Strand – *Computation and Estimation*

Primary SOL: 5.5b The student will

(b) create and solve single-step and multi-step practical problems involving addition, subtraction, and multiplication of decimals, and create and solve single-step practical problems involving division of decimals.

Related SOL: 4.6b, 5.4, 6.5

Learning Intention(s):

- **Content -** I am learning to recognize the relationship between computing whole numbers and computing decimals.
- **Language -** I am learning to understand and use the language that describes computation of decimals (i.e., decimal place value, operation).
- **Social -** I am learning how to listen and respond to my peers' explanations in ways that move us all forward as math learners.

Success Criteria (Evidence of Student Learning):

- I can represent my thinking using a picture, model or words.
- I can connect my thinking to the models created by others.
- I can determine how many pairs of shoes fit on the wall and justify my reasoning to my peers.
- I can communicate my process for solving using specific mathematical language such as tenths, decimal point, operation, sum, and/or product.

Mathematics Process Goals

Problem Solving	• Students will choose an appropriate strategy related to computation of decimals to find the minimum length of wall space needed. • Students will accurately apply their strategy to obtain at least one valid solution.
Communication and Reasoning	• Students will communicate their thinking process of the minimum length of wall space needed in order to fit all 15 new pairs of shoes to their peers and learning community. • Students will justify their solution process in an organized and coherent manner. • Students will use appropriate mathematical language, including decimal place value and operation, to express ideas with accuracy and precision.
Connections and Representations	• Students will use at least one appropriate representation to explore the problem and justify their solution. • Students will describe connections between their representations and the representations of their peers.

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	• Students will connect and/or extend thinking to other mathematical ideas such as base ten relationships and procedures developed from whole number computation.

Task Pre-Planning

Approximate Length/Time Frame*:* 60 minutes

Grouping of Students: This task is meant to introduce SOL 5.5b. Students should be placed in partners or collaborative groups of 3-4 students. A heterogeneous grouping strategy could include using formative data from SOL 5.5 and placing student scores in order from most proficient to least proficient. Next, sort student scores into seven piles, one at a time. This results in 3-4 students per group (for class of 21 or more) in an alternative ranking order. Last, make adjustments based on language and social needs, creating teams where students can communicate and persevere productively.

Materials and Technology:
- anchor chart paper
- markers
- copy of task for each student
- pencil, grid paper
- base ten blocks
- meter stick
- calculator (handheld or DESMOS)

Vocabulary:
- product, factor
- digit
- quotient, sum, difference
- decimal point
- whole number
- tenths
- minimum

Anticipate Responses: See the Planning for Mathematical Discourse Chart (columns 1-3).

Task Implementation (Before) 10-15 minutes

Task Launch:
- The teacher will bring students to a whole group setting for a number talk.
- The purpose of the number talk is for students to access their prior knowledge related to estimation of decimals. This thinking will support students in estimating the number of shoes needed in the task.
- Complete the following Number Talk recording multiple student strategies on poster paper.
    - Closer to 0 or 1
        - 0.75
        - 0.5
        - 0.25
        - 0.3
- The teacher will complete the Number Talk with a summary of strategies used to justify reasoning, such as a number line. The Number Talk recording poster will remain posted as a reference throughout the task.
- The teacher will pass out task and have a student read the task aloud. Students should be asked to restate the problem with a partner and to ask clarifying questions that will be answered whole group.
- The teacher will share the Learning Intentions and the Success Criteria with the class, highlighting examples within the Number Talk. Be sure to review expectations for collaborative work before dismissing into groups. Support materials and manipulatives should be accessible for student use.

Task Implementation (During) 20-30 minutes

Directions for Supporting Implementation of the Task
- Monitor – Teacher will listen and observe students as they work on task and ask assessing or advancing questions (see the Planning for Mathematical Discourse chart on next page).

- Select – Teacher will decide which strategies will be highlighted (after student task implementation) that will advance mathematical ideas and support student learning.

- Sequence – Teacher will decide the order in which student ideas will be highlighted (after student task implementation).
- Connect – Teacher will consider ways to facilitate connections between different student responses.
    - Students work in purposefully planned groups for 20-25 minutes to explore strategies, share ideas and transfer their ideas to paper using pictures, words, and symbols.
        - As the teacher is monitoring, teacher will look for strategies that are being used and record on Planning Chart.
        - The teacher should use questions to assess or advance student thinking.
        - Students should be encouraged to explore different strategies for solving and evaluate effectiveness.

Suggestions For Additional Student Support

- Sentence frames:
    - I agree/disagree with _____'s strategy because _____.
    - The strategy I used to solve is _____.
    - I know that _____ pairs of shoes will fit on the wall display because _____.
    - First I am going to _____. Next I will _____. I will know I have solved the problem because _____.
- Possible problem solving strategies
    - Use a 4-square problem solving mat (attached)
- Extension:
    - Ask students how many pairs of shoes would fit if there were 30 meters of wall space? Use pictures, words, and symbols to show your thinking.

Task Implementation (After) 15-20 minutes

Connecting Student Responses (From Anticipating Student Response Chart) and Closure of the Task:

- Based on the actual student responses, sequence and select particular students to present their mathematical work during a whole class discussion. Some possible big mathematical ideas to highlight could include:
    - A common misconception
    - Trajectory of sophistication in student ideas (i.e. concrete to abstract; learning trajectories for multiplication or division of decimals)
    - Connection between multiplication and division (could both operations provide the same outcome?)
- Connect different students' responses and connect the responses to the key mathematical ideas to bring closure to the task. Possible questions and sentence frames to connect student strategies:
    - How are these strategies alike? How are they different?
    - _____'s strategy is similar to _____'s strategy because _____
    - How do these connect to our Learning Intentions?
    - Why is this important?
- Highlight student strategies to show the connections, either between different ideas for solutions or to show the connection between levels of sophistication of student ideas (connect strategy of repeated addition to strategy of multiplication – what is similar? Different?). Allow students to ask clarifying questions.
- Consider ways to ensure that each student will have an equitable opportunity to share his/her thinking during task discussion.
    - Students can participate in a Gallery Walk to view all strategies prior to coming together to discuss selected strategies.
    - Students can "Think, Pair, Share" strategies for solving.

- Close the lesson by returning to the success criteria. Have students reflect on their progress toward the criteria.

Teacher Reflection About Student Learning

- Teacher will use the chart with anticipated student solutions to monitor which students are using which strategies. This will include: possible misconceptions, learning trajectories and sophistication of student ideas, and multiple solution pathways. Next steps based on this information could include:
    - Informing sequence of future tasks. What will come next in instruction to further student thinking in decimal computation?
    - Informing small groups based on misconceptions that are not addressed in sharing.
- After task implementation, the teacher will use the Process Goals rubric to assess student understanding in relation to the process goals. The teacher may decide to focus on one category. Next steps based on this information could include:
    - Informing small groups based on current student engagement with the process goal(s) (i.e. think aloud, using specific sentence frames for communication, etc.).

Planning for Mathematical Discourse

Mathematical Task: Room for Shoes

Content Standard(s): SOL 5.5b

Teacher Completes Prior to Task Implementation			**Teacher Completes During Task Implementation**	
Anticipated Student Response/Strategy *Provide examples of possible correct student responses along with examples of student errors/misconceptions*	**Assessing Questions – Teacher Stays to Hear Response** *Teacher questioning that allows student to explain and clarify thinking*	**Advancing Questions – Teacher Poses Question and Walks Away** *Teacher questioning that moves thinking forward*	**List of Students Providing Response** *Who? Which students used this strategy?*	**Discussion Order - sequencing student responses** ● *Based on the actual student responses, sequence and select particular students to present their mathematical work during class discussion* ● *Consider ways to ensure that each student will have an equitable opportunity to share his/her thinking during task discussion*
Anticipated Student Response A: Student multiplies 15 and 8 instead of recognizing the decimal.	• Where do you see 8 in this problem? Is 8 the same as 0.8? • Does 120 meters sound like a reasonable answer for 15 pairs of shoes?	• How can you apply your strategy for multiplying 15 and 8 to find the product of 15 and .8?	See Student A work sample	
Anticipated Student Response B: Student uses repeated addition to solve problem correctly.	• Tell me about your thinking. • Do you see a pattern?	• Is there another operation that would give you the same result?	See Student D work sample	
Anticipated Student Response C: Student is able to correctly solve by using repeated addition to get to a whole number and then multiplies.	• Tell me about your thinking. • What did you notice when you added 0.8 five times?	• How can you use this information to help you solve the problem? • What is your next step?	See Students C & F work samples	
Anticipated Student Response D: Student attempts to multiply decimals incorrectly.	• I see you know a lot about multiplication! Tell me about your thinking. • Could you use addition to prove that 0.8 ten times is still 0.8? • Can you use addition to prove 0.8 five times is 0.4?	• What happened to the decimal point when you used repeated addition? • How is multiplication of decimals different from multiplication of whole numbers?	See Student H work sample	

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Anticipated Student Response E: Student is able to solve correctly with calculator but unable to communicate thinking.	• Tell me about your thinking. • What did you type into the calculator? Why did you type that in? Can you record your thinking? • Would you like me to record for you?	• What specific math vocabulary helped you solve this problem? Can you add that into your justification?	See Students B & E work samples	
Anticipated Student Response F: Student is able to solve correctly and able to communicate thinking.	• Tell me about your thinking? • What would happen if the wall space was 30 meters in length? How many pairs of shoes could you fit in that space?	• How could you use what you know from the original question to help you solve this question?		

Name _____ Date _____

Room for Shoes

Shoe Locker is organizing their shoe display. They would like to fit their new arrival of shoes in one row along the wall.

- Each pair of shoes takes up 0.8 meters of space.
- What is the minimum length of wall space needed to fit all 15 pairs of new shoes?

Show and justify your thinking using pictures, words, and symbols.

Rich Mathematical Task Rubric

	Advanced	Proficient	Developing	Emerging
Mathematical Understanding	Proficient Plus: ● Uses relationships among mathematical concepts or makes mathematical generalizations	● Demonstrates an understanding of concepts and skills associated with task ● Applies mathematical concepts and skills which lead to a valid and correct solution	● Demonstrates a partial understanding of concepts and skills associated with task ● Applies mathematical concepts and skills which lead to an incomplete or incorrect solution	● Demonstrates no understanding of concepts and skills associated with task ● Applies limited mathematical concepts and skills in an attempt to find a solution or provides no solution
Problem Solving	Proficient Plus: ● Problem solving strategy is well developed or efficient	● Problem solving strategy displays an understanding of the underlying mathematical concept ● Produces a solution relevant to the problem and confirms the reasonableness of the solution	● Problem solving strategy displays a limited understanding of the underlying mathematical concept ● Produces a solution relevant to the problem but does not confirm the reasonableness of the solution	● A problem solving strategy is not evident ● Does not produce a solution that is relevant to the problem
Communication and Reasoning	Proficient Plus: ● Reasoning or justification is comprehensive ● Consistently uses precise mathematical language to communicate thinking	● Demonstrates reasoning and/or justifies solution steps ● Supports arguments and claims with evidence ● Uses mathematical language to communicate thinking	● Reasoning or justification of solution steps is limited or contains misconceptions ● Provides limited or inconsistent evidence to support arguments and claims ● Uses limited mathematical language to partially communicate thinking	● Provides no correct reasoning or justification ● Does not provide evidence to support arguments and claims ● Uses no mathematical language to communicate thinking
Representations and Connections	Proficient Plus: ● Uses representations to analyze relationships and extend thinking ● Uses mathematical connections to extend the solution to other mathematics or to deepen understanding	● Uses a representation or multiple representations, with accurate labels, to explore and model the problem ● Makes a mathematical connection that is relevant to the context of the problem	● Uses an incomplete or limited representation to model the problem ● Makes a partial mathematical connection or the connection is not relevant to the context of the problem	● Uses no representation or uses a representation that does not model the problem ● Makes no mathematical connections

Possible Graphic Organizers

UPSE Problem Solving Mat

UNDERSTAND (What do I know?)	PLAN (What strategy will I use?)
SOLVE	EXPLAIN