

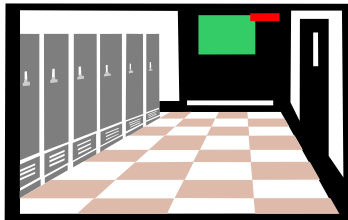
CCSS-Aligned Mathematical Task

School Main Hallway Flooring Project-Grade 4

By Joseph Espinosa, Douglas Zamora

Task

The principal at Lincoln Avenue Elementary needs to retile a section of the school main hallway floor, which was damaged. That section of the main hallway floor has an area with dimensions of 12 ft. by 12 ft. The school has \$600 for this repair and has to decide between two proposals from building contractors.



Proposal A	Proposal B
Material Costs: <ul style="list-style-type: none">• 9 – 1 square foot tiles per case, \$10 per case• 1 bag of title spacers, \$5• 1 bag of grout, \$13	Material Costs: <ul style="list-style-type: none">• 6 – 1 square foot tiles per case, \$12 per case• 1 bag of title spacers, \$5• 1 bag of grout, \$13
Labor Costs: \$50/per hour for 8 hours	Labor Costs: \$40/per hour for 8 hours

Part 1: What are the material costs for each proposal for the main hallway floor? Show and explain your work. Use at least two models to show your calculations including an equation with a symbol for the unknown.

Part 2: What are the labor costs for each proposal for the main hallway floor? Show and explain your work. Use at least two models to show your calculations including an equation with a symbol for the unknown.

Part 3: Which proposal can the principal afford with the school's \$600 budget? Show and explain your work. Use at least two models to show your calculations including an equation with the letter t as a symbol for the unknown.

Rationale for Lesson

Develop students' proficiency with multi-step word problems using whole numbers and the four operations with an emphasis on multi-digit multiplication and division. Solidify students' understanding of the distributive property, open arrays, and an equation with a symbol for the unknown as strategies to model their multiplication and division calculations for multi-digit numbers.

Common Core State Standards for Content

4.OA.3 Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.

4.NBT.5 Multiply a whole number of up to four digits by a one-digit whole number, and multiply two two-digit numbers, using strategies based on place value and the properties of operations. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.

4.NBT.6 Find whole-number quotients and remainders with up to four-digit dividends and one-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.

Common Core State Standards for Mathematical Practice

MP 1-Make sense of problems and persevere in solving them.

MP 2-Reason abstractly and quantitatively

MP 3-Construct viable arguments and critique the reasoning of others.

MP 4-Model with mathematics

MP 5-Use tools appropriately and strategically

MP 6-Attend to precision

DOK Level: 3

Strategic Thinking

Enduring Understandings

- Each multiplicative expression developed in the context of a problem situation has an accompanying explanation, and different representations and ways of reasoning about a situation can lead to different expressions or equations (NCTM, 2011).
- Division is defined by its inverse relationship with multiplication (NCTM, 2011).

- The ability to use the distributive property of multiplication over addition ensures flexibility in computations with whole numbers and provides justifications for sequences in computation with them (NCTM, 2011).
- The distributive property is connected to the area model, the partial products method of multiplication, and the partial quotients method of division.

Materials Needed

- Reproducible Task for Students
- Colored Square Tiles
- Graph Paper
- Pencils, Colored Pencils

Set-Up Phase

Teacher: Read the task to yourself. What does the school main hallway floor need and why? What does a building contractor do? What is a proposal?

Note to teacher: Include visuals/pictures of the tiles, grout, tile spacers or realia of these items with labels. Possibly include visuals/pictures of a contractor tiling a floor with these materials or a video from the internet.

Teacher: Now turn and talk with a partner about the two proposals from each building contractor. What do you know? What do you need to find out?

Teacher: You will have ten minutes of productive struggle time to work independently on solving the problem. Then you may work with your partner and table group.

Explore Phase

Possible Student Strategies	Focusing Questions	Assessing Questions	Advancing Questions
Can't get started	What do you know? What do you need to find? What do you know about the area of the hallway?		
Uses the partial products method to solve for the area of the school main hallway		How did you use multiplication to solve for the area of the school main hallway?	How is the partial products method of multiplication an example of the distributive property? What

Possible Student Strategies	Focusing Questions	Assessing Questions	Advancing Questions
			might be another equivalent equation to use?
Can't determine the correct equation with a symbol for the unknown	How might you use graph paper to show the area of the hallway? How might you connect a model and an equation? What is the missing information?		
Uses an area model for division with partial quotients to solve for the number of cases of tiles needed		How did you use the area model to divide? What does your side length represent in the problem? What does your quotient represent in the problem?	What might be the equation for your area model?
Uses an area model for multiplication with partial products to solve for the total cost of the tiles		How did you use the area model to multiply? What do the side lengths represent in your problem? What does your product represent in the problem?	What might be the equation for your area model? What is another equation using partial products which you could use? What would the area model look like for that equation?
Uses the inverse relationship between multiplication and division to find the number of cases		How did you use multiplication to solve for the number of cases of tiles needed for each proposal?	How can you model this multiplication sentence with an equation with a symbol for the

Possible Student Strategies	Focusing Questions	Assessing Questions	Advancing Questions
of tiles needed			unknown?
Uses an area model for multiplication with or without partial products to solve for the labor costs		What do the side lengths represent in the problem? What does the area represent in the problem?	What might be the equation with a symbol for the unknown that you can use to solve for the labor costs for each proposal?
Uses a multiplication equation to solve for the labor costs		What do the numbers represent in your equation?	How might you use a symbol for the unknown in your equation? How might you use the distributive property to solve for the costs? How might you use an open array to connect to an equation?
Can't get started in finding the total costs	What do we need to find to figure out which proposal the principal can afford? How can you use the answers in Part 1 and Part 2 to help you?		
Finds the sum of the materials and labor costs		How did you determine how much each proposal cost?	Which proposal should the principal choose? How do know?

Share, Discuss, and Analyze Phase

Student work is carefully selected for display for furthering a discussion of the mathematical goals of the lesson. The work may be projected, on posters, posted anonymously, or shared personally.

- How did the student go about solving the problem? What visual model represented the thinking?
 - Why did they choose an area model? How did that represent the problem?
 - What do the numbers in the equation represent in the problem situation?
 - What equation, with a symbol for the unknown, is used to represent the problem?
 - How does the equation match the model?
 - What might be another equation to represent the problem?
-
- How did the partial product method help in finding the area of the school main hallway?
 - If you used the area model and/or the partial products method of multiplication how do they connect to the distributive property? How does using the distributive property make it easier to find the area?
 - How could we use the distributive property to solve Part 2, which asks for the labor costs of each proposal? What is the equation? What is the area model, which represents the use of the distributive property in each proposal?
-
- How might the area model help us to divide the area of the floor by the number of tiles per case? What equation models the division calculations?
 - Why did you choose to divide to solve for the number of cases of tiles? How does division represent the problem? What does the dividend represent in the problem? The divisor? The quotient? Is this measurement division or partitive division?
 - How does the partial quotient method help find the number of cases of tiles needed? What equation matches the division calculations?
-
- If you used the area model and/or the partial quotients method of division how do they connect to the distributive property? How does using the distributive property make it easier to find the number of cases of tiles you need based on the area?
 - Is there another way to break up the quotient or dimension of the area model using the distributive property? What is an equation that matches the area model?
 - Is it possible to distribute the divisor? Why or why not?

Application

What parts of the problem might you change for the other proposal to be the best deal?

Summary

The distributive property can be used with the area model in multiplication and division, and with the partial products method to solve multi-digit multiplication, and with the partial quotients method to solve multi-digit division problems.

Quick-Write

Journal prompt:

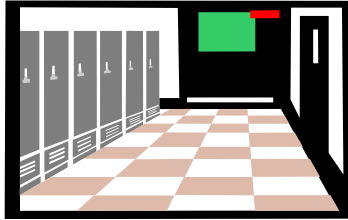
What strategies did you use to solve multi-digit multiplication and division problems? What models did you use to show your calculations? How were these models the same? How were they different?

Support for English Language Learners

1. Encourage students to continually reference the problems when thinking through the problem and explaining their thinking.
2. Students are asked to write out reference relationships within the problem.
3. Provide a communication guide for math discourse moves needed in problem solving, explaining one's work, and justifying one's thinking, including analyzing a problem and preparing to solve it, using multiple approaches and representations, explaining and supporting reasoning, and connecting to, building on, and challenging other students' ideas.
4. Collaboration allows students to work through ideas and practice discussions first, before moving to a whole group discussion.
5. The teacher marks verbally and in writing key ideas from the lesson as they are revealed through the Share, Discuss, and Analyze phase.

Student Task Sheet

The principal at Lincoln Avenue Elementary needs to retile a section of the school main hallway floor, which was damaged. That section of the main hallway floor has an area with dimensions of 12 ft. by 12 ft. The school has \$600 for this repair and has to decide between two proposals from building contractors.



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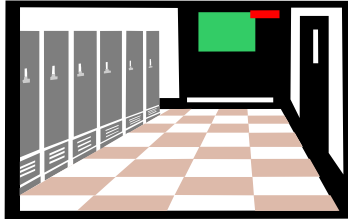
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Student Task Sheet: Teacher Pages

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Part 1: What are the material costs for each proposal for the main hallway floor? Show and explain your work. Use at least two models to show your calculations including an equation with a symbol for the unknown.

Proposal A:

$$144 \text{ tiles} / 9 \text{ tiles per case} = 16 \text{ cases}$$

$$(16 \text{ cases} \times \$10) + \$5 + \$13 = \$178$$

$$M = \text{number of cases} \times \text{cost per case} + \text{spacers} + \text{grout}$$

Proposal B:

$$144 \text{ tiles} / 6 \text{ tiles per case} = 24 \text{ cases}$$

$$(24 \text{ cases} \times \$12) + \$5 + \$13 = \$306$$

Part 2: What are the labor costs for each proposal for the main hallway floor? Show and explain your work. Use at least two models to show your calculations including an equation with a symbol for the unknown.

Proposal A:

$$\$50 \times 8 \text{ hours} = \$400$$

$$L = \text{hours} \times \text{cost per hour}$$

Proposal B:

$$\$40 \times 8 \text{ hours} = \$320$$

Part 3: Which proposal can the principal afford with the school's \$600 budget? Show and explain your work. Use at least two models to show your calculations including an equation with the letter t as a symbol for the unknown.


Proposal A

$$\$178 + \$400 = \$578$$

$$t = \text{materials} + \text{labor}$$

Proposal B

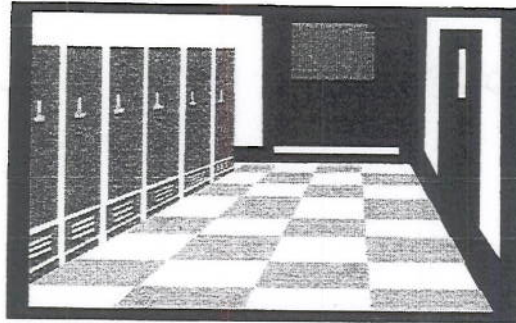
$$\$306 + \$320 = \$626$$

High


Primary Standard: 4.OA.3
 Secondary Standards: 4.NBT.5 & 4.NBT.6

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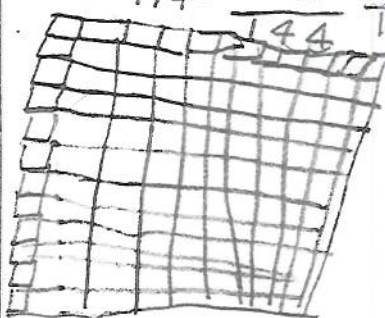
Part 1: What are the material costs for each proposal for the main hallway floor? Show and explain your work. Use two models to show your calculations including an equation with a symbol for the unknown.

Proposal A

$$\begin{array}{r} 12 \\ \times 12 \\ \hline 144 \end{array}$$

$$\begin{array}{r} 59 \\ \times 16 \\ \hline 144 \end{array}$$

$$\begin{array}{r} 10 \\ \times 16 \\ \hline 160 \end{array}$$

$$\begin{array}{r} 55 \\ 135 \\ \hline 1785 \end{array}$$


Proposal B

$$\begin{array}{r} 12 \\ \times 12 \\ \hline 144 \end{array}$$

$$\begin{array}{r} 6 \\ \times 24 \\ \hline 144 \end{array}$$

$$\begin{array}{r} 12 \\ \times 22 \\ \hline 264 \end{array}$$

$$\begin{array}{r} \$5 \\ \$13 \\ \hline \$288 \end{array}$$

$$\begin{array}{r} 306 \end{array}$$

$144 \text{ tiles} \div 9 \text{ cases} = 16$

Primary Standard: 4.OA.3
Secondary Standards: 4.NBT.5 & 4.NBT.6

Part 2: What are the labor costs for each proposal for the main hallway floor? Show and explain your work. Use two models to show your calculations including an equation with a symbol for the unknown.

The cost for Proposal A is \$50 per hour. 50 For 8 hours you pay \$400. $\frac{400}{50} = 8$

The cost for Proposal B is \$40 per hour. 40 For 8 hours you pay \$320. $\frac{320}{40} = 8$

Part 3: Which proposal can the principal afford with the school's \$600 budget? Show and explain your work. Use models to show your calculations including an equation with the letter t as a symbol for the unknown.

$$\begin{array}{r} 160 \\ + 13 \\ \hline 173 \\ + 5 \\ \hline 178 \\ + 400 \\ \hline 578 \end{array}$$

$$\begin{array}{r} 288 \\ + 13 \\ \hline 301 \\ + 5 \\ \hline 306 \\ + 320 \\ \hline 626 \end{array}$$

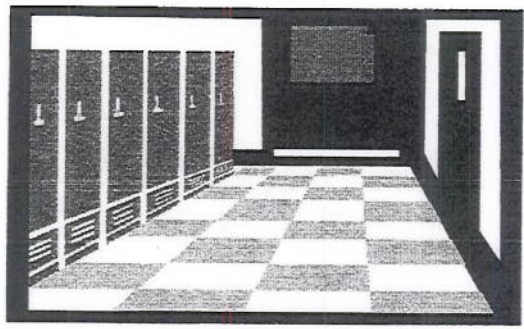
They should buy Proposal A because Proposal B is 26 more.

Middle

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Secondary Standards: 4.NBT.5 & 4.NBT.6

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Part 1: What are the material costs for each proposal for the main hallway floor? Show and explain your work. Use two models to show your calculations including an equation with a symbol for the unknown.

The material costs for A is \$28 all together.

The material costs for B is \$30.

$$\begin{array}{r}
 10 \\
 + 5 \\
 + 3 \\
 \hline
 18
 \end{array}$$

$$\begin{array}{r}
 12 \\
 + 5 \\
 + 3 \\
 \hline
 20
 \end{array}$$

Handwritten diagrams showing 12 squares for Proposal A and 6 squares for Proposal B.

Primary Standard: 4.OA.3
 Secondary Standards: 4.NBT.5 & 4.NBT.6

Part 2: What are the labor costs for each proposal for the main hallway floor? Show and explain your work. Use two models to show your calculations including an equation with a symbol for the unknown.

The labor costs for A is \$50 per hour. The hours A works for is 8 hours.

$$\begin{array}{r} \$50 \\ \times 8 \text{ hr} \\ \hline \$400 \end{array}$$

The labor for B is \$40 per hour. The hours B works for is 8 hours.

$$\begin{array}{r} \$40 \\ \times 8 \\ \hline \$320 \end{array}$$

Part 3: Which proposal can the principal afford with the school's \$600 budget? Show and explain your work. Use models to show your calculations including an equation with the letter *t* as a symbol for the unknown.

$$\begin{array}{r} \$400 \\ + \$28 \\ \hline \$428 \end{array}$$

$$\begin{array}{r} \$320 \\ + \$30 \\ \hline \$350 \end{array}$$

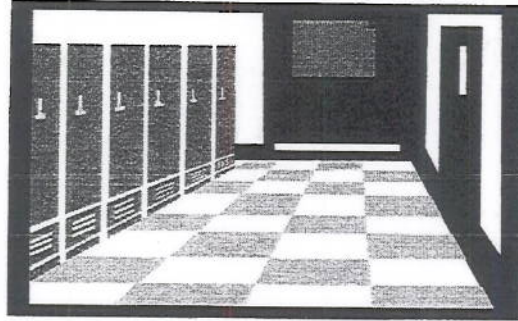
510
600
- 250
\$350

The principal can afford B because the total amount of money given is \$350 and the is \$428. The school will have \$250 left.

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 Secondary Standards: 4.NBT.5 & 4.NBT.6

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A

$$\begin{array}{r}
 144 \div 9 = 16 \\
 16 \times 12 \text{ ft.} \\
 + 5 \\
 + 13 \\
 \hline
 28 \text{ } 12 \\
 \hline
 12
 \end{array}$$

B

$$\begin{array}{r}
 12 \\
 + 5 \\
 + 13 \\
 \hline
 30
 \end{array}$$

144 dollars for tiles

Primary Standard: 4.OA.3
 Secondary Standards: 4.NBT.5 & 4.NBT.6

Part 2: What are the labor costs for each proposal for the main hallway floor? Show and explain your work. Use two models to show your calculations including an equation with a symbol for the unknown.

<p style="margin: 0;">A</p> $\begin{array}{r} 50/\text{hr.} \\ 8 \text{ hrs.} \\ \hline 50 \\ \times 8 \\ \hline 400 \end{array}$	<p style="margin: 0;">B</p> $\begin{array}{r} 40/\text{hr } 8 \text{ hrs} \\ 40 \\ \times 8 \\ \hline 320 \end{array}$
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Part 3: Which proposal can the principal afford with the school's \$600 budget? Show and explain your work. Use models to show your calculations including an equation with the letter *loop* as a symbol for the unknown.

<p style="margin: 0;">A</p> $\begin{array}{r} 600 \\ - 400 \\ \hline 200 \end{array}$	<p style="margin: 0;">B</p> $\begin{array}{r} 510 \\ - 320 \\ \hline 190 \end{array}$ <p style="margin: 0;">P.A is 280 dollars less.</p>
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