Inspect

CCR Performance Task

Math Grade 4: Extended Performance Task
Tile Floors

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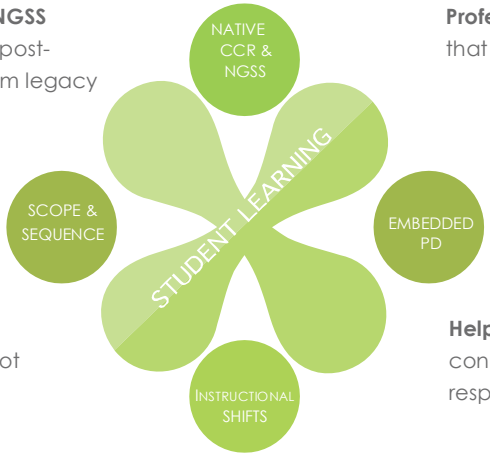

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CCR Performance Tasks

Math Grade 4: Extended Performance Task
Tile Floors

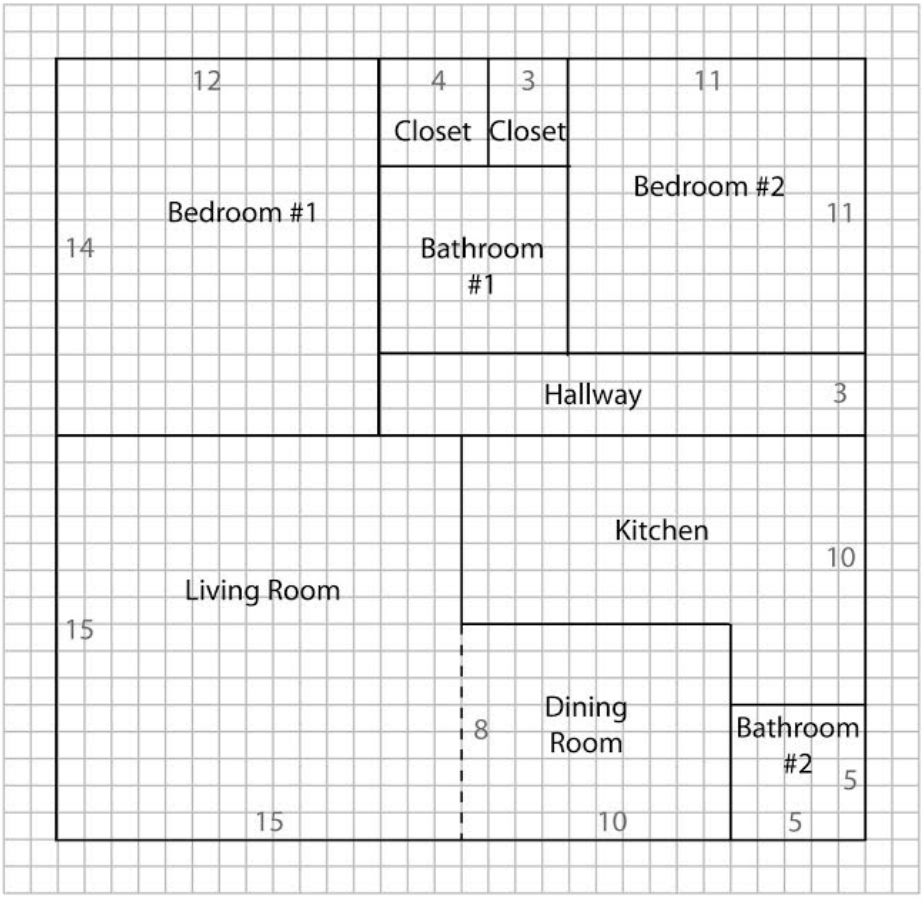
Student Test Booklet

Name:

Math Grade 4: Extended Performance Task: Tile Floors

Complete all the tasks in the test booklet.

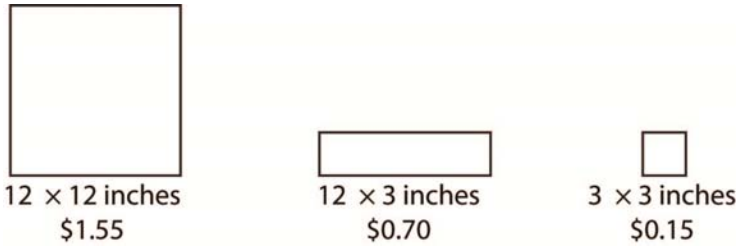
The Hanson family wants to put down new tile floors. The tile floors will go in the two bathrooms of their house. The floor plan of their home is shown below. Each square unit of the grid represents 1 foot by 1 foot.



Mr. Hanson will put in the tile flooring for the two bathrooms.

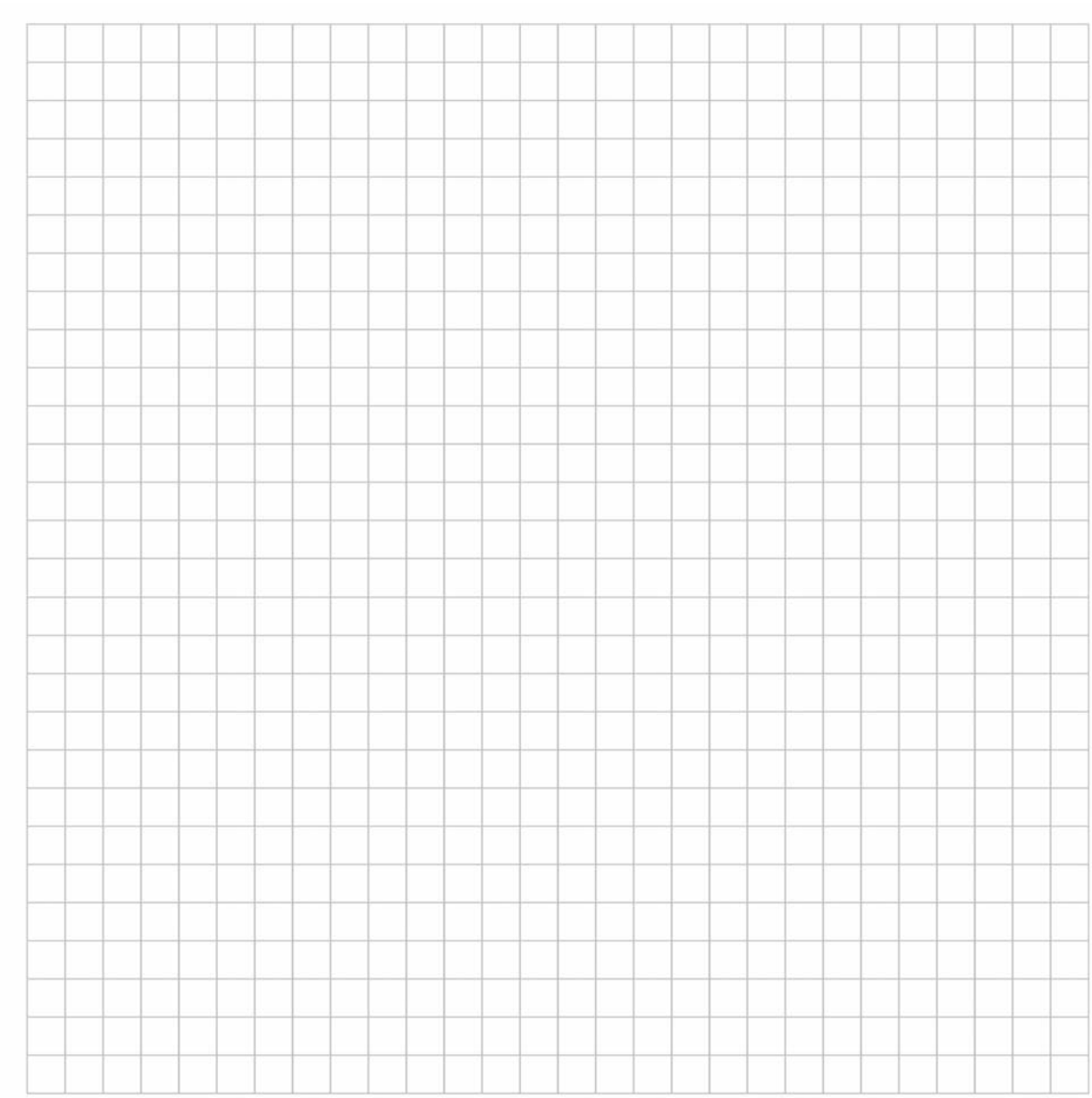
Part A: Bathroom Tiles

For the floor in bathroom #1, Mr. Hanson would like to make a pattern with the tiles he has chosen. He would like your help in coming up with a pattern that uses all three tile sizes shown below. Mr. Hanson does not own a tile cutter so the tiles can't be cut.

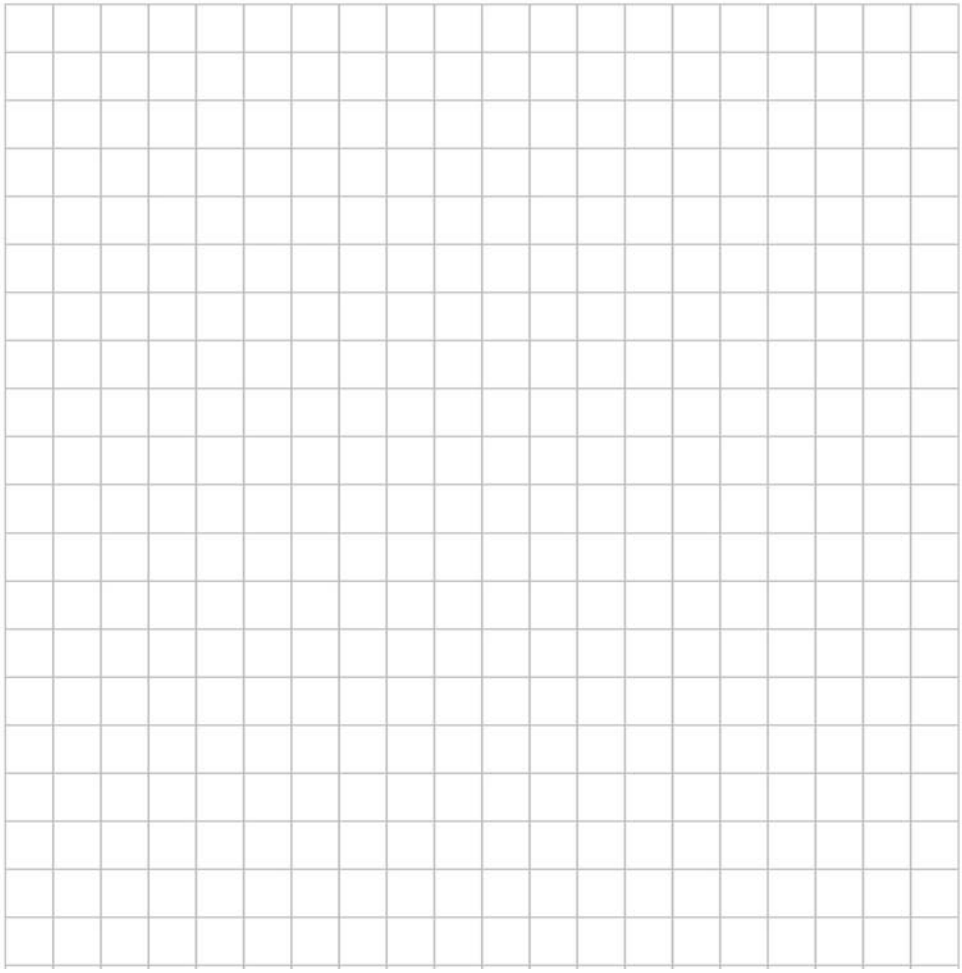


Go On

1. The pattern should be drawn on the grid provided below. Each square on the grid is equal to the 3-inch-by-3-inch tile.



2. Mr. Hanson would like to use the same pattern for bathroom #2 that was used for bathroom #1. Draw the pattern for bathroom #2 on the grid provided below. Each square on the grid is equal to the 3-inch-by-3-inch tile.

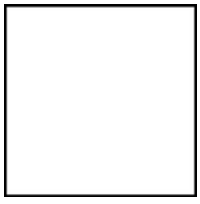


3. How many of each tile did you use in your pattern for bathroom #1 and bathroom #2? What is the total number of tiles you used? Explain or show how you found your answer using pictures, numbers, and/or words.

4. How much will the tiles cost for each bathroom using the pattern that you made? Explain or show how you found your answer using pictures, numbers, and/or words.

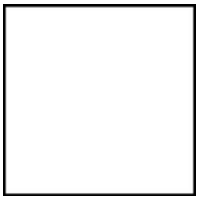
Support worksheet for Part A Question 3

3. How many of each tile did you use in your pattern for bathroom #1 and bathroom #2? Explain or show how you found your answer using pictures, numbers, and/or words.

	Bathroom #1	Bathroom #2	Total
3×3 tiles 			
3×12 tiles 			
12×12 tiles 			

Support worksheet for part A question 4

4. How much will the tiles cost for each bathroom using the pattern that you made? Explain how you found your answer using pictures, numbers, and/or words.

	Bathroom #1 cost	Bathroom #2 cost	Cost for both bathrooms
3×3 tiles 			
3×12 tiles 			
12×12 tiles 			
Total Cost			

Part B (optional): Group Work and Reflection

Look at the patterns that the other people in your group made for their floors in **bathroom #2**. Here are some questions for you to think about:

- Are their patterns the same as yours?
- Does their pattern in bathroom #2 match the pattern in bathroom #1? If not, help them to change their pattern so that it is similar.
- Was your cost for the bathroom tiles more or less than the other people in your group? Why?

Take notes on what you learn from this discussion.

Tile patterns that are more expensive than mine
{use a separate sheet of the 20 x 20 grid paper to show your work}

Tile patterns that are less expensive than mine
{use a separate sheet of the 20 x 20 grid paper to show your work}

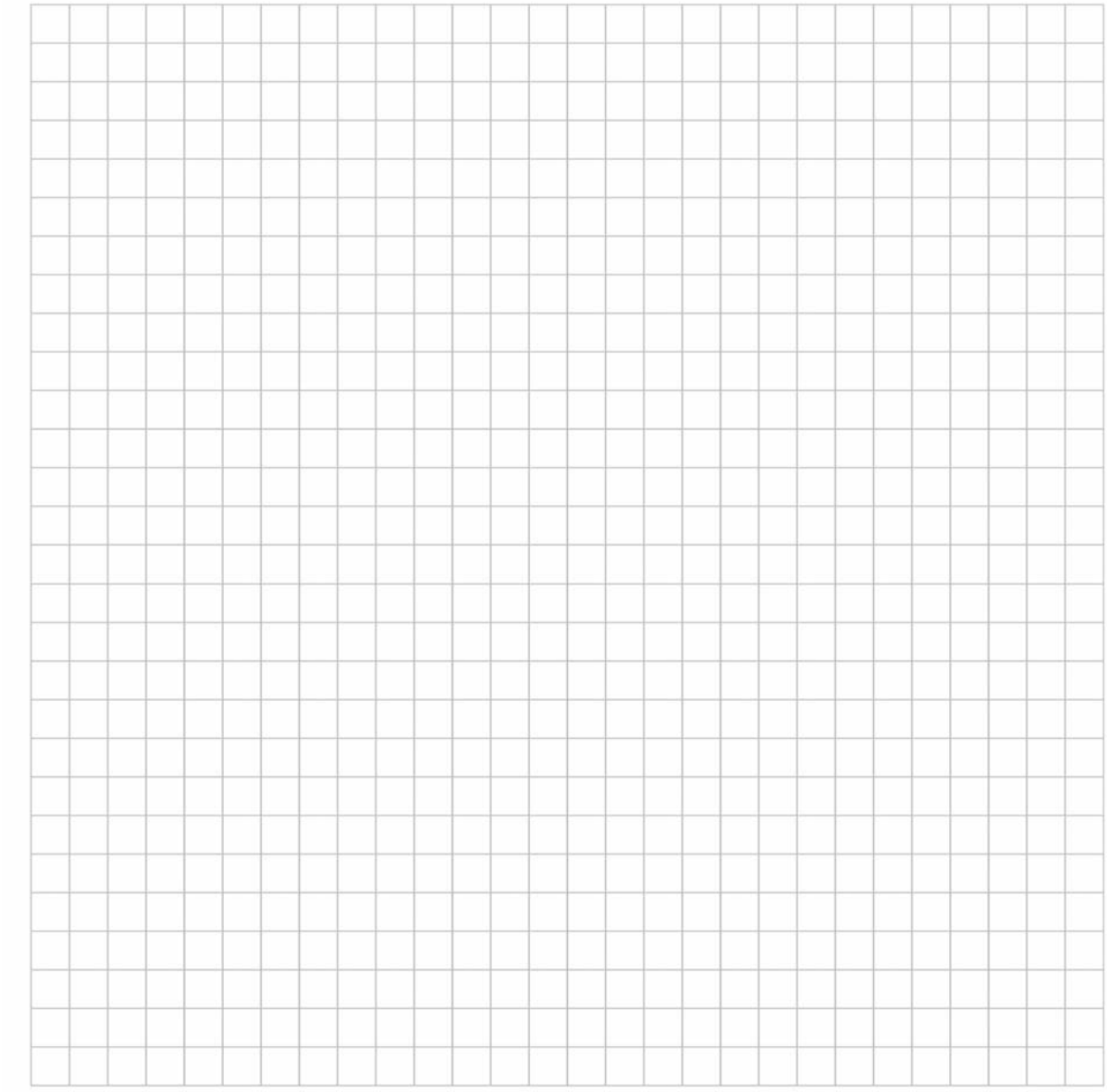
What makes a pattern more expensive?

What makes a pattern less expensive?

Part B: Reflection on Area

5.

a. Using your pattern for bathroom #1, replace tiles either in a 2-feet-by-2-feet area or in four separate 1-foot-by-1-foot areas. The tiles in the area(s) that you choose should be replaced with another tile size or a combination of tile sizes that are different from your original design. Only use the three sizes of tiles given at the beginning of this task. Use the grid below to show an example of the new pattern.



Use the new pattern you created in problem 5a to answer the question below.

b. Why is there more than one way to make a pattern with the three tile sizes that fits the floors for both bathrooms? Write your answer using at least 2-3 sentences in the response box.

Part C: Budget for Tile

Mr. Hanson has saved $150 to use for the cost of the tiles.

6. Answer ONE of these questions. If your pattern costs MORE than $150 answer question a. If your pattern costs LESS than $150 answer question b.
    a. How can you change your pattern so that the total cost of the tiles is less than or equal to $150? Explain your answer using pictures, numbers, and/or words.
    b. What is the total cost of the tiles for your bathroom floors? Explain in detail why some tile patterns are more expensive than others. Use pictures, numbers, and/or words in your explanation.

Part D: Writing Component

7. Write up a plan for Mr. Hanson. The plan should include all of the information Mr. Hanson will need to decide if he wants to use your design. Make sure to explain 1) how many tiles to buy, 2) how much it will cost, and 3) why it is a good design to use.

Support worksheet for Part D: Writing Component

7. Write up a plan for Mr. Hanson. The plan should include all of the information Mr. Hanson will need to decide if he wants to use your design. Make sure to explain 1) how many tiles to buy, 2) how much it will cost, and 3) why it is a good design to use.

Plan Title: _____

By: _____

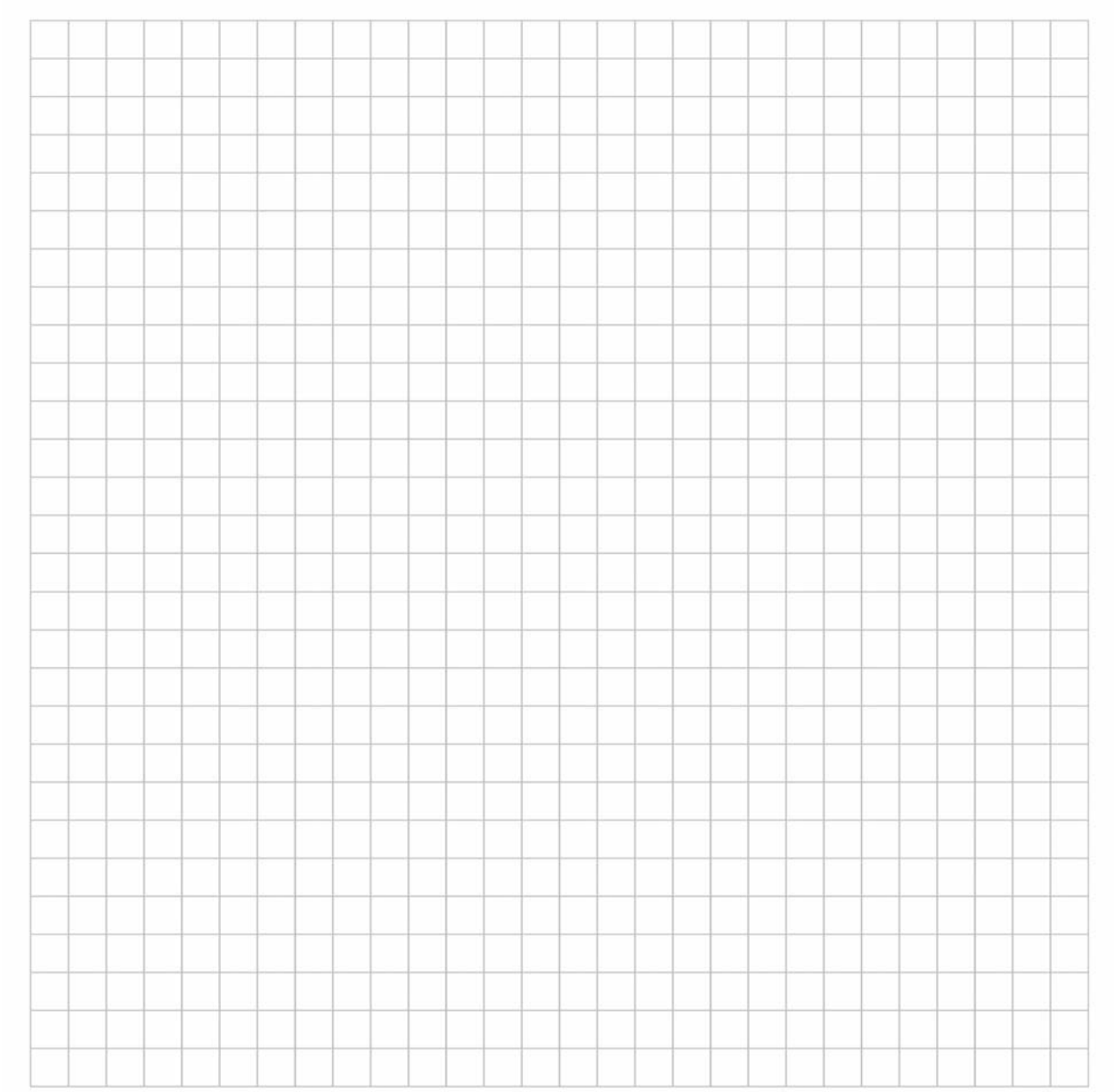
For bathroom 1 you will need...

For bathroom 2 you will need...

The total cost of the tiles will be...

I chose this design because...

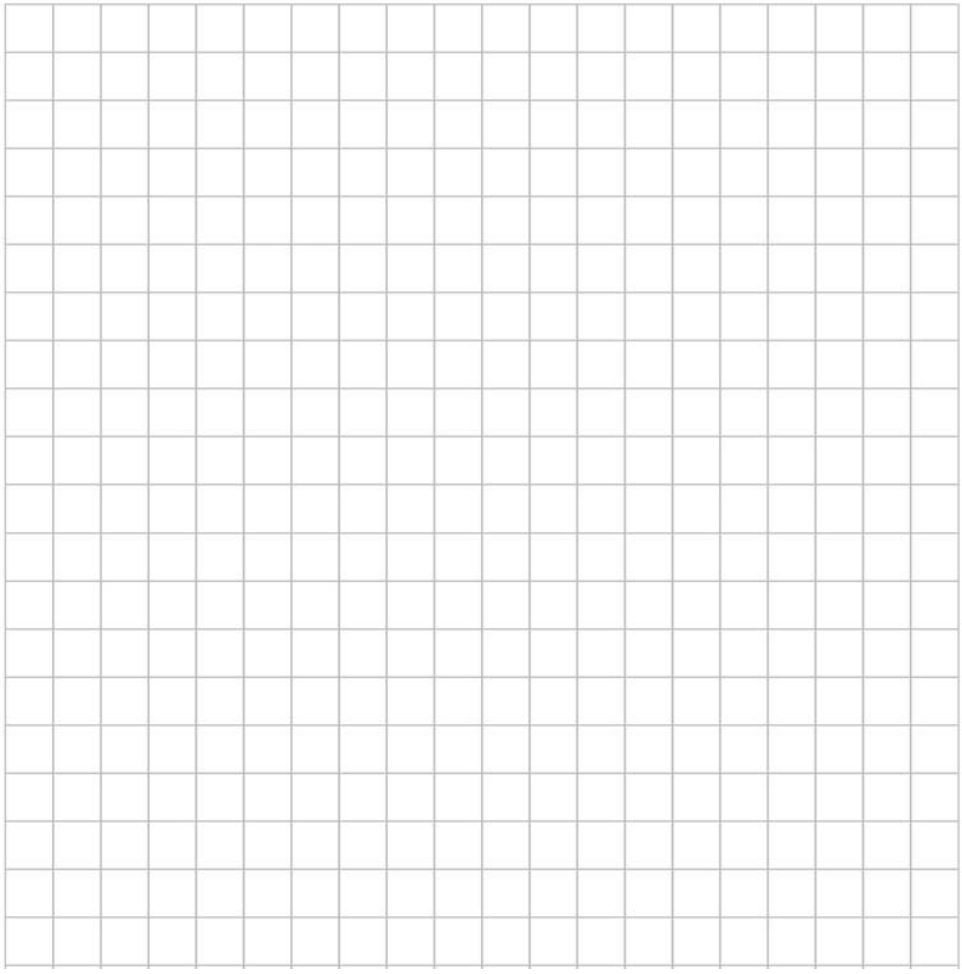
Extra 28×28 grid



Name:_____

Math Grade 4: Extended Performance Task: Tile Floors

Extra 20×20 grid



CCR Performance Tasks

Math Grade 4: Extended Performance Task
Tile Floors

Teacher Guide

Name:

Task Specifications

Content Area	Mathematics
Title	Tile Floors
Grade Level	Grade 4
Problem Type	Extended Performance Task
Standards for Mathematical Practices	**Mathematical Practice 2 (MP.2):** Reason abstractly and quantitatively. Mathematically proficient students: • Make sense of quantities and their relationships in problem situations. • Bring two complementary abilities to bear on problems involving quantitative relationships: o Decontextualize—to abstract a given situation and represent it symbolically, and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents; and o Contextualize—to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. • Use quantitative reasoning that entails creating a coherent representation of the problem at hand, consider the units involved, attend to the meaning of quantities (not just how to compute them) and know and flexibly use different properties of operations and objects. **Mathematical Practice 4 (MP.4):** Model with mathematics. Mathematically proficient students: • Solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. • Can apply what they know and are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. • Are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

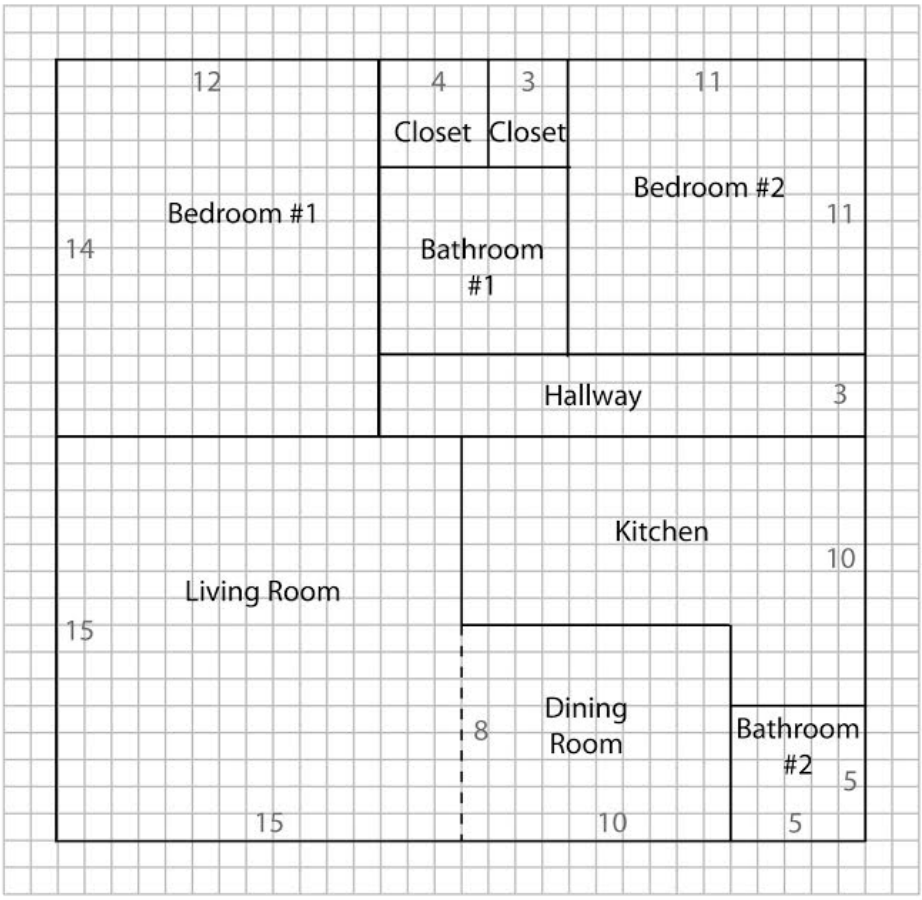
Common Core State Standards	**4.MD.2** Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale. **4.MD.3** Apply the area and perimeter formulas for rectangles in real world and mathematical problems. **4.OA.2** Multiply or divide to solve word problems involving multiplicative comparison, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem, distinguishing multiplicative comparison from additive comparison. **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.NF.1** Explain why a fraction a/b is equivalent to a fraction (n × a)/(n × b) by using visual fraction models, with attention to how the number and size of the parts differ even though the two fractions themselves are the same size. Use this principle to recognize and generate equivalent fractions.
CCSS ELA-Literacy Standards	**W.3.2** Write informative/explanatory texts to examine a topic and convey ideas and information clearly. **W.3.10** Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.
SBAC Assessment Claims	**Claim 4: Modeling and Data Analysis**—Students can analyze complex, real-world scenarios and can construct and use mathematical models to interpret and solve problems.
PARCC Assessment Claims	**Sub-Claim D: Highlighted Practice MP.4 with Connections to Content (modeling/application)—**The student solves real-world problems with a degree of difficulty appropriate to the grade/course by applying knowledge and skills articulated in the standards for the current grade/course (or for more complex problems, knowledge and skills articulated in the standards for previous grades/courses), engaging particularly in the Modeling practice.
Depth of Knowledge	**Level 4: Extended Strategic Thinking**—Curricular elements assigned to the level demand extended use of higher order thinking processes such as synthesis, reflection, assessment and adjustment of plans over time. Students are engaged in conducting investigations to solve real-world problems with unpredictable outcomes. Employing and sustaining strategic thinking processes over a longer period of time to solve the problem is a key feature of curricular objectives that are assigned to this level. Key strategic thinking processes that denote this particular level include: synthesize, reflect, conduct, and manage.

Math Grade 4: Extended Math Performance Task: Tile Floors

Task Overview	In this task you will use your knowledge of measurement, properties of shapes and multiplication skills to solve a problem. You will be asked to analyze what is given to you and plan a solution pathway. Once you have an understanding of the problem and you have determined how you can solve this problem, you will have the opportunity to solve it. You may find that your solution has errors so you will be given a chance to reflect on your work and then try a different method in order to find a more appropriate solution.

Student Task

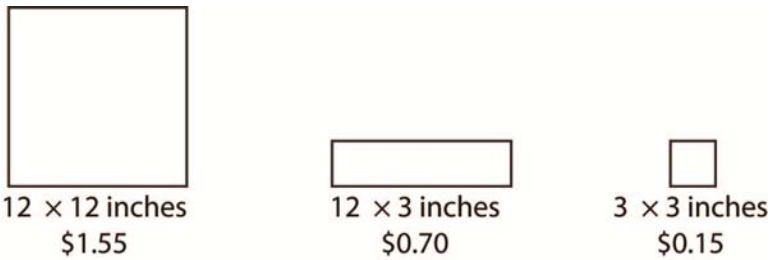
The Hanson family wants to put down new tile floors. The tile floors will go in the two bathrooms of their house. The floor plan of their home is shown below. Each square unit of the grid represents 1 foot by 1 foot.



Mr. Hanson will put in the tile flooring for the two bathrooms.

Part A: Bathroom Tiles

For the floor in bathroom #1, Mr. Hanson would like to make a pattern with the tiles he has chosen. He would like your help in coming up with a pattern that uses all three tile sizes shown below. Mr. Hanson does not own a tile cutter so the tiles can't be cut.



1. The pattern should be drawn on the grid provided below. Each square on the grid is equal to the 3-inch-by-3-inch tile.
2. Mr. Hanson would like to use the same pattern for bathroom #2 that was used for bathroom #1. Draw the pattern for bathroom #2 on the grid provided below. Each square on the grid is equal to the 3-inch-by-3-inch tile.
3. How many of each tile did you use in your pattern for bathroom #1 and bathroom #2? What is the total number of tiles you used? Explain or show how you found your answer using pictures, numbers, and/or words.
4. How much will the tiles cost for each bathroom using the pattern that you made? Explain or show how you found your answer using pictures, numbers, and/or words.

Part B (optional): Group Work and Reflection

Look at the patterns that the other people in your group made for their floors in **bathroom #2**. Here are some questions for you to think about:

- Are their patterns the same as yours?
- Does their pattern in bathroom #2 match the pattern in bathroom #1? If not, help them to change their pattern so that it is similar.
- Was your cost for the bathroom tiles more or less than the other people in your group? Why?

Take notes on what you learn from this discussion.

Tile patterns that are more expensive than mine
{use a separate sheet of the 20×20 grid paper to show your work}

Tile patterns that are less expensive than mine
{use a separate sheet of the 20×20 grid paper to show your work}

What makes a pattern more expensive?

What makes a pattern less expensive?

Part B: Reflection on Area

5. a. Using your pattern for bathroom #1, replace tiles either in a 2-feet-by-2-feet area or in four separate 1-foot-by-1-foot areas. The tiles in the area(s) that you choose should be replaced with another tile size or a combination of tile sizes that are different from your original design. Only use the three sizes of tiles given at the beginning of this task. Use the grid below to show an example of the new pattern.

Use the new pattern you created in problem 5a to answer the question below.

b. Why is there more than one way to make a pattern with the three tile sizes that fits the floors for both bathrooms? Write your answer using at least 2-3 sentences in the response box.

Part C: Budget for Tile

Mr. Hanson has saved $150 to use for the cost of the tiles.

6. Answer ONE of these questions. If your pattern costs MORE than $150 answer question a. If your pattern costs LESS than $150 answer question b.
    a. How can you change your pattern so that the total cost of the tiles is less than or equal to $150? Explain your answer using pictures, numbers, and/or words.
    b. What is the total cost of the tiles for your bathroom floors? Explain in detail why some tile patterns are more expensive than others. Use pictures, numbers, and/or words in your explanation.

Part D: Writing Component

7. Write up a plan for Mr. Hanson. The plan should include all of the information Mr. Hanson will need to decide if he wants to use your design. Make sure to explain 1) how many tiles to buy 2) how much it will cost, and 3) why it is a good design to use.

Teacher Instructions

This performance task is designed to assess student understanding of a variety of standards and claims. Students are challenged to use and apply knowledge of measurement units for the real world task of designing and costing tile as flooring. The task was designed with the understanding that all classrooms and students are different. Some students may need an extension activity, some may need to reduce the number of days planned for this task, and some may need to omit or simplify certain parts depending on what time during the school year this task is given.

Test Definition File

Item	Correct Answer	Practice Standard	Common Core Standards
1	See Scoring Rubric	Mathematical Practice 2 and 4	4.MD.2, 4.MD.3, 4.OA.2, 4.OA.3, 4.NBT.5, 4.NF.1
			CCSS ELA-Literacy Standards
			W.3.2, W.3.10

SBAC Claims	PARCC Sub-Claims
4	D

- Before the task, use a set of area manipulatives to explore how unit squares relate to the application of area formulas (e.g., counting squares inside a rectangular shape transitioning to finding the area by multiplying length and width).
- Students should review finding unknown side lengths of complex figures by decomposing them into non-overlapping rectangles and adding the areas of non-overlapping parts.
- Students should review basic measurement conversions involving length (specifically 12 inches to 1 foot).
- Students should review computation skills involving whole numbers (adding, subtracting, multiplication, division) and involving money, and involving finding fractional amounts of whole numbers/money. The inclusion of standard 4NBT.5 in this task requires that computation tasks should not be completed with a calculator. Students that have not mastered computational fluency may struggle with task completion without the use of a calculator. Since the main focus is on the problem solving aspects, using a calculator is optional and should be up to the teacher. Even if the students are allowed to use a calculator, they should still explain and show all of their computations in the response boxes provided.
- Students should review finding a unit rate and using the unit rate to find the total costs of larger measurement quantities.

Vocabulary:
Area
Dimensions (of a room)
Unit square
Budget (in budget and over budget)

Setting the Context:

Teacher: "Have you ever seen a house being remodeled or renovated? There is a lot of mathematics involved with tasks such as painting walls or putting down various types of floors. When putting in new floors, the area of the floor is an important measurement in determining how much carpet, or how much wood, or how many tiles are needed to completely cover the floor."

[Let students respond and share information. Use a square piece of paper as a visual for students to estimate how many squares would be needed to cover the classroom floor.]

Teacher: "Homeowners have a lot of decisions when it comes to remodeling rooms by putting in a new floor. Most of the time, the owner wants to keep the costs within a specific limit. How much do you think it would cost to put tile in two bathrooms?"

[Let students respond. Ask them how much they think a tile costs and what would make a tile cost more than another.]

Give an introduction to the task. A suggested introduction is below. Some of the information may need to be repeated each day.

Teacher: "You will be working to help a family plan a design for putting in tile floors. You will determine how much flooring is needed for two bathrooms. You will create a tile pattern using three different size tiles. After you have designed your bathroom floors you will figure out the total cost for all of the tiles you plan to use."

Timeline:

There are two different options to choose.

Option 1: This option should take two days (or 2 hours with the assumption that math lessons/activities take up an hour during a school day).

> **Day 1:** The students should complete Part A.*
> **Day 2:** The students should complete Parts B, C, and D. In Part B the optional group work and reflection activity is omitted.**

*Some students may need extra time to complete part A. This time could either be given as outside work (homework) or an extra day could be added to the timeline.
**Some students may need extra time in writing the plan for part D. This time could either be given as outside work (homework) or an extra 15-20 minutes could be given on the following day.

Option 2: This option should take three days (or 3 hours with the assumption that math lessons/activities take up an hour during a school day).

> **Day 1:** The students should complete Part A.*
> **Day 2:** The students should complete Part B with the group activity.
> **Day 3:** The students should complete Parts C and D.

*Some students may need extra time to complete part A. This time could either be given as outside work (homework) or an extra 15-20 minutes could be given on Day 2 before Part B is started.

Other suggestions:

- The grids given in Part A are set up so that the squares in the grid are the same size as the 3×3 tile. The student (or the teacher) can determine the colors for the three tiles (they should be three different colors). The grid can be colored to show the design of the tiles (an example is given in the scoring guide).
- Some students may require more support in answering the questions. Support worksheets are also included within this task to assist in breaking down the question that is being asked in a more organized manner. Consider reviewing the worksheets with the whole class as a model for how to organize the information in a multi-step problem. Then students may be able to create their own organizational systems or re-create the table model themselves.
- In Part B of this task, there is an optional collaborative activity. The students should be divided into groups of 3-4 students. They should be given about 15-30 minutes to look at each other's designs and the questions given. After they have had a chance to look at each of the patterns, they will need to reflect on what they designed and compare that to the other designs. Encourage them to take detailed notes. The information they gather during this part will be useful in problems 5 and 6.
- In Part C of this task, make sure the students know that they do NOT have to draw a completely new tile design if their original one costs more than $150. Suggest that they replace tiles in order to get the cost below $150 (similar to the process used in problem 5).
- There is a writing component at the end of the task. Included with this task is an optional graphic organizer/sentence starter to help scaffold the writing.

Extension Activity:

After completion of the initial task, students can be asked to create a design for the kitchen with the three tiles given in the task. But before designing the pattern for the tile floor they should include cabinets and appliances that are on the floor where tile is not needed. They should draw the appliances (refrigerator, stove/oven, and dishwasher) and cabinets on one wall on grid paper. Then find a design that will work for the kitchen floor. Students may determine that tiles should be cut in order to fit (or may have gaps where the tiles may not fit because they are too big or not the correct size). Students should plan how to fix this problem, if it occurs (cut the tiles and give the size of the cut tile or buy new tiles that have the size needed to fill the space) so that the entire floor is covered.

Cross Curricular Extension Idea: Have the students research the history of tiles and/or the different types of tiles that are used around the world. They can then draw a tile design that represents one that may be seen in another country.

Scoring Rubric

Part A

4 Point Response:

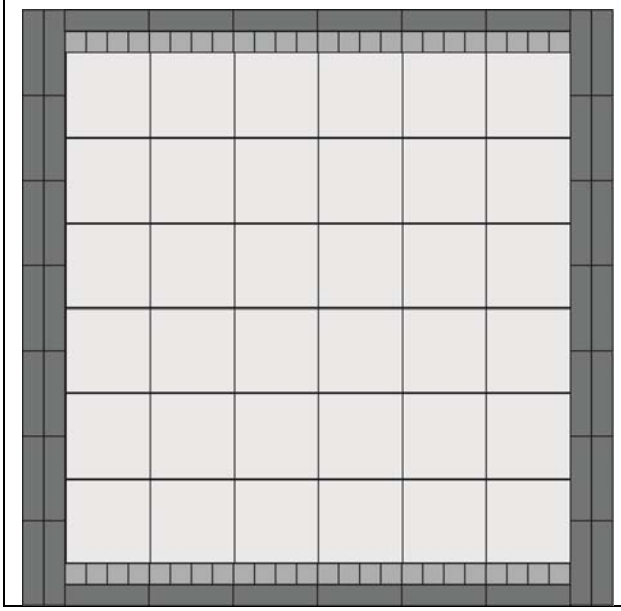
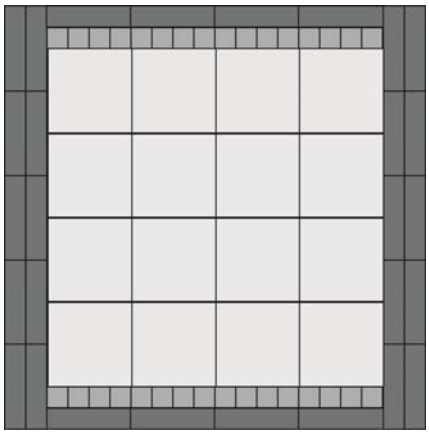
The response demonstrates a high level of understanding. The response demonstrates:

- A strong ability to make sense of a design problem and develop a solution that meets given requirements;
- A strong ability to adjust the solution to a problem when one of the constraints changes;
- A strong ability to check work and communicate reasoning in a clear and precise way;
- A strong ability to use area, measurement, and number and operations concepts to solve real-world problems.

A level 4 response should include:

- A pattern for bathroom 1 that uses all 3 tile sizes and covers the entire grid with no gaps or overlaps;
- A pattern for bathroom 2 that is clearly an adjustment of the pattern in bathroom 1 that meets the size requirements for bathroom 2;
- All tiles correctly drawn to scale;
- In problem 3, the correct total number of tiles of each size for both bathrooms; a clear and correct explanation or work to find the total number of tiles (if the optional support worksheet is used by the student it should not be scored unless it was used by the student as the only method of showing their work);
- In problem 4, the correct total cost for the tiles used in the pattern for both bathrooms; a clear and correct explanation or work to find the total cost of the tiles used (if the optional support worksheet is used by the student it should not be scored unless it was used by the student as the only method of showing their work);

Sample Response for Part A

Question 1: **Bathroom #1**	Question 2: **Bathroom #2**
	

Question 3:
For bathroom #1, I used 36 12×12 tiles, 40 3×12 tiles, and 48 3×3 tiles for my pattern. The total number of tiles is 36 + 40 + 48 = 124. For bathroom #2, I used 16 12×12 tiles, 28 3×12 tiles, and 32 3×3 tiles. The total number of tiles is 16 + 28 + 32 = 76. The tile pattern for bathroom #2 matches the pattern in bathroom #1 but it is smaller, with less tiles because the area of the bathroom is smaller. In total for both bathrooms, I used 52 12×12 tiles, 68 3×12 tiles, and 80 3×3 tiles. The total number of tiles used is 52 + 68 + 80 = 200.

Question 4:
For bathroom #1, I used 36 12×12 tiles, 40 3×12 tiles, and 48 3×3 tiles. I can find the amount for each type by multiplying the total number of tiles used by the cost of each tile. Each 12×12 tile costs $1.55, so 36×1.55 = 55.80. Each 3×12 tile costs $0.70, so 40×0.70 = 28. Each 3×3 tile costs 0.15, so 48×0.15 = 7.20. Add all of these costs together: 55.80 + 28 + 7.20 = 91.00. The total cost of the tiles for bathroom #1 is $91.00. For bathroom #2, since I used 16 12×12 tiles, 28 3×12 tiles, and 32 3×3 tiles I can multiply these totals by the cost of each tile. Each 12×12 tile costs $1.55, so 16×1.55 = 24.80. Each 3×12 tile costs $0.70, so 28×0.70 = 19.60. Each 3×3 tile costs 0.15, so 32×0.15 = 4.80. Add all of these costs together: 24.80 + 19.60 + 4.80 = 49.20. The total cost of the tiles for bathroom 2 is $49.20.

3 Point Response:
The response demonstrates a strong understanding, but the work is incomplete or contains minor errors.

A level 3 response is characterized by:

- A strong ability to make sense of the design problem and develop a pattern that uses all three tile sizes and fits in the bathrooms correctly, thus meeting the design requirements;
- A strong understanding of area and measurement conversion demonstrated by correctly drawing the tiles on the grid and covering the grid with no overlaps or gaps;
- A strong ability to make sense of problems 3 and 4 and develop a solution strategy, but a minor counting or calculation error occurs, or the work shown is incomplete.

2 Point Response:
The response demonstrates a basic but incomplete understanding.

A level 2 response is characterized by:

- The ability to develop a pattern, but the pattern does not meet the design requirements: the pattern may use all three tile sizes but they do not fit in the bathrooms correctly; or the pattern uses less than three of the tile sizes that fit in the bathrooms correctly;
- A basic understanding of area and measurement conversion demonstrated by drawing the tiles on the grid, but two or more minor errors or one major error are made, thus having overlaps or gaps;
- An incorrect or incomplete strategy for solving problems 3 and 4 resulting in incorrect answers, but a basic understanding of how to find area and use basic operations is demonstrated;
- An explanation and an example drawn on the grid in problem 5 that shows a basic understanding of the relationship between the tile sizes, where both the explanation and drawing are either incomplete or contain a major counting or calculation error.

1 Point Response:
The response demonstrates minimal understanding.

A level 1 response is characterized by:

- A weak ability to develop a pattern, but the pattern does not meet the design requirements: the pattern may use all three tile sizes but they do not fit in the bathrooms correctly, or the pattern uses less than three of the tile sizes and does not fit in the bathrooms correctly but it covers the entire grid;
- A weak understanding of area and measurement conversion demonstrated by drawing the tiles incorrectly on the grid so that there are overlaps or gaps or the sizes of the tiles are incorrect;
- An incorrect or incomplete strategy for solving problems 3 and 4 resulting in incorrect answers, and little to no understanding of how to find area and use basic operations is demonstrated;
- An explanation and an example drawn on the grid in problem 5 that shows a weak understanding of the relationship between the tile sizes, where both the explanation and drawing contain two major counting or calculation errors or one of the parts is missing.

0 Point Response:
There is no response, or the response is off topic.

Part B

4 Point Response:
The response demonstrates a high level of understanding. The response demonstrates:

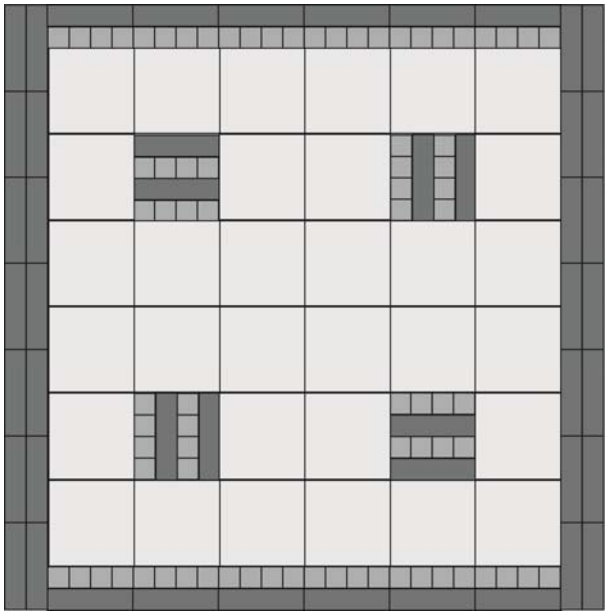
- A strong ability to adjust the solution to a problem when one of the constraints changes;
- A strong ability to check work and communicate reasoning in a clear and precise way;
- A strong ability to use area, measurement, equivalent fractions, and number and operations concepts to solve real-world problems.

A level 4 response should include:

- An explanation that shows a strong understanding as to why more than one pattern that uses all three tiles can be designed for the bathroom floors; the new pattern designed with the replacement tiles, which is clearly explained with the reasoning that the larger tiles can be replaced with a specific number of smaller tiles or vice versa because the smaller tiles are a fraction of the larger tiles or that the area of a tile or combination of tiles can be used as a way to compare why the replacement tile(s) are equivalent;
- An example that correctly replaces either a 2×2 area or four 1×1 areas of the original tile design in bathroom #1 with at least one different tile size.

Sample Response for Part B

Question 5a:
Example with replacement of tiles in four 1×1 areas:



Question 5b:
I can replace one 12×12 tile with two 3×12 tiles and eight 3x3 tiles. A 12×12 tile has an area of 144 in.^{2}. A 3x12 tile has an area of 36 in.^{2} and a 3×3 tile has an area of 9 in.^{2}. If I add 36 + 36 + 9 + 9 + 9 + 9 + 9 + 9 + 9 = (36×2) + (9×8) = 72 + 72 = 144. This shows that one 12×12 tile has the same area as two 3×12 tiles plus eight 3×3 tiles. (A student can also use the reasoning that the smaller tiles are fractions of the larger tiles.)

3 Point Response:
The response demonstrates a strong understanding, but the work is incomplete or contains minor errors.

A level 3 response is characterized by:

- An example drawn on the grid that correctly shows the required tile replacements or a drawing that is incomplete or incorrect due to a minor counting or calculation error;
- An explanation that shows a strong understanding of the relationship between the replacement of the tiles in the correctly drawn example by including important information such as area or fractional equivalencies of the tiles but the explanation may be incomplete, or the explanation may include this important information that correctly explains an incorrect example given in problem 5a.

2 Point Response:
The response demonstrates a basic but incomplete understanding.

A level 2 response is characterized by:

- An example drawn on the grid that shows tile replacements but the drawing is incomplete or contains a major counting or calculation error;
- An explanation that shows a basic understanding of the relationship between the replacement of the tiles in the example drawn due to incorrect information which includes a major counting or calculation error.

1 Point Response:
The response demonstrates minimal understanding.

A level 1 response is characterized by:

- An example drawn on the grid that shows tile replacements but the drawing is incorrect due to two or more major counting or calculation errors, or an example is not drawn but an incorrect explanation is attempted;
- An explanation that shows a weak understanding of the relationship between the replacement of the tiles in the example drawn, due to missing information or incorrect information which includes two or more major counting or calculation errors, or an explanation is not given but an incorrect example is drawn.

0 Point Response:
There is no response, or the response is off topic.

Part C

4 Point Response:
The response demonstrates a high level of understanding. The response demonstrates:

- A strong ability to make sense of a design problem and develop a solution that meets given requirements;
- A strong ability to adjust the solution to a problem when one of the constraints changes;
- A strong ability to check work and communicate reasoning in a clear and precise way;
- A strong ability to use area, measurement, and number and operations concepts to solve real-world problems.

A level 4 response should include:

- The correct total cost of the tiles for bathroom 1 and bathroom 2 with correct work shown;
- If the total cost of the tiles used is higher than $150, a complete and correct explanation for a new pattern (or an example can be drawn) for both bathrooms so that the tile cost is within the budget;
- If the total cost of the tiles used is lower than $150, a complete and correct explanation as to why certain patterns are more expensive than others (or an example of a tile pattern that has a cost greater than $150 can be drawn).

Sample Response for Part C

Since the example given in Part A has a tile design that is less than $150, a sample answer for 6b is given below.

The total cost of my tile design in bathroom #1 is $91.00. The total cost of my tile design in bathroom #2 is $49.20. The total cost for both bathrooms is $140.20. I can redesign my original pattern by replacing some of my 12×12 tiles with 3×12 tiles. I chose to take out the middle 9 12×12 tiles in bathroom #1 and replace them with 36 3×12 tiles. The 9 12×12 tiles that I took out have a total cost of $13.95 (9×1.55). The 36 3×12 that I will replace them with have a total cost of $25.20 (36×0.70). For bathroom #2, I want to keep the designs the same so I will take out the middle 4 12×12 tiles and replace them with 16 3×12 tiles. The 12×12 tiles cost $6.20 (4×1.55) and the replacement tiles cost $11.20 (16×0.70). The total cost of tiles that are taken out of the designs from both bathrooms is $20.15. So 140.20 – 20.15 = 120.05, then add the total cost of the replacement tiles, which is 36.40 (25.20 + 11.20). The final total cost is $156.45 (120.05 + 36.40), which is greater than $150.

3 Point Response:
The response demonstrates a strong understanding, but the work is incomplete or contains minor errors.

A level 3 response is characterized by:

- A strong understanding of number and operations concepts, demonstrated by developing a solution strategy in calculating the total cost of the tiles for the bathrooms, but a minor calculation error is made or the work shown is incomplete;
- A strong understanding of how to adjust the solution to create a new tile pattern with a total cost less than $150, demonstrated by a correct explanation, but the explanation may be incomplete or a minor counting or calculation error is made in a given example; or a strong understanding as to why certain patterns are more expensive than others is given but a minor counting or calculation error is made; or because of a calculation error in finding the total cost of the tiles the wrong question is answered, but it is answered completely and correctly.

2 Point Response:
The response demonstrates a basic but incomplete understanding.

A level 2 response is characterized by:

- A basic understanding of number and operations concepts, demonstrated by a response that develops a solution strategy in calculating the total cost of the tiles for the bathrooms, but two minor calculation errors are made or the work shown is incomplete;
- A basic understanding of how to adjust the solution to create a new tile pattern with a total cost less than $150, demonstrated by an explanation or an example that is incorrect because of two or more minor counting or calculation errors or one major error; or an explanation that demonstrates a basic understanding as to why certain patterns are more expensive than others, where two or more minor counting or calculation errors or one major error are made.

1 Point Response:
The response demonstrates minimal understanding.

A level 1 response is characterized by:

- A weak understanding of number and operations concepts, demonstrated by a response that develops a solution strategy in calculating the total cost of the tiles for the bathrooms, but two or more major calculation errors occur or no work is shown;
- A response that demonstrates little to no understanding of how to adjust the solution to create a new tile pattern with a total cost less than $150, demonstrated by an explanation or an example that is incorrect because of two or more major counting or calculation errors, or information is missing; or an explanation that demonstrates little to no understanding as to why certain patterns are more expensive than others where information is missing, vague, or incorrect due to two or more major counting or calculation errors.

0 Point Response:
There is no response, or the response is off topic.

Part D

4 Point Response:

The response demonstrates a high level of understanding. The response demonstrates:

- A strong ability to make sense of a design problem and develop a solution that meets given requirements;
- A strong ability to use area, measurement, and number and operations concepts to solve real-world problems;
- A strong ability to convey and support ideas and information clearly in a written plan.

A level 4 response should include:

- A plan that clearly explains the design the student made for both bathrooms and the tiles they used. Within the plan, the number of tiles Mr. Hanson needs to buy and the cost for the tiles are detailed and are within his budget, and the explanation of why the design was chosen is given;
- A plan that contains the reasoning behind the choices made by the student, accompanied by correct calculations. The choices are strongly supported with at least four sentences that clearly demonstrate a strong understanding of the thought process involved in making these decisions.

3 Point Response:
The response demonstrates a strong understanding, but the work is incomplete or contains minor errors.

A level 3 response is characterized by:

- A plan that demonstrates a strong understanding of the design the student made for both bathrooms and the number of tiles used; detailed cost for the tiles that is within Mr. Hanson's budget; the reason the student chose the tile design, though the plan may contain one or two minor errors or may be incomplete;
- A plan that contains the reasoning behind the choices made by the student but one or two minor errors are made in the calculations given; choices that are strongly supported with three or four sentences that demonstrate a strong understanding of the thought process involved in making these decisions but one or two ideas are incomplete or incorrect due to minor errors made in the calculations.

2 Point Response:
The response demonstrates a basic but incomplete understanding.

A level 2 response is characterized by:

- A plan that demonstrates a basic understanding of the design the student made for both bathrooms and the number of tiles used; detailed cost for the tiles that is within Mr. Hanson's budget; the reason the student chose the tile design, though the plan may contain more than two minor errors or one major error or may be incomplete;
- A plan that contains the reasoning behind the choices made by the student but more than two minor errors are made or one major error is made in the calculations given; choices that are supported with three or four sentences demonstrating a basic understanding in the thought process involved in making these decisions, but two or more ideas are incomplete or incorrect due to the errors made in the calculations.

1 Point Response:
The response demonstrates minimal understanding.

A level 1 response is characterized by:

- A plan that demonstrates minimal understanding of the design the student made for both bathrooms and the number of tiles used. Though the cost for the tiles is included in the plan, the plan may contain two major errors or may be incomplete;

- A plan that contains the reasoning behind the choices made by the student but two major errors are made in the calculations given. The choices are supported with three or four sentences that demonstrate a minimal understanding in the thought process involved in making these decisions but two or more ideas are incomplete or incorrect due to the errors made in the calculations.

0 Point Response:
There is no response, or the response is off topic.