Math Objectives

- Students will use visual representations of fractions to estimate the area of irregular shapes.
- Students will use arithmetic operations with mixed numbers and decimals in a real-life context.
- Students will solve real-world and mathematical problems involving the four operations with rational numbers (Computations with rational numbers extend the rules for manipulating fractions to complex fractions) (CCSS).
- Students will model with mathematics (CCSS Mathematical Practice).
- Students will make sense of problems and persevere in solving them (CCSS Mathematical Practice).
- Students will use appropriate tools strategically (CCSS Mathematical Practice).

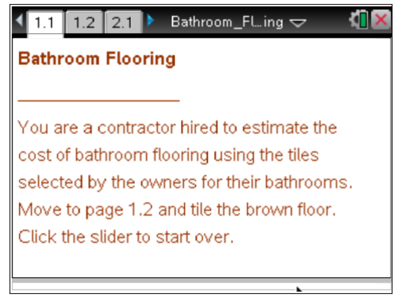
Vocabulary

- mixed number
- decimal
- rational number

About the Lesson

- This lesson involves students tiling the floors of three bathrooms with provided tiles and determining the cost of the floor based on the unit price of each tile.
- As a result, students will:
  - Use fraction pieces of tiles to completely cover the floor of each bathroom.
  - Calculate the total number of tiles used for each bathroom and represent their result as a mixed number.
  - Use the provided unit price of each tile in order to determine the total cost of materials necessary to complete the bathroom flooring job.

As an additional challenge and/or assessment, students will then be asked to design their own bathroom and estimate the cost of bathroom flooring with given tiles. The Bathroom_Design.doc and Bathroom_Design.tns files are provided for this part of the lesson.



TI-Nspire™ Technology Skills:

- Download a TI-Nspire document
- Open a document
- Move between pages
- Grab and drag a point

Tech Tips:

- Make sure the font size on your TI-Nspire handhelds is set to Medium.
- You can use Scratchpad for basic calculations by pressing

Lesson Files:

Student Activity

Bathroom_Flooring_Student.pdf
Bathroom_Flooring_Student.doc
Bathroom_Design_Student.pdf
Bathroom_Design_Student.doc
Bathroom_Design_Rubrics.pdf

TI-Nspire document

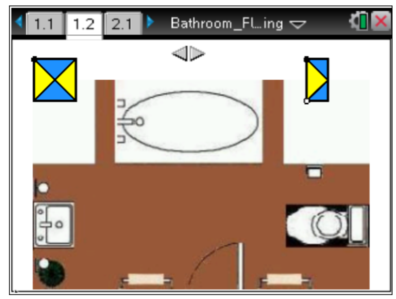
Bathroom_Flooring.tns
Bathroom_Design.tns

Visit www.mathnspired.com for lesson updates and tech tip videos.

TI-Nspire™ Navigator™ System

- Send file.
- Screen Capture
- Quick Poll
- Live Presenter

Discussion Points and Possible Answers



Read the instructions on page 1.1, and move to page 1.2.

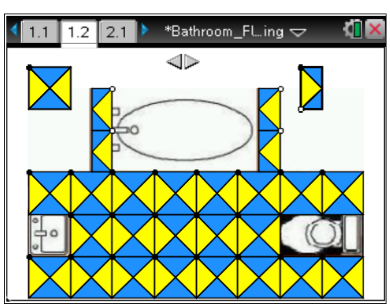
1. This guest bathroom has three permanent fixtures: bathtub, toilet, and sink. Your task is to tile the bathroom around these fixtures with the given square tiles. Grab and drag the black point on each tile to move it into the bathroom area. Grab and drag the white point to rotate the tile. Click the slider to start over.

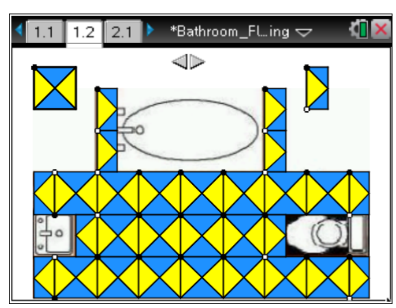
> **TI-Nspire Navigator Opportunity:** ***Screen Capture***
> **See Note 1 at the end of this lesson.**

Tech Tip: In order to rotate the tile, first move it from the "storage" area and then rotate it. The tiles will not rotate in the place where they are "stored".

Teacher Tip: Ask students how they selected tiles to cover the floor around the bathtub in order to keep the pattern. Note that students can select to use different numbers of half-tiles and whole tiles to complete the floor. If all students select the same method of tiling, ask them if another way of tiling is possible. Reinforce student understanding that two half-tiles are equivalent to one whole tile.

Sample Patterns

1. 

2. 

a. After you complete the tiling, record the number of different tile pieces you used and the fraction representation of each piece.

Sample Answers:

Tile piece	Fraction representation of the piece	Number of pieces used – pattern 1	Number of pieces used – pattern 2
	1	21	18
	$\frac{1}{2}$	4	10

Tech Tip: In order to correctly calculate the number different pieces used for tiling, suggest students move one piece at a time back to "storing area" while keeping tally.

b. Calculate the number of tiles you need for this bathroom floor. Show the process you used to do the calculations.

Answer: pattern 1: $21\times1+4\times\frac{1}{2}=21+2=23$; pattern 2: $18\times1+10\times\frac{1}{2}=18+5=23$.

There will be total of 23 tiles.

c. These tiles are sold at $35.95 per tile. What is the cost of tiling the whole floor?

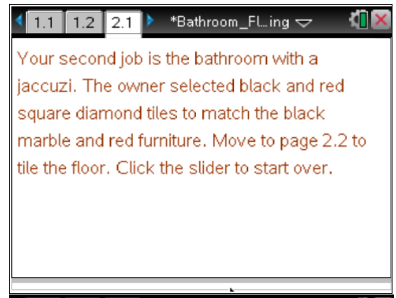
Answer: $23\times\$35.95=\$826.85$

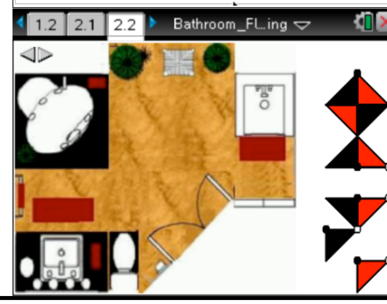
Teacher Tip: Students can use Scratchpad by pressing in order to complete calculations. In order to close Scratchpad and return to the document, click on ☒ in the upper right corner.

TI-Nspire Navigator Opportunity: ***Quick Poll***
See Note 2 at the end of this lesson.

Move to page 2.1.

Read the instructions on page 2.1, and move to page 2.2.



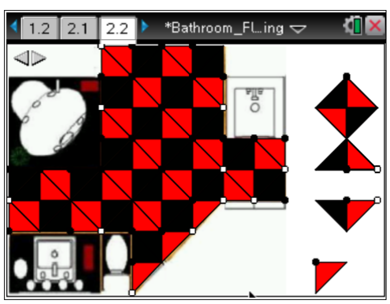


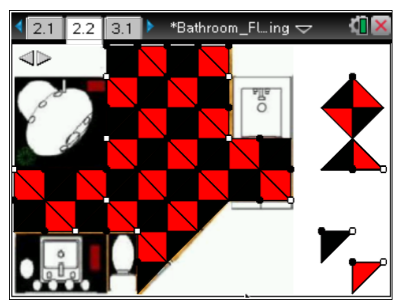
2. This deluxe bathroom has four permanent fixtures: bathtub with Jacuzzi, shower stall, toilet, and sink. Your task is to tile the bathroom around these fixtures with the given square diamond-patterned tiles. Grab and drag the black point on each piece to move it into the bathroom area. Grab and drag the white point on each piece to rotate it. Click the slider to start over.

TI-Nspire Navigator Opportunity: *Screen Capture*
See Note 1 at the end of this lesson.

Teacher Tip: In order to rotate the tile, first move it from the "storage" area and then rotate it. The tiles will not rotate in the place where they are "stored". Students might have to try different half-tile pieces to determine which piece to use in order to keep the pattern.

Sample Patterns

1. 

2. 

Teacher Tip: Ask students how they selected tiles to cover the floor around all fixtures in order to keep the pattern. With four different pieces and an irregularly shaped floor, there will be a larger variety of floor design. Select several different designs to discuss with the class. Reinforce student understanding of equivalent fractions and understanding that regardless of the design the total number of tiles should be the same as they are covering the same area.

a. After you complete the tiling, record the number of different tile pieces you used and the fraction representation of each piece.

Sample Answers:

Tile piece	Fraction representation of the piece	Number of pieces used – pattern 1	Number of pieces used – pattern 2
	1	10	11
	$\frac{1}{2}$	12	12
	$\frac{1}{4}$	4	1
	$\frac{1}{4}$	3	2

b. Calculate the number of tiles you need for this bathroom floor. Show the process you used to complete the calculations.

Answer: pattern1: $10\times 1+12\times\frac{1}{2}+7\times\frac{1}{4}=10+6+1\frac{3}{4}=17\frac{3}{4}$; pattern 2:
$11\times 1+12\times\frac{1}{2}+3\times\frac{1}{4}=11+6+\frac{3}{4}=17\frac{3}{4}$.

There will be total of $17\frac{3}{4}$ tiles.

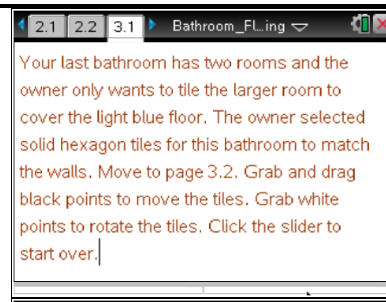
c. These tiles are sold at $40.50 per tile. What is the cost of tiling the whole floor?

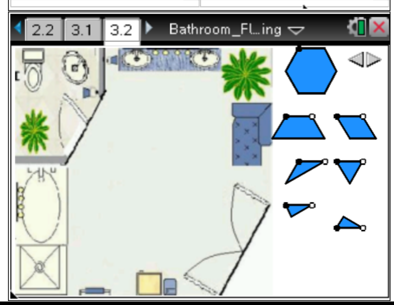
Answer: $17\frac{3}{4}\times\$40.50=\$718.875\approx\$718.88$

Teacher Tip: Encourage students to explain how they used the calculator to find the cost. For the number of tiles, they can use $\left(17+\dfrac{3}{4}\right)$ multiplied by the price of the tile, or they can use a decimal representation of the mixed number, 17.75 and multiply that by the price of the tile. The exact product is $718.875. Ask students to interpret the answer in the context of the problem. Students should realize that the answer should be rounded up so the price can be stated in dollars and cents.

TI-Nspire Navigator Opportunity: ***Quick Poll***
See Note 2 at the end of this lesson.

Move to page 3.1.
Read the instructions on page 3.1, and move to page 3.2.





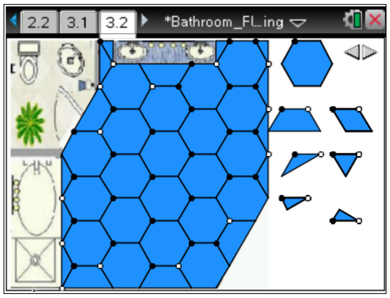
3. This luxury master bathroom has two rooms. The small toilet room has already been tiled, so your job is to tile the floor in the large room. This room has a Jacuzzi bath with attached cabinet and a double sink. Your task is to tile this room around the fixtures with the given hexagon tiles. Grab and drag the black point on each piece to move it into the bathroom area. Grab and drag the white point on each piece to rotate it. Click the slider to start over.

TI-Nspire Navigator Opportunity: ***Screen Capture***
See Note 1 at the end of this lesson.

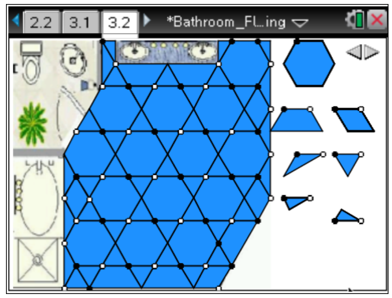
Teacher Tip: Suggest students start with whole tiles and place them on the floor and only then complete the empty spaces with the fraction pieces. Encourage them to think of different patterns. They might not have enough pieces for a different pattern to model it, but they can start it and calculate the number of pieces needed.

Sample Patterns

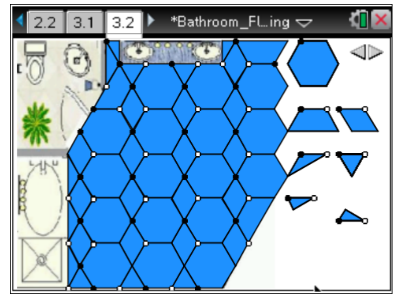
1.



2.



3.



a. After you complete the tiling, record the number of different tile pieces you used and the fraction representation of each piece.

Sample Answers:

Tile piece	Fraction representation of the piece	Number of pieces used – pattern 1	Number of pieces used – pattern 2	Number of pieces used – pattern 3
	1	21	14	17
	$\frac{1}{2}$	5	5	3
	$\frac{1}{3}$	0	4	16
	$\frac{1}{6}$	0	34	5
	$\frac{1}{6}$	7	7	4 + (-3)
	$\frac{1}{12}$	3	3	2 + (-1)

Teacher Tip: In pattern 3, we need to cut the left-most tiles in order to fit them along the wall, thus we count pieces we cut as negative. Use the idea of cutting the tiles to reinforce the skills of subtracting the mixed numbers.

b. Calculate the number of tiles you need for this bathroom floor. Show the process you used to complete the calculations.

Answer:

Pattern 1: $21\times1+5\times\frac{1}{2}+7\times\frac{1}{6}+3\times\frac{1}{12}=21+2\frac{6}{12}+1\frac{2}{12}+\frac{3}{12}=24\frac{11}{12}$

Pattern 2:

$14\times1+5\times\frac{1}{2}+4\times\frac{1}{3}+(34+7)\times\frac{1}{6}+3\times\frac{1}{12}=14+2\frac{6}{12}+1\frac{4}{12}+6\frac{10}{12}+\frac{3}{12}=23\frac{23}{12}=24\frac{11}{12}$

Pattern 3:

$17\times1+3\times\frac{1}{2}+16\times\frac{1}{3}+(5+4-3)\times\frac{1}{6}+(2-1)\times\frac{1}{12}=17+1\frac{6}{12}+5\frac{4}{12}+1+\frac{1}{12}=23\frac{23}{12}=24\frac{11}{12}$

There will be total of $24\frac{11}{12}$ tiles with any design.

c. These tiles are sold at $24.99 per tile. What is the cost of tiling the whole floor?

Answer: $24\frac{11}{12}\times\$24.9==\$622.668\approx\$622.67$

Teacher Tip: Discuss with the students the reasons why different patterns lead to the same result. Help students to make the connection between the number of tiles and the area of the room that needs to be covered. Since we cover the same area and the area of a whole tile is fixed, the total number of tiles can be found as the area of the room divided by the area of a hexagon. Thus any configuration of tiles will require the same number of tiles.

TI-Nspire Navigator Opportunity: *Quick Poll*
See Note 2 at the end of this lesson.

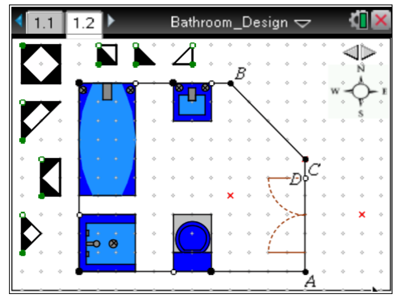
Wrap Up

Upon completion of the lesson, the teacher should ensure that students are able to understand:

- How to model a real-life situation with mixed numbers and decimals.
- Basic operations with mixed numbers and decimals.
- How to interpret results in the context of the situation.

Assessment

Open the TI-Nspire document *Bathroom_Design.tns.*
The Bathroom Design project is an optional assessment tool for this lesson. In this assessment project, students can design their own bathrooms and determine the cost of tiling the floor of the bathroom. This activity involves students changing the size of the bathroom, moving and rotating bathroom fixtures, and then tiling the floor around the fixtures. These tasks allow teachers to assess students' skills in solving real-world problems that require the use of the four operations with rational numbers.



Move to page 1.2.

1. Choose the size and shape of the bathroom by adjusting the position and shape of the east wall.
   a. Grab and drag point A to change the length of the south wall of the bathroom.
   b. Grab and drag point B to change the length of the north wall of the bathroom.
   c. Grab and drag point C to change the position of the corner on the east wall of the bathroom. Note that only positions marked with "red cross" are allowed for the corner C.
   d. Grab and drag point D along the east wall to position the doors to the bathroom.
2. You are given four bathroom pieces: a bathtub, a shower stall, a toilet, and a sink. These will become permanent fixtures after you install them. Place bathroom pieces inside your bathroom.
   a. Grab and drag the black point on each bathroom piece in order to move it.
   b. Grab and drag the white point on each bathroom piece in order to rotate it.
3. Use provided tiles to cover the floor of the bathroom around the bathroom pieces.
   a. Grab and drag the green point on each tile piece in order to move it.
   b. Grab and drag the white point on each tile piece in order to rotate it.

TI-Nspire Navigator Opportunity: *Screen Capture and Live Presenter*
See Note 3 at the end of this lesson.

4. After you complete the tiling, record the number of different tile pieces you used and the fraction representation of each piece

Tile piece	Fraction representation of the piece	Number of pieces used to tile the floor of the bathroom
	1	
		
		
		
		
		
		

5. Given the price of the tile is $30, estimate the cost of tiling the floor of your bathroom.
   a. Calculate the total number of tiles you used to cover the floor. Show the process you used to do the calculations.
   b. Estimate the number of tiles needed to cover the remaining free space (if any). Explain the process you used to do the estimation.
   c. Estimate the total number of tiles and determine the approximate cost of tiling the floor of the bathroom.

Teacher Tip: Since students have an option to change the size of the bathroom and place the bathroom pieces anywhere in the room with various orientations, the available tile pieces might not completely cover the open floor in the student-designed bathroom. Thus, students will need to estimate the number of tiles needed to cover all floor space. Encourage students to use the grid and concept of an area in order to perform the estimation. Here are the steps that students can follow in order to verify their estimation:

- Find the area of the bathroom in square units (we will call it A).

- Find the total area that will be covered by bathroom pieces (we will call it B).
- Find the area of the floor that needs to be covered by tiles (calculate as A – B).
- Find the area of a single tile (we will call it C).
- Find the total number of tiles (calculate as $\frac{A-B}{C}$).

The rubric that could be used for assessment of students' projects is included with the teacher materials for this activity.

TI-Nspire Navigator

Note 1

Use *Screen Capture* to display student designs. Have students explain their designs. Encourage students to explain their choices of tile pieces and their orientation in order to create a specific pattern on the floor of each bathroom.

Note 2

Use the Open Response option in *Quick Poll* to collect student answers to questions. For each bathroom, ask students to submit the number sequence they used to calculate the number of tiles, the total number of tiles, and the cost of tiling the floor. Use their answers to generate discussion of using rational numbers in calculations.

Note 3

Use *Live Presenter* for students to explain how they designed their bathrooms and how they estimated the number of tiles needed to tile the floor. Use *Screen Capture* to compare different designs and costs.