



Addition and Subtraction of Rational Numbers—Part 1

MATH NSPIRED



TEACHER NOTES

Math Objectives

- Students will use interactive models and pattern blocks to model positive mixed numbers and the sums and differences of positive mixed numbers.
- Students will understand subtraction of mixed numbers as adding the additive inverse.
- Students will model with mathematics (CCSS Mathematical Practice).

Vocabulary

- rational number
- equivalent fractions
- mixed numbers

About the Lesson




- This lesson involves using pattern blocks to model addition and subtraction of positive mixed numbers for randomly generated numeric expressions.
- As a result, students will:
 - Use pattern blocks to model addition and subtraction of positive mixed numbers.
 - Calculate sums and differences, and use the TI-Nspire to check the accuracy of their calculations.

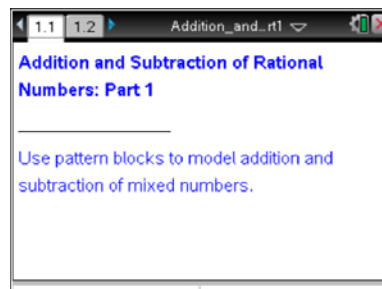


TI-Nspire™ Navigator™

- Send file to students.
- Use Class Capture to examine patterns that emerge.
- Use Live Presenter to debrief solutions.
- Use Quick Poll to assess students' understanding.

Activity Materials

- Compatible TI Technologies:  TI-Nspire™ CX Handhelds,  TI-Nspire™ Apps for iPad®,  TI-Nspire™ Software
- Colored pencils (optional)
- Pattern Blocks (optional)



Tech Tips:

- This activity includes screen captures taken from the TI-Nspire CX handheld. It is also appropriate for use with the TI-Nspire family of products including TI-Nspire software and TI-Nspire App. Slight variations to these directions may be required if using other technologies besides the handheld.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at <http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials>

Lesson Files:

- Add_Sub_Rational_Numbers_Part1_Student.pdf
- Add_Sub_Rational_Numbers_Part1_Student.doc
- Add_Sub_Rational_Numbers_Part1_Supplement.pdf (optional)
- Add_Sub_Rational_Numbers_Part1.tns



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Discussion Points and Possible Answers



Tech Tip: Due to the rich graphic environment, it might take a little longer than usual to transfer the *Add_Sub_Rational_Numbers_Part1.tns* file to student handhelds and/or for students to open the file on the handheld. Instruct students to be patient and avoid clicking additional keys once they have clicked on the file to open. After the document is open, there should be no delays as students work with the document. The teacher should try this activity on the handheld before using this activity with students.

Teacher Tip: The two parts of this activity can be used as a single lesson or independently at different times.

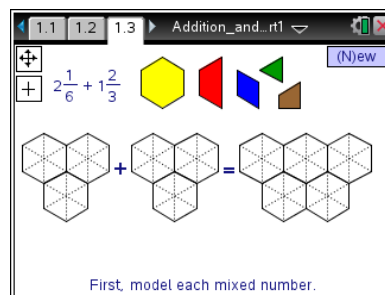
Teacher Tip: It is recommended that students have prior experience with physical pattern blocks prior to this activity. The amount of previous student experience with the pattern blocks will determine how much pre-teaching is required. It is also recommended that the teacher model at least one addition and one subtraction problem with physical pattern blocks before beginning this activity. (see *Add_Sub_Rational_Numbers_Part1_Supplement.pdf* for more details and examples).

Page 1.3 will help you model addition and subtraction of mixed numbers. It is divided into two work areas:

- In the top work area, you are given an expression to evaluate and a set of pattern blocks.
- The bottom work area is reserved for modeling the problem by using these pattern blocks.
- The message at the bottom of the page gives you suggestions for the next step in order to evaluate the given expression.

Move to page 1.3.

1. Consider the yellow hexagon to have a value of 1. For each shape shown on page 1.3, record the value of the fractional representations in the table below.










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Answer:

Pattern Block	Fraction
	1
	$\frac{1}{2}$
	$\frac{1}{3}$
	$\frac{1}{4}$
	$\frac{1}{6}$

To model the problems using the pattern blocks:

- Move a pattern block from the top work area by grabbing and dragging to the desired location.
- After blocks are moved from their initial position, they can be rotated selecting the tool box on the top box on the left to change to the rotation tool and selecting a tile.
- For each correctly modeled mixed number, you will receive a checkmark.
- For each problem, show your solution on this worksheet using colored pencils.

Students can generate a new problem by selecting **(N)ew** at the top right side of the screen. The problems are generated randomly. Students can change from addition to subtraction problems by selecting $+$ or $-$ at the top left side of the screen. The message at the bottom of the screen will display the steps of modeling each number in the expression. As blocks are moved into each addend area, the value of the model will appear below. As each addend is modeled correctly, a checkmark will appear. As students model the answer, the message *Keep Trying!* will appear. When students model the result of the operation correctly, the message will display *Great! You did it!*



Tech Tip: The pattern blocks can be moved by clicking once on the block, moving the cursor to the desired location and clicking once again. After blocks are moved from their initial position, they can be rotated by clicking on the top box on the left and clicking on a tile.



Tech Tip: The pattern blocks can be moved by tapping and dragging the block and selecting anywhere else to de-select the block. After blocks are moved from their initial position, they can be rotated by selecting the top box on the left and selecting a tile.



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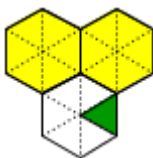
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Teacher Tip: When the TI-Nspire document is first opened, all students will have the same first problem: $2\frac{1}{6} + 1\frac{2}{3}$, which gives you the opportunity to have a whole class discussion about modeling the process of solving the first problem. The new problems are generated randomly so different students might end up with different problems. This gives you an opportunity to select a few students to share their solutions. Another possibility would be to put students in small groups and ask each group to share their solutions. Once you have generated new problems, you can always go back to the first problem by selecting the left arrow until you can no longer do so.

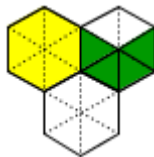
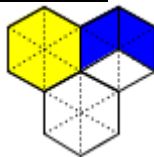
2. Find the value of $2\frac{1}{6} + 1\frac{2}{3}$ using the pattern blocks on page 1.3.
- a. Which pattern blocks did you use to model the first mixed number?

Answer: : two hexagons and one triangle



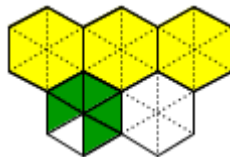
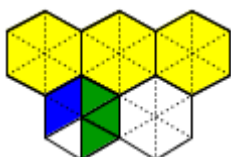
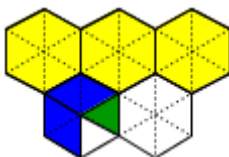
- b. Which pattern blocks did you use to model the second mixed number?

Answer: one hexagon and two rhombi **or** one hexagon and four triangles



- c. Which pattern blocks did you use to model the sum of the two mixed numbers?

Answer: three yellow hexagons plus one green triangle and two blue rhombi **or** three green triangles and one blue rhombus **or** six green triangles





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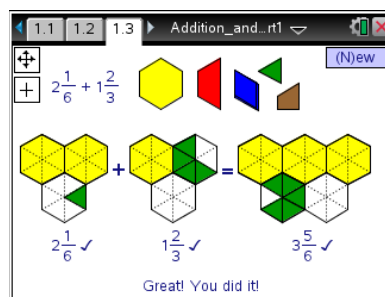
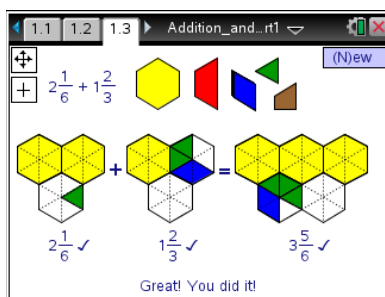
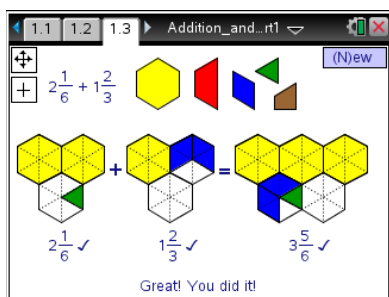
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- d. Explain how your visual representation of the sum is equivalent to the numerical representation of the sum.

Answer: $\frac{2}{3} + \frac{1}{6} = \frac{2}{3} \cdot \frac{2}{2} + \frac{1}{6} = \frac{4}{6} + \frac{1}{6} = \frac{5}{6}$ or $\frac{1}{3} + \frac{3}{6} = \frac{1}{3} \cdot \frac{2}{2} + \frac{3}{6} = \frac{5}{6}$; These are the same because the fractions $\frac{1}{3}$ and $\frac{2}{6}$ are equivalent. This can be seen from the visual representation that two green triangles fully cover one blue rhombus. Since these two fractions are equivalents, we can use the common denominator method to add these fractions.



TI-Nspire Navigator Opportunities

Use Quick Poll to determine students' understanding of fraction representations of pattern blocks.

Sample questions to ask:

- If the large red trapezoid has a value of 1, what is the value of the green triangle?
- If the small brown trapezoid has a value of $\frac{1}{2}$, what is the value of 4 small brown trapezoids?
- If two yellow hexagons adjacent at one edge have a value of 1, what is the value of the green triangle?

Teacher Tip: The most natural solution for students will be to use the blocks they had in the addends to model the sum (as shown in the screenshots above). Have students explain how their pattern block representation is equivalent to the numerical representation given by the technology. If all students provide the same solution, ask students if they can think of different representations of the sum. Students should explain why the fractional parts of all the representations are equivalent. If some students solve the problem differently, give them the opportunity to present their models and to explain why their representations are equivalent. After this discussion, students should be able to explain why a common denominator is usually found when adding and subtracting fractions.



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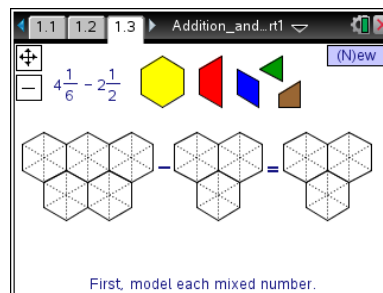
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3. Select the **(N)ew** box in the top right corner of page 1.3 to get a new addition problem. Record your problem below. Find the value of your new problem using the pattern blocks on page 1.3, and answer the questions below. Record your calculation sequence and numerical answer for all parts of this problem.

Record your problem:



- Which pattern blocks did you use to model the first mixed number?
- Which pattern blocks did you use to model the second mixed number?
- Which pattern blocks did you use to model the sum of the two mixed numbers?
- Explain how your visual representation of the sum is equivalent to the numerical representation of the sum.

Sample Answers: Student answers will vary since the problems are randomly generated on each handheld.



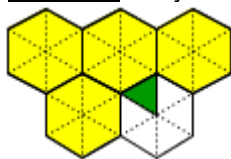
TI-Nspire Navigator Opportunities

Use Quick Poll to evaluate students understanding of equivalent fractions, using common denominators, adding up to an integer and additive inverses; use Class Capture to sort the solutions of each group; and use Live Presenter to allow each group to debrief their solutions.

4. Select the bottom box in the top left corner of page 1.3 to generate the subtraction problem, $4\frac{1}{6} - 2\frac{1}{2}$. Evaluate the difference, and answer the questions below (use colored pencils to record your block patterns).

- Which pattern blocks did you use to model the first mixed number?

Answer: four yellow hexagons and one green triangle



- Which pattern blocks did you use to model the second mixed number?



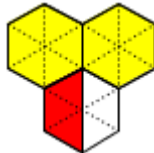
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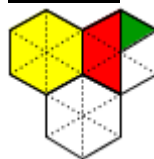


Answer: two yellow hexagon and one large red trapezoid



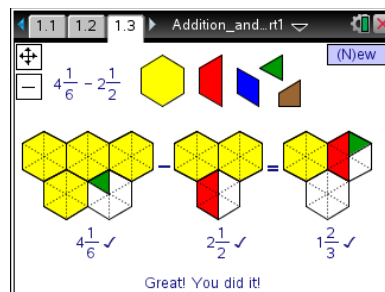
c. Which pattern blocks did you use to model the difference of the two mixed numbers?

Answer: one yellow hexagon, one large red trapezoid, and one green triangle



d. Explain how your visual representation of the difference is equivalent to the numerical representation of the sum.

Answer: $3 \cdot \frac{1}{6} + \frac{1}{6} = \frac{3}{6} + \frac{1}{6} = \frac{4}{6} = \frac{2}{3}$; Therefore, the difference is 1 units and $\frac{2}{3}$ of a unit.



Teacher Tip: Students might choose to use two large red trapezoids in place of one or more hexagons or four green triangles instead of two blue rhombi. Also, the location of each block can vary.

Teacher Tip: As stated earlier, problems are randomly generated from this point forward. If you need to return to the original problem, select the left arrow until you cannot do so anymore. Since it is possible students could be working several different problems, you might want to assign students to groups to limit the number of problems to be discussed.



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5. Select the **(N)ew** box in the top right corner of page 1.3 to generate a new subtraction problem. Record your problem below. Find the value of your new problem using the pattern blocks on page 1.3, and answer the questions below. Record your calculation sequence and numerical answer for all parts of this problem.

Record your problem:

- Which pattern blocks did you use to model the first mixed number?
- Which pattern blocks did you use to model the second mixed number?
- Which pattern blocks did you use to model the difference of the two mixed numbers?
- Explain how your visual representation of the difference is equivalent to the numerical representation of the difference.

Sample Answers: Student answers will vary.



TI-Nspire Navigator Opportunities

Use Quick Poll to evaluate students understanding of equivalent fractions, using common denominators, adding up to an integer and additive inverses; use Class Capture to sort the solutions of each group; and use Live Presenter to allow each group to debrief their solutions.

Wrap Up

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

- How to use equivalent fractions and common denominators for the addition and subtraction of signed mixed numbers.
- How to generalize the results of addition and subtraction of signed mixed numbers.

Assessment

Generate new problems using TI-Nspire documents. Use questions provided in the lesson for these problems to assess students' understanding of addition and subtraction of signed mixed numbers.