

Lab 7

Addition and Subtraction of Fractional Numbers

Objectives:

1. The teacher will understand how to create single unit models (models for 1) that can be used to model more than one fraction at a time. The teacher will do this as a preliminary step to modeling the addition or subtractions of fractional numbers.
 2. The teacher will explore adding and subtracting fractions using wooden blocks, Geoboards and Cuisenaire Rods.
 3. The teacher will use appropriate fraction terminology and appropriate manipulative terminology when describing how to modeling fraction addition and subtraction with manipulatives.
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Terms and Ideas to Know

- Two fractions are **LIKE FRACTIONS** if they have the same denominator. To add or subtract like fractions we add or subtract the numerators.

Examples

i. $[1/5] + [2/5] = [3/5]$ ($3 = 1 + 2$)

ii. $[3/5] - [1/5] = [2/5]$ ($2 = 3 - 1$)

- Two fractions are **UNLIKE FRACTIONS** if they do not have the same denominator. To add or subtract unlike fractions we must first rewrite them with common denominators.

Examples

i. $[1/3] + [1/4] = [4/(12)] + [3/(12)] = 7/(12)$

ii. $[1/3] - [1/4] = [4/(12)] - [3/(12)] = 1/(12)$

- A **COMMON DENOMINATOR** for two unlike fractions is a new denominator that both fractions share. The common denominator for two fractions is also a common multiple of the two denominators. All unlike fractions can be rewritten with many different common denominators.
- The easiest way to find one common denominator is to just multiply the (unlike) denominators.

Examples:

- i. One common denominator for $1/3$ and $1/4$ is 12 since $[3 \times 4 = 12]$.
- ii. One common denominator for $1/3$ and $1/6$ is 18 since $[3 \times 6 = 18]$.
- iii. One common denominator for $1/6$ and $1/8$ is 48 since $[6 \times 8 = 48]$.

- Although, we can always find a common denominator by multiplying the two (unlike) denominators, we prefer to find the **Least Common Denominator (or LCD)**. For two unlike fractions, the **LCD** is the smallest of all common denominator. The LCD of two fractions is also the LCM of the two denominators. Unlike fractions have only least common denominator.

Examples:

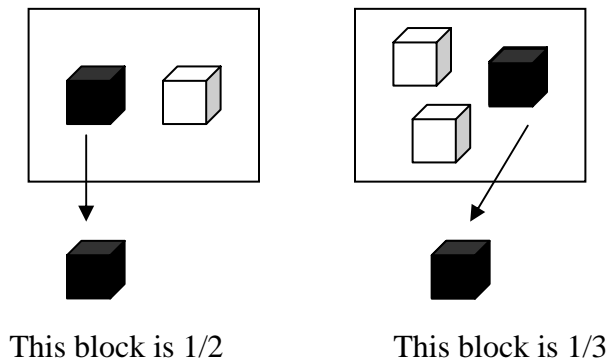
- i. One common denominator for $1/3$ and $1/4$ is 12 and, in fact, this is the Least Common Denominator for $1/3$ and $1/4$.
- ii. One common denominator for $1/3$ and $1/6$ is 18. However, since $[1/3] = [2/6]$, 6 is also a common denominator, and, in fact, is the Least Common Denominator for $1/3$ and $1/6$.
- iii. One common denominator for $1/6$ and $1/8$ is 48. However, since $[1/6] = [4/(24)]$ and $[1/8] = [3/(24)]$, 24 is also a common denominator, and, in fact, is the Least Common Denominator for $1/6$ and $1/8$.

TOPIC: ADDITION AND SUBTRACTION OF FRACTIONS

➤ **Materials: WOODEN CUBES**

1.

- a. Suppose one of your students comes to you and says: “Look at these cubes, I think I have figured our fractions. This shows that $[1/2] + [1/3] = [2/5]$!” (The arrows indicate which blocks they are pointing to.)



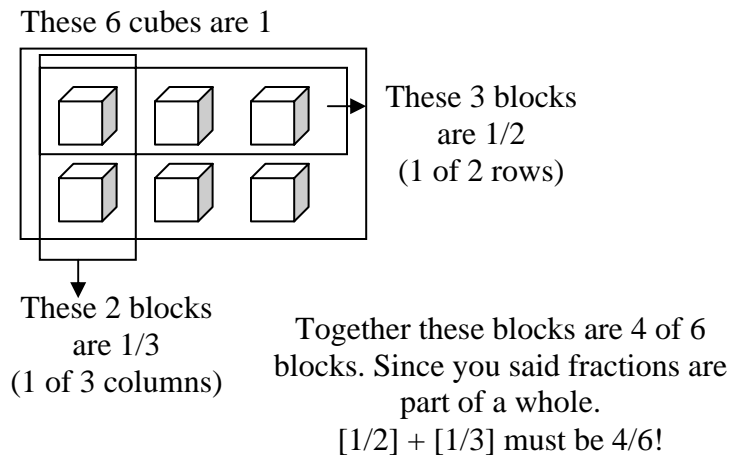
Together these blocks are 2 of 5
blocks. Since you said fractions are
part of a whole.

$$[1/2] + [1/3] \text{ must be } 2/5!$$

As a group:

- Determine what your student did incorrectly and
- Briefly discuss ideas for the correct solution path and jot notes here. Don't model the solution path, this will be explored in the rest of this lab.

- b. Suppose your student now comes to you and says: “OK, now I get the idea of “This is One” I think I have figured our fractions now! This shows that $[1/2] + [1/3] = [4/6]$!” (The arrows indicate which blocks they are pointing to.)



As a group:

- Determine what your student did incorrectly and
- Briefly discuss ideas for the correct solution path and jot notes here. Don't model the solution path, this will be explored in the rest of this lab.

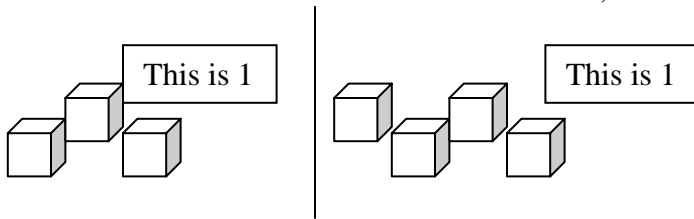
End note for #1:

- The idea behind this problem is to get you to re-think the importance of setting the model for 1 and to think about carefully using the model for 1.
- To help keep track of “What’s 1?” while modeling fraction operations it helps to always “set aside” (separate from the modeling of the fractions and the operation) the model for 1. As a group, for each problem in this lab, please use your “This is One” circle to “set aside” your model for 1.

2. As a group, use wooden blocks and work through these steps to model the addition of $[1/3] + [1/4]$.

$$[1/3] + [1/4] = ?$$

a. We need to model $1/3$ and we need to model $1/4$, that is, we need to model thirds and fourths first.



Neither of these models seems like it will work for BOTH thirds and fourths. So this is **NOT** the correct place to start. These two models are shown here to show that they **DON'T WORK** and should not usually be part of your modeling. Let's try this:

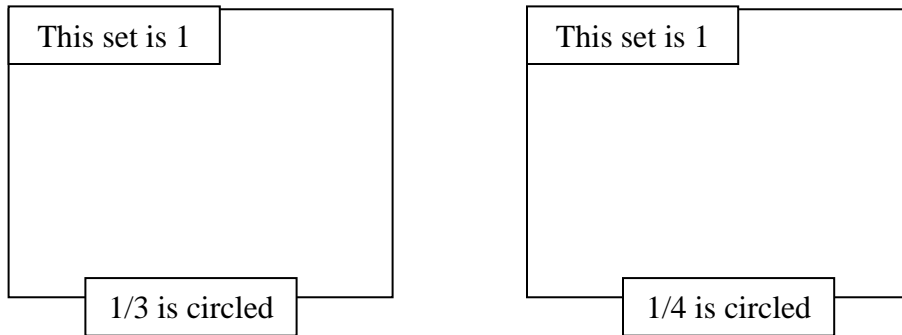
This is 1

Fill in with the correct number of cubes:

Put the correct number of blocks in your "This is One" circle for reference.

The value of each block is: _____

b. Now model $1/3$ and model $1/4$ separately to make sure your model for 1 works here. Set your model up so that $1/3$ looks like 1 of 3 parts and $1/4$ looks like 1 of 4 parts



c. Now we will model $1/3$ and we will model $1/4$ together—and we will be careful to keep the models disjoint (non-overlapping). (Circle and label both $1/3$ and $1/4$ here.)

This set is 1

Looking at the model for one we see: The value of each block is: _____

d. We can now count our blocks, look at our model for 1 (still in our "This is One" circle) and see that

$$[1/3] + [1/4] = \underline{\hspace{2cm}}$$

3. As a group, use the wooden blocks to model and solve the following. Draw clear, well-labeled pictures of your work. (Don't forget to use your "This is One" circle)

$$[1/6] + [3/8] = \underline{\hspace{2cm}} ?$$

The value of each
block is:

4. Fraction Addition Guide (Wooden Cubes)

As a group write a *brief summary* of the steps that you need to show to clearly model fraction addition. Use your previous work as a guide and check to make sure you have all of the steps that a student would need to follow your procedure. **Use the terms addend and sum.**

5. *Practice Using Your Guide:*

As a group, use the wooden blocks to model the following. Draw clear, well-labeled pictures of your work. (Don't forget to use your "This is One" circle)

$$[2/3] + [1/6] = \underline{\hspace{2cm}} ?$$

The value of each
block is:

6. As a group, explore how to use the wooden blocks to model $[2/3] - [1/6] = ?$
Draw clear, well-labeled pictures of your work here. (Don't forget to use your "This is One" circle)

The value of each
block is: _____

7. As a group write a *brief summary* of the steps that you need to show to clearly model fraction subtraction. Use your previous work as a guide and check to make sure you have all of the steps that a student would need to follow your procedure. Use the terms minuend, subtrahend and difference.

Fraction Subtraction Guide (Wooden Cubes)

8. *Practice Using Your Guide:*

As a group, use the wooden blocks to model the following. Draw clear, well-labeled pictures of your work. (Don't forget to use your "This is One" circle). To model $4/3$ you will need two copies of the model for 1.

$$[4/3] - [1/6] = \text{_____} ?$$

The value of each
block is: _____

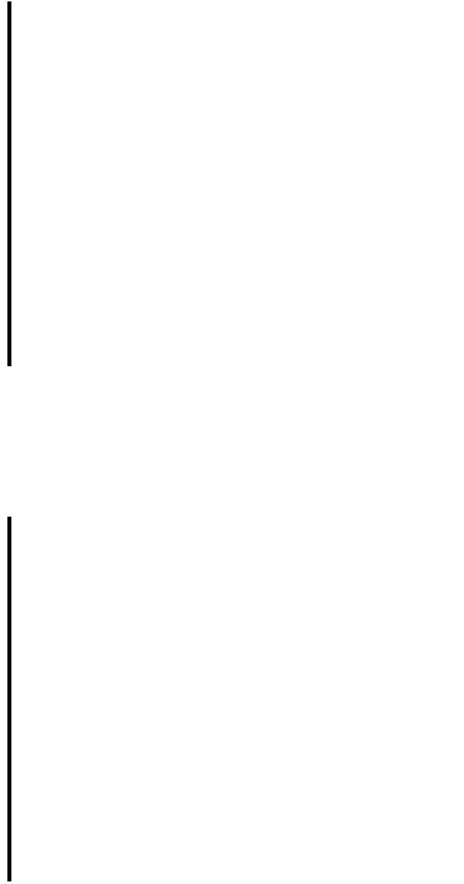
TOPIC: ADDITION OF FRACTIONS

➤ *Materials: GEOBOARDS*

9. As a group, explore how to use a Geoboard to model $[1/2] + [1/3] = ?$

Draw a clear, well-labeled picture of your work here. (Instead of using a “This is One” circle, use a separate Geoboard (the “This is 1 board” to keep a model of 1 for reference)

- As a group decide how many Geoboard pictures to draw for this problem.



The value of each square is: _____

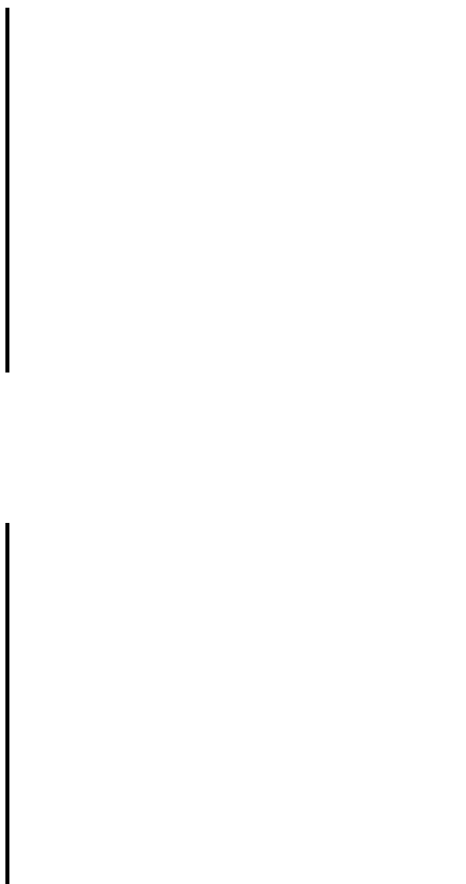
10. As a group write a *brief summary* of the steps that you need to show to clearly model fraction addition with a Geoboard. Use your previous work as a guide and check to make sure you have all of the steps that a student would need to follow your procedure. Use the terms addends and sum.

Fraction Addition Guide (Geoboards)

11. *Practice Using Your Guide:*

As a group, use a Geoboard to model the following. Draw a clear, well-labeled picture of your work. (Don't forget to use your "This is One" board for reference)

$$[3/(16)] + [2/8] = \underline{\hspace{2cm}} ?$$



The value of each square is:

12. How does your *Fraction Addition Guide for Wooden Cubes* compare to your *Fraction Addition Guide for Geoboards*? As a group discuss which components are the same and which components are different and summarize your discussion here:

Note: Geoboards can also be used for subtracting fractions.

TOPIC: FRACTION ADDITION AND SUBTRACTION

➤ **Materials: CUISENAIRE RODS**

13. As a group, use Cuisenaire Rods and work through the following to model $[1/6] + [1/8]$.

a. We wish to model $1/6$ (sixths) and we wish to model $1/8$ (eighths). We know the LCM (6, 8) = 24 and so we know the LCD ($1/6, 1/8$) = _____.

b. We wish to use a train that is _____ whites long to model sixths and a second train (still _____ whites long) to model eighths.

These two trains look like this (use Cuisenaire Rods to model and fill in the colors here):

This train is 1													
Orange				Orange				Purple					
1/6													
1/8												Leave this model intact throughout this problem	

c. We now wish to use this model to rewrite $1/6$ and $1/8$ as like fractions..

In our model this rod represents $1/6$ (fill in the color):

Since 1 is a train that is 24 whites long and this rod is _____ whites long, we can rewrite $1/6$ as: _____

In our model this rod represents $1/8$ (fill in the color):

Since 1 is a train that is 24 whites long and this rod is _____ whites long, we can rewrite $1/8$ as: _____

d. We now wish to add $1/6$ and $1/8$. We leave our previous model intact for reference, thus:

- **FIRST** we make a **NEW** (2nd) model for 1
- **SECOND** we line up the rods for $1/6$ and $1/8$ to model this (fill in the like fractional names for $1/6$ and $1/8$):

This train is 1													
Orange				Orange				Purple					
_____ Purple		_____ LG											
Black Rod fits here													

This train models $[1/6] + [1/8]$
 This train models the solution to $[1/6] + [1/8]$

The value of the white rod is: _____

Since 1 is a train that is 24 whites long and the black rod is _____ whites long we now know that $[1/6] + [1/8] = \underline{\hspace{2cm}}/24$

14. As a group:

- Write a *brief summary* of the steps that you need to show to clearly model fraction addition with Cuisenaire Rods. Use your previous work as a guide. Use the terms addends and sum.
- You may wish to combine some steps, but be very clear. You must include finding the LCD of two unlike fractions, finding the model for 1, modeling the fractions with one train set and modeling the fraction addition with a different train set.
- Check to make sure you have all of the steps that a student would need to follow your procedure.

Fraction Addition Guide (Cuisenaire Rods)

15. How does your *Fraction Addition Guide for Cuisenaire Rods* compare to your *Fraction Addition Guides for Wooden Cubes and Geoboards*? As a group discuss which components are the same and which components are different and summarize your discussion here:

16. *Practice Using Your Guide:*

As a group, use Cuisenaire Rods to model the following. Draw a clear, well-labeled picture of your work. Don't forget to always use your model (train) for 1 in both parts (find the fractions, show the addition) of your problem.

a. $[2/3] + [1/6]$

The value of the
white rod is: _____

b. $[\frac{2}{5}] + [\frac{1}{3}]$

The value of the
white rod is: _____

c. $[\frac{5}{6}] + [\frac{2}{9}]$

The value of the
white rod is: _____

17. As a group, explore how to use a Cuisenaire Rods to model $[\frac{5}{6}] - [\frac{1}{4}] = ?$

Draw a clear, well-labeled picture of your work. Don't forget to always use your model (train) for 1 in both parts (find the fractions, show the subtraction) of your problem. Be sure to include finding the LCD in your work.

The value of the
white rod is: _____

18. As a group write a *brief summary* of the steps that you need to show to clearly model fraction subtraction with Cuisenaire Rods. Use your previous work as a guide and check to make sure you have all of the steps that a student would need to follow your procedure. Use the terms minuend, subtrahend and difference.

Fraction Subtraction Guide (Cuisenaire Rods)

19. How does your *Fraction Subtraction Guide for Cuisenaire Rods* compare to your *Fraction Subtraction Guide for Wooden Cubes*? As a group discuss which components are the same and which components are different and summarize your discussion here:

20. *Practice Using Your Guide:*

As a group, use Cuisenaire Rods to model the following. Draw a clear, well-labeled picture of your work. Don't forget to always use your model (train) for 1 in both parts (find the fractions, show the subtraction) of your problem.

a. $[\frac{2}{3}] - [\frac{1}{4}]$

The value of the
white rod is: _____

b. $[2/5] - [1/10]$

The value of the
white rod is: _____

c. $[5/6] - [2/9]$

The value of the
white rod is: _____

LAB SEVEN DISCUSSION QUESTIONS

As a group, discuss and fill in the blank arrows. Feel free to also discuss/talk with the other groups.

What manipulatives could be used for ADDING AND SUBTRACTING FRACTIONS?

- Blocks
- Cuisenaire Rods
- Geoboards
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-
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What mathematical knowledge would you want your students to KNOW prior to introducing ADDING AND SUBTRACTING FRACTIONS?

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What mathematical knowledge would you want to EMPHASIZE while introducing ADDING AND SUBTRACTING FRACTIONS?

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