

Lab 8

Multiplication Models for Fractions

Objectives:

- Given any sentence of the form (a/b) of $c = \boxed{?}$ or (a/b) of $\boxed{?} = c$ where a, b & c are whole numbers with b nonzero, the teacher will model a solution with wooden blocks and Cuisenaire Rods.
- Given any sentence of the form (a/b) of $(c/d) = \boxed{?}$ where a, b, c & d are whole numbers with b and d nonzero, the teacher will model a solution with wooden blocks and Cuisenaire Rods.

TOPIC: MULTIPLYING A WHOLE NUMBER BY A FRACTION $[a/b]$ of c

➤ **Materials: WOODEN BLOCKS**

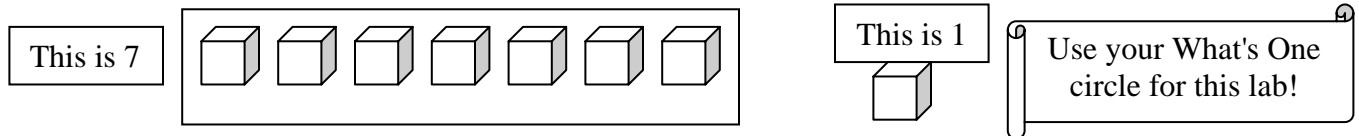
- As a group, use wooden blocks and work through the following steps to model the multiplication problem and solution to:

$[3/7]$ of $7 = ?$  Note the details of this problem are stepped out below

a. What is the first thing that we need to model?

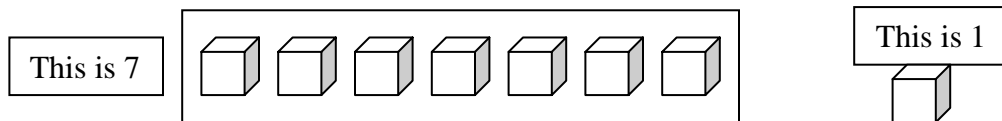
We might think $3/7$, but since we are looking for $[3/7]$ of 7 , we must model 7 first.

Using wooden blocks, the simplest model for 7 is 7 blocks and so one block is 1 .



b. As a group discuss how to use this set of 7 wooden blocks to model $[3/7]$ of 7 .

Show your work by **MARKING** (circle the correct blocks) & **LABELING** this picture correctly.



By comparing the circled blocks to the model for 1 , we conclude that $[3/7]$ of $7 = \underline{\hspace{2cm}}$

- Now, use wooden blocks and work through the following steps to model the multiplication problem and solution to: $[2/3]$ of $7 = ?$

- As before, the first thing we need to model is 7 . However, if we look ahead we will see that we must have a model of 7 that can be **divided into 3 parts**. In fact, our model for 7 in 1a. required that we be able to divide 7 into 7 parts!

- As a group, discuss how to model 7 with wooden blocks so that 7 can be divided into 3 parts. Draw pictures of your work here. Don't forget to fill in the "This is 1" picture too.
- BE SURE to model with the wooden blocks.



Keep going to model the rest of the problem ↓

- b. As a group determine how to mark your model of 7 to show thirds and in particular, $[\frac{2}{3}]$ of 7.

This is 7

This is 1

The value of each block is: ____

IMPROPER fraction solution: ____ & (Hint: Each block is worth?)

the MIXED NUMBER solution: ____ (Hint: How many sets of 1 do you have?)

- c. Referring to your model for $[\frac{2}{3}]$ of 7 and your model for 1, answer the question: $[\frac{2}{3}]$ of 7 = ____? by giving the both the

- d. What was the difference between the last two problems that required us to change our model for 7?

3. $[\frac{a}{b}]$ of c

Fraction Multiplication Guide (Wooden Cubes)

As a group write a *brief summary* of the steps that you need to show to clearly model this type of multiplication problem. 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.

4. Practice Using Your Guide:

As a group, use the wooden blocks to model each of the following. Draw clear, well-labeled pictures of your work. Don't forget to use your "This is One" circle and to give the final answers in BOTH improper fraction and mixed number forms.

- a. $[\frac{3}{11}]$ of 22 [Hint: Can 22 blocks be placed in 11 piles?]

This is 22

This is 1

The value of each block is: ____

IMPROPER fraction solution: ____ &

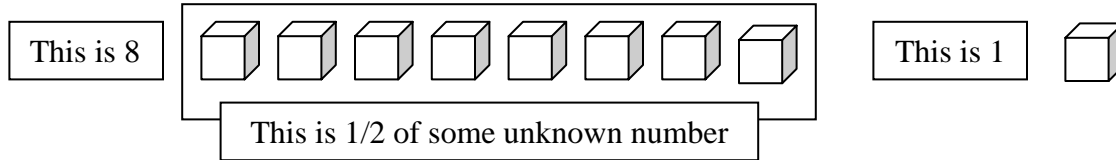
the MIXED NUMBER solution: ____

TOPIC: A WHOLE NUMBER AS A FRACTIONAL PART OF ANOTHER NUMBER

➤ **Materials: WOODEN BLOCKS**

5. As a group, use wooden blocks and work through the following steps to model the multiplication problem: 8 is $[\frac{1}{2}]$ of what number?

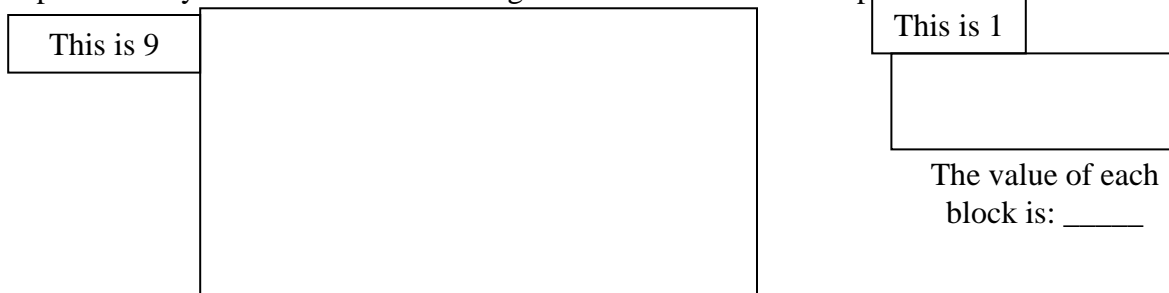
- The first thing we need to model is 8. If we look ahead we will see that 8 will be 1 of 2 parts and so the simplest model for 8 is 8 wooden blocks. Always start with the simplest model for 1: Let 1 block be 1.



- As a group, discuss how use this set of 8 wooden blocks to model the solution to $[\frac{1}{2}]$ of what number is 8? You should notice that 8 is 1 of 2 parts and "what number" is the whole or 2 of 2 parts.
- Summarize your discussion here and draw a picture of your model, give the solution.

6. As a group, use wooden blocks and work through the following steps to model the multiplication problem: 10 is $[\frac{2}{3}]$ of what number?

- As before, the first thing we need to model is 9. However, if we look ahead we will see that we must have a model of 9 that can be **divided into 2 parts since 10 is 2 of 3 parts**. In fact, our model for 8 in 5a. required that we be able to divide 8 into 1 part! (8 was 1 of 2 parts)
- As a group, dicuss how to model 10 with wooden blocks so that 10 can be divided into 2 parts. Draw pictures of your work here. Don't forget to fill in the "This is 1" picture too.



Keep going to model the rest of the problem

- As a group determine how to model the rest of the problem: 9 is $[\frac{2}{3}]$ of what number? Give the final answer in both improper fraction and mixed number form refer to your model for 1!).

IMPROPER fraction solution: _____ & the MIXED NUMBER solution: _____

7. As a group write a *brief summary* of the steps that you need to show to clearly model this type of multiplication problem and solution. 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.

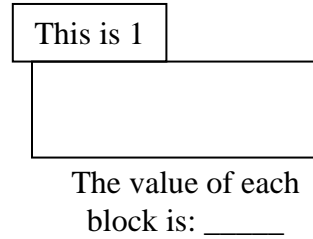
c is $[a/b]$ of ?

Fraction Multiplication Guide (Wooden Cubes)

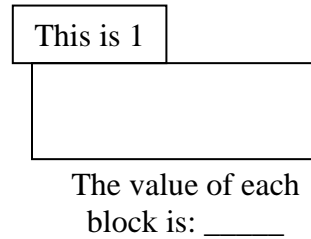
9. *Practice Using Your Guide:*

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

- a. 3 is $[1/7]$ of what number?



- b. 2 is $[3/8]$ of what number?



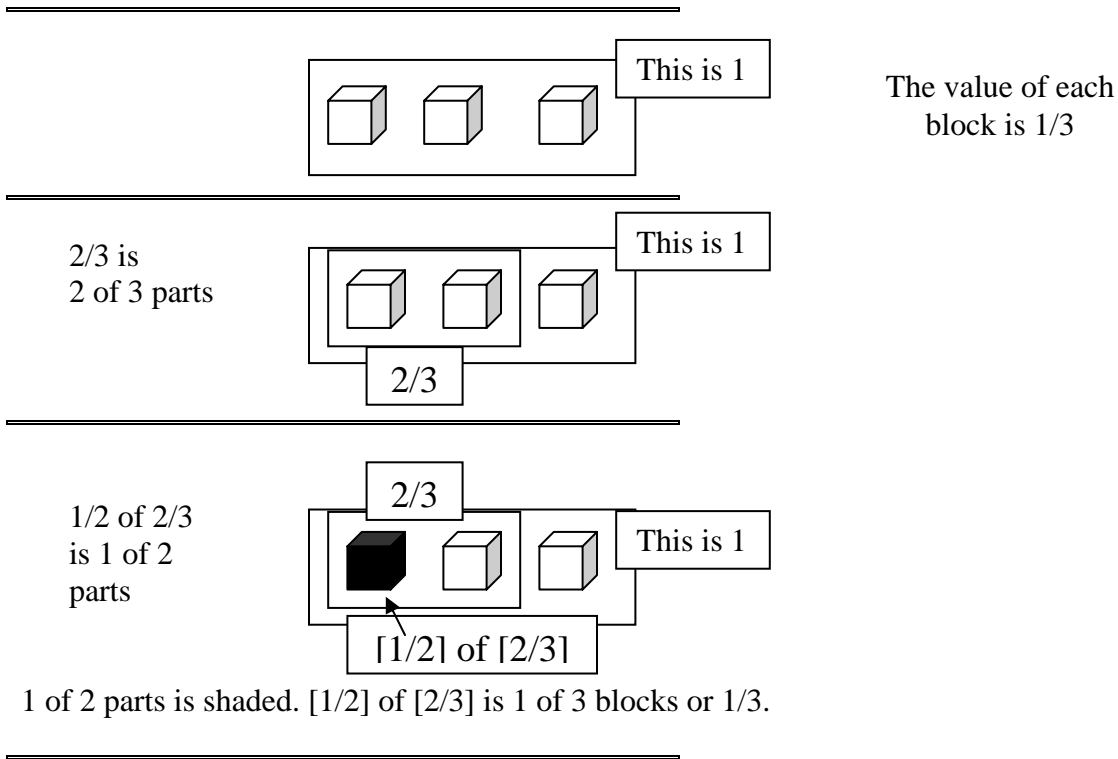
TOPIC: MULTIPLYING A FRACTION BY A FRACTION $[a/b]$ of $[c/d]$

➤ **Materials: WOODEN BLOCKS**

10. As a group, use wooden blocks and work through the following steps to model the multiplication problem: $[1/2]$ of $[2/3] = ?$

- a. What is the first thing that we need to model? Just like with $[1/2]$ of 4 we need to model the second number first. We cannot take $1/2$ of $2/3$ if we don't know what **$2/3$ is first.**

- Using wooden blocks the simplest model to use for $2/3$ is 2 of 3 blocks--where 3 blocks is 1. Looking ahead we see that we ALSO need to be able to divide $2/3$ into 2 parts (since $1/2$ is 1 of 2 parts). Let's see if the 3 blocks = 1 model works.

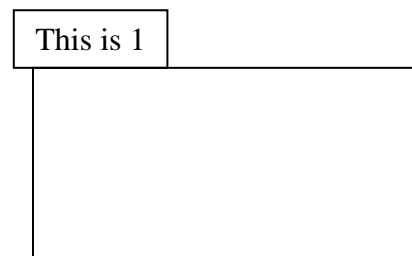


b. As a group briefly discuss how this model worked.

11. As a group, use wooden blocks to model the multiplication problem and solution to:
 $[2/3]$ of $[2/5] = ?$

Hints and guidelines:

- If the model for 1 is 5 blocks, can the model for $2/5$ be split into 3 parts?
 NO, so we must increase the number of blocks in the model for 1, always in such a way that we can divide the model for 1 into 5 parts.
- If the model for 1 is 10 blocks, can the model for $2/5$ be split into 3 parts?
 NO, so we must increase the number of blocks in the model for 1, always in such a way that we can divide the model for 1 into 5 parts.
- If the model for 1 is 15 blocks, can the model for $2/5$ be split into 3 parts?
 YES, so we may now model the problem:



The value of each block is: _____

12. As a group, use the ideas from the previous problems and wooden blocks to model the multiplication problem and solution to:

$$[3/4] \text{ of } [2/3] = ?$$

Examine your set up carefully, you don't need the LCM here or for fraction multiplication in general. What is the most efficient set of blocks that you can use for your model for 1 here?

This is 1
The value of each block is: _____

13. As a group, use wooden blocks to model the multiplication problem and solution to:

$$[2/9] \text{ of } [3/2] = ?$$

This is 1
The value of each block is: _____

14. As a group briefly summarize the procedure for fraction multiplication of the form $\{a/b\}$ of (c/d) .

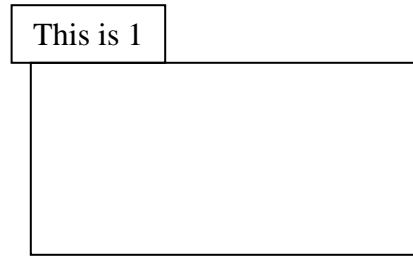
$[a/b]$ of $[c/d]$

Fraction Multiplication Guide (Wooden Cubes)

15. *Practice Using Your Guide:*

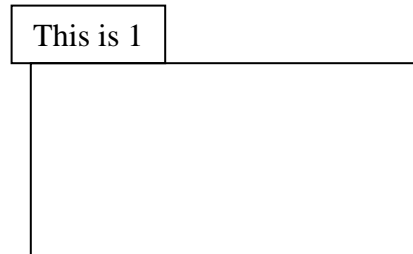
As a group, use the wooden blocks to model each of the following. Draw clear, well-labeled pictures of your work and solution. (Don't forget to use your "This is One" circle!)

a. $[4/7]$ of $[1/2]$



The value of each block is: _____

b. $[3/5]$ of $[10/9]$



The value of each block is: _____

TOPIC: MULTIPLYING A WHOLE NUMBER BY A FRACTION $[a/b]$ of c

➤ **Materials: CUISENAIRE RODS**

16. As a group, use Cuisenaire Rods and work through the following steps to work through two ways to model the multiplication problem and solution to: $[2/5]$ of $5 = ?$

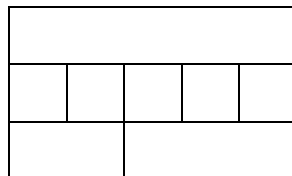
a. What is the first thing that we need to model? We need to model the number: _____.
The shortest rod that can be used to show this number is (fill in the color)



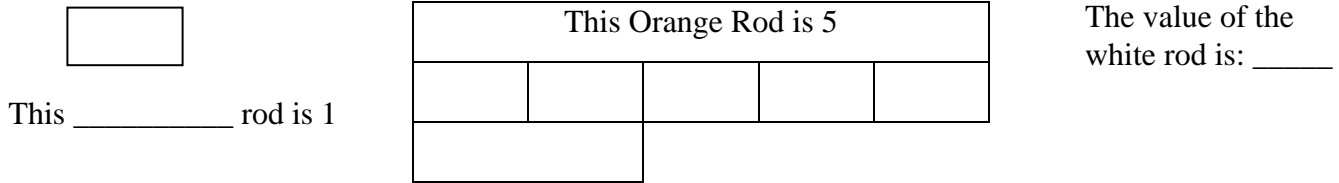
And, in this case, the rod that is 1 is:



b. Can we divide this rod into 5 parts? Yes, we can always divide 5 into 5 parts. Use Cuisenaire Rods to show $[2/5]$ of 5 and label this picture to show your model.



- c. Cuisenaire Rods are very flexible to work with. You may see a problem one way, but a student may see the problem another way. As a group discuss how to label the rest of these pictures to show a correct solution path to $[\frac{2}{5}]$ of 5.



- As a group be sure to discuss how this solution path correctly models the problem and how may seem perfectly reasonable to a student to model the problem this way.

17. As a group: Use Cuisenaire Rods to model the multiplication problem: $[\frac{3}{4}]$ of $10 = ?$

- Use all of the ideas that your group established before to model similar problems with wooden cubes.
- Make sure that everyone in your group understands the process (use the Rods!) and sketch a well-labeled picture of your work here:
- Give the final answer in both improper fraction (check the value of the white rod) and mixed number form (which rod has value 1?).

The value of the white rod is: _____

18. As a group, discuss the difference between the last two problems. Summarize your discussion here.

19. As a group write a *brief summary* of the steps that you need to show to clearly model this type of multiplication problem. 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.

[a/b] of c

Fraction Multiplication Guide (Cuisenaire Rods)

21. *Practice Using Your Guide:*

As a group, use Cuisenaire Rods to model the following. Draw a clear, well-labeled picture of your work. Always state and use your model for 1 AND note the value of the white rod.

[3/(13)] of 26

TOPIC: A WHOLE NUMBER AS A FRACTIONAL PART OF ANOTHER NUMBER

➤ ***Materials: CUISENAIRE RODS***

22. As a group, use Cuisenaire Rods to model this problem. Clearly label everything. Always state and use your model for 1 AND note the value of the white rod.

4 is [1/3] of what number?

23. As a group, use Cuisenaire Rods to model this problem. Clearly label everything. Always state and use your model for 1 AND note the value of the white rod. Note: You can use clusters instead of trains if you like.
6 is $[\frac{3}{7}]$ of what number?

24. As a group write a *brief summary* of the steps that you need to show to clearly model this type of multiplication problem. 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.

c is $[\frac{a}{b}]$ of

$?$

Fraction Multiplication Guide (Cuisenaire Rods)

TOPIC: MULTIPLYING A FRACTION BY A FRACTION $[\frac{a}{b}]$ of $[\frac{c}{d}]$

➤ **Materials: CUISENAIRE RODS**

25. As a group, use Cuisenaire Rods to model this problem. Clearly label everything. Always state and use your model for 1 AND note the value of the white rod.

$$[\frac{1}{2}] \text{ of } [\frac{3}{5}] = ?$$

26. As a group, use Cuisenaire Rods to model this problem. Clearly label everything. Always state and use your model for 1 AND note the value of the white rod. Note: You DON'T need the model for 1 to be 36 whites long.

$$[\frac{3}{4}] \text{ of } [\frac{8}{9}] =$$

27. As a group write a *brief summary* of the steps that you need to show to clearly model this type of multiplication problem. 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.

[a/b] of [c/d]

Fraction Multiplication Guide (Cuisenaire Rods)

LAB EIGHT DISCUSSION QUESTIONS

As a group, discuss and answer the following questions. Feel free to also discuss with the other groups.

1. Name one other manipulative that could be used for MULTIPLYING FRACTIONS.
2. What mathematical knowledge would you want your students to KNOW prior to introducing MULTIPLYING FRACTIONS?
3. What mathematical knowledge would you want to EMPHASIZE while introducing MULTIPLYING FRACTIONS?
4. What manipulative (if any) do you feel is most effective in introducing MULTIPLYING FRACTIONS? (If none, please tell how you would INTRODUCE it.)
5. Suppose you have introduced MULTIPLYING FRACTIONS to your students through the use of manipulatives. What are the rules for multiplying fractions?

a. $\frac{a}{b} \times c = c \times \frac{a}{b} =$

b. $\frac{a}{b}$ of $\frac{c}{d}$ also known as $\frac{a}{b} \times \frac{c}{d} =$