

Lab 9

Division Models for Fractions

Objectives:

1. Given any sentence of the form $c \div (a/b) = \underline{\hspace{2cm}}$ where a, b & c are whole numbers with b nonzero, the teacher will model a solution with wooden blocks and Cuisenaire Rods
2. Given any sentence of the form $(a/b) \div (c/d) = \underline{\hspace{2cm}}$ where a, b, c & d are non zero whole numbers with b and d nonzero, the teacher will model a solution with wooden blocks and Cuisenaire Rods

TOPIC: DIVIDING A WHOLE NUMBER BY A FRACTION $c \div [a/b]$

➤ **Materials: WOODEN BLOCKS**

1. As a group, use wooden blocks and work through the following steps to model the division problem:
 $6 \div 2/3 = ?$

As a division sentence this means: "How many times does $2/3$ go into 6?"

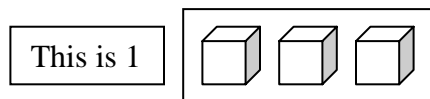
To model this problem you must:

- Define what you are using for 1
- Define what you are using for $2/3$ (note $2/3$ here is " $2/3$ of 1")
- Define what you are using for 6

Let's do this with wooden blocks:

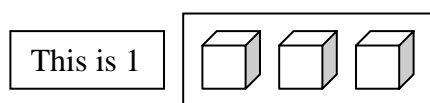
a. Define One

A reasonable model for 1 (keeping in mind that we need $2/3$) is a 3 wooden blocks



b. Define $2/3$

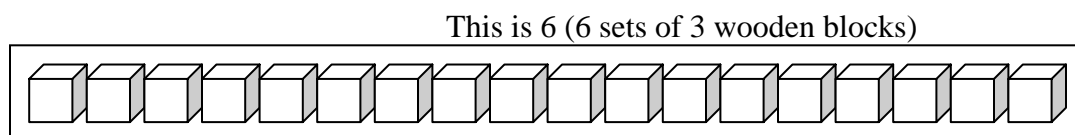
$2/3$ is 2 of 3 parts thus--as a group, mark and label $2/3$:



Model this at your table by placing 3 blocks aside -- separate or color code them so you can see the $2/3$

c. Define Six

Since 1 is a set of 3 wooden blocks, 6 is six sets of 3 wooden blocks. (Model this with blocks at your table)

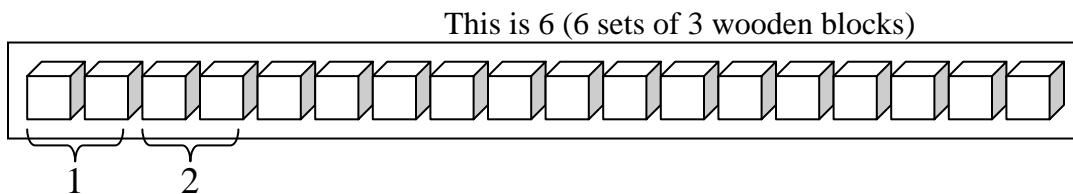


Now we can finally ask the question, how many times does $\frac{2}{3}$ go into 6?

In terms of wooden blocks this means:

"How many sets of 2 blocks are there in 6 sets of 3 blocks?"

- d. The first two sets of 2 blocks are marked. As a group, mark the rest of the blocks--model this on your table by separating the blocks into sets of 2 blocks.



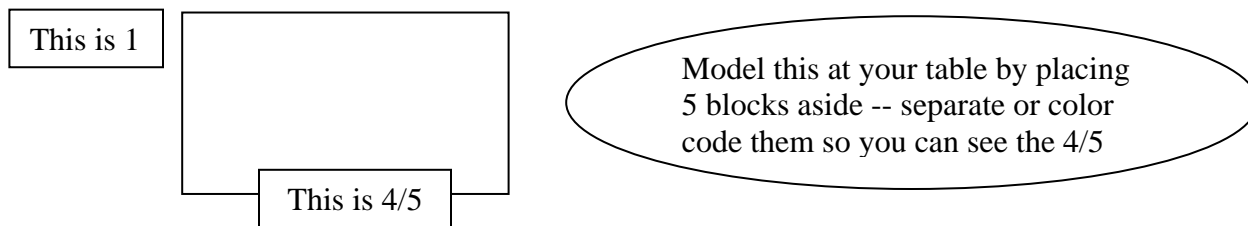
We count that there are _____ sets of 2-block sets in our model for 6.

$\frac{2}{3}$ goes into 6 _____ times so $6 \div \frac{2}{3} =$ _____

- Can you think of a context for this type of problem? Using items that require measuring often results in this type of division sentence. For example: My cookie recipe calls for $\frac{2}{3}$ of a cup of raisins. If I have 6 cups of raisins how many batches of cookies can I make?
2. As a group, use wooden blocks and work through the following steps to model the division problem: $3 \div \frac{4}{5} = ?$

- a. As a division sentence this means: _____
- b. As before, the first thing we need to model is 1, but then we'll also have to model $\frac{4}{5}$.

As a group, model 1 with wooden blocks so that you can also model $\frac{4}{5}$. Circle $\frac{4}{5}$ to mark it.



- c. As before we now need to model 3. As a group model this on your table and sketch a picture of your blocks here:



d. Now we can ask the question:

"How many times does $4/5$ go into 3?"

Rephrasing this in terms of wooden blocks we can say:

"How many sets of _____ blocks are there in _____ sets of _____ blocks?"

e. Separate your blocks on your table to show this, sketch a (labeled) picture of your work here.

We count that there are _____ sets of _____ block sets in our model for 3 and _____ blocks left over.

How do we describe the _____ left over blocks?

When we look to see how many times $4/5$ goes into 3, we are looking for sets of _____ blocks.

We should ask ourselves: "What part of a set of 4 blocks is the leftover group of 3 blocks?"

Thus we have _____ blocks of the set of _____ blocks that we need or _____ of the blocks that we need.

Fill in with the correct fraction

$4/5$ goes into 3 _____ times so $3 \div 4/5 =$ _____ (this should be a mixed number).

3. As a group, discuss the difference between problem 1 and problem 2. Summarize your discussion here.

4. As a group write a brief summary of the steps that you need to show to clearly model this type of fraction division 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.

$c \div [a/b]$

Fraction Division Guide (Wooden Cubes)

5. *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 set aside a model of the fractional divisor for reference and to give the final answer.

a. $4 \div \frac{2}{3} = \underline{\hspace{2cm}}$

b. $4 \div \frac{3}{5} = \underline{\hspace{2cm}}$

TOPIC: DIVIDING A WHOLE NUMBER BY A FRACTION $c \div [a/b]$

➤ ***Materials: CUISENAIRE RODS***

6. As a group, use Cuisenaire Rods to model the fraction division from problem 1. Notice in particular that:
- All of the abstract components of the two manipulative models we are currently using (wooden blocks, Cuisenaire Rods) are the same.
 - Some of the physical characteristics of the manipulatives are different. Be sure to think about this and discuss this with your group.

Modeling the division problem: $6 \div \frac{2}{3} = ?$ with Cuisenaire Rods

As a group, fill in all of the details (short descriptions and clear, well-labeled pictures) in this brief outline. Remember, a train can be 1 rod!

- a. Create a train to define what you are using for 1

This is your
1st train

- b. Add on to your first train set to define what you are using for $\frac{2}{3}$. The completed train set should include a train that models 1. After you have modeled $\frac{2}{3}$, model $\frac{2}{3}$ with a single rod (if you have not already done so).

Complete your
1st train set

- c. Create a new train to define what you are using for 6. This train does not need to include the model for 1--it should look like 6 "1 trains" in a row.

This is your
2nd train set

- d. Now use your model for $\frac{2}{3}$ to determine how many times $\frac{2}{3}$ goes into 6. Show your model here.

We count that there are _____ rods that fit in our train that models 6 and we conclude that:

color

$\frac{2}{3}$ goes into 6 _____ times so $6 \div \frac{2}{3} =$ _____

7. As a group, model the following problem with Cuisenaire Rods. $3 \div \frac{5}{6} =$ _____

- a. What's 1?

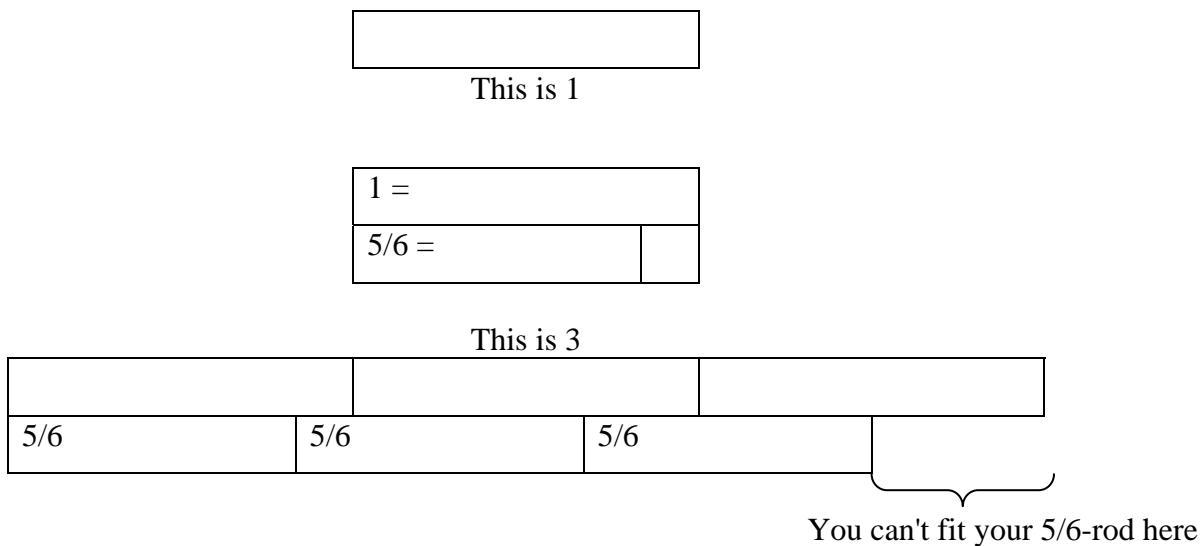
- b. What's $\frac{5}{6}$?

Draw labeled
trains and
train sets here

- c. What's 3?

d. How many times does $\frac{5}{6}$ go into 3? (Sketch your model here)

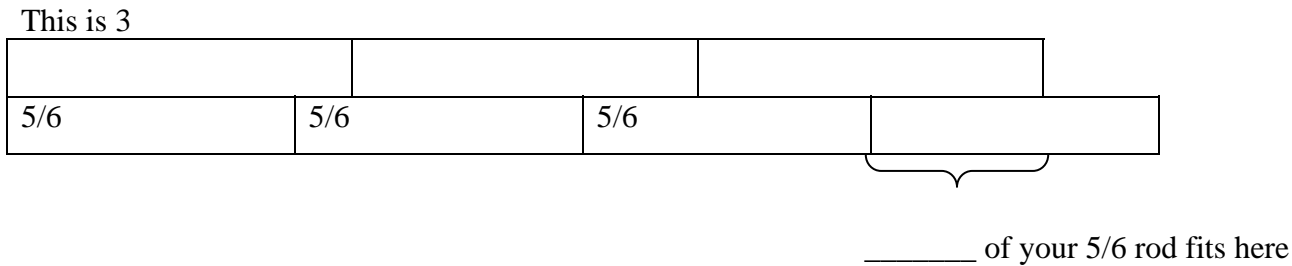
e. What happens with the "leftovers"? At this point you should have the following on your table (fill in the rod colors in all of the pictures):



Here is a nice way to get the correct fractional remainder using Cuisenaire Rods. Our question is "How many times does $\frac{5}{6}$ go into 3?" In terms of Cuisenaire Rods we can rephrase that question as:

How many times does the _____ rod fit into a train of _____ rods?
color # color

Our dilemma is that our last and fourth _____ rod didn't fit into our train. How much of the rod did fit? You can compare the fourth rod to the train and see:



$\frac{5}{6}$ goes into 3 _____ times so $3 \div \frac{5}{6} =$ _____ (this should be a mixed number).

TOPIC: DIVIDING A FRACTION BY A FRACTION [a/b] ÷ [c/d]

➤ **Materials: WOODEN BLOCKS**

8. As a group, use wooden blocks and work through the following steps to model the division problem: $3/4 \div 2/3 = ?$

As a division sentence, this (still) means: "How many times does $2/3$ go into $3/4$?"

To model this problem you must:

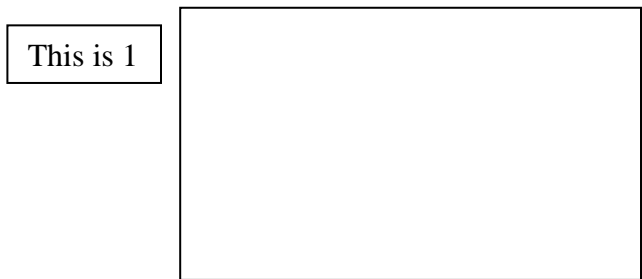
- Define what you are using for 1
- Define what you are using for $2/3$ (note $2/3$ here is "2/3 of 1")
- Define what you are using for $3/4$ (note $3/4$ here is "3/4 of 1")
- Note: NOW you should be using a LCD model for one.

Let's do this with wooden blocks:

a. Define One

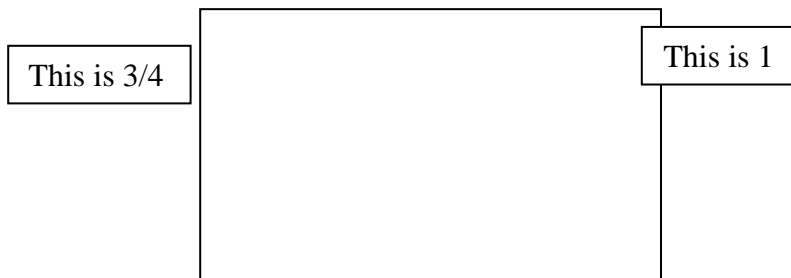
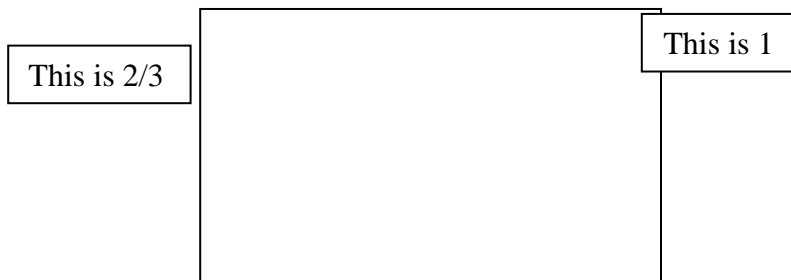
A reasonable model for 1 (keeping in mind that we need $2/3$ AND that we need $3/4$) is:

A set of _____ wooden blocks



b. Define 2/3, define 3/4

Use TWO new sets of blocks to model the two fractions.



Model this at your table by placing _____ blocks aside -- separate or color-code them so you can see the $2/3$

c. Determine how many times $\frac{2}{3}$ goes into $\frac{3}{4}$.

Leave your model for $\frac{2}{3}$ intact for reference and move the blocks in your model for $\frac{3}{4}$ around to determine the answer to this question. Sketch a picture of your work here:

Be very careful determining the fractional number that describes your "left over blocks". Refer to problem #2 for help with this. In conclusion we see that:

$\frac{2}{3}$ goes into $\frac{3}{4}$ _____ times so $\frac{3}{4} \div \frac{2}{3} =$ _____ (*this should be a mixed number*).

- Can you think of a context for this type of problem? Using items that require measuring often results in this type of division sentence. For example: My cookie recipe calls for $\frac{2}{3}$ of a cup of raisins. If I have $\frac{3}{4}$ of a cup of raisins how many batches of cookies can I make?

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

➤ ***Materials: CUISENAIRE RODS***

9. As a group determine how to do this type of fractional division problem with Cuisenaire Rods. Carefully follow the established procedure and show all of your work here in clear, well-labeled pictures: $\frac{5}{6} \div \frac{1}{3} = ?$

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

$$\left(\frac{a}{b} \div \frac{c}{d} \right)$$

Fraction Division Guide (Cuisenaire Rods)

11. *Practice Using Your Guide:*

As a group, use Cuisenaire Rods to model each of the following. Draw clear, well-labeled pictures of your work.

a. $\frac{2}{3} \div \frac{1}{4} = \underline{\hspace{2cm}}$

b. $\frac{6}{7} \div \frac{2}{3} = \underline{\hspace{2cm}}$

Note, when you are determining your remainder here, you should be using TWO rods for $\frac{2}{3}$ (two of three parts), not one rod.

LAB NINE 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 DIVIDING FRACTIONS?

- Blocks
- Cuisenaire Rods
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What mathematical knowledge would you want your students to KNOW prior to introducing DIVIDING FRACTIONS?

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What mathematical knowledge would you want to EMPHASIZE while introducing DIVIDING FRACTIONS?

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