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Ruler Fractions



Common Core
Math Standards
included!

Helping students see
fractions, decimals, and percent

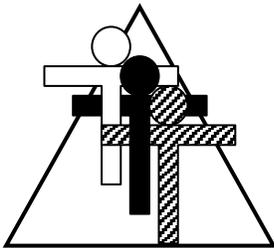
By Brad Fulton

Educator of the Year, 2005

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Known throughout the country for motivating and engaging teachers and students, Brad has co-authored over a dozen books that provide easy-to-teach yet mathematically rich activities for busy teachers while teaching full time for over 30 years. In addition, he has co-authored over 40 teacher training manuals full of activities and ideas that help teachers who believe mathematics must be both meaningful and powerful.

Seminar leader and trainer of mathematics teachers

- ◆ 2005 California League of Middle Schools Educator of the Year
- ◆ California Math Council and NCTM national featured presenter
- ◆ Lead trainer for summer teacher training institutes
- ◆ Trainer/consultant for district, county, regional, and national workshops

Author and co-author of mathematics curriculum

- ◆ Simply Great Math Activities series: six books covering all major strands
- ◆ Angle On Geometry Program: over 400 pages of research-based geometry instruction
- ◆ Math Discoveries series: bringing math alive for students in middle schools
- ◆ Teacher training seminar materials handbooks for elementary, middle, and secondary school

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Ruler Fraction

Helping students *see* fractions, decimals, and percent.

Overview:

This activity allows students to *see* the relationships between fractions, decimals, and percents. It accomplishes this by using a visual model and fractions of halves, fourths and eighths. These denominators are more understandable to beginning students. This eases them into the lesson. Then they progress to thirds, fifths, sixths, tenths, and twelfths later. Part whole concepts are presented concurrently as fractions, decimals, and percent representations.

Required Materials:

Copy of activity master

Optional Materials:

Calculators

Procedure:

- 1 Pass out the worksheet titled "Ruler Fractions: $\frac{1}{2}$ and $\frac{1}{4}$." Have the students mark the inches on the first ruler from zero to six. Then they should mark the halves using common fractions. Next they move to the second ruler and do the same thing, but using decimals this time. Most students will be able to see that $\frac{1}{2}$ is equivalent to .5. On the third ruler, they mark it in percents. These labels will look like the first ruler in the margin.

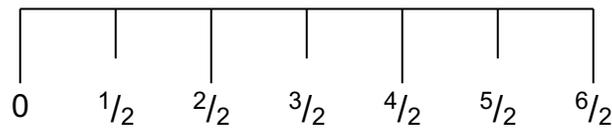


- 2 Next they should mark the fourths in common fractions, decimals, and percents. (They will need to write small.) As they work, discuss with them about how this should be labeled. Allow students to make suggestions, right or wrong, discuss them, and come to a sensible conclusion using your help. It is important for students to see that anything over 1" is over 100%. Discuss why this is true. They should also see the relationships between .5 and 50% and .25 and 25%. Many students are under the impression that .5 is 5%. They can see though, that if that were true, then 1" would be

10% and $\frac{1}{2}$ would be only 5%. They can see that both of these are erroneous. Once .5 is written as .50, they can make an easier transition to 50%.

Similarly, some students may have trouble writing $\frac{1}{4}$ as a decimal. They may want to cut .5 into $.2\frac{1}{2}$. Again, if .5 is written as .50, it will make it easier to see the correct answer.

- 3 Once this is done, you can ask students to label the fourth ruler using improper fractions. It will look like this:



This should also help students see the relationship between mixed numbers and improper fractions and spur some useful discussion.

- 4 Once students are successful at this you can have them graduate to the next level. Have them try the worksheet called "Ruler Fractions: $\frac{1}{3}$." This helps students see the relationship between the different representations for thirds and sixths. There is a third worksheet that measures in halves, fifths, and tenths. This is a good way to familiarize students with fraction to decimal equivalencies.

Good Tip!



Have students learn the "benchmark fractions" and their decimal and percent equivalents. These are the fractions we encounter every day. Young learners should memorize halves and fourths. As they mature, they should add the thirds family, then tenths and eighths.



Journal Prompts:



Which representations do you find easiest to understand: fractions, decimals or percents? Explain why.

Write a note to a student explaining how to find $1\frac{1}{2}$ on a ruler.

Homework:



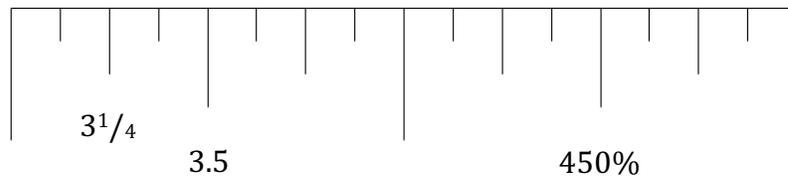
List some common fractions on the board. Have the students write their decimal and percent equivalents.

Alternately, write some various representations of fractions, decimals, and percents on the board. Students then would set them in order for homework as shown here:

9% $\frac{1}{5}$.25 30% .50 $\frac{2}{3}$.9

You can also assign one of the other activity masters as homework.

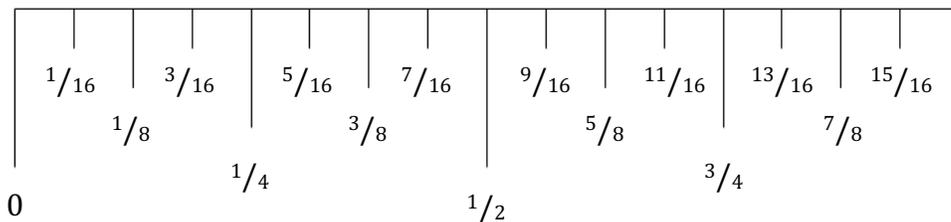
Here is another easy option that allows you to design an assignment targeted to the specific needs of your students. Simply take the enlarged rulers activity master and assign values to any particular tick marks you wish. You can label them with fractions, decimals, or percents or use all three for more advanced students. Their job is to fill in the missing fractions, decimals, and/or percents as shown here.



Taking a Closer Look:



Enlarged rulers have been provided so that students can mark smaller divisions of the inch. Students should be told that since these are enlarged they are not to scale. Students place a zero on the left tick mark and a one on the mark farthest to the right. This allows students to divide the rulers into sixteenths as shown:



Assessment:



Allowing students to work in groups will help them check their own work against that of others. A key is provided on the following page that shows the fractions, decimals, and percents for the first inch of each activity master.

A note about learning fractions:

Typical instruction in fractions includes examples with many different denominators, but in the mind of the learners, not all fractions are the same.

- Initially, instruction should be limited to unit fractions with denominators that are powers of two such as $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$. The term *unit fraction* means that the numerator is one. Powers of two include halves, halves of halves (fourths), and so on. Doubling and cutting numbers in half is a rudimentary skill that enables students to master this type of fraction first.
- Next, students can work with odd denominators.
- Ultimately, they can then explore non-unit fractions and mixed numbers.

The Common Core Connection:

Grade 3:

CCSS.MATH.CONTENT.3.MD.B.4

Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units— whole numbers, halves, or quarters.

CCSS.MATH.CONTENT.3.NF.A.2.A

Represent a fraction $\frac{1}{b}$ on a number line diagram by defining the interval from 0 to 1 as the whole and partitioning it into b equal parts. Recognize that each part has size $\frac{1}{b}$ and that the endpoint of the part based at 0 locates the number $\frac{1}{b}$ on the number line.

CCSS.MATH.CONTENT.3.NF.A.2.B

Represent a fraction $\frac{a}{b}$ on a number line diagram by marking off a lengths $\frac{1}{b}$ from 0. Recognize that the resulting interval has size $\frac{a}{b}$ and that its endpoint locates the number $\frac{a}{b}$ on the number line.

CCSS.MATH.CONTENT.3.NF.A.3.A

Understand two fractions as equivalent (equal) if they are the same size, or the same point on a number line.

CCSS.MATH.CONTENT.3.NF.A.3.B

Recognize and generate simple equivalent fractions, e.g., $1/2 = 2/4$, $4/6 = 2/3$. Explain why the fractions are equivalent, e.g., by using a visual fraction model.

CCSS.MATH.CONTENT.3.NF.A.3.C

Express whole numbers as fractions, and recognize fractions that are equivalent to whole numbers. Examples: Express 3 in the form $3 = 3/1$; recognize that $6/1 = 6$; locate $4/4$ and 1 at the same point of a number line diagram.

Grade 4:

CCSS.MATH.CONTENT.4.MD.A.1

Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36), ...

CCSS.MATH.CONTENT.4.NF.A.1

Explain why a fraction a/b is equivalent to a fraction $(n \times a)/(n \times b)$ by using visual fraction models, with attention to how the number and size of the parts differ even though the two fractions themselves are the same size. Use this principle to recognize and generate equivalent fractions.

CCSS.MATH.CONTENT.4.NF.A.2

Compare two fractions with different numerators and different denominators, e.g., by creating common denominators or numerators, or by comparing to a benchmark fraction such as $1/2$. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with symbols $>$, $=$, or $<$, and justify the conclusions, e.g., by using a visual fraction model.

CCSS.MATH.CONTENT.4.NF.B.3.B

Decompose a fraction into a sum of fractions with the same denominator in more than one way, recording each decomposition by an equation. Justify decompositions,

e.g., by using a visual fraction model. Examples: $3/8 = 1/8 + 1/8 + 1/8$; $3/8 = 1/8 + 2/8$; $2 \frac{1}{8} = 1 + 1 + 1/8 = 8/8 + 8/8 + 1/8$.

Grade 5:

CCSS.MATH.CONTENT.5.MD.A.1

Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems.

CCSS.MATH.CONTENT.5.NBT.A.3.A

Read and write decimals to thousandths using base-ten numerals, number names, and expanded form, e.g., $347.392 = 3 \times 100 + 4 \times 10 + 7 \times 1 + 3 \times (1/10) + 9 \times (1/100) + 2 \times (1/1000)$.

CCSS.MATH.CONTENT.5.NBT.A.3.B

Compare two decimals to thousandths based on meanings of the digits in each place, using $>$, $=$, and $<$ symbols to record the results of comparisons.

Grade 6:

CCSS.MATH.CONTENT.6.RP.A.3.C

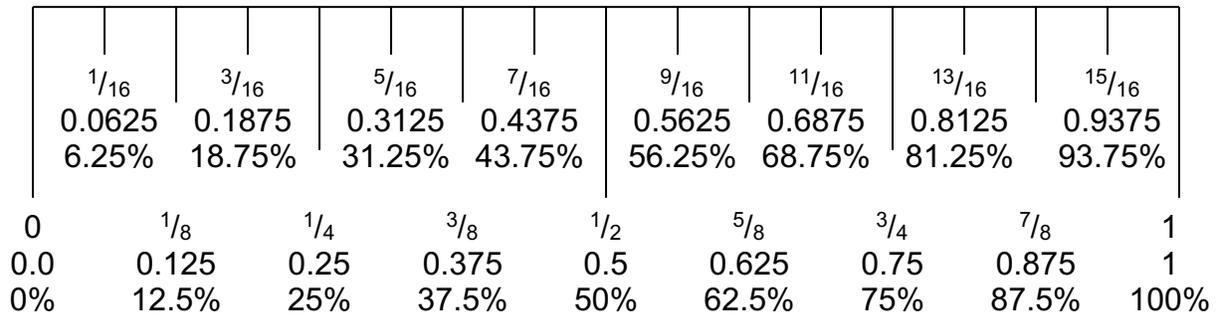
Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent.

CCSS.MATH.CONTENT.6.RP.A.3.D

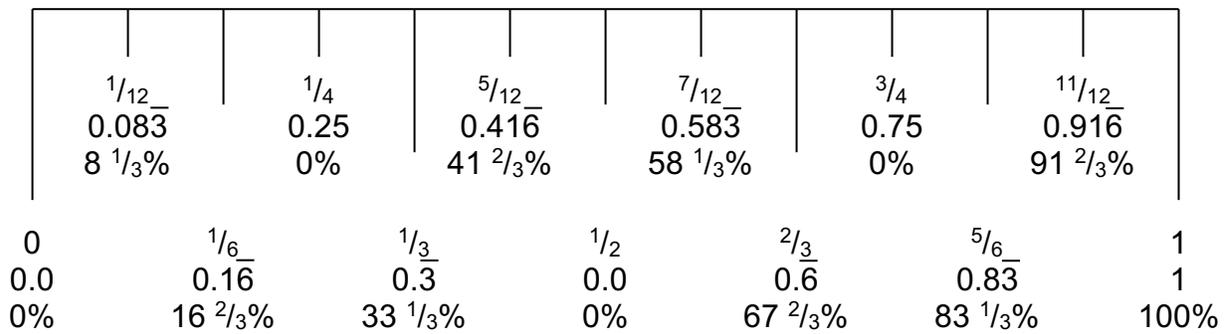
Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.

Answer Key:

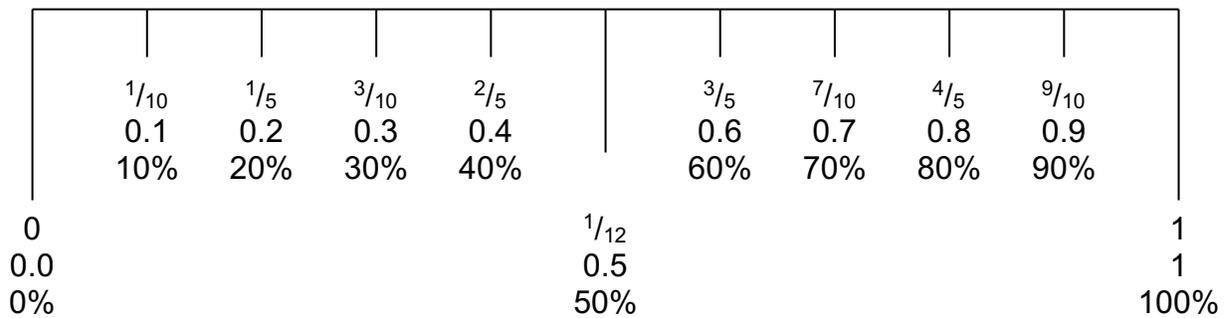
$\frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \frac{1}{16}$



$\frac{1}{3}, \frac{1}{6}, \frac{1}{12}$



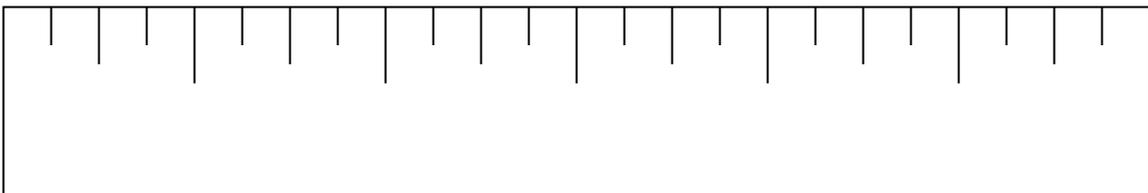
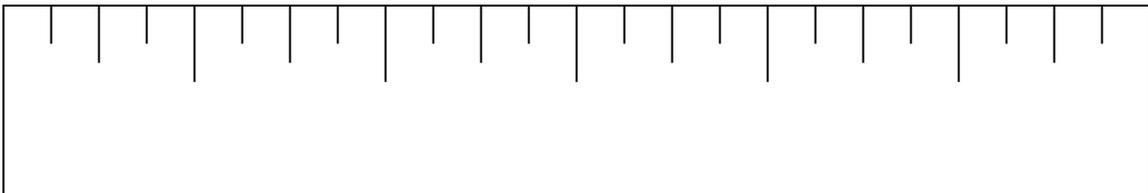
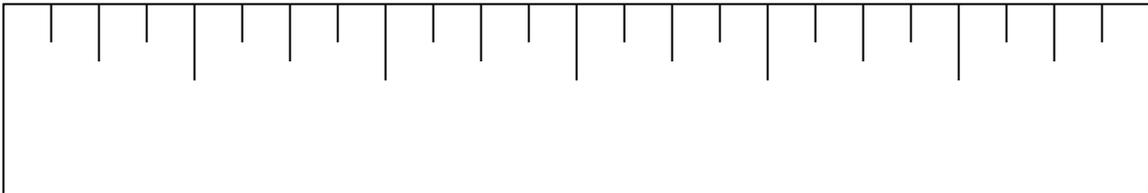
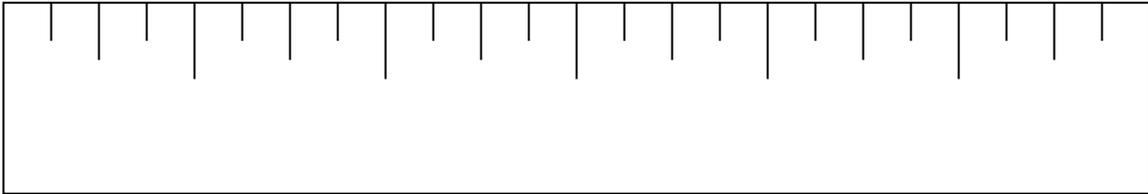
$\frac{1}{2}, \frac{1}{5}, \frac{1}{10}$



Activity master 1

Name _____

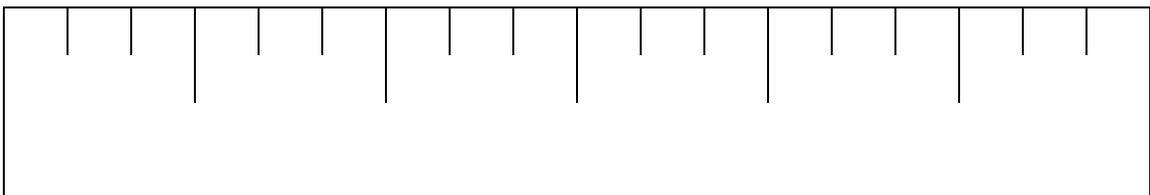
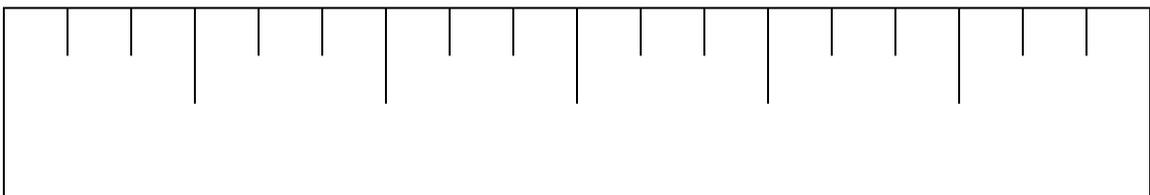
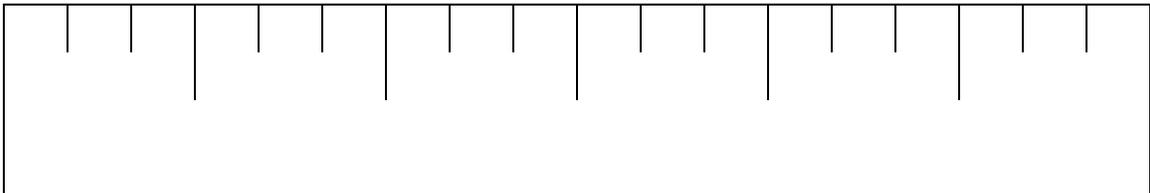
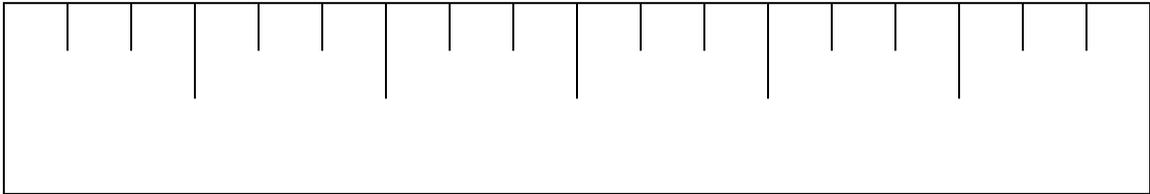
Ruler Fractions: $\frac{1}{2}$ and $\frac{1}{4}$



Activity master 2

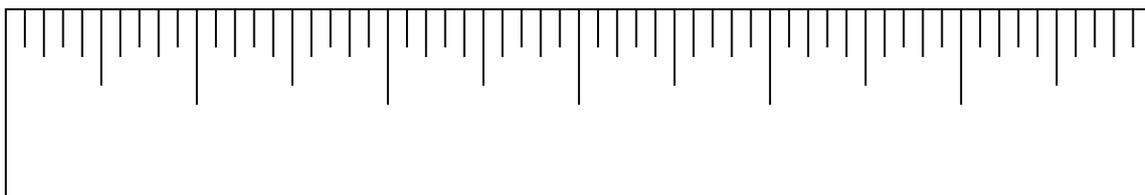
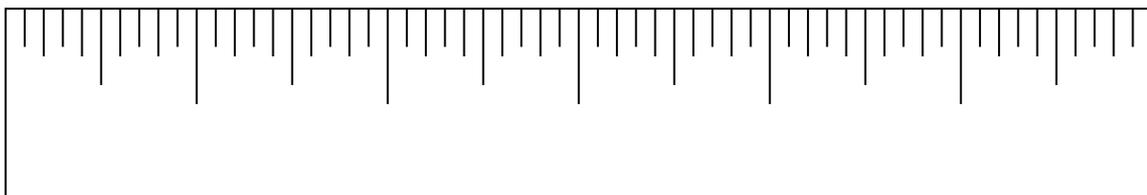
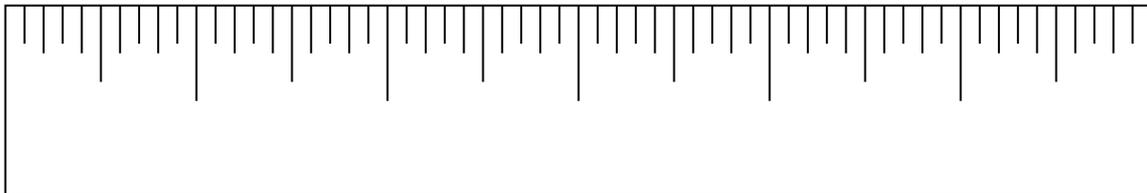
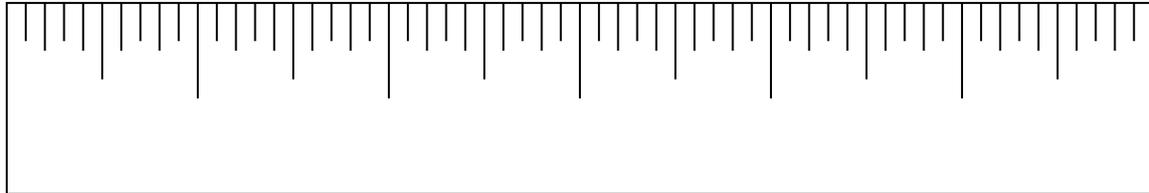
Ruler Fractions: $\frac{1}{3}$

Name _____



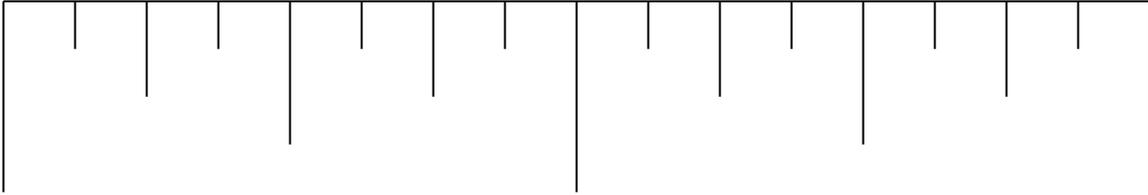
Name _____

Ruler Fractions: $\frac{1}{2}$, $\frac{1}{5}$, $\frac{1}{10}$

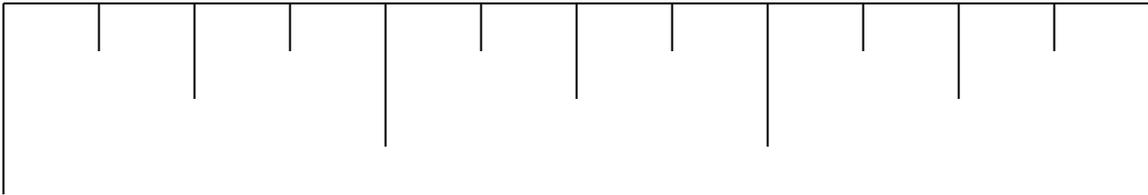


Enlarged Rulers

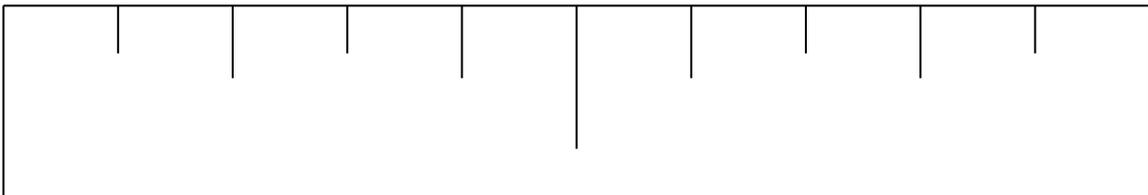
Enlarged $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{16}$



Enlarged $\frac{1}{3}$, $\frac{1}{6}$, $\frac{1}{12}$



Enlarged $\frac{1}{2}$, $\frac{1}{5}$, $\frac{1}{10}$



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- *Four in a Row* – A fun game that your students will want to play over and over as they practice with whole number, fraction, and decimal multiplication.
- *House Plan Fractions*– Foster conceptual understanding of fraction, decimal, and percent comparisons in this geometry-based model that will intrigue and engage your students.

Feel free to contact me if you have questions or comments or would like to discuss a staff development training or keynote address at your site.

Happy teaching,
Brad