Major areas tested on 5th grade MEAP (from the 4th grade GLCEs)

1) multi-digit multiplication and simple division problems involving remainders (green)
2) introduction to decimal numbers (yellow)
3) basic fraction concepts including improper fractions/mixed numbers and number line (blue)
4) basic geometry: parallel, perpendicular, distance on a line (pink)

GLCEs in grey will not be tested on the MEAP because they moved to a higher grade in the CCSS.

GLCE	GLCE Grade	CALC	GLCE Descriptor	Match to CCSS	
N.ME.04.01	4th	N	Read, write, compare & order numbers to 1,000,000	4th	
N.ME.04.02	4th	N	Compose & decompose numbers to 1,000,000	4th	
N.ME.04.03	4th	N	Know size & place value of numbers to 1,000,000	4th	
N.ME.04.04	4th	N	List all factors & factor pairs of numbers to 50	4th	core
N.ME.04.05	4th	N	List first 10 multiples of 1-9	4th	core
N.ME.04.09	4th	N	Multiply 2 digit # by 2-5 using the distributive property	4th	core
N.FL.04.10	4th	N	Multiply 3 digit by 2 digit; understand the algorithm	4th	core
N.FL.04.11	4th	N	Divide numbers to 4 digits by 1-digit numbers and by 10	4th	core
N.FL.04.12	4th	N	Find value of unknowns in equations such as a ÷ 10 = 25	4th	core
N.MR.04.14	4th	Y	Solve problems involving multiplication & division	4th	core
N.MR.03.14	3rd	Y	Solve division problems involving remainders	4th	core
N.MR.04.06	4th	N	Know prime numbers	4th	
N.MR.04.07	4th	N	Use factors/multiples to compose/decompose numbers	6th	core
N.FL.04.08	4th	N	Add and subtract whole numbers fluently	4th	
N.MR.04.13	4th	Y	Use x, ÷ to simplify computations & check results	4th	
N.ME.04.16	4th	Y	Know & identify terminating decimals	4th	
N.ME.04.17	4th	N	Locate tenths and hundredths on a number line	4th	
N.ME.04.15	4th	Y	Know decimals up to two places & relate to money	4th	core
N.ME.04.18	4th	N	Read, write, interpret, and compare decimals (2 places)	4th	core
N.MR.04.19	4th	N	Write tenths & hundredths as dec. & frac.; know 1/2 & 1/4	4th	core
N.ME.04.20	4th	N	Understand fractions as parts of a set of objects	4th	
N.MR.04.21	4th	Y	Explain why equivalent fractions are equal	4th	core
N.MR.04.22	4th	N	Locate fractions w/denominators <=12 on number line	4th	core
N.MR.04.23	4th	N	Understand relationships within fraction families	4th	core
N.MR.04.25	4th	N	Write improper fractions as mixed numbers	4th	core
N.MR.04.26	4th	N	Compare and order up to three fractions	4th	core
N.ME.04.24	4th	N	Understand improper fractions, locate on # line	4th	
N.MR.04.27	4th	N	Add and subtract common fractions less than 1	4th	
N.MR.04.28	4th	N	Solve fraction problems involving sums & differences	4th	
N.MR.04.29	4th	N	Find value of unknown in equations with fractions	4th	
N.MR.04.30	4th	N	x fractions using repeated +, area or array models	4th	
N.MR.04.31	4th	Y	Solve problems by adding & subtracting decimals	5th	
N.FL.04.32	4th	N	Add and subtract decimals through hundredths	5th	
N.FL.04.33	4th	Y	x and ÷ decimals up to two decimal places	5th	
N.FL.04.34	4th	N	Estimate answers involving +, -, or x	4th	
N.FL.04.35	4th	N	Know & use approximation appropriately	4th	
M.UN.04.01	4th	N	Measure using common tools & appropriate units	4th	
M.PS.04.02	4th	Y	Give answers to a reasonable degree of precision	4th	
M.UN.04.03	4th	N	Measure & compare integer temperatures in degrees	N	
M.TE.04.05	4th	Y	Convert units of measure within a system	4th	
M.TE.04.06	4th	Y	Know & understand formulas for P/A of square, rect	4th	

M.TE.04.07	4th	Y	Find length of rectangle given width and A or P	4th	
M.TE.04.08	4th	Y	Find side of a square given its perimeter or area	4th	
M.PS.04.09	4th	Y	Solve P/A problems of rects in compound shapes	4th	
M.TE.04.10	4th	N	Know right angles & compare angles to right angles	4th	
M.PS.04.11	4th	Y	Solve contextual problems about surface area	6th	
G.GS.03.01	3rd	N	Identify points, line segments, lines and distance	4th	core
G.GS.03.02	3rd	N	Identify perpendicular lines and parallel lines	4th	core
G.GS.03.03	3rd	N	Identify parallel faces of rectangular prisms	4th	core
G.GS.04.01	4th	N	Identify, draw , parallel, & intersecting lines	4th	
G.GS.04.02	4th	N	Identify basic geometric shapes and solve problems	4th	
G.SR.04.03	4th	N	Identify attributes of 3-D solids	2nd	
G.TR.04.04	4th	N	Recognize plane figures that have line symmetry	4th	
G.TR.04.05	4th	N	Recognize transformations of a 2-D object	HS	
D.RE.04.01	4th	Y	Construct tables and bar graphs from given data	4th	
D.RE.04.02	4th	Y	Order a given set of data, find the median, range	6th	
D.RE.04.03	4th	Y	Solve problems using data tables, bar graphs	3rd	

Learning Progression for Multi-digit Multiplication

1. Does the student understand the concept of multiplication? (3^{rd} grade)

   Concept 1: Multiplication is counting by equal size groups. Skip counting or repeated addition are both simple forms of multiplication
   Concept 2: The area model
   Concept 3: Scaling up (“3 times as large” – 4^{th} grade in CCSS)

2. Does the student know and draw on basic facts and other number relationships? (Find products fluently up to 10 x 10 – 3^{rd} grade)

   Basic number combination facts are learned easily over time by most children, when their teachers use a program that builds on students’ innate problem-solving abilities and allows them to develop multiple strategies for number combinations. The use of flash cards alone does not result in fluency with number facts for most students. They need to build familiarity with fact families through exposure to the facts in many problem situations and through the development of increasingly abstracted strategies for processing more difficult number combinations.

3. Does the student know how to multiply by 10’s and 100’s?

   e.g. 10 x 3 = 30, 70 x 3 = 210, etc.

4. Can the student estimate using rounding or compensating?

   Rounding: 26 x 4 is close to 25 x 4, which is like using money (4 quarters). Compensating involves adjusting each factor, for example, 95 x 11 could be estimated using 100 x 10. Good for checking the reasonableness of answers.

5. If the problem is put in context, can the student estimate an answer? Does the context give the student a clue about how to solve the problem directly?

   Contexts such as price, rates, comparisons, or simply “6 groups of 54” sometimes help the student visualize the problem – for example, “If you travel 54 miles each day for 6 days, how far would you travel altogether?” The student might round down to 50 miles and easily figure 50 x 6 = 300. Let the student make a drawing, if that helps.

6. Does the student understand graphical representations like area or array representations?

   Start with simple ones, such as 7 x 8 and 7 x 10, to make sure students understand the concept. They should make a connection to finding the area of rectangles, where the question is: “How many unit squares cover the entire rectangle?” Area representations that show clusterings of 100’s and 10’s are easier to add up (they are related to base 10 blocks) and students can use them to see the distributive property, as shown in the example at the end.

7. Does the student understand the distributive property with simple problems? (N.ME.04.09 Multiply two-digit numbers by 2, 3, 4, and 5, using the distributive property…)

   e.g. 54 • 5 = (50 • 5) + (4 • 5) = 250 + 20 = 270   This is the concept behind both the partial product algorithm (which makes much more sense to students) and the standard algorithm. In both cases, students multiply the ones, ten, hundreds, etc. separately. This problem is easily worked out mentally when a student understands how to use the distributive property.

8. Does the student have any strategies for solving the problem, such as grouping or skip counting, or creating more easily managed sub-problems?

   This might involve an intuitive use of factors, for example:
   54 x 6 = 54 x 2 x 3 = 108 + 108 + 108. The use of this strategy depends on the problem. In this case, doubling 54 was relatively easy, and adding it 3 times was also relatively easy. Give the student simple problems like this to try.
   For 54 x 23, the student might simplify the problem like this:
   (54 • 10) + (54 • 10) + 108 + 54   This is a good build-up to the partial product method.

9. Can the student multiply fluently any whole number by a one-digit number, and a three-digit number by a two-digit number?

10. Can the student use alternative algorithms like the partial product method or lattice method?

    The lattice method, and a variation of the partial product method, are shown at the end.

```
  54
x  6
 300
  24
 324
```

```
   54
x  23
   12
  150
   80
 1000
 1242
```

11. Does the student make typical errors when using the standard algorithm?

    Some students know most of the steps of the standard algorithm but make typical errors, which can be corrected with direct instruction on the concepts behind the algorithm. See the section on errors below.

Common errors using multi-digit algorithms

There is no need to teach the standard algorithm if the student makes too many errors with it – students can be fluent with the partial product method. Or use the lattice method if you insist on something more compact. It is less error-prone. (See graphic at end for lattice method. It is the same as the standard algorithm, only on the diagonal.)

Typical errors using the standard algorithm involve not accounting correctly for place value, especially when there is a zero in one of the numbers to be multiplied.

Another error involves not knowing what to do with the number that is "carried." In this example, the student multiplied 7 x 4 and got 28. He put down the 8 and wrote the 2 above the ten's place. But then he added the 2 and the 5 *before* multiplying by 4.

```
  2
 57
x 4
288
```

Area multiplication showing the lattice method
http://nlvm.usu.edu/en/nav/frames_asid_192_g_2_t_1.html

Multi-digit Multiplication Diagnostic Problems

1. How much is 25 x 10? ________________

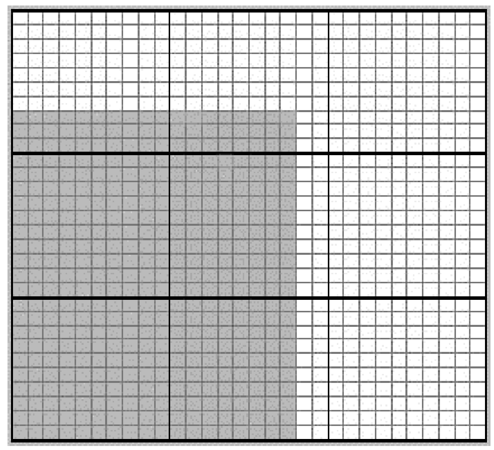
2. 43 x 25 = ______________ **Show all your work.** You can solve this any way you want.

3. How much is 78 x 1000? _______________

4. What multiplication does this picture represent?

   What's the answer to this multiplication?

   How did you get your answer?



5. If one lamp costs $45, how much do 12 lamps cost? **Show how you figured this out and circle your answer.**

6. Mike has 27 boxes of trading cards. Each box has 68 cards in it. How many cards does Mike have altogether? **Show all your work and circle your answer.**

7. Solve these two problems about a bus trip to Chicago:

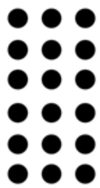
   57 people were taking a trip to Chicago on buses. 3 buses were hired to take them there. The distance to Chicago is 248 miles. Half-way to Chicago, one of the buses broke down. Everyone could fit on the remaining two buses except for 5 people. What is the maximum number of people that one of the buses could hold?

   The 5 people who couldn't fit on the two buses hired a small plane to take them the rest of the way to Chicago. The plane cost $13 per mile. How much did the plane ride cost?

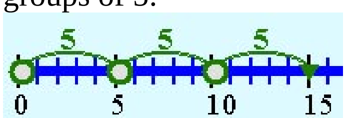
Objects (Concrete manipulatives)

You have six cookies and want to share them equally with two friends. How many cookies does each friend get? Students use 6 counters and "deal" them one at a time to each friend. Then they count how many each friend received.

Bugs have six legs each. How many legs are there on three bugs? Students use manipulatives to create an array like this:



Students skip count on a number line to find 3 groups of 5:

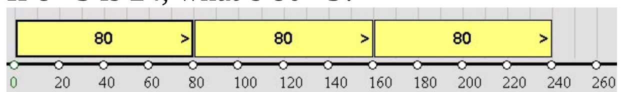


Use bundles of 10's and some ones in simple multiplication problems to learn place value: *Each box of crayons has 10 crayons in it. Karen has 3 boxes of crayons and 4 extra crayons. How many is this? Write this number.*

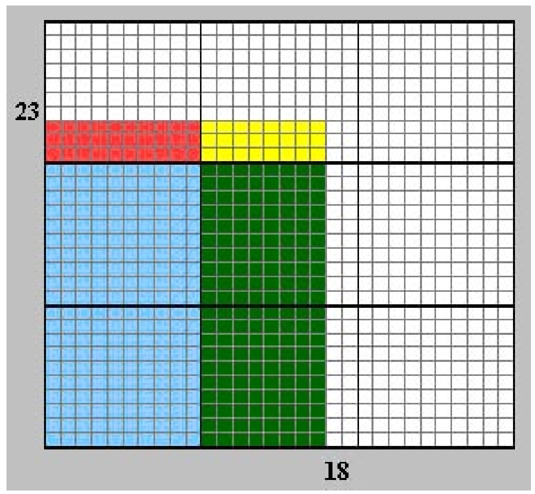
Students use base ten blocks to model 16 × 12, showing the distributive property ($16\times10 + 16\times2$; $10\times10 + 6\times10 + 10\times2 + 6\times2$) by regrouping the blocks.

Pictures (Graphic representations)

Multiplying by 10's and 100's: Use number line bars, have students generate the pattern: If 8×3 is 24, what's 80×3?



Area model showing full distributive property:



Symbols (Symbolic representations)

The distributive property

$$23\times18 = 20\times(10 + 8) + 3\times(10 + 8)$$
$$= 20\times10 + 20\times8 + 3\times10 + 3\times8$$

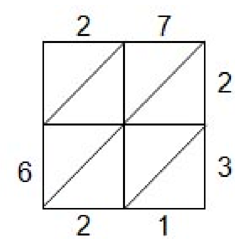
18 × 23	10	8	
20	200	160	360
3	30	24	54
			414

The partial product method

	2	3
×	1	8
	2	4
1	6	0
	3	0
2	0	0
4	1	4

Other methods

Lattice method (also involves regrouping but no "little numbers" in the multiplication stage)



Types of division problems

Partitive division problems

You have 24 cookies and want to share them equally with 6 people. How many cookies would each person get? 24 ÷ 6 = 4 cookies

You are reading a book with 120 pages. If you want to read the same number of pages each night, how many would you have to read each night to finish in 10 days? 120 ÷ 10 = 12 pages (sharing the pages equally among the nights)

Measurement division problems

A cereal box holds 18 cups of cereal. Each serving is 2 cups. How many servings are in the whole box? 18 ÷ 2 = 9 servings (The question can be restated as "How many times does 2 go into 18?)

An airplane hangar is 300 feet long. How many planes can fit into it, end to end, if each plane is 50 feet long? 300 ÷ 50 = 6 planes

A box of books weighs 42 pounds. Each book weights 3 pounds. How many books are there in the box? 42 ÷ 3 = 14 books (How many things of 3 pounds each are there in 42 pounds?)

Sue's mother made 75 cookies. She put the cookies in bags, with 3 cookies in each bag. How many bags could she fill up?

Remainder problems

The remainder is simply left over and not taken into account (ignored)

It takes 3 eggs to make a cake. How many cakes can you make with 17 eggs?

The remainder means an extra is needed

20 people are going to a movie. 6 people can ride in each car. How many cars are needed to get all 20 people to the movie?

The remainder is the answer to the problem

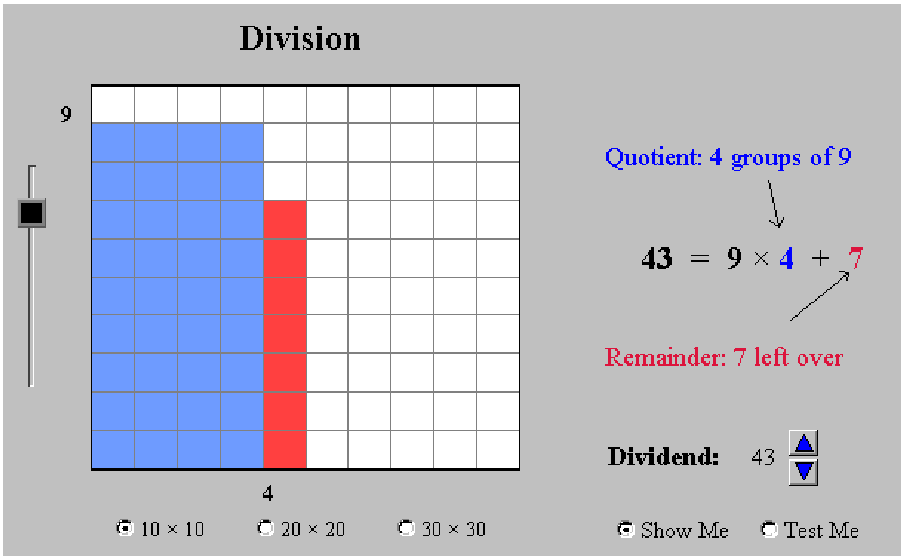
Ms. Baker has 17 cupcakes. She wants to share them equally among her 3 children so that no one gets more than anyone else. If she gives each child as many cupcakes as possible, how many cupcakes will be left over for Ms. Baker to eat?

The answer includes a fractional part

9 cookies are being shared equally among 4 people. How much does each person get?

Problems need to be used over and over to develop meaning of remainders. The shift from remainders to fractional parts only makes sense in problems where the fraction part is asked for.

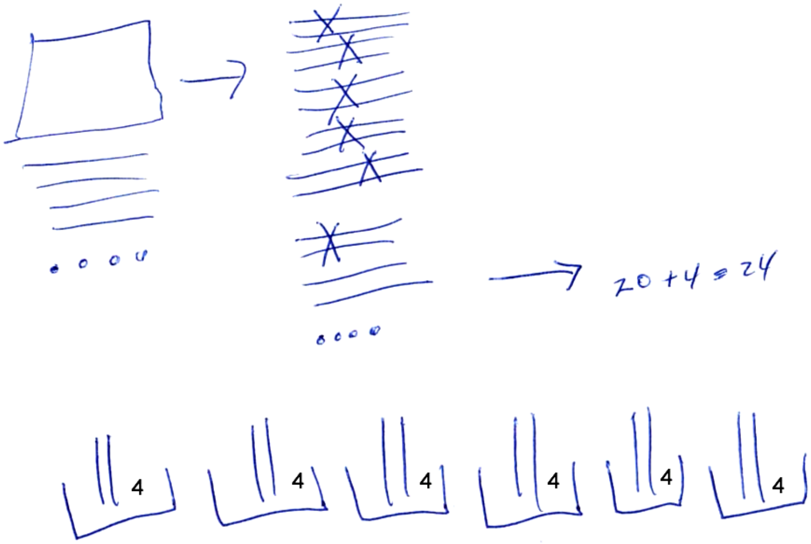
Rectangle division
http://nlvm.usu.edu/en/nav/category_g_2_t_1.html



Dividing multi-digit numbers by one digit

Students learn the concepts of division and develop fluency within the 10 by 10 fact families in 3rd grade. In 4th grade they should begin to estimate or use mental math for divisions of larger numbers by one digit, such as 96÷6, 120÷6, 144÷6, 300÷6, and 356÷6.

The development of procedures should follow the C-R-A approach (concrete to representational to abstract, or object-pictures-symbols.) Objects like base ten blocks can be used to show division, where the blocks are partitioned into groups to show the division, starting with the largest place value. When a set of place value blocks cannot be partitioned by the divisor, they are "traded" for an equivalent set of the next lower place-value blocks. The answer is found by counting how many are in each group. The drawing shows 144 ÷ 6. The one hundred "flat" cannot be partitioned into 6 groups, so it is "traded" for 10 rods, which are then partitioned into the six groups, leaving 2 rods and 4 cubes. The two rods are traded for 20 cubes, leaving 24 cubes, which are partitioned into the 6 groups. The answer is found by counting how many are in each group: 2 tens and 4 ones, or 24.



To translate this into a procedure, ask the questions and record the process symbolically:

If we divide this number into 6 equal groups, how many will be in each group?
Start with the 1 hundred, then the 4 tens, then the 4 ones.

```
        4      4 ones in each group
       2       2 tens in each group
      0        no 100's in each group
6    )144      1 hundred? no, so regroup. 14 tens? yes
     -120      We've taken out 12 tens. 2 tens left.
       24      2 tens? no, so regroup. 24 ones? yes
      -24      We've taken out 24 ones. 0 ones left.
        0
```

A card can be placed over the tens and ones to show just the hundreds, and then slid to the right to reveal each place as the question is asked about whether it can be partitioned into 6 equal groups.

Another procedure for long division is the repeated subtraction (or partial quotients) method. Repeated subtraction is more error-free than the traditional algorithm for many students. An example is shown below.

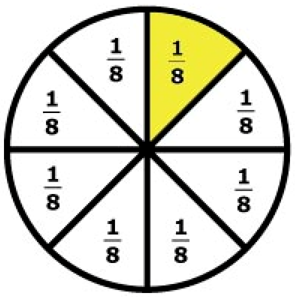
```
6  )144
    -60   10
     84
    -60   10
     24
    -24    4
          24
```

Basic Fraction Concepts

By the end of 4th grade, students should have learned these fundamentals of fractions (this learning started in 3rd grade):

1. A fraction is a part of a whole. When a whole is divided into equal-sized pieces, a fraction of the whole is one or more of those pieces. The numerator of the fractions tells how many pieces there are, and the denominator tells how many pieces the whole was divided into.

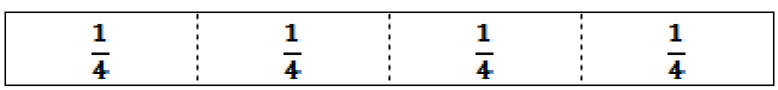
For example, a pizza cut into 8 slices can represent eighths. One slice is 1/8. 4 slices is 4/8.



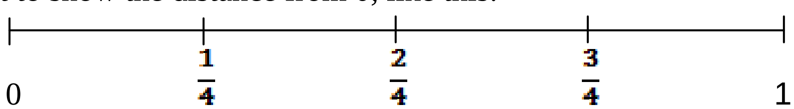
2. Manipulatives and drawings are good ways of representing fractions. Circle fractions can be used as direct models of pizza slices (like the drawing to the left.) Other representations include bar models (think about 1/8 of a Tootsie Roll) and area models (1/8 of a pan of brownies cut 4x2). Fraction representations are used extensively to compare and order fractions.

3. Rulers are marked to show fractions of one inch. Number lines can be drawn to show that fractions are numbers between integers.

Students may have difficulty knowing where fractions are on a number line because their first introduction to fractions is often with paper folding, where we often write the fraction name in the middle of the segment, like this:

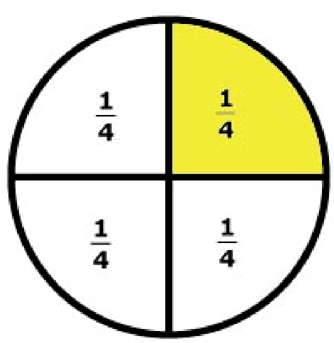


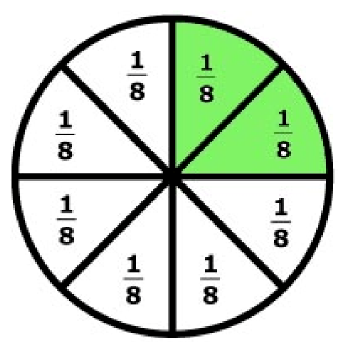
Fraction bars are labeled like this too. However, on a number line, the fraction is placed at the end of the segment to show the distance from 0, like this:



4. Fractions can also be used to represent parts of a set of object. For example, if there are 10 red M&M's in a bag of 50 M&M's, then the fraction of red M&M's is 10/50.

5. Equivalent fractions are the same size (the same total amount of the whole) but they are divided into different numbers of pieces. For example, if you cut a pizza into fourths, one section would be 1/4. If you cut a pizza of the same size into eighths, two sections of that pizza would be 2/8. Both of these sections are the same size.





6. Equivalent fractions can be found by “scaling up” or “scaling down.” This makes sense when you think of a fraction as part of a set of objects. In the M&M example above, if there is always the same fraction of red M&M's in every bag, then a bag of 25 (half the original bag) would have 5 red M&M's (half the original amount). The fraction is 5/25, which is equivalent to 10/50. In this case, we have scaled down by a factor of 2, or divided both the part and the whole by 2. In a bag of 100 M&M's, there would be 20 red M&M's, scaling up by a factor of 2 - multiplying both the part and the whole by 2. Students need to be able to “Recognize, name and use equivalent fractions with denominators 2, 4, and 8, using strips as area models.” (N.ME.03.17) “Strips as area models” means using the folded paper strips or fraction bars.

7. "Mixed numbers" are numbers that have both an integer part and a fraction part, like 5 1/3. On the number line, this would be 1/3 of the way from 5 to 6. As a real object, this might be 5 1/3 cups of flour in a cake recipe (5 cups and 1/3 cup more). Mixed numbers can also be represented as "improper fractions," an equivalent number with no integer part. In improper fractions, the numerator is larger than the denominator. For example, 5 1/3 is equivalent to 16/3 because 1 = 3/3, 2 = 6/3, 5 = 15/3, 5 *and* 1/3 = 16/3.

8. Decimal numbers can be written as fractions with denominators of 10, 100, 1000, etc. The first place to the right of the decimal represents tenths, the second decimal place represents hundredths, the third decimal place represents thousandths, etc. For example, the number 7.3 is equivalent to 7 3/10. The number 20.45 is equivalent to 20 45/100.

9. Fractions are also a way of writing a division statement. 4/5 means 4 divided by 5. You can use this concept to find the decimal equivalent for a fraction: 4 divided by 5 = 0.8. Common decimal/fraction equivalents are represented by our money system: one quarter (1/4) = 0.25 (cents); one half dollar (1/2) = 0.50 or 0.5; there are 10 dimes in one dollar, so each dime is 1/10 of a dollar, and equal to 10 cents (0.10 or 0.1). Other common equivalents are 1/3 = .33 repeating, 2/3 = .66 repeating; 1/5 is twice 1/10, or 0.2.

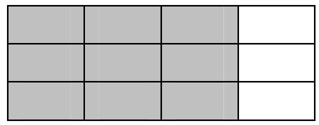
10. Not all fractions can be represented by terminating decimal numbers. For example, 1/3 has the decimal equivalent of 0.333333... a repeating, non-terminating decimal (it goes on forever).

11. Percents represent parts out of 100. 50% means 50 parts out of 100. This is equivalent to the fraction 50/100, or the decimal 0.5.

Basic fraction problems

1. Three brownies have been eaten out of this pan. What fraction of the pan of brownies is left?

    a) 3/9
    b) 3/12
    c) 9/12
    d) 9/3



2. In a bag of 40 M&M's, you count 12 red ones. What fraction of the M&M's are red?

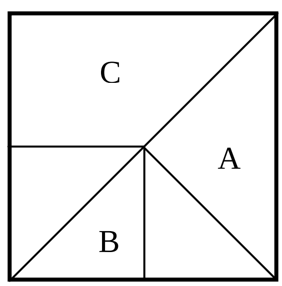
    a) 40/12
    b) 12/28
    c) 6/40
    d) 12/40

3. Which is larger, 3/4 or 3/7? Make a drawing to explain your answer.

4. Look at the drawing below. What fraction of the whole square is region A? __________

region B? __________

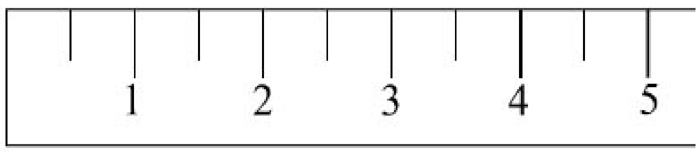
region C? __________



5. Which is larger, $\frac{3}{4}$ or $\frac{2}{3}$? Explain why you think this.

6. Show where these fractions would be on this ruler:

$\frac{1}{4}$ $1\frac{1}{2}$ $2\frac{3}{4}$ $\frac{8}{4}$



7. Order these fractions from smallest to largest:

$\frac{3}{4}, \frac{1}{10}, \frac{5}{12}, \frac{3}{5}, \frac{14}{15}$

smallest ________________________________ largest

8. Which would you rather have, 3/5 of a bag of M&M's that contain 50 pieces, or 2/3 of a bag of M&M's that contains 30 pieces? Explain your answer.

9. Locate and label $\frac{21}{8}$ on a number line. How much is this as a mixed number?

10. Write a fraction that is equivalent to $\frac{9}{12}$

Decimals

1. Write each of these decimal numbers as a fraction:

0.1   0.5   0.03   0.25   0.78

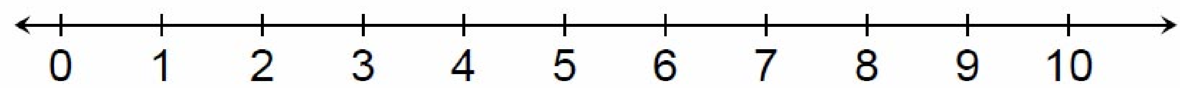
__________   __________   __________   __________   _________

2. Write these decimal numbers:

two tenths ______   7 hundredths ______   34 hundredths ______

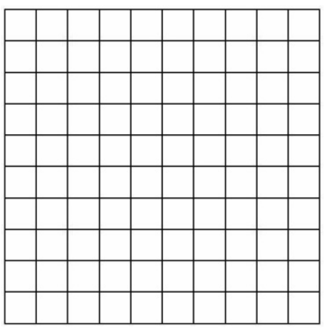
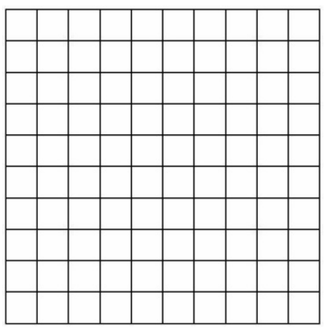
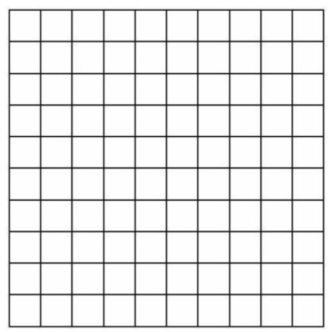
3. What is the place value of the "4" in this number? 23.54 ___________________

4. Locate the number 5.3 on the number line:



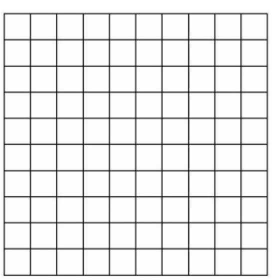
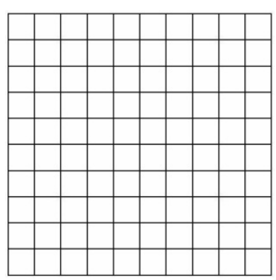
5. Color in the correct number of squares on the hundredths grids below to show each fraction. Then write each fraction as a decimal number.

1/10 _________   3/10 _________   1/5 _________

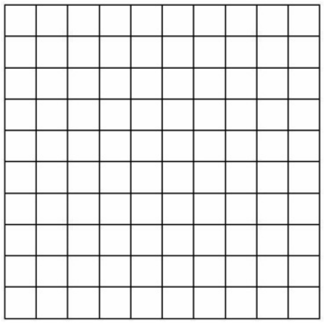
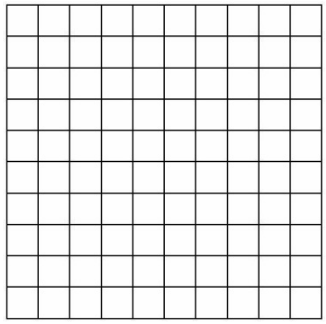
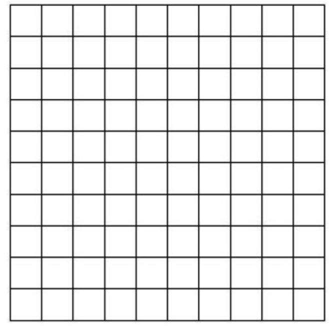
6. Color in the correct number of squares on the hundredths grids below to show each fraction. Then write each fraction as a decimal number.

1/2 _________ How much of a dollar is this?______   1/4 _________ Money? _______

7. Color in the correct number of squares on the hundredths grids below to show each fraction. Then write each fraction as a decimal number.

4/10 _______________ 5/100 ______________ 45/100 ______________

8. Write an equivalent fraction or decimal for the number given in each row.

$\frac{1}{2}$	
$\frac{1}{10}$	
	0.5
$\frac{1}{4}$	
	.03
	0.6
$\frac{3}{10}$	
$\frac{27}{100}$	

	0.25
	0.43
$\frac{4}{10}$	

9. List these decimal numbers in order from smallest to largest:

0.5, 0.10, 0.2, 0.25, 0.45

smallest _____________________________________ largest