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Teaching Math with Everyday Manipulatives Curriculum Map

The major curriculum expectations for junior math are brought to life with these hands-on activities that involve students directly in their learning.

There is no better way to learn concepts than to experience them, and with these activities students create their own math manipulatives with everyday items found in the classroom or at home.

Whether you use these at the start or conclusion of math lessons, or as the basis of individual or group work, you'll find them a valuable addition to your teaching strategies.

You should find many of these activities adaptable in terms of actual materials used. For example, if the activity suggests “buttons”, often “pennies” can be used. Many activities suggest a game to play and implies that the games are 2 Player games, however, many activities can have more than two students and often, a single person can follow the steps alone.

Finally, most of the activities are suitable for the average Grade 4, 5, or 6 student. While some activities will be quite challenging for Grade 4 or review for Grade 6, many can be adapted to each of the grade levels.

Teachers can set the standard that they expect their students to achieve by showing examples of students who are performing the activity at the expected level. For example, save a student sample of a graph or pattern (take a picture if it was done with manipulatives) of a suitable level of work and leave it at the centre.

Students working below or above grade level should be encouraged to work to the best of their own ability. Students who achieve below grade level results should be encouraged to watch and learn from others and observe how they are getting their results.

Students working above grade level should be encouraged to model how they are working through the activity. Encourage peer teaching whenever possible.

The NCTM standards covered are included with each topic.

Teacher Notes Include:

- At a Glance – Learning Expectations Covered
- Teacher Rubric
- Student Rubric
- Teacher Suggestions

<u>Everyday Manipulatives for:</u>

Number Sense and Numeration

- Numeration and place value
- Arithmetic functions with whole numbers, rational numbers, and integers (break down to add/subtract, multiply/divide, rationals, integers)
- Fractions, decimals, and percents

Geometry

- Two and three dimensional shapes
- Symmetry and translation

Measurement

- Distance, in appropriate units
- Time, in appropriate units
- Perimeter and area
- Volume and surface area

Data and Probability

- Chance and probability
- Data collection and management
- Measurement of central tendency

Algebra

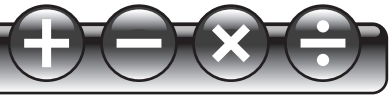
- Patterns and variables
- Graphical representation

Teaching Math with Everyday Manipulatives

Teacher Suggestions:

You should find many of these activities adaptable in terms of actual materials used. For example, if the activity suggests "buttons", often "pennies" can be used. Many activities suggest a game to play and implies that the games are 2 Player games, however, many activities can have more than two students and often, a single person can follow the steps alone. Finally, most of the activities are suitable for the average Grade 4, 5, or 6 student. While some activities will be quite challenging for Grade 4 or review for Grade 6, many can be adapted to each of the grade levels. Teachers can set the standard that they expect their students to achieve by showing examples of students who are performing the activity at the expected level. For example, save a student sample of a graph or pattern (take a picture if it was done with manipulatives) of a suitable level of work and leave it at the centre. Students working below or above grade level should be encouraged to work to the best of their own ability. Students who achieve below grade level results should be encouraged to watch and learn from others and observe how they are getting their results. Students working above grade level should be encouraged to model how they are working through the activity. Encourage peer teaching whenever possible.

Number Sense and Numeracy



Overview:

Number sense and numeration/operations is the ability to relate numbers to the quantities they represent. Numeration/operations are the computations that students perform with numbers. Manipulatives should be used to help students use representations, develop mathematical thinking and reasoning skills and to create problem solving strategies.

The NCTM Standards for the Junior Grade levels suggest that students should:

- understand the place-value structure of the base-ten number system and be able to represent and compare whole numbers and decimals;
- recognize equivalent representations for the same number and generate them by decomposing and composing numbers;
- develop understanding of fractions as parts of unit wholes, as parts of a collection, as locations on number lines, and as divisions of whole numbers;
- use models, benchmarks, and equivalent forms to judge the size of fractions;
- recognize and generate equivalent forms of commonly used fractions, decimals, and percents;

- explore numbers less than 0 by extending the number line and through familiar applications;
- describe classes of numbers according to characteristics such as the nature of their factors;
- understand various meanings of multiplication and division;
- understand the effects of multiplying and dividing whole numbers;
- identify and use relationships between operations, such as division as the inverse of multiplication, to solve problems;
- understand and use properties of operations, such as the distributivity of multiplication over addition;
- develop fluency with basic number combinations for multiplication and division and use these combinations to mentally compute related problems;
- develop fluency in adding, subtracting, multiplying, and dividing whole numbers;
- develop and use strategies to estimate the results of whole-number computations and to judge the reasonableness of such results;
- develop and use strategies to estimate computations involving fractions and decimals in situations relevant to students' experience;
- use visual models, benchmarks, and equivalent forms to add and subtract commonly used fractions and decimals;
- select appropriate methods and tools for computing with whole numbers from among mental computation, estimation, calculators, and paper and pencil according to the context and nature of the computation and use the selected method or tools.

The activities suggested in this book should, with regular practice over time, allow students to develop stronger number and numeration/operations skills.

Teacher Preparation Notes:

Spinning in Circles *(page 14)*
You will need to fill in the fractions that you would like converted to decimals, appropriate for your students' level. You can photocopy the blank sectioned circle many times and fill in one with fractions to be reduced or fractions to be converted to a decimal or decimals to be converted to fractions. Make several different versions so that the students can use different spinners each time. You may want to "code" them according to what level they are at for easy future reference. Grade 4 example: fraction to reduced fraction 3/6 4/12 5/25; fraction to decimal 1/10 66/100; decimal to fraction 0.2 0.65 0.08

Dice Fractions *(page 18)*
Using a wooden cube, write fractions on it that are appropriate for your class, (e.g., 1/2, 1/4, 1/3 for Grade 4; 1/6, 1/5, for Grade 5; 2/3, 3/5 for Grade 6)

Equality Pies *(page 19)*
Divide the paper plates (or circles) into 3rds or 5ths or 8ths, etc., depending on your students' skill level. You may even want to challenge them by not having the pies divided into equal sections, but instead combining, for example two 8ths, so that the pie has one 1/4 section and six 1/8 sections.

Dividing Dice *(page 21)*
Using 2 blank cubes and a permanent marker, create 2 die for this game using numbers appropriate for your students' skill level. For practice or review of simpler long division use small, even digit numerals for the divisor die (2, 2, 4, 4, 6, 8) and large, even digit numerals for the dividend die (e.g., 24, 36, 40, 48, 56, 80) which reduces the possibility of having a remainder. (Eliminate the possibility of having a remainder entirely by filling in the dividend die with only common multiples of the numerals on the divisor die.) For practice with more complicated long division, with remainders, use larger numerals on the divisor die, and large 3 or 4 digit numerals on the dividend die.

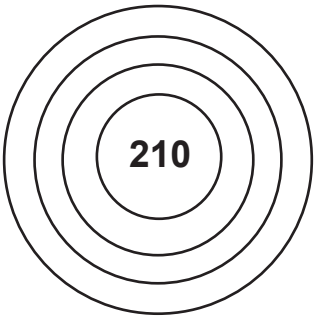
Estimating Decimals *(page 22)*
The students will be estimating multiplication. Make 2 sets of cards, in different colors. One set will be a whole number (put a multiplication sign in front of the whole number) and the other set will be a decimal. Choose numerals appropriate for your students' skill level.

Bull's Eye Estimates *(page 23)*
Use small paper plates, or cut out circles about the size of small paper plates. Draw about 3 circumference rings around the plate and one numeral in the middle to make it appear as a "bull's eye". Note: for easiest skill level use 3-digit "bull's eye" numerals that are multiples of 100 or of 10 (i.e., 400, 210, etc.). Then move on to multiples of 10 or 5 (i.e., 315 or 950). Increase the difficulty for your class, as required. For each "bull's eye" circle, have an index card that matches it (they should both be clearly lettered to indicate that they are a match).

Examples:

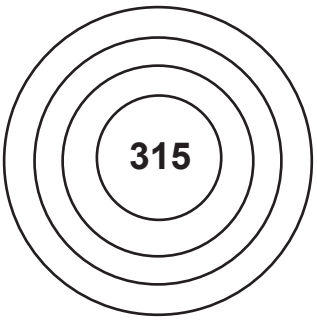
Target 210 Matching Card:

Column A	Column B
2	2
4	4
5	5
10	10
20	20
100	100



Target 315 Matching Card:

Column A	Column B
2	15
3	50
5	58
10	60
15	63
20	66
25	70
100	100



Name: _____

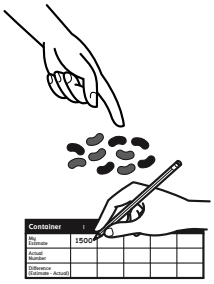
Estimation Jars

You Will Need:

- small objects (dried beans, pennies, buttons, etc.)
- clear containers

Steps:

1. Fill a container with the objects.
2. Estimate how many you think are in the container. Record your guess in the chart below.
3. Next, count the objects. In the chart, record the actual number.
4. Fill the container with different objects and repeat steps 2 and 3.
5. Try using different containers to see which container holds more.
6. After several times of guessing and counting, find the **differences** between each guess and actual number.



Container	1	2	3	4	5
My Estimate					
Actual Number					
Difference (Estimate – Actual)					

Make It a Game!

1. You and another player can both try guessing how many objects are in the containers.
2. Find the differences between each guess and actual number, and **add** all the differences together to figure out who had the closest guess overall!

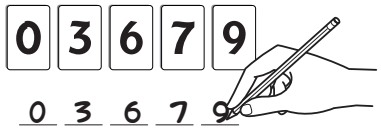
Name: _____

Place Value

You Will Need:

- index cards numbered 0 to 9

Steps:



1. Take any 5 numbers. Record the numbers that you chose.

_____ _____ _____ _____ _____

2. Arrange them to make the smallest even-number 5-digit number possible.

Ten Thousands	Thousands	Hundreds	Tens	Ones
_____	_____	_____	_____	_____

3. Arrange them to make the largest even-number 5-digit number possible.

Ten Thousands	Thousands	Hundreds	Tens	Ones
_____	_____	_____	_____	_____

4. Arrange them to make the smallest odd-number 5-digit number possible.

Ten Thousands	Thousands	Hundreds	Tens	Ones
_____	_____	_____	_____	_____

5. Arrange them to make the largest odd-number 5-digit number possible.

Ten Thousands	Thousands	Hundreds	Tens	Ones
_____	_____	_____	_____	_____

Make It a Game!

1. Each player starts with their own set of numbered cards, face down.
2. Decide on a rule about what kind of number you are going to make (for example, "largest even-number").
3. At the same time, each player will choose any 5 cards from their pile and make the number that follows the rule.
4. The first person to correctly make the number scores a point.
5. The first player to score 5 points wins.

Tip: You can also play with more than 5 cards to make bigger numbers.

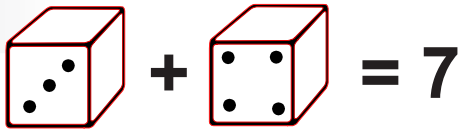
Name: _____

Number Contest

You Will Need:

- 2 die each numbered 0, 1, 2, 3, 4, and 5
- 2 Players

Steps:



1. Player 1 rolls both die and adds the numbers.
2. In the Player 1 column, fill in any space on the first row with that number. If the total is 10, use a zero.
3. Player 2 rolls both die and fills in one space in their column on the first row.
4. Repeat until all spaces in the first row are filled in.
5. The player who creates the largest number is the winner and gets a point. Put a checkmark after your row if you created the largest number.

Tip: If you are just learning this game, use 5 spaces per line instead of 6.

Player 1: _____	**Player 2:** _____
1. _____ _____ _____ _____ _____ _____	_____ _____ _____ _____ _____ _____
2. _____ _____ _____ _____ _____ _____	_____ _____ _____ _____ _____ _____
3. _____ _____ _____ _____ _____ _____	_____ _____ _____ _____ _____ _____
4. _____ _____ _____ _____ _____ _____	_____ _____ _____ _____ _____ _____
5. _____ _____ _____ _____ _____ _____	_____ _____ _____ _____ _____ _____

Extension:

Put a decimal between the fourth and fifth spaces!

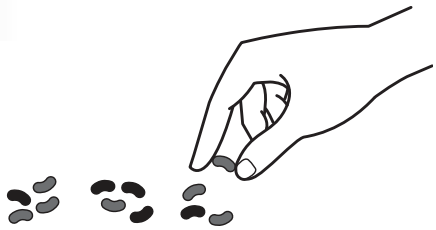
Name: _____

Multiplying Mania

You Will Need:

- about 100 small objects (beans, buttons, pennies, etc.)

Steps:



1. Arrange the objects into groups of equal sets (for example, 3 sets of 4 beans).

2. **a)** Sketch a picture of the sets.
   b) Make 2 multiplication and 2 division sentences.

   Example: 3x4=12 4x3=12 12 ÷ 3=4 12 ÷ 4=3

3. Repeat steps 1 and 2.

Sketch:

Multiplication Sentences _____ = _____ _____ = _____

Division Sentences _____ = _____ _____ = _____

Sketch:

Multiplication Sentences _____ = _____ _____ = _____

Division Sentences _____ = _____ _____ = _____

Extension:

Instead of arranging the objects into sets, you can arrange them into an array.

Name: _____

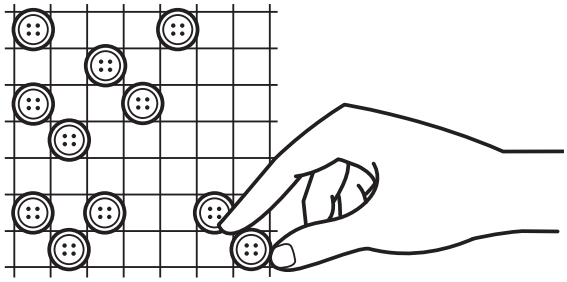
Figuring Fractions

You Will Need:

- small objects about the size of a square on the grid (buttons, dried beans, etc.)

Steps:

1. On the grid, cover some of the squares with small objects.
2. Write a fraction for the amount of the grid that is covered. Reduce the fraction to lowest terms.
3. Repeat these steps 5 more times.



Fraction 1: = **Fraction 2:** = **Fraction 3:** =

Fraction 4: = **Fraction 5:** = **Fraction 6:** =

Extension:

When you get really good at making a fraction, try also writing a decimal for the amount of the grid covered. Then, try changing the fraction or the decimal into a percent to describe the amount covered.

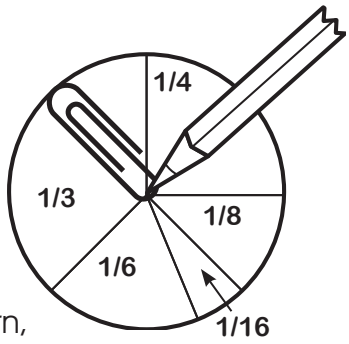
Name: _____

Spinning in Circles!

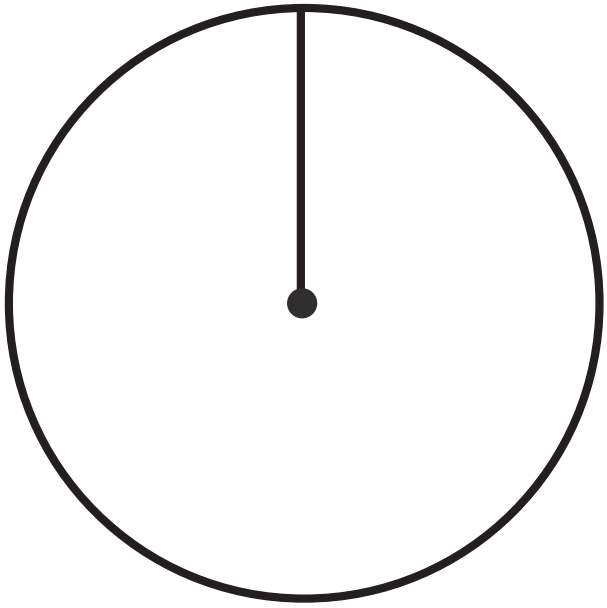
You Will Need:

- paperclip
- circle with fractions (see instructions page 7)

Steps:



1. Place the end of the paperclip in the center of circle. Hold the tip of your pencil in place and spin the paperclip.
2. Look at the pie piece on which the paperclip stops. Write the equivalent decimal for this fraction in the player 1 row below.
3. If you are playing with a partner, then player 2 takes their turn, repeating steps 1 and 2.
4. Keep playing until you fill in each space.



Player 1: _____ _____ _____ _____ _____ _____ _____ _____

Player 2: _____ _____ _____ _____ _____ _____ _____ _____

Name: _____

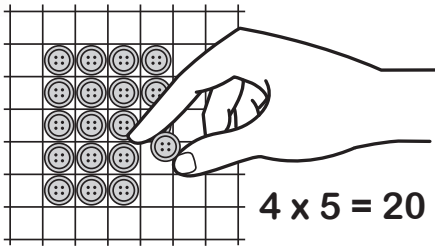
Multiple Arrays

You Will Need:

- grid paper
- small objects (beans, counters, pennies, etc.)

Steps:

1. Cover part of the grid with small objects in an array.
2. Then, write a multiplication sentence for the array in the space below.
3. Repeat steps 1 and 2.



Array 1	Array 2	Array 3
_____ = _____	_____ = _____	_____ = _____
Array 4	Array 5	Array 6
_____ = _____	_____ = _____	_____ = _____
Array 7	Array 8	Array 9
_____ = _____	_____ = _____	_____ = _____
Array 10	Array 11	Array 12
_____ = _____	_____ = _____	_____ = _____

Make It a Game!

1. Find a partner, and have Player 1 cover part of the grid with objects in an array.
2. Player 2 writes the multiplication sentence for the array.
3. Player 1 checks the multiplication sentence and, if correct, gives Player 2 one point.
4. Switch roles.

Tip: Players can also make a multiplication sentence and ask the other Player to arrange the objects in that array.

Name: _____

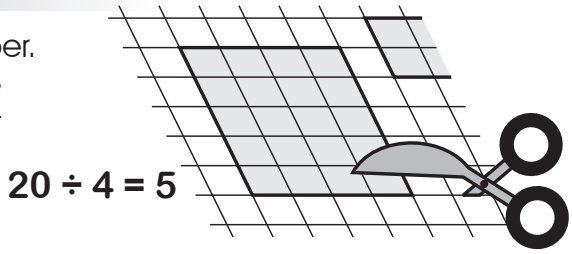
Grid Division

You Will Need:

- grid paper
- scissors
- glue

Steps:

1. Trace 4 rectangular shapes on the grid paper. Use straight lines along grid lines only. There may be some extra squares extending past one row or one column.



2. Cut out the shapes.

3. Glue each shape in a space below, and write a division question for each shape.

_____ = _____	_____ = _____
_____ = _____	_____ = _____

Make It a Game!

1. Find a partner, and both Players trace and cut out 4 rectangular shapes.
2. Trade shapes.
3. Glue each shape to your paper and write a division question for each shape.
4. Each Player gets a point for a correct division question. The first player to reach 5 points wins. (If there is a tie, you both win!)

Name: _____

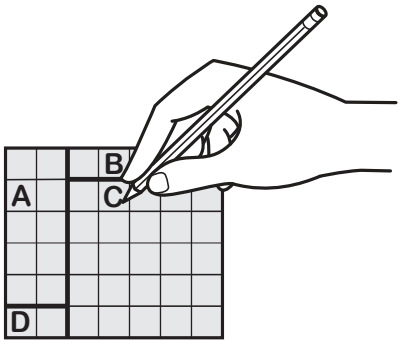
Grid Fractions

You Will Need:

- grid paper
- scissors
- glue

Steps:

1. Draw a rectangle on grid paper and cut it out.
2. In the rectangle, draw 3 straight lines. These lines should be straight along the grid lines, not overlapping. You should now have 4 small shapes within your rectangle.
3. Label each shape inside the rectangle A, B, C, or D.
4. Glue the rectangle grid into the space below.
5. Write the fractions that each grid area represents.



$A = \frac{10}{42}$

a) _____ b) _____ c) _____ d) _____

Make It a Game!

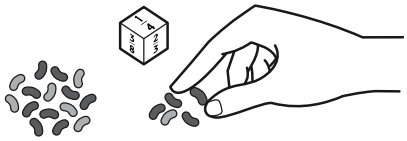
1. Find a partner, and both Players square off and cut out a rectangular section of the grid paper. Draw 3 straight lines along the grid lines in your rectangle.
2. Exchange grids and glue the grid (from the other Player) onto your own paper.
3. Glue each shape to your paper and write a division question for each shape.
4. Write the fractions that each grid area represents.

Name: _____

Dice Fractions

You Will Need:

- 20 to 40 small objects (pennies, beans, etc.) per Player
- Fraction Dice (see instructions page 7)



Steps:

1. Each Player takes the same amount of objects.
2. Player 1 rolls the dice and takes the exact fraction of the other Player's objects. If they cannot take the exact fraction rolled, they do not take anything. (Example: if Player 2 has 30 objects and Player 1 rolls 2/3, Player 2 takes 20 out of the 30 objects; if Player 2 rolls ¼, then he or she does not take any.)
3. Record your roll and actions in the Game Card below.
4. Players reverse their roles after each roll of the dice.
5. When one Player has taken away all the objects from the other Player, that Player wins.

Game Card

Roll	Fraction on dice	Number of objects my opponent has	Number of objects I take away
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Name: _____

Equality Pies

You Will Need:

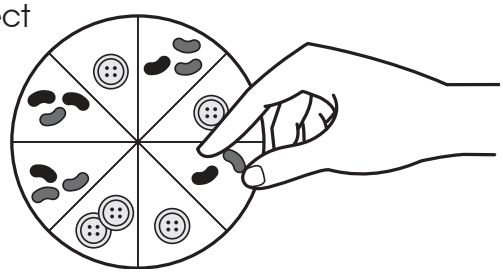
- paper plates (or cut-out circles) divided into equal sections (see instructions page 7)
- 2 sets of small objects (pennies, beans, buttons, etc.)

Steps:

1. Place object 1 in some of the sections, and object 2 in each of the other sections.

2. Draw a sketch of your "pie" and then record the ratio of one object to the second object (example: 1:3).

3. Repeat steps 1 and 2 with different objects.



Sketch Ratio _____	Sketch Ratio _____
Sketch Ratio _____	Sketch Ratio _____
Sketch Ratio _____	Sketch Ratio _____
Sketch Ratio _____	Sketch Ratio _____

Extension:

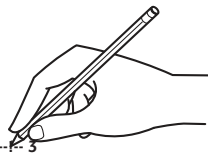
Write fractions that represent each object (for example, 1/4 and 3/4).

Name: _____

Lining Up Decimals

Steps:

1. Place a mark anywhere on the first number line below.
2. Record the decimal represented by the mark.



Example: 2.9

0--|--|--|--|--|--|--|--|--|--|-- 1 --|--|--|--|--|--|--|--|--|--|-- 2 --|--|--|--|--|--|--|--|--|--|-- 3

3. On the second number line, put a mark on a different place and record the decimal.
4. Repeat these steps for all the number lines.

		Decimal
1.	0--|--|--|--|--|--|--|--|--|--|--1--|--|--|--|--|--|--|--|--|--|--2--|--|--|--|--|--|--|--|--|--|--3	_____
2.	0--|--|--|--|--|--|--|--|--|--|--1--|--|--|--|--|--|--|--|--|--|--2--|--|--|--|--|--|--|--|--|--|--3	_____
3.	0--|--|--|--|--|--|--|--|--|--|--1--|--|--|--|--|--|--|--|--|--|--2--|--|--|--|--|--|--|--|--|--|--3	_____
4.	0--|--|--|--|--|--|--|--|--|--|--1--|--|--|--|--|--|--|--|--|--|--2--|--|--|--|--|--|--|--|--|--|--3	_____
5.	0--|--|--|--|--|--|--|--|--|--|--1--|--|--|--|--|--|--|--|--|--|--2--|--|--|--|--|--|--|--|--|--|--3	_____
6.	0--|--|--|--|--|--|--|--|--|--|--1--|--|--|--|--|--|--|--|--|--|--2--|--|--|--|--|--|--|--|--|--|--3	_____
7.	0--|--|--|--|--|--|--|--|--|--|--1--|--|--|--|--|--|--|--|--|--|--2--|--|--|--|--|--|--|--|--|--|--3	_____
8.	0--|--|--|--|--|--|--|--|--|--|--1--|--|--|--|--|--|--|--|--|--|--2--|--|--|--|--|--|--|--|--|--|--3	_____
9.	0--|--|--|--|--|--|--|--|--|--|--1--|--|--|--|--|--|--|--|--|--|--2--|--|--|--|--|--|--|--|--|--|--3	_____
10.	0--|--|--|--|--|--|--|--|--|--|--1--|--|--|--|--|--|--|--|--|--|--2--|--|--|--|--|--|--|--|--|--|--3	_____

Extension:

Record the fraction as well; reduced to lowest terms (for example, 2.9 is 2 9/10)

Name: _____

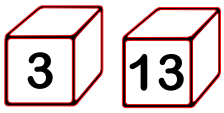
Dividing Dice

You Will Need:

- a divisor die of one color and a dividend die of another color (see instructions page 8)

Steps:

1. Roll both die.
2. Record the 2 numbers you rolled.
3. Make a division question. Solve.
4. Repeat steps 1 to 3.



3 13

Division Question

13 ÷ 3

My Calculation

$$3\overline{)13} = 4\text{R}1$$
$$-12$$
$$1$$

	Dice 1	Dice 2	Division Question	My Calculation
1.				
2.				
3.				
4.				
5.				

Make It a Game!

1. Play in pairs and take turns rolling and solving. Check each other's answers.
2. Each time you solve the question correctly, you earn a point.
3. First Player to 10 wins.

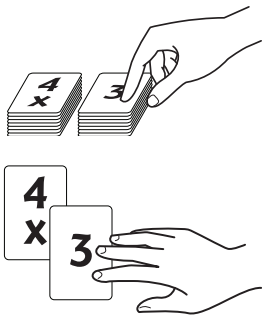
Name: _____

Estimating Decimals

You Will Need:

- 2 sets of cards (see instructions page 8)

Steps:



1. Choose one card from each pile.
2. Place both cards on the table, one above the other, with the card with the multiplication sign under the other.
3. Estimate the product of the 2 numbers and record your answer.
4. Write down the question and figure out the actual answer.
5. Find the difference between the 2 products to find out how close your estimate was.
6. Repeat steps 1 to 5.

	Estimate	Calculation	Difference (Estimate – Actual Answer)
1.			
2.			
3.			
4.			
5.			

Make It a Game!

1. Player 1 chooses a card from one pile, and Player 2 chooses a card from the other pile.
2. Follow steps 2 to 4 above, doing your estimation and calculation silently.
3. Find the difference between the 2 products and that is your score.
4. Do this a total of 5 times. Add all your scores together and the player with the lowest overall score is the winner.

Name: _____

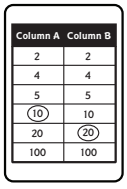
Bull's Eye Estimates!

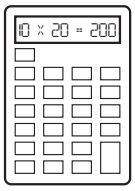
You Will Need:

- Bull's Eye Targets (see instructions page 8)
- color-coded matching cards
- calculator

Steps:

1. Player 1 chooses a Bull's Eye Target and matching card.
2. Both Players individually choose one number from each column, the product of which they estimate will be closest to the bull's eye number.
3. Players use the calculator to find out who was closest to the bull's eye. That Player gets a point.
4. Next, Player 2 chooses a Bull's Eye Target and Matching Card and the game is repeated.





A x B = _____

5. The Player with the most points at the end wins the game.

Bull's Eye Target Number	Multiplication Question	Answer	Difference (Target – Answer)	Points
	_____ x _____		_____ – _____ = _____	
	_____ x _____		_____ – _____ = _____	
	_____ x _____		_____ – _____ = _____	
	_____ x _____		_____ – _____ = _____	
	_____ x _____		_____ – _____ = _____	

Name: _____

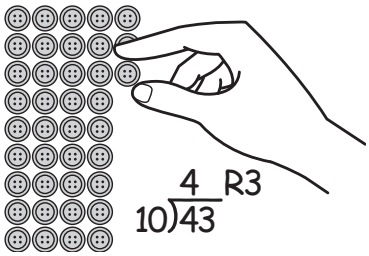
Array Division

You Will Need:

- array
- about 150 small objects (pennies, buttons, paper squares)

Steps:

1. Arrange the objects in an array. There may be objects that don't exactly fit into a row.
2. Sketch the array.
3. Write down a division number sentence that tells about the array, and solve.



Sketch	Division Sentence	Calculation
	_____ – _____	
	_____ – _____	
	_____ – _____	
	_____ – _____	

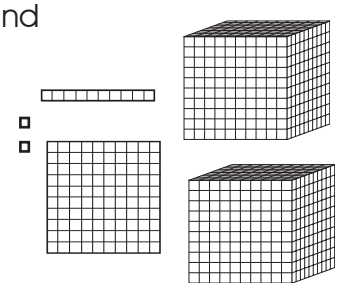
Name: _____

Base Ten Estimation

You Will Need:

- base ten blocks (several each of ones, tens, hundreds, thousands)

Steps:



1. Player 1 takes a random amount of ones, tens, hundreds, and thousands blocks and places them in front of Player 2.
2. Player 2 quickly estimates the number represented by the blocks in front of them. Record the estimate.
3. Count them to find the actual numbers. (**Hint:** Put all the thousands blocks together, then the hundreds, tens and ones.)

Estimated Total	Actual Total
3120	2112

4. Record the actual number in digits and then in words.
5. Find the difference between the estimate and the actual answer.
6. Switch roles.
7. The Player with the lowest total differences at the end, wins.

Estimated Total	Actual Total	Difference (Estimated – Actual)
Total Differences:		

Name: _____

Adding Fractions with Cuisenaire Rods

You Will Need:

- Cuisenaire Rods (to create your own rods, do Cool Cuisenaire Rods)

Steps:

1. Choose any 2 Cuisenaire Rods and record both fractions.

1/7 7/1

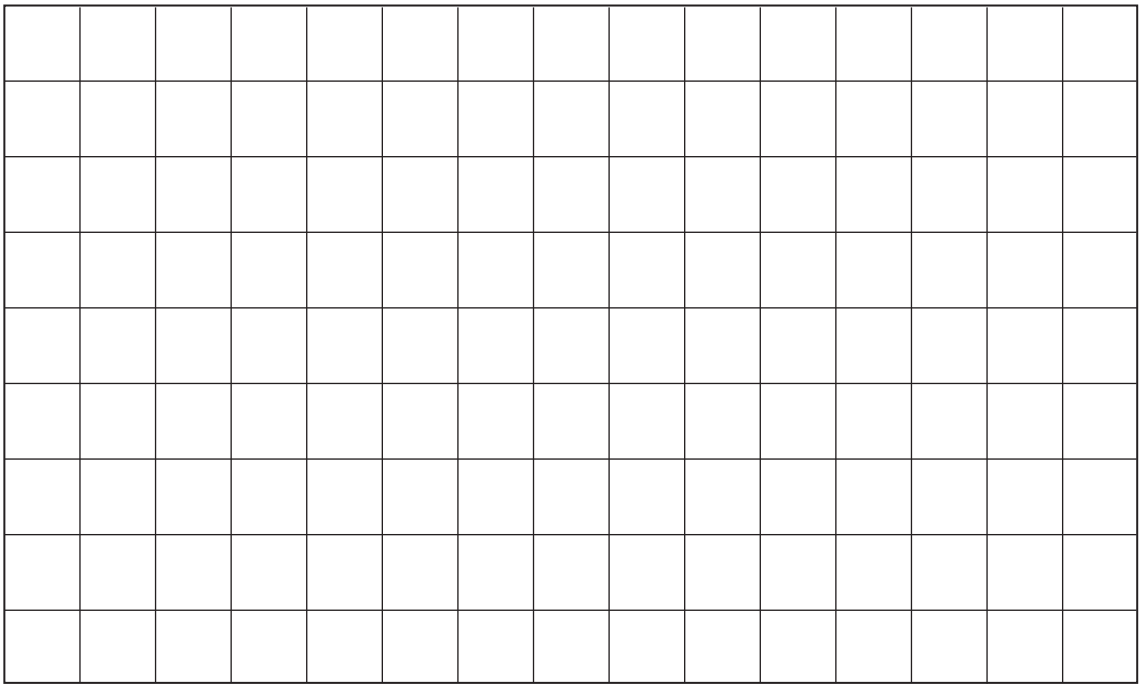
2. Make an addition sentence with them, and solve. **1/7 + 7/1 = 7 1/7**

Fraction1	Fraction 2	Addition Sentence
		+ =
		+ =
		+ =
		+ =
		+ =
		+ =
		+ =

Make it a Game!

1. Player 1 chooses any 2 cuisenaire rods and gives them to Player 2.
2. Player 2 records the 2 fractions given to them and adds them.
3. Player 1 checks their work and, if correct, gives Player 2 one point.
4. Switch roles.
5. The player with the most points at the end wins.

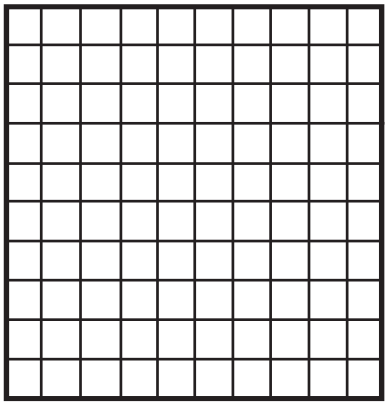
Grid (1 cm)



Base Ten Blocks

1

10



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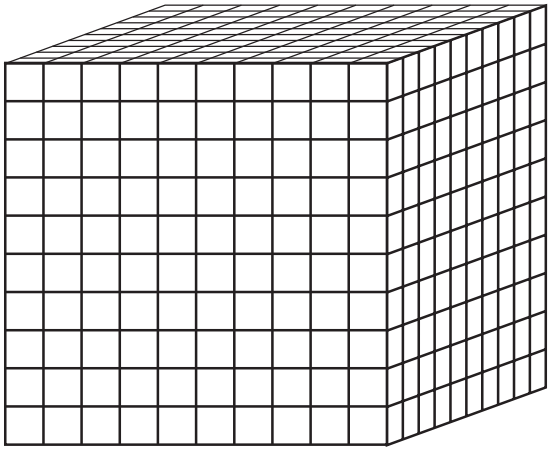

1 000

Cuisenaire Rods


white
1 cm


orange
10 cm


red
2 cm


blue
9 cm


light green
3 cm


brown
8 cm


purple
4 cm


black
7 cm


yellow
5 cm


dark green
6 cm