4th Grade Mathematics

Curriculum Map April 28th – June 27
New Content – Measurement & Data/ Geometry
Review Content - In-Depth Opportunities

ORANGE PUBLIC SCHOOLS

OFFICE OF CURRICULUM AND INSTRUCTION

OFFICE OF MATHEMATICS

Unit Overview

4th Grade
New Standards
4.MD.1, 4.MD.3, 4.MD.4, 4.MD.5, 4.MD.6, 4.MD.7
4.G.3
In-Depth Opportunity Standards
4.NBT.5
4.NBT.6
4.NF.1
4.NF.3
4.NF.4

Essential Concepts

4.MD

• There are two distinct systems of measurement with unique units of measure for each one, Metric and Customary (sometimes referred to as U.S. Customary).

• Units of measure can be expressed as whole numbers, decimals and fractions, (e.g., one inch equals 1/12th of a foot, 1 gram is .01 kilogram).

• The area of a rectangular can be calculated when the lengths of two of the sides of the rectangle are known.

• Knowing the area and the length of one side of a rectangle enables one to determine the lengths of the other three sides.

• Measurements can be converted into different sized standard unit measurements within a given measurement system (i.e. cm to m)

• Data can be collected and represented in many ways, including graphs or line plots.

• Data can be interpreted, analyzed and compared using graphs or line plots.

• The foundation of a line plot is a number line. Data sets of measurements are recorded with an 'X' above the corresponding value

• An angle is formed when two rays share a common endpoint.

• Angles can be measured using tools and can refer to the turn around the center of a circle.

• An angle's measure is not related to the area between the two rays.

• Benchmark angles include 45, 90, 180 and 360 degree angles.

• Angles can be classified and sorted by the degrees of their angles (acute, obtuse, right, and straight).

• Knowledge of benchmark angles can be used to find the measure of an unknown angle.

• A 360 degree rotation around a point makes a complete circle.

Essential Questions

4.MD

• Why does “what” we measure influence “how” we measure?
• What operations could you use to calculate the area and the perimeter of a rectangle?
• How are the area and perimeter of a rectangle related?
• Why does multiplying a rectangle’s length by its width give you its area?
• How can you determine the lengths of all the sides of a rectangle if you just know the length of one side and its area?
• Why do we measure perimeter with linear units and area with square units?
• Describe the relationship between kilograms and grams.
• Why would you want to convert centimeters to meters when measuring?
• Why does “what” we measure influence “how” we measure?
• How does the smallest data entry compare to the largest data entry?
• How is adding/subtracting fractions similar to or different from adding/subtracting whole numbers?

• Why does “what” we measure influence “how” we measure?
• What tools could one use to make or measure angles?
• Where can we find angles in the world around us? How are they alike or different?
• Who measures angles in the real world, and why do they need to measure them?
• How can you identify and describe benchmark angles?
• How can the measurement of a benchmark angle help you determine the measurement of an unknown angle(s)?

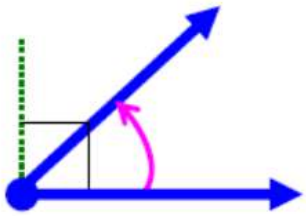
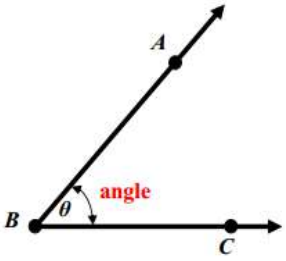
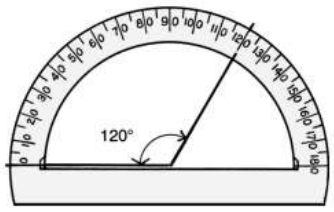
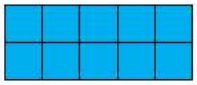
Common Core Standards

Unit 5	
4.MD.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.
4.MD.3	Apply the area and perimeter formulas for rectangles in real world and mathematical problems. *For example, find the width of a rectangular room given the area of the flooring and the length, by viewing the area formula as a multiplication equation with an unknown factor*.
4.MD.4	Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Solve problems involving addition and subtraction of fractions by using information presented in line plots. *For example, from a line plot find and interpret the difference in length between the longest and shortest specimens in an insect collection*.
4.MD.5	Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement: 4.MD.5A An angle is measured with reference to a circle with its center at the common endpoint of the rays, by considering the fraction of the circular arc between the points where the two rays intersect the circle. An angle that turns through 1/360 of a circle is called a "one-degree angle," and can be used to measure angles. 4.MD.5B An angle that turns through *n* one-degree angles is said to have an angle measure of *n* degrees.
4.MD.7	Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real world and mathematical problems, e.g., by using an equation with a symbol for the unknown angle measure.
4.G.3	Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry.

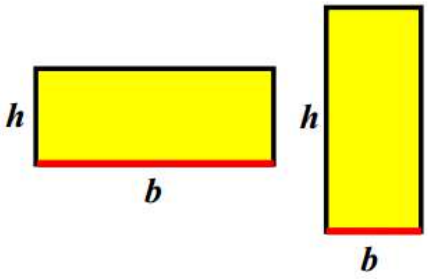
Connections to the Mathematical Practices

1	Make sense of problems and persevere in solving them
	Students solve problems by applying their understanding of operations with whole numbers, decimals, and fractions including mixed numbers. They solve problems related to volume and measurement conversions. Students seek the meaning of a problem and look for efficient ways to represent and solve it. They may check their thinking by asking themselves, "What is the most efficient way to solve the problem?", "Does this make sense?", and "Can I solve the problem in a different way?"
2	Reason abstractly and quantitatively
	Fifth graders should recognize that a number represents a specific quantity. They connect quantities to written symbols and create a logical representation of the problem at hand, considering both the appropriate units involved and the meaning of quantities. They extend this understanding from whole numbers to their work with fractions and decimals. Students write simple expressions that record calculations with numbers and represent or round numbers using place value concepts.
3	Construct viable arguments and critique the reasoning of others
	In **fifth** grade, students may construct arguments using concrete referents, such as objects, pictures, and drawings. They explain calculations based upon models and properties of operations and rules that generate patterns. They demonstrate and explain the relationship between volume and multiplication. They refine their mathematical communication skills as they participate in mathematical discussions involving questions like "How did you get that?" and "Why is that true?" They explain their thinking to others and respond to others' thinking.
4	Model with mathematics
	Students experiment with representing problem situations in multiple ways including numbers, words (mathematical language), drawing pictures, using objects, making a chart, list, or graph, creating equations, etc. Students need opportunities to connect the different representations and explain the connections. They should be able to use all of these representations as needed. Fifth graders should evaluate their results in the context of the situation and whether the results make sense. They also evaluate the utility of models to determine which models are most useful and efficient to solve problems.
5	Use appropriate tools strategically
	Fifth graders consider the available tools (including estimation) when solving a mathematical problem and decide when certain tools might be helpful. For instance, they may use unit cubes to fill a rectangular prism and then use a ruler to measure the dimensions. They use graph paper to accurately create graphs and solve problems or make predictions from real world data.
6	Attend to precision
	Students continue to refine their mathematical communication skills by using clear and precise language in their discussions with others and in their own reasoning. Students use appropriate terminology when referring to expressions, fractions, geometric figures, and coordinate grids. They are careful about specifying units of measure and state the meaning of the symbols they choose. For instance, when figuring out the volume of a rectangular prism they record their answers in cubic units.
7	Look for and make use of structure
	In **fifth grade**, students look closely to discover a pattern or structure. For instance, students use properties of operations as strategies to add, subtract, multiply and divide with whole numbers, fractions, and decimals. They examine numerical patterns and relate them to a rule or a graphical representation.
8	Look for and express regularity in repeated reasoning
	Fifth graders use repeated reasoning to understand algorithms and make generalizations about patterns. Students connect place value and their prior work with operations to understand algorithms to fluently multiply multi-digit numbers and perform all operations with decimals to hundredths. Students explore operations with fractions with visual models and begin to formulate generalizations.

Vocabulary

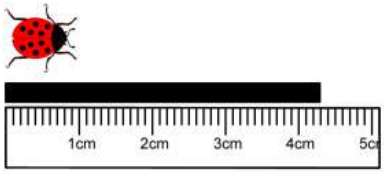
Visual Definition **The terms below are for teacher reference only and are not to be memorized by students.** Teachers should first present these concepts to students with models and real life examples. Students should understand the concepts involved and be able to recognize and/or use them with words, models, pictures, or numbers.		
acute angle		An angle with a measure less than 90°.
angle		Two rays or line segments that share an endpoint.
angle measure		The measure of the size of an angle. It tells how far one side is turned from the other side. A one degree angle turns through 1/360 of a full circle.
area	**2 rows of 5 = 10 square units** **or** **2 × 5 = 10 square units** 	The measure, in square units, of the inside of a plane figure.

base



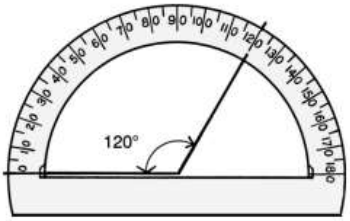
Any side of a plane figure. Usually thought of as a side where the figure "sits."

centimeter (cm)



A metric unit of length equal to 0.01 of a meter.

degree (angle measure)



A unit for measuring angles. It is based on dividing one complete circle into 360 equal parts.

endpoint

A point at either end of a line segment, or a point at one end of a ray.

formula

To find the area of any rectangle, multiply its length by its width. This rule can be written as an equation:

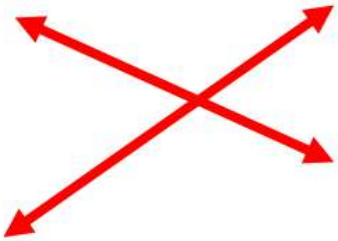
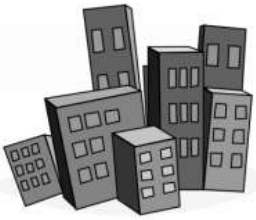
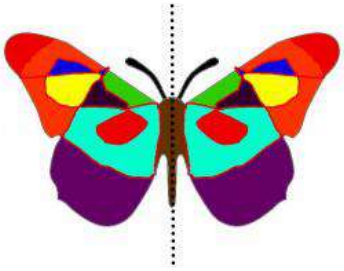
$$A = l \times w$$

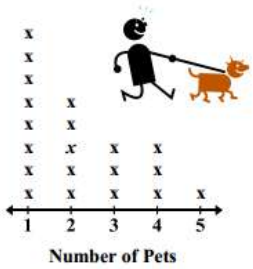
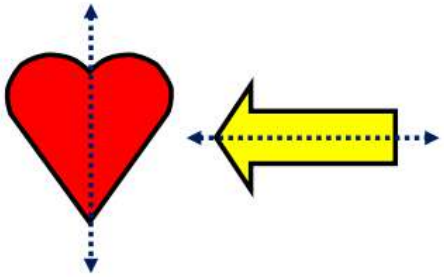
A general mathematical rule that is written as an equation.

gram (g)

The mass of a paperclip is about 1 gram.

The standard unit of mass in the metric system.
1,000 grams = 1 kilogram

intersecting lines		Lines that cross at a point.
kilogram (kg)	 Math book **About $2\frac{1}{2}$ pounds**	A metric unit of mass equal to 1000 grams.
kilometer (km)	 **A kilometer (km) is about the length of 4 city blocks.**	A metric unit of length equal to 1000 meters.
line		A set of connected points continuing without end in both directions.
line of symmetry		A line that divides a figure into two congruent halves that are mirror images of each other.

line plot		A diagram showing frequency of data on a number line.
line segment		A part of a line with two endpoints.
line symmetry		What a figure has if it can be folded in half and its two parts match exactly.
liter (L)	large bottle of soda or bottle of water  1,000 mL = 1 L	The basic unit of capacity in the metric system. 1 liter = 1,000 milliliters
meter (m)	 **A baseball bat is *about* 1 meter long.**	A standard unit of length in the metric system.

milliliter (mL)

This holds about 10 drops or 1 milliliter.

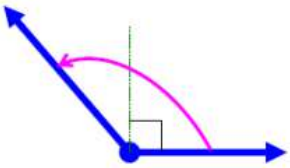
A metric unit of capacity.
1,000 milliliters = 1 liter

millimeter (mm)

The dot on a ladybug is *about* 1 millimeter wide.

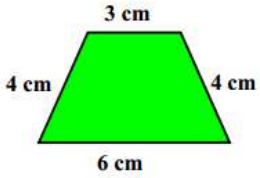
A metric unit of length.
1,000 millimeters = 1 meter

obtuse angle



An angle with a measure greater than 90º but less than 180º.

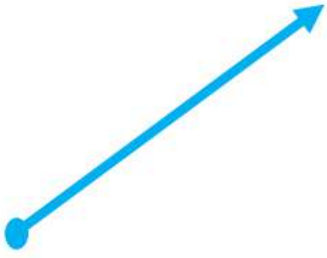
perimeter



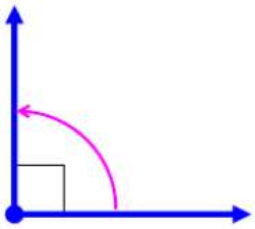
The distance around the outside of a figure.

Perimeter = 4 cm + 6 cm + 4 cm + 3 cm
= 17 cm

ray



A part of a line that has one endpoint and goes on forever in one direction.

right angle		An angle that measures exactly 90º.
straight angle		An angle that measures exactly 180º.

NEW CONTENT

Suggested Lessons, Tasks and Projects

Lesson Suggestion from Current Resources	CCSS	Teacher Notes
EDM 6-5	4.MD.5-7	Part 1
EDM 6-6	4.MD.5-7	Part 1
EDM 6-7	4.MD.5-7	Part 1
EDM 6-8	4.MD.5-7	Part 2 Angle Add Up
EDM 7-10	4.MD.4	Part 2: Plotting Insect Data Only
EDM 8-3	4.MD.3	Part 1
EDM 8-5	4.MD.3	Part 1
EDM 9-2	4.MD.3	Part 2: Rugs and Fences
EDM 10-4	4.G.3	Part 1
EDM 11-1	4.MD.1	Part 1
EDM 11-3	4.MD.4	Part 2: Plotting Book Heights Only
EDM 11-7	4.MD.1	Part 1 (Measuring Capacity, Liter and Milliliter Museum, Comparing Capacity using Metric Measures, Solving capacity number stories)

Tasks

4.MD.1

Mr. Liu asked the students in his fourth grade class to measure their heights. Here are some of the heights they recorded:

Student	Height
Sarah	50 inches
Jake	41/4 feet
Andy	1 1/2 yards
Emily	4 feet and 4 inches

List the four students from tallest to shortest.

4.MD.3

Karl's Garden

Karl's rectangular vegetable garden is 20 feet by 45 feet, and Makenna's is 25 feet by 40 feet. Whose garden is larger in area?

4.MD.4

Button Diameters

a. With a partner or group, gather a handful of round buttons from a diverse collection, and use a ruler to measure the diameter of each button to the nearest eighth-inch.

b. Make a line plot of button diameters, marking your scale in eighth-inch increments.

c. What is the most common diameter in your collection? How does that compare with the collection from another group?

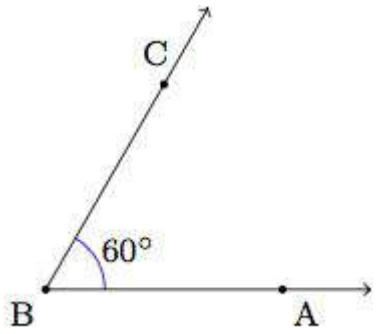
d. Now measure the diameters of these same buttons to the nearest quarter-inch.

e. Make a line plot of button diameters, marking your scale in quarter-inch increments.

f. Describe the differences between the two line plots you created. Which one gives you more information? Which one is easier to read?

4.G Measuring Angles

a. Draw an angle that measures 60 degrees like the one shown here:



b. Draw another angle that measures 25 degrees. It should have the same vertex and share side *BA*.

c. How many angles are there in the figure you drew? What are their measures?

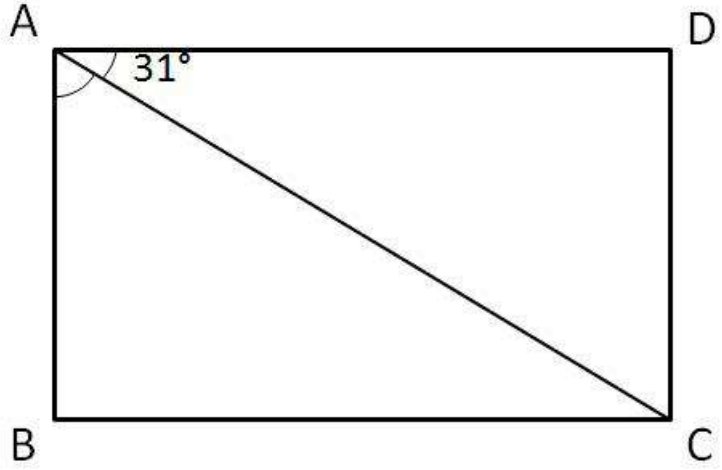
d. Make a copy of your 60 degree angle. Draw a different angle that measures 25 degrees and has the same vertex and also shares side *BA*.

e. How many angles are there in the figure you drew? What are their measures?

4.MD 7

Finding an Unknown Angle

In the figure, *ABCD* is a rectangle and $\angle CAD = 31^\circ$. Find $\angle BAC$.



4.G

Letters can be thought of as geometric figures.

a. How many line segments are needed to make the letter A? How many angles are there? Are they acute, obtuse, or right angles? Are any of the line segments perpendicular? Are any of the line segments parallel?

b. We can build all of these letters from line segments and arcs of circles. Build all of the capital letters with the smallest number of "pieces," where each piece is either a line segment or an arc of a circle.

c. Which letters have perpendicular line segments?

d. Which letters have parallel line segments?

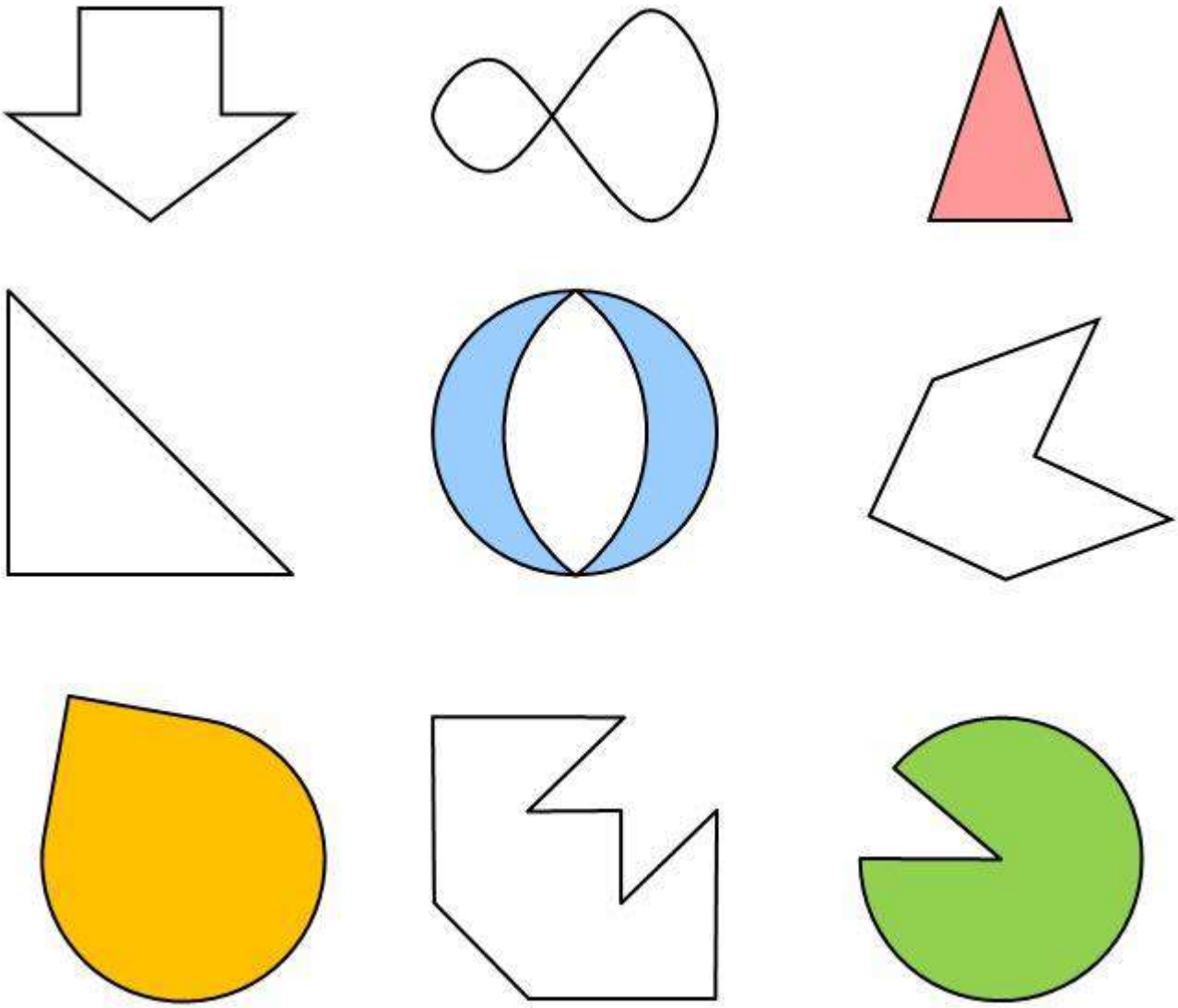
e. Which letters have no line segments?

f. Do any letters contain both parallel and perpendicular lines?

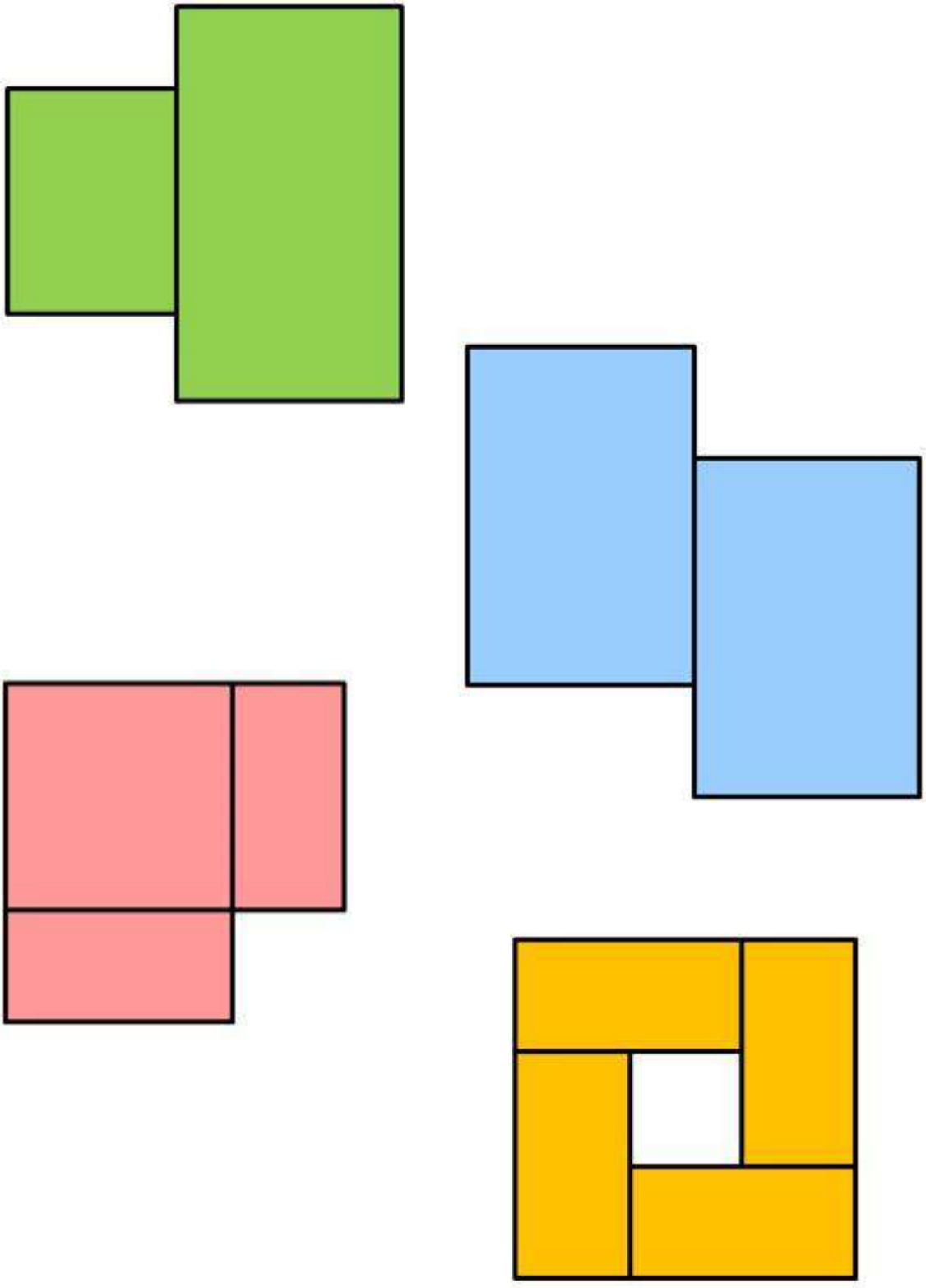
g. What makes the lower case letters "i" and "j" different than all of the capital letters?

4.G.3

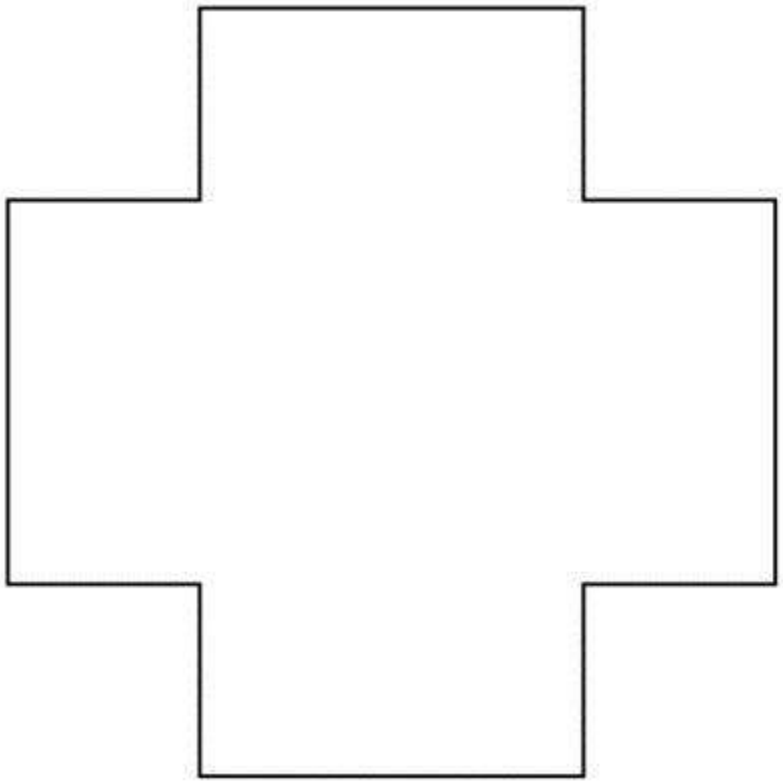
Each shape below has a line of symmetry. Draw a line of symmetry for each shape.



Not every shape has an line of symmetry. Which of the four shapes below have a line of symmetry? Draw a line of symmetry on them.



Some shapes have many lines of symmetry. Draw all the lines of symmetry you can on the shape below. How many are there?



CUMULATIVE REVIEW

Standards for In-Depth Opportunities

The Common Core Standards with opportunities for in-depth focus are identified in the PARCC Model Content Frameworks. These standards highlight some individual standards that play an important role in the content at each grade. The indicated mathematics might be given an especially in-depth treatment, as measured, for example, by the type of assessment items; the number of days; the quality of classroom activities to support varied methods, reasoning, and explanation; the amount of student practice; and the rigor of expectations for depth of understanding or mastery of skills.

Description of Unit Materials

The curriculum guide in this section of the unit consists primarily of projects and tasks. Students should work in groups or pairs with teacher facilitation and a strong focus on problem solving skills and logical reasoning. Since these standards have already been formally taught in previous units, the teacher should release responsibility to students and allow for student exploration, growth, and critique of their own work and the work of classmates.

The teacher should collect all student tasks in a portfolio for the items to move on with the student in future mathematics classes.

In-Depth Opportunity Standards
4.NBT.5
4.NBT.6
4.NF.1
4.NF.3
4.NF.4

4.NBT.5– Measuring Up

Level A

A small group of six soldiers came into a small town. They were very hungry, but none of the townspeople offered them food. One of the soldiers announced that they would make Stone Soup. “How do you make Stone Soup a towns’ person asked?” Well the soldier replied, “You need a big pot, water and a large stone.” The townspeople, very curious to see how Stone Soup was made, gathered together the materials. The soldiers started to cook the soup over a fire they made. Once the soup began to boil, a soldier said, “sure this will be a tasty stone soup, but a delicious stone soup would have additional ingredients.” The townspeople, now even more curious, asked what extra ingredients might be added. “Well for each person you would need 2 baby carrots, 3 green onions and five chunks of meat.”

What ingredients are needed to make a delicious stone soup for the six soldiers?

What ingredients are needed to make a delicious stone soup for ten people?

What ingredients are needed to make a delicious stone soup for 25 people?

Explain how you determined you answers.

Level B

The townspeople brought more and more ingredients and put them in the soup. They began to lose track of how many people they could serve. One young girl who was careful to count the green onions announced that there were 69 green onions in the soup.

How many chunks of meat would need to be in the soup to make the recipe taste right?

How many people can be served soup with all these ingredients? Show how you figured it out.

One man said, “If we have 69 green onions, then I know we need 45 carrots.” Is the man right, explain your answer.

4.NBT.6 – Diminishing Returns

Students have a given amount of money and a list of possible toys to purchase. Their goal is to determine a list of toys whose prices sum to the exact amount provided.

Mia has earned $43.94 of tokens playing games at the amusement center. The store in the amusement center has the following toys for sale. She plans to get toys and donate them to a local charity for needy children. The tokens are only good in this store, so she plans to spend all the tokens. What combinations of toys can she buy in order to spend all the tokens?

a. Show how you found your solution.

b. Is your solution the only possible answer? Explain.

The Baker - 4.NBT.5 & 5.NBT.6

This problem gives you the chance to:
• choose and perform number operations in a practical context

The baker uses boxes of different sizes to carry her goods.

Cookie boxes hold 12 cookies.
Donut boxes hold 4 donuts.
Muffin boxes hold 2 muffins.
Bagel boxes hold 6 bagels.
Bagel boxes hold 4

1. On Monday she baked 24 of everything.
How many boxes did she need? Fill in the empty spaces.

cookie boxes _____ donut boxes _____

muffin boxes _____ bagel boxes _____

2. On Tuesday she baked just bagels. She filled 7 boxes.

How many bagels did she make? _____ Show your calculations.

3. On Wednesday she baked 42 cookies.

How many boxes did she fill? _____

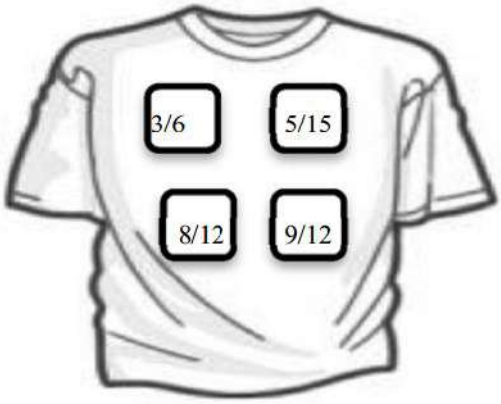
How many cookies were left over? _____

Explain how you figured this out.
_____

_____

4. On Thursday she baked 32 of just one item and she filled 8 boxes.
What did she bake on Thursday? _____
Show how you figured this out.

4.NF.1 – Fractured Numbers



Jeff is playing a new video game. The goal is to explore a cave with many levels and collect gold coins. In order to get through a door to the next level, you must master a secret code. Jeff's video character has four pockets on his jacket. The top left pocket is marked 3/6, the top right pocket is marked 5/15, the lower left pocket is marked 8/12 and the lower right pocket is marked 9/12.

Above the cave door at each level is a number card. To open the door, he must take the number card from the door and put it in the correct pocket. If he puts it in the wrong pocket, he loses one of his 3 lives. Here are the cave doors he must travel through.

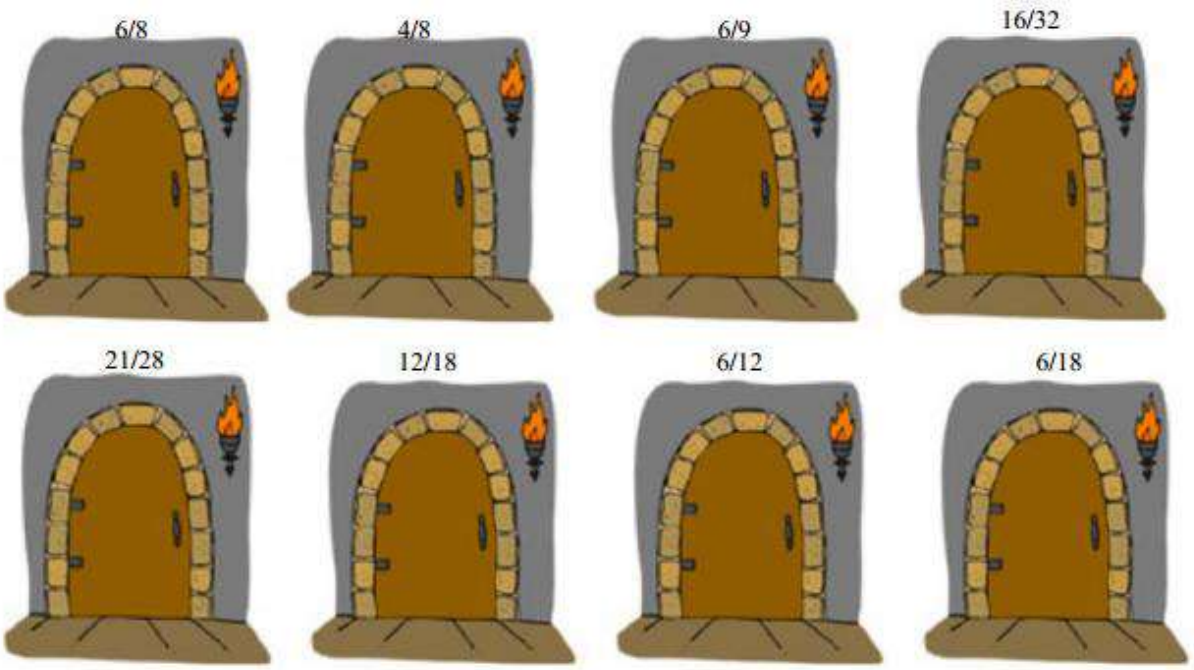


Figure out the secret code to get through all the doors. Write Jeff a note letting him know which numbers go into which pocket. Explain to Jeff how you know for sure. Remember, if you get it wrong he loses a life!

4.NF.4 – Party Time

At Leslie's party ¼ of the people had long hair. One half of the people at the party were boys, ¼ of the girls had short blond hair. None of the boys had long hair.

If there were 32 guests, what is the maximum number of girls who could have had short red hair?

Show how you determined you answer and why you know you have a correct solution.

NEW CONTENT PROJECTS

Resource Title: Dream Clubhouse

CCSS: 4.MD.3	**Time Frame:** Short term project

Brief Description of Lesson/Task/Activity: This lesson is designed to challenge students to learn about how geometry and measurement are used in the real world by architects. The students will explore various concepts such as area and perimeter as well as developing benchmarks for measurement.

The open-ended task requires the students to apply mathematics in a real-world context. The process goals include creative thinking, problem solving, and critical thinking.

Needed Resources/Materials

- Graph paper
- Internet access (examples of blueprints; research of items)
- Masking tape
- Rulers
- Possible read aloud: *Iggy Peck, Architect* by Andrea Beaty

Sources

- Adapted from "Junior Architects": http://illuminations.nctm.org./

STAGE ONE: ENGAGE

Possible questions: In what real world situations are area and perimeter used? How do area and perimeter relate? Inform the students that they will be junior architects by designing a room for their dream clubhouse. Have the students explore the various websites to gain a better understanding of how the process works: www.archkidecture.org/learn.html and www.math-kitecture.com/what.htm (description of floor plans as well as various examples). Discuss with students: Why do architects use blueprints to draw buildings to scale? (blueprints would be much too large if drawn to show actual size); What criteria must be considered when constructing buildings? (cost of materials, size of building/property, realistic measurement, etc.). Possible read aloud: *Iggy Peck, Architect* by Andrea Beaty.

STAGE TWO: ELABORATE

Discuss the architectural criteria with students (see attached packet). It is important that students understand all of the architectural criteria requirements prior to starting. Students need to begin to develop a sense of size so that they can determine dimensions for their clubhouse that are realistic and proportional to humans. To develop these spatial concepts, have the students explore various dimensions of the given area by placing masking tape on the floor of the classroom (variety of rectangular shapes with various dimensions to represent different room sizes). Ask the students: "What can you fit into a room this size?" Having the students "see" the possible sizes of the room will assist in helping them realize the scarcity of space and realistic furniture options. Additionally, students will need to generate a list of furniture items and then research realistic dimensions of those items. They may begin their research by measuring furniture in the classroom. This will ensure the students have considered realistic measurements before designing the clubhouse.

STAGE THREE: EVALUATE
Task 1: Have students describe their dream clubhouse. You may want them to describe the room in one paragraph or have them combine several paragraphs into one descriptive essay. Have the students justify their decision for the shape, dimensions, and design for the clubhouse. The students could also address any challenges they encountered as well as possible changes/improvements that could be made to their clubhouse designs. **Determine if the students' blueprints meet the architectural criteria requirements.** **Task 2:** If time allowed, have the students construct a 3D representation of their 2D blueprint (without a roof; ceilings shouldn't exceed 10 feet).

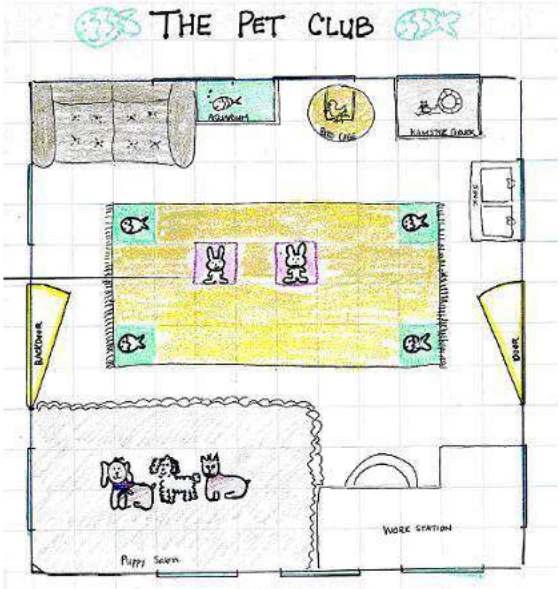
Architectural Criteria for the Clubhouse

Design a scale drawing of your clubhouse on one-inch graph paper. A scale is a proportion between two sets of measurements. When architects draw plans for a house, they cannot draw the plans the same size as the real house because the plans would be too large. Therefore, they must scale the drawing to a smaller size.

As you create a scale drawing, be sure that your clubhouse meets the following criteria:

1. The total perimeter cannot exceed 48 feet.
2. The clubhouse should be no larger than 150 square feet.
3. The clubhouse may be any shape.
4. Doors and windows must be at least 1 foot apart. Doors should be wide enough that furniture will fit through. You must have at least 1 door and no more than 6 windows.
5. All walls, doors, and windows must be drawn with a 90° angle, perpendicular to the floor.
6. The clubhouse should be drawn to scale and should be realistic and reasonable in size.
7. Remember 1 inch = 1 foot on the graph paper. For example, a doorway should be at least 3 inches wide on the drawing, so that in real life it would be 3 feet wide.

Example:



Room Sizes Comparisons

Given that the total perimeter cannot exceed 48 feet and that the clubhouse should be no larger than 150 square feet, what are some possible dimensions for the room?

Room Dimensions	Perimeter	Area

Observations noted between the room dimensions and the area and perimeter:

Based on my observations, I feel that the clubhouse dimensions should be: _____.

Include justification as to why you chose those dimensions:

Theme for Dream Clubhouse:

Furniture items to be included in my dream Clubhouse:

(Make sure you record realistic measurements for items listed below.)

Name of Item and Quantity	Dimensions (in feet)

Note: Your included items must be able to fit given the dimensions of your room.

Now, draw your floor blueprint using graph paper. Make sure you include a key stating that each square equals 1 foot by 1 foot.

Resource Title: Tree Height Dilemma	
CCSS: 4.MD.1 & 5	**Time Frame:** 3-4 class periods or short project
Additional Standards Addressed: **Science: Earth in the Universe-** Recognize that changes in the length and direction of an object's shadow indicate the apparent changing position of the Sun during the day although the patterns of the stars in the sky, to include the Sun, stay the same.	
Brief Description of Lesson/Task/Activity: In this activity, students generate measurement data by measuring various lengths using the appropriate tools (rulers, yard sticks). This lesson is designed for students who show mastery in measurement data (linear units) and displaying the data in a line plot using appropriate units. Additionally, the students are informally introduced to proportional reasoning when analyzing the relationship of heights of items to lengths of shadows.	
This activity varies in terms of content through abstractness, complexity, and variety. The students make generalizations about the relationship between the heights of items to the lengths of the shadows while moving beyond the regular curriculum. Proportional reasoning is informally introduced in the lesson. While exploring a real-world problem, the students are able to reach their own conclusions through a discovery learning approach.	
Needed Resources/Materials • *My Shadow* by Robert Louis Stevenson (poem) • Flashlight or direct light source • Items that vary in heights (i.e. building blocks, Cuisenaire rods, snap cubes, pencils) • Measuring device (ruler) • Calculator	
Sources: • *Fostering Children's Mathematical Power: An investigative Approach to K-8 Mathematics Instruction* (Baroody, A. & Coslick, R.T., 1998)	
Stage 1: Engage	

Pose the question: What factors affect the length of shadows? When are shadows less visible? Record student responses on chart paper and allow students to briefly discuss the factors noted. Have the students read the poem *My Shadow* by Robert Louis Stevenson. Guiding questions for discussion after the students read the poem: How is the speaker portrayed in the poem? How does the speaker feel about the shadow? Provide evidence from the poem. What misconceptions does the speaker have about shadows?

Have the students experiment with shadows- using a flashlight or other direct light source placed at different angles on a constant object (building block). What happens to the length of the item's shadow at the different angles? How does the placement of the flashlight affect the length of the shadow? It may be a good idea to have the students trace the item and then sketch the shadow (length) at the various angles.

Stage 2: Elaborate

Pose the problem: Mr. Gonzalez, a landscaper, was asked to relocate trees on a construction site for a new elementary school. In order to determine the cost of uprooting and relocating trees, Mr. Gonzalez must know the height of the trees, which indicates the extent of the root system. This also tells Mr. Gonzalez how much digging should occur based on the root system and the height of the trees. The school system wanted several large pine trees to be relocated to the perimeter of the property. Due to Mr. Gonzalez's fear of heights, he needs to figure out a way to measure the height of the trees without having to climb the trees to measure them.

Ask students:
How could Mr. Gonzalez figure out the height of the pine trees without climbing them?
What unit of measurement seems realistic in measuring the trees?
What information is needed in order to help Mr. Gonzalez make an accurate decision- without causing harm to the trees?
What should be considered when measuring the trees?

Through the questions, students should realize that the 1st activity relates to Mr. Gonzalez's problem as well as follow the **PCAI** model {**p**ose a question, **c**ollect, **a**nalyze, and **i**nterpret data} to explore/solve the problem. In order to collect data, the students will need to measure various items (either outside using the sunlight or inside using a flashlight) and the length of the shadow for each item. Before collecting the data, students need to establish the appropriate tools that need to be used to solve the problem (ruler with appropriate unit established, measure to the nearest halves and fourths of an inch, data chart to record data). Ask students: Do all of the objects being measured need to have the light source in the same exact position? Why?

After the students have collected the data, they should summarize their findings and determine the relationship between the height of the items measured and the lengths of their shadow. (Note: The lengths of shadows cast by the same light source are always proportional. For example, if the shadow of a meter stick is twice as long as its height, then the shadow of a tree will also be twice as long as the tree's height. If the shadow of the meter stick is 2 meters long, then the shadow of the tree is 12 meters long. If we divide the length of tree's shadow by the length of the shadow of the meter stick, we get the height of the tree: 6 meters! Try it at different times.)

Guiding questions:
How did you organize your data? What did you find most challenging about collecting the data?
How did you know if your measurements seemed reasonable?

What conclusion can be made based on your findings?
What is the relationship between an item's height and its shadow? Explain your thinking.

Stage 3: Evaluate

Once the students have analyzed their data, have the students develop a proposal plan to assist in helping Mr. Gonzalez solve his dilemma.

The proposal plan should include:

- all of the information found in the task regarding heights of items and their shadows
- evidence student was able to apply and analyze findings to draw conclusions on how to solve the task
- mathematical reasoning that is precise and accurate

a clear and concise explanation; justification supported with data

Resource Title: New-Fangled Tangrams

CCSS: 4.G. 1-3	**Time Frame:** 2 days

Brief Description of Lesson/Task/Activity: In this task, students will apply their knowledge of polygons and their properties to create "New-Fangled Tangram" puzzles. Students will need to pull from their understanding that polygons may have shared attributes, utilize visual-spatial skills, and employ a variety of problem solving strategies. Additionally, students will need to prove that their puzzles were designed correctly by using a variety of tools and apply fourth grade knowledge of polygons.

The fourth grade geometry standards require students to classify shapes based on the absence or presence of attributes. This task extends that knowledge by asking students to create polygons with given attributes. However, the task requires students to carefully manipulate their polygons because changing one will affect the attributes of all surrounding polygons. This task is open-ended in that it allows for multiple solutions and multiple solution strategies.

Needed Resources/Materials

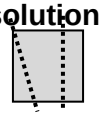
- *Employee Notice*
- *Customer Order Forms*
- *Tangram Squares*
- poster board or construction paper to display student work
- rulers
- protractors

STAGE ONE: ENGAGE

Tangrams are puzzles that are composed of seven shapes cut from a single square. The challenge of the puzzle is to create figures by arranging the shapes. The tangram puzzle was invented hundreds of years ago in China. It was brought to the United States by sailors in the nineteenth century and became extremely popular. Tangrams have been made out of clay, wood, plastic, ivory, and even jade. Today, tangram puzzles can be found in geometry classrooms around the world.

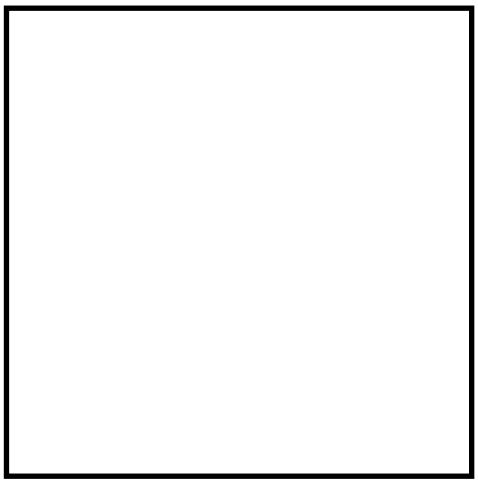
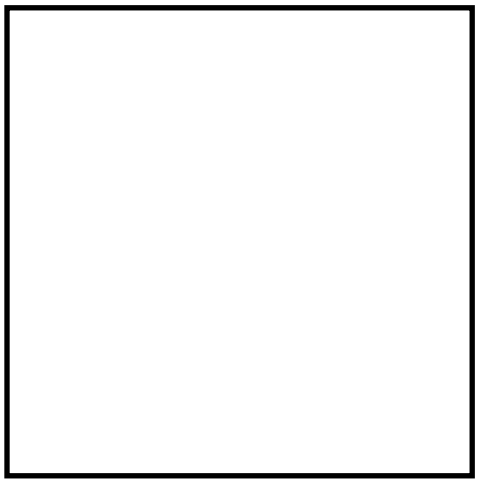
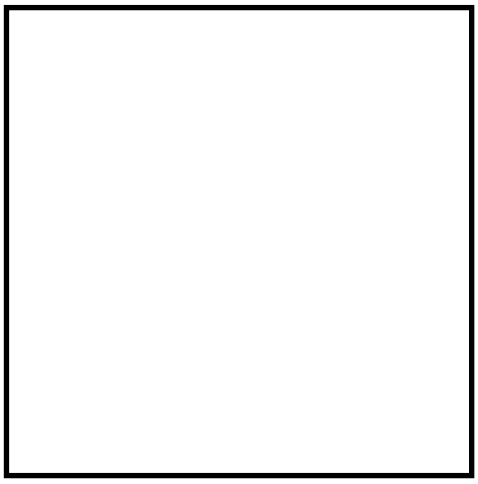
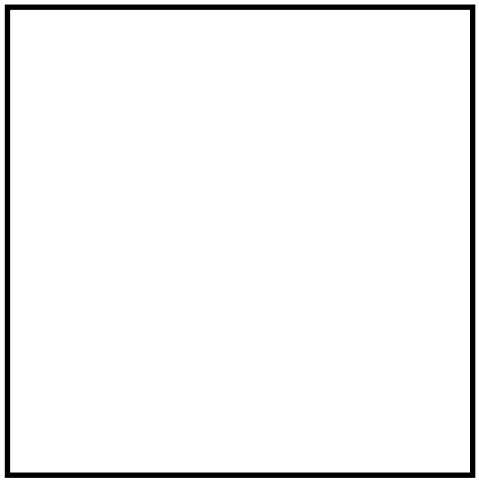
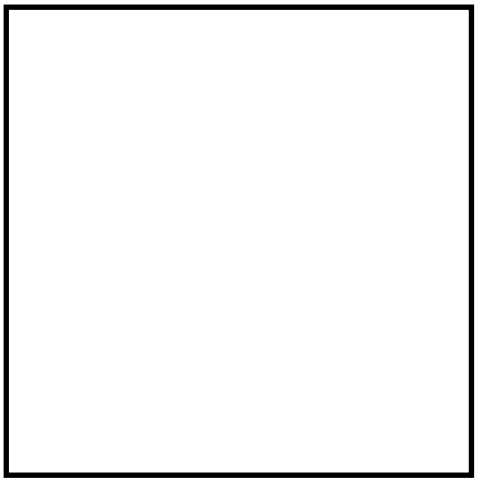
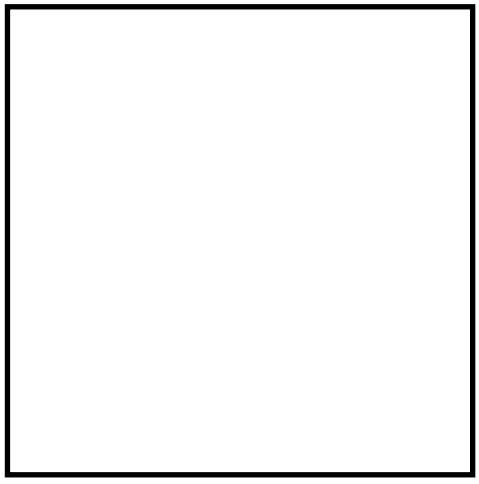
Due to the popularity of tangram puzzles, a company called "New-Fangled Tangrams" is opening down the street from our school. They have decided that their "new-fangled tangrams" will be composed of as few or as many shapes as the customer desires. For example, their very first customer asked for a three-piece tangram puzzle consisting of a triangle, trapezoid, and rectangle. To make the tangram, the puzzle company starts with one square piece of material. When cutting the square into shapes, they slice straight through the square moving from one side to another (see example).

How might the company have made their very first tangram puzzle (see below for sample solution)? Ask students how they can prove that all shapes are correct in their solution (revisit properties of trapezoids, triangles, and rectangles.



STAGE TWO: ELABORATE
Explain task to students: In order to earn some extra money, you have taken a part time job at "New-Fangled Tangrams." Your job is to create as many custom-made puzzles as you can before the end of your shift. Read the customer order forms and create the matching tangrams. Be sure to write a short note to each customer that proves that the tangram meets the description in the order form; the note may use drawings, words, numbers, or symbols. Before starting your shift, please read the employee notice that was just posted today (show employee notice). **Have a whole group discussion to compare solutions. Draw attention to times when there were several different solutions for a single order form. Ask students to discuss why there could be so many solutions (e.g., there are many different polygons that have parallel lines.) Ask students to discuss the trickiest part of this task and the strategies that helped them. Refer students to Darla's order form; what strategies were used to make sure there were no perpendicular lines (e.g., perpendicular lines form a right angle; students could have matched up the corner of a paper to ensure that there were no right angles or used a protractor)?** **Extension: Create a tangram picture using tangram pieces. Hide it behind a file folder so that your partner cannot see it. Give clues using mathematical terms to your partner and see if he or she can correctly build the same tangram picture that is identical to yours. Be sure to use precise language such as parallel, perpendicular, line segment, acute, obtuse, right angle, and line symmetry.**
STAGE THREE: EVALUATE
Students should be able to accurately decompose the tangram squares into polygons that meet the descriptions on the Customer Order Forms. Students should use specific language to prove that their solutions are correct; this will be assessed during one-on-one conversations and whole group discussions. In addition, students should recognize that it is possible to have more than one solution based on a given description because many polygons share attributes.

Tangram Squares

Resource Title: Tiny Homes	
CCSS: 4.MD.1-3	**Time Frame:** Two-three days
Brief Description of Lesson/Task/Activity: Students are asked to use their knowledge of area and perimeter to develop a blueprint for an eco-friendly "tiny home." The home must be innovative in design while meeting specific requirements from an architect. In order to stay within these requirements, students must monitor the area of the home, gardens, patios, and other spaces.	
Students have moved past acquiring knowledge related to area and perimeter and will now apply that knowledge to solve a real-world problem. This open-ended problem allows for creativity and student-individuality. Students are able to consider their own perspectives, interests, and ideas as they generate blueprints for an eco-friendly "tiny home."	
Needed Resources/Materials • *Sample Blueprint* • graph paper • computers with internet access • rulers • calculators • furniture and appliance catalogs (optional)	
Sources (all sources must be cited) • (www.pbs.org) - The Tiny House Movement • http://floorplanner.com/	
TEACHER NOTES: The main purpose of this task is for students to extend their knowledge of standard 4.MD.3. Standards 4.MD.1 and 4.MD.2 may also be addressed during the task depending on the measures that students select (inches versus feet).	
STAGE ONE: ENGAGE	
Explain that people all over the world have discovered the benefits of living in "tiny homes." A tiny home costs much less than a standard home, requires less energy, is better for the environment, and reduces the amount of clutter people typically collect. Most tiny homes have less than 400 heated square feet. Preview the PBS video titled "The Tiny House Movement". **The typical tiny home is shaped like a rectangular shoe box. In order to prove that a tiny home does not have to be boring and rectangular in design, a local architect is having a contest to see who can generate a blueprint for the most innovative tiny home. The architect will select his favorite blueprint and have the home built for the winner.** **Examine the Sample Blueprint provided by the architect. Ask:** • **How can you determine the area of each room? Encourage students to use the**	

formula for area – length x width.

- **What strategies can be used to find the total area of the home? The porch is not included in the area since it is not a heated space.**

STAGE TWO: ELABORATE

The task: Generate a blueprint for a tiny home that will fit on a 750 square feet plot of land that is 30 feet long. The home must be no larger than 400 square feet (Remember, area includes the heated square feet. Porches and patios are not included in this figure). In order for people to walk around the outside of the house, each side of the tiny home must be at least two feet away from the perimeter of the land.

After reading the task, ask students to silently think about the following questions:

- **What will you need to determine first?**
- **What tools will you use to create your blueprint? (e.g., graph paper, ruler, calculator, Microsoft Word)**
- **Many tiny homes have lofts, rooms that have multi-purposes, outside cooking spaces, gardens, composting areas, and patios. What unique features will your home have?**
- **What tools or resources will you use to make sure that furniture and appliances will fit in your tiny home? (e.g., the internet or catalogs to determine dimensions of furniture and appliances)**

Have students share their blueprints. Conduct a whole group discussion about the strategies and mathematics used to complete the task. Discuss any difficulties that students may have encountered and strategies for rectifying these issues (e.g., the home was a few feet too big; the house was too close to the perimeter of the land).

Extension:

- **In order to prove that the winning home will be innovative, yet functional, the architect holding the contest would like to see a 3D floor plan to go along with each blueprint. The floor plan must display the home completely furnished in order to show off its full potential. Your plan can be created at http://floorplanner.com/.**

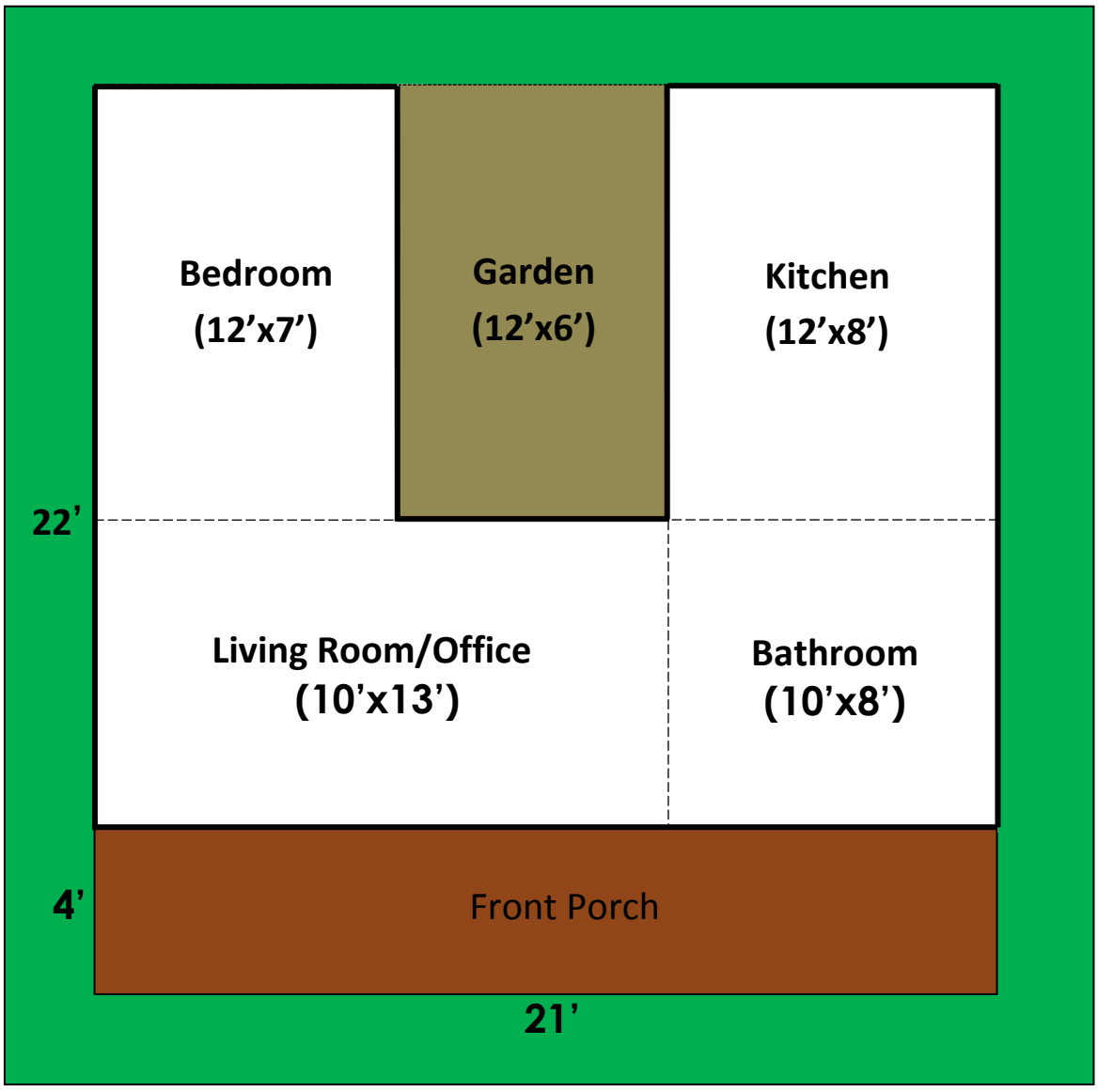
STAGE THREE: EVALUATE

Students will be assessed as they complete the task and during whole group discussion. The teacher should ask:

- **What did you do first? Students will need to start by determining the missing dimension for the plot of land: 30 x n = 750**
- **What strategy did you use to determine the total area of your home? Students should apply the standard formula of length x width. Students should also recognize that the area of each room can be added together to find the total area of the home.**
- **What other mathematics did you use as you created your blue print?**
- **At any point did you find that your home was greater than 400 square feet? What strategy did you use to fix this?**

TEACHER NOTES: When using http://floorplanner.com/, students will see two sets of dimensions for the area of the home (interior and exterior). Once the student creates a home, he/she can click on each wall and reduce its thickness, minimizing the difference between the two dimensions.

Sample Tiny Home Blueprint



Lot Size: 750 sq. ft.
Home Size: 390 sq. ft.

Resource Title: Great Estimations	
CCSS: 4.MD.1 & 2	**Time Frame:** One day
Students will apply fourth grade measurement concepts of composing and decomposing units to solve a discovery-based task. The open-endedness of this task will allow students to enrich their current knowledge, develop a variety of problem solving strategies, and be truly engaged in mathematics at a deeper level.	
Needed Resources/Materials: • Food scale • Meter stick • Ruler • Calculator • *Great Estimations* by Bruce Goldstone (if available)	

STAGE ONE: ENGAGE

Set up a estimation station in your classroom where students can guess the # of paper clips, sheets of paper in a stack, jelly beans, pencils etc. and have student note their strategies for their estimation.

After everyone has made their guesses, give the actual numbers and as a class discuss several strategies for making a great estimate. Explain that the reason for making estimates is to make problem solving easier or to find more manageable ways to work with really large numbers.

Next, explain to students that the world's longest spaghetti noodle was made by several chefs in Italy, and it was 100 meters long! Ask, *about how long is 100 meters? About, how many centimeters long is an average spaghetti noodle? Do you estimate that one box of spaghetti noodles lined up end to end is 100 meters long?* Have students share thoughts.

STAGE TWO: ELABORATE

Now that students have had a chance to warm up their estimation skills, present the task. Give each pair (or small group) of students a box of spaghetti. Ask, *If the spaghetti in your box was lined up end to end, would it be 100 meters long like the world's longest spaghetti noodle? About how long would it be? Today you are challenged to make a "great estimate" of the approximate length of the noodles in the box if they were lined up end to end. You may open the box, take out the noodles, and use any strategies and tools you choose. However, you must not actually line up the entire box of noodles end to end and measure the entire length. You must provide your final*

solution in two different ways: in both meters and centimeters.

Before students begin working, ask them to think about tools they might use for this task (e.g., food scale, meter stick, ruler, nutrition label on the box). Next, ask students to think about strategies they might use. (e.g., Look at the weight of a serving size, weigh one serving, measure the single serving, and multiply by the number of servings in the box. Another strategy is to count out ten noodles, measure the length of the ten noodles, estimate the how many groups of ten noodles are in the entire box, and multiply the number of groups by the length measured. Also, students may find out how many noodles are equal to one meter and then determine about how many meters of noodles are in the entire box.)

Once all groups have a solution, lead the whole group in a discussion. Ask students to share their solution strategies, critique each other's strategies, and add on to each other's thinking. As students are discussing, be sure to put emphasis on the strategies, rather than the actual solutions since estimates often lead to a variety of answers. Make sure that each group provides their solutions in two different ways: first, in meters and then again in centimeters. Record group solutions in a chart on the board (with a column for the answer in meters and another column for the answer in centimeters). Ask students to look at the chart and discuss why there were differences between each group's estimates *(when people estimate, the answers are not exact and may vary depending on the strategy used).* Ask students to compare the groups' estimates in the meters column. Then, compare the groups' answers in the centimeters column. Which column has less variation? Why is this? *(The meters column should have less variation because meters are a larger unit and less precise.)* Finally, ask students to think back to the world's largest noodle and compare its length to their measurements.

STAGE THREE: EVALUATE

Students will be evaluated on the efficiency and accuracy of their estimation strategies. For example, a student who needs to count every noodle and measure each noodle is not as efficient as the student who measures one serving and multiplies by the total number of servings. Students will also be evaluated on their ability to precisely communicate their strategies and attaching appropriate units to quantities. Lastly, students will be assessed on their ability to use appropriate tools efficiently and effectively.

TEACHER NOTES: As students discuss strategies, make sure that they attached units to the numbers discussed. If students are having difficulty solving the problem, suggest that they find a method for keeping track of their work (i.e., in a table or chart).

Potential Student Misconceptions

Measurement & Data

Students may memorize formulas without understanding the reasoning behind them.
Students may simply memorize a formula for area "length times width," without understanding *how* to measure length and width. Provide lots of opportunities to measure various objects using metric and standards units.

Students have difficulty interpreting a ruler.
Rulers often label the metric side solely with millimeters, so students don't always associate 10 millimeters as being equal to one centimeter. Students may not understand that zero (0) is the starting point of measurement on a ruler and that the numbers indicate the distance from the end of the ruler. Discuss the importance of the spaces between the lines on the ruler and the distance that the lines represent.

When making line plots, students may not record each piece of data.
For example, If the data includes 2, 2, 2, 3, 3, 3, 4, the student may just record 2, 3, and 4. Discuss how a line plot is a representation of an entire set of data, and that omitting data will alter the conclusions that can be drawn.

Geometry

Students believe an obtuse angle with short rays is a smaller angle than an acute angle with long rays.
Students can compare two angles by tracing one and placing it over the other. Students will then realize that the length of the rays does not determine whether one angle is larger or smaller than another angle. Also use straws that bend to model angles of different degrees. As students hinge the straw to open and close, they model the fact that angles are two rays that share a common endpoint, and the distance between the rays is what degrees measure.

Students may think that when you double the two dimensions of the rectangle, the area is doubled.
In fact, doubling both dimensions quadruples a rectangle's area. Students must investigate the patterns that emerge when both dimensions are doubled or tripled. Students must describe and defend their findings in order to understand this conceptual idea. (Simply telling students about this relationship does not build their conceptual understanding.)

Students confuse area and perimeter
Introduce the ideas separately. Create real world connections for these ideas; e.g., your belt is a perimeter of your waist, the metal frame around the white board is the perimeter of the white board; the concrete slab of the basketball court is the area of the court, the area of the floor is illustrated by the floor tiles. Use the vocabulary of area and perimeter in the context of the school day. For example, have students sit on the "perimeter" of the rug.

Students may incorrectly classify shapes.
Students may not realize that a square is a special type of rectangle. Clarify properties that define different categories. Offer students many chances to classify shapes, and use and apply the classification systems that mathematics uses.

Extensions and Sources

Online Resources

Common Core Tools
http://commoncoretools.me/
http://www.ccsstoolbox.com/
http://www.achievethecore.org/steal-these-tools

Manipulatives

http://nlvm.usu.edu/en/nav/vlibrary.html
http://www.explorelearning.com/index.cfm?method=cResource.dspBrowseCorrelations&v=s&id=USA-000
http://www.thinkingblocks.com/

Problem Solving Resources

***Illustrative Math Project**
http://illustrativemathematics.org/standards/k8
http://illustrativemathematics.org/standards/hs
The site contains sets of tasks that illustrate the expectations of various CCSS in grades K–8 grade and high school. More tasks will be appearing over the coming weeks. Eventually the sets of tasks will include elaborated teaching tasks with detailed information about using them for instructional purposes, rubrics, and student work.

***Inside Mathematics**
http://www.insidemathematics.org/index.php/tools-for-teachers
Inside Mathematics showcases multiple ways for educators to begin to transform their teaching practices. On this site, educators can find materials and tasks developed by grade level and content area.

IXL
http://www.ixl.com/

Sample Balance Math Tasks
http://www.nottingham.ac.uk/~ttzedweb/MARS/tasks/

New York City Department of Education
http://schools.nyc.gov/Academics/CommonCoreLibrary/SeeStudentWork/default.htm
NYC educators and national experts developed Common Core-aligned tasks embedded in units of study to support schools in implementation of the CCSSM.

***Georgia Department of Education**
https://www.georgiastandards.org/Common-Core/Pages/Math-K-5.aspx
Georgia State Educator have created common core aligned units of study to support schools as they implement the Common Core State Standards.

Gates Foundations Tasks

http://www.gatesfoundation.org/college-ready-education/Documents/supporting-instruction-cards-math.pdf

Minnesota STEM Teachers' Center
http://www.scimathmn.org/stemtc/frameworks/721-proportional-relationships

Singapore Math Tests K-12
http://www.misskoh.com

Math Score:
Math practices and assessments online developed by MIT graduates.
http://www.mathscore.com/

Massachusetts Comprehensive Assessment System
www.doe.mass.edu/mcas/search

Performance Assessment Links in Math (PALM)

PALM is currently being developed as an on-line, standards-based, resource bank of mathematics performance assessment tasks indexed via the National Council of Teachers of Mathematics (NCTM).
http://palm.sri.com/

Mathematics Vision Project
http://www.mathematicsvisionproject.org/

***NCTM**
http://illuminations.nctm.org/

Assessment Resources

- *Illustrative Math: http://illustrativemathematics.org/
- *PARCC: http://www.parcconline.org/samples/item-task-prototypes
- NJDOE: http://www.state.nj.us/education/modelcurriculum/math/ (username: model; password: curriculum)
- DANA: http://www.ccsstoolbox.com/parcc/PARCCPrototype_main.html
- New York: http://www.p12.nysed.gov/assessment/common-core-sample-questions/
- *Delaware: http://www.doe.k12.de.us/assessment/CCSS-comparison-docs.shtml

PARCC Prototyping Project		
Elementary Tasks (ctrl+click)	Middle Level Tasks (ctrl+click)	High School Tasks (ctrl+click)
• **Flower gardens (grade 3)** • **Fractions on the number line (grade 3)** • **Mariana's fractions (grade 3)** • **School mural (grade 3)** • **Buses, vans, and cars (grade 4)** • **Deer in the park (grade 4)** • **Numbers of stadium seats (grade 4)** • **Ordering juice drinks (grade 4)**	• **Cake weighing (grade 6)** • **Gasoline consumption (grade 6)** • **Inches and centimeters (grade 6)** • **Anne's family trip (grade 7)** • **School supplies (grade 7)** • **Spicy veggies (grade 7)** • **TV sales (grade 7)**	• **Cellular growth** • **Golf balls in water** • **Isabella's credit card** • **Rabbit populations** • **Transforming graphs of quadratic functions**

Professional Development Resources

Edmodo

http://www.edmodo.com

Course: iibn34

Clark County School District Wiki Teacher

http://www.wiki-teacher.com/wikiDevelopment/unwrappedSearch.php#contentAreaId=6&courseId=474

Learner Express Modules for Teaching and Learning

http://www.learner.org/series/modules/express/videos/video_clips.html?type=1&subject=math

Additional Videos
http://www.achieve.org/achieving-common-core;
http://www.youtube.com/user/TheHuntInstitute/videos

Mathematical Practices

Inside Mathematics

http://www.insidemathematics.org/index.php/commmon-core-math-intro

Also see the ***Tools for Educators***

The Teaching Channel

https://www.teachingchannel.org

***Learnzillion**

https://www.learnzillion.com

***Engage NY**

http://www.engageny.org/video-library?f[0]=im_field_subject%3A19

**Adaptations of the these resources has been included in various lessons.*