Imagine Schools
Summer Math Challenge

Grade 5

Answer Key

When completing the problems we need to show all of our work and show all of our thinking. In this answer key, important information that was used to solve the problem is included. Compare your work to ours, especially if your answer is different than our answer.

Project #1

Domain: Operations and Algebraic Thinking

Standard:

5.OA.1 Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.

Directions:

1. Write out the order of operations in correct order.

Subtraction	Exponents	Division
Multiplication	Addition	Parenthesis

2. Write a common acronym used to help you remember the order of operations (that your teacher taught you or you came up with on your own).

3. Complete the following problem using the order of operations:

   1,006 – 4 (10 X 8) + 7 = _____

   Show your work.

4. Create five problems of your own with at least three operations in each.
5. Show your solutions for each problem.

Solutions:

1. Write out the order of operations in correct order.

   Parenthesis, Exponents, Multiplication, Division, Addition, Subtraction

2. Write a common acronym used to help you remember the order of operations (that your teacher taught you or you came up with on your own). Please excuse my dear Aunt Sally.

3. Complete the following problem using the order of operations:

   1,006 – 4 (10 X 8) + 7 = _____ 1,006 – 320 + 7 = 693

4. & 5. Create five problems of your own with at least three operations in each. Problems and solutions will vary.

Project # 2

Domain: Operations and Algebraic Thinking

Standard:

5.OA.1 Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.

Directions:

Part I:

Evaluate the following expressions.

1. (2 x 6) + (6 x 4)
2. 486 – (12 x 3)
3. 6 x (14 ÷ 7) – 3
4. 89 (16 ÷ 4) + 8^3
5. 328 ÷ (8 x 3) + 6 x 2
6. 4.8 x 36 ÷ 12

Part II:

Tell how the order of operations affects the outcomes of each of the above problems. Write out the answer you would get if you did not follow the order of operations and common mistakes that are made when the order of operations is not applied.

Part III:

Evaluate the expression: 2{ 5[12 + 5(500 - 100) + 399]}

Solutions:

1. (2 x 6) + (6 x 4)= 36
2. 486 – (12 x 3)= 450
3. 6 x (14 ÷ 7) – 3 = 9
4. 89 (16 ÷ 4) + 8^3 = 46.25
5. 328 ÷ (8 x 3) + 6 x 2 = 25.6666667
6. 4.8 x 36 ÷ 12 = 14.4

Part II: Students should write an explanation for each problem above. Explanations will vary.

Part III: The first step would be to subtract 500 – 100 = 400.
Then multiply 400 by 5 = 2,000.
Inside the bracket, there is now [12 + 2,000 + 399]. That equals 2,411.
Next multiply by the 5 outside of the bracket. 2,411 x 5 = 12,055.
Next multiply by the 2 outside of the braces. 12,055 x 2= 24,110.

Project # 3

Domain: Operations and Algebraic Thinking

Standard:

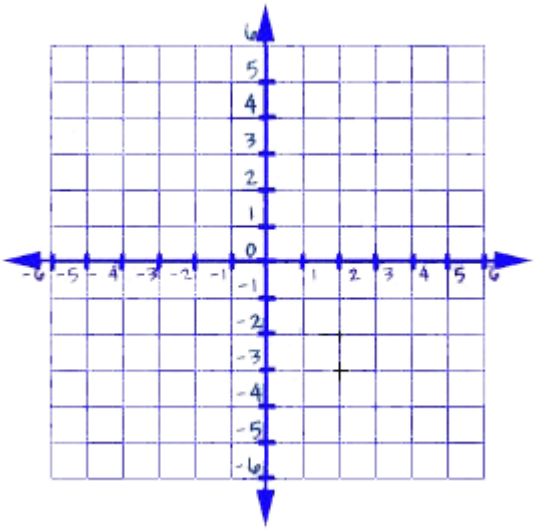
5.OA.3 Generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs consisting of corresponding terms from the two patterns, and graph the ordered pairs on a coordinate plane.

Directions:

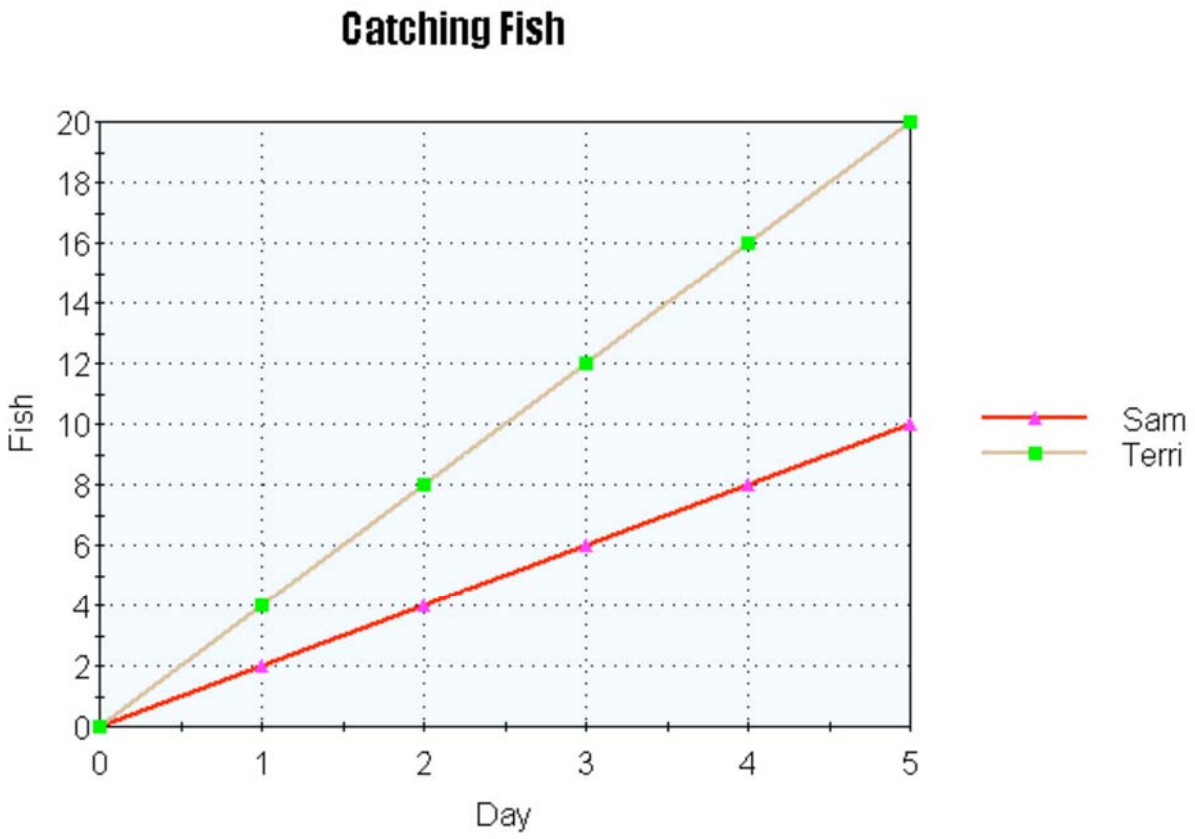
1. Make a chart (table) to represent the number of fish that Sam and Terri catch.

   Sam: 0, 2, 4, 6, 8, 10
   Terri: 0, 4, 8, 12, 16, 20

2. Describe the pattern.
3. How many fish do they have after each of the five days?
4. Make a graph of the number of fish.
5. Plot the points on a coordinate plane and make a line graph, and then interpret the graph.



Solutions: See next page.



My graph shows that Terri always has more fish than Sam. Terri's fish increases at a higher rate since she catches 4 fish every day. Sam only catches 2 fish every day, so his number of fish increases at a smaller rate than Terri.

It is important to note as well that the lines become increasingly further apart. Students should identify apparent relationships between corresponding terms. Additional relationships: The two lines will never intersect; there will not be a day in which boys have the same total of fish, explain the relationship between the number of days that has passed and the number of fish a boy has (2n or 4n, n being the number of days).

Project #4

Domain: Operations and Algebraic Thinking

Standard:

5.OA.3 Generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs consisting of corresponding terms from the two patterns, and graph the ordered pairs on a coordinate plane.

Directions:

1. Play "Guess My Rule."
2. Make up a rule that generates one number from another.
   Example: "Add 5" generates 8 from 3.
3. Make a table of both numbers from this rule in an input/output tale.
4. Plot the points on a graph and describe the graph.

Rule: _____

Table:

5. Try out this problem using the same methods as above.
   Choose one of three different situations by looking at the pattern in each option:

   Mr. Trumpet would like to offer you a job. He will hire you for ten days.
   He will pay you one of three ways:

   a) $2 the first day, $4 the second day, $6 the third day and so on.
   b) $0.50 the first day, $1.00 the second day, and each day after will be double the day before.
   c) $6 a day for each of the ten days.

   Which way would you choose? Explain why. Show the work you completed to reach your decision.

Project #5

Domain: Number and Operations in Base Ten

Standard:

5.NBT.1 Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and 1/10 of what it represents in the place to its left.

Directions:

1. Explain the difference in the value of the number 5 in the following numbers:

   1,005 543 5,099,433 1.05 51

   *Hint: Tell what the five represents in each of the numbers above and how it's position within the number is related to its value.

2. Write out each of the above numbers in expanded form to prove the value of each.
3. Look for numbers in your home, around your neighborhood, on the internet, or in the newspaper. Write down these numbers when you find them and keep a log of them throughout the summer. Choose one of your numbers to tell what would happen if you multiplied the number by 10. Choose one of your numbers to tell what would happen to it if you divided by ten.

Solution:

Example Explanation:

A student thinks, "I know that in the number 5555, the 5 in the tens place (5555) represents 50 and the 5 in the hundreds place (5555) represents 500. So a 5 in the hundreds place is ten times as much as a 5 in the tens place or a 5 in the tens place is 1/10 of the value of a 5 in the hundreds place.

Base on the base-10 number system digits to the left are times as great as digits to the right; likewise, digits to the right are 1/10th of digits to the left. For example, the 8 in 845 has a value of 800 which is ten times as much as the 8 in the number 782. In the same spirit, the 8 in 782 is 1/10th the value of the 8 in 845.

Project #6

Domain: Number and Operations in Base Ten

Standard:

5.NBT.3 Read, write, and compare decimals to thousandths.
a. Read and write decimals to thousandths using base-ten numerals, number names, and expanded form, e.g., 347.392 = 3 × 100 + 4 × 10 + 7 × 1 + 3 × (1/10) + 9 × (1/100) + 2 × (1/1000).
b. Compare two decimals to thousandths based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.

Directions:

1. Complete the following problems below.

    1. Write eighteen hundredths written in standard form?

    2. Write the following in standard form:
        a. 234,000,000
        b. 76,000
        c. 0.000543

    3. Now write 12,345,678.

        Short word form

        Expanded form

        Standard form

    4. Write each of the following in short word form.

        3,560,099

        950,382

        39,678,381

    5. Write the following in standard form.

        600,000+50,000+2,000+300+7

        32 million, 379 thousand, 408

398 thousand, 6

200,000+500+20+8

6. Choose a correct number for each of the following.

   Write any number with an 8 in the hundred thousands place.

   Write any number that has a 2 in the hundredths place.

   Write any number that has 20 thousands + 3 thousands.

   Write the number that is 10 thousand less than 845,340.

2. Create ten original problems comparing decimals with numbers in the thousandths place to challenge a friend or family member.

Solutions:

1. Write eighteen hundredths written in standard form?
   0.18

2. Write the following in standard form:
   d. 234,000,000 2.34×10^{8}
   e. 76,000 7.6×10^{4}
   f. 0.000543 5.43×10^{-4}

3. Now write 12,345,678.

   Short word form:

   Expanded form

   Standard form

4. Write the following in short word form:

   3,560,099

   950,382

39,678,381

5. Write the following in standard form.

600,000+50,000+2,000+300+7 = 652,307

32 million, 379 thousand, 408 = 32,379,408

398 thousand, 6 = 398,006

200,000+500+20+8 = 200,528

7. Choose a correct number for each of the following.

Write any number with an 8 in the hundred thousands place. Answers will vary.

Write any number that has a 2 in the hundredths place. Answers will vary.

Write any number that has 20 thousands + 3 thousands. Answers will vary.

Write the number that is 10 thousand less than 845,340. Answers will vary.

Project #7

Domain: Number and Operations in Base Ten

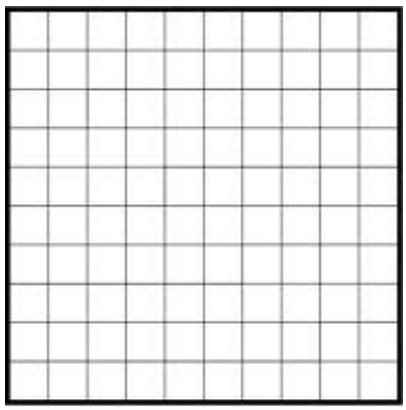
Standard:

5.NBT.4 Use place value understanding to round decimals to any place.

Directions:

1. Round 14.235 to the nearest tenth.
2. Explain your thinking.

3. Using a hundreds chart, create a model by shading to show the number 72.

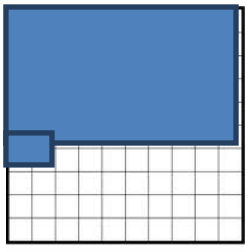


Solutions:

1. Round 14.235 to the nearest tenth.
2. Explain your thinking.

   Students recognize that the possible answer must be in tenths thus, it is either 14.2 or 14.3. They then identify that 14.235 is closer to 14.2 (14.20) than to 14.3 (14.30).

3. Using a hundreds chart, create a model by shading to show the number 72.



Project #8

Domain: Number and Operations in Base Ten

Standard:

5.NBT.4 Use place value understanding to round decimals to any place.

Directions:

1. Round each of the following to the tens place.

884	973	8,222	10.02	8,003

2. Round each of the following to the hundreds place.

884	973	8,222	10.02	8,003

3. Round each of the following to the tenths place.

0.667	30.09	432.002	78.8	3.4007

4. Round each of the following to the hundredths place.

0.667	30.09	432.002	78.8	3.4007

5. Round each of the following to the thousandths place.

0.667	30.09	432.002	78.8	3.4007

6. Create twenty rounding problems with decimals and whole numbers for a friend to solve. Include an answer key.

Project #8 continued

Solutions:

1. Round each of the following to the tens place.

884	973	8,222	10.02	8,003

2. Round each of the following to the hundreds place.

884	973	8,222	10.02	8,003

3. Round each of the following to the tenths place.

0.667	30.09	432.002	78.8	3.4007

4. Round each of the following to the hundredths place.

0.667	30.09	432.002	78.8	3.4007

5. Round each of the following to the thousandths place.

0.667	30.09	432.002	78.8	3.4007

6. Create twenty rounding problems with decimals and whole numbers for a friend to solve. Include an answer key. Student problems and answers will vary.

Project #9

Domain: Number and Operations in Base Ten

Standard:

5.NBT.5 Fluently multiply multi-digit whole numbers using the standard algorithm.

Directions:

1. Solve the following. Explain your thinking and how you solved the problem.

   There are 225 dozen cookies in the bakery. How many cookies are there?

2. Draw an array model for 225 x 12…. 200 x 10, 200 x 2, 20 x 10, 20 x 2, 5 x 10, 5 x 2

Solutions:

1. 225 x 12 = I broke 12 up into 10 and 2.
   225 x 10 = 2,250
   225 x 2 = 450
   2,250 + 450 = 2,700

2.

225 x 12

	200	20	5
10	2,000	200	50
2	400	40	10

Project #10

Domain: Number and Operations—Fractions

Standard:

5.NF.1 Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators.

Directions:

1. Read the following scenario and make a plan for how to solve.
   Considering that one box of cake mix usually makes 24 cupcakes, how many boxes of cake mix would you need to purchase to feed your entire math class if each student and teacher were going to have 2 ½ cupcakes?

2. Create 10 addition problems with fractions with unlike denominators (including mixed numbers).
   Example: 8 ½ + 2 ¼
   *Make sure to create an answer key with answers and explanations.

3. Create 10 subtraction problems with fractions with unlike denominators.
   Example: 4 (2/3) – 1 (2/5)
   *Make sure to create an answer key with answers and explanations.

4. Finally, create your own story problem using one of your problems from #2 or #3 above. Use #1 to help you if needed. *Be sure to work out the problem and explain your thinking.

Solutions:

1. 25 students x 2 ½ = 62 ½

Answers will vary for problems #2-#4.

Project #11

Domain: Number and Operations—Fractions

Standard:

5.NF.2 Solve word problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators, e.g., by using visual fraction models or equations to represent the problem. Use benchmark fractions and number sense of fractions to estimate mentally and assess the reasonableness of answers.

Directions:

1. Finish drawing a number line divided into twelfths. Show that the twelve equal parts add up to one whole.
2. Label your twelve parts on the number line.
3. Below the line, write each fraction in lowest terms.

4. Draw your own number line below (or on a separate sheet of paper) to show fifteenths.
5. Label your fifteen parts on the number line.
6. Below the line, write each fraction in lowest terms.
7. Finally, shade your number line to show how it might be divided into thirds and halves.

8. Solve the following:

   Your teacher gave you 1/7 of the bag of candy. She also gave your friend 1/3 of the bag of candy. If you and your friend combined your candy, what fraction of the bag would you have? Estimate your answer and then calculate. How reasonable was your estimate?

Solutions:

*The above number line should be completed to include 3/12 – 12/12.
*Student number lines should include 15 equal parts labeled with 1/15—15/15 and translated to lowest terms under the number line.
*Check shading.
#8: You have 10/21 of the bag collectively.

Project # 12

Domain: Number and Operations—Fractions
Standard:
5.NF.7 Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions. a. Interpret division of a unit fraction by a non-zero whole number and compute such quotients.

Directions:
Part I:

1. Create a story context for (1/2) ÷ 6.

2. Use a visual fraction model to show the quotient.

3. Finally, use the relationship between multiplication and division to explain that (1/2) ÷ 6 = n because n x 6 = 1/2.

Part II:

1. Create a story context for 5 (1/4) ÷ 8.
2. Use a visual fraction model to show the quotient.

3. Finally, use the relationship between multiplication and division to explain that 5 (1/4) ÷ 8 = n because n x 8 = 5 (1/4).

Solutions:
Solutions will vary for both Part I and Part II. Pay close attention to see that students understand the concept of dividing parts of a whole by a whole number. They should be able to develop a simple story problem and create a model using blocks or a number line to show the quotient.

Project #13

Domain: Measurement and Data

Directions:
Read the following problems and solve using the information provided and by creating graphs or charts to help.

1. Sara has saved $20. She earns $8 for each hour she works.

   A. If Sara saves all of her money, how much will she have after working 3 hours? 5 hours? 10 hours?
   B. Create a graph that shows the relationship between the hours Sara worked and the amount of money she has saved.
   C. What other information do you know from analyzing the graph?

2. Use the graph below to determine how much money Jack makes after working exactly 9 hours.

   Explain your answer.

Solutions:

1. A. $20 + (8 x 3) = $44; $20 + (8 x 5)=$60; . $20 + (8 x 10)= $100
   B. Graphs should be similar to the one created for #2 but show the amounts set in #1.
   C. Students should describe the slope of the line and the amount of money Sara earns as directly proportional to the amount of time she works.
2. Jack makes $22. Students should explain how they solved for the unknown, then applied their understanding to find out the amount Jack will earn once he has worked 9 hours.

Project #14

Domain: Measurement and Data

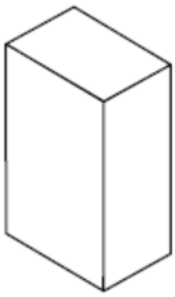
Standard:

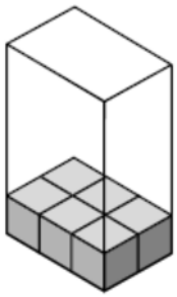
5.MD.3 Recognize volume as an attribute of solid figures and understand concepts of volume measurement. a. A cube with side length 1 unit, called a "unit cube," is said to have "one cubic unit" of volume, and can be used to measure volume. b. A solid figure which can be packed without gaps or overlaps using *n* unit cubes is said to have a volume of *n* cubic units.

5.MD.4 Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units.

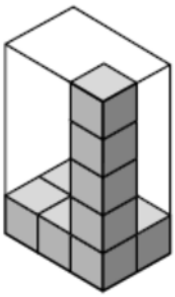
Directions:

1. Estimate how many cubic yards would be needed to fill your classroom with cubic centimeters.
2. Estimate how many cubic centimeters would be needed to fill a pencil box.
   *Use the model below to help you.





one layer



five layers
fill the box

(3 x 2) represented by first layer
(3 x 2) x 5 represented by number of 3 x 2 layers
(3 x 2) + (3 x 2) + (3 x 2) + (3 x 2)+ (3 x 2) = 6 + 6 + 6 + 6 + 6 + 6 = 30
6 representing the size/area of one layer

3. Choose one additional space to estimate and find the true measure of how many cubic centimeters are needed to fill it. *Example: Your kitchen, bedroom, backpack or little brother's toy chest.

Solutions:

Solutions will vary depending on the size of your classroom. It may be a good idea to go over this problem in class with your students before the summer. You may also want to model how to find cubic yards and cubic centimeters if this is new for your students.

Project # 15

Domain: Measurement and Data

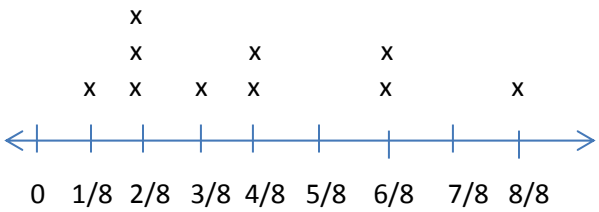
Standard:

5.MD.2 Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Use operations on fractions for this grade to solve problems involving information presented in line plots.

Directions:

1. Solve the following:

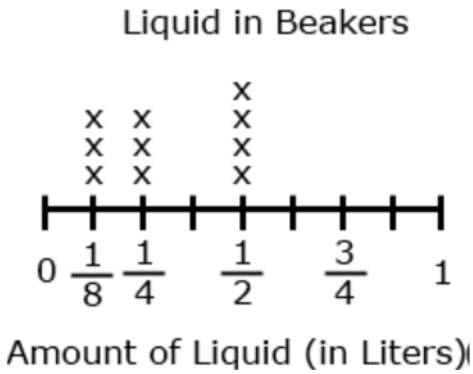
   Students measured objects in their desk to the nearest 1/8 of an inch then displayed data collected on a line plot. How many objects measured .? .?



   If you put all the objects together end to end what would be the total length of **all** the objects?

2. Solve the following using the information on the line plot.

   Ten beakers, measured in liters, are filled with a liquid.



   The line plot above shows the amount of liquid in liters in 10 beakers. If the liquid is redistributed equally, how much liquid would each beaker have? (This amount is the mean.)

Project # 16

Domain: Geometry

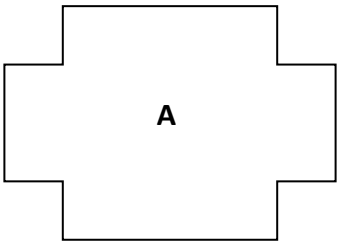
Standard:

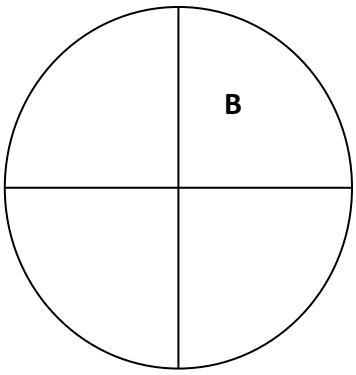
5.G.3 Understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category. *For example, all rectangles have four right angles and squares are rectangles, so all squares have four right angles.*

5.G.4 Classify two-dimensional figures in a hierarchy based on properties.

Directions:

1. Look at figure A below. Label it using your knowledge of the lengths of sides of polygons.
2. Use your ruler to measure the lengths of all of the sides. Determine the perimeter and area of the figure.
3. Now look at the circle (figure B). Find the area of one of the four sections of the circle.
4. Complete a reflection of figure C.
5. Complete a 90 degree clockwise rotation of figure D.
6. Create a tessellation on graph paper with figure E.





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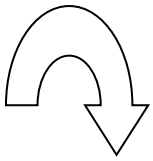
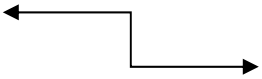


D



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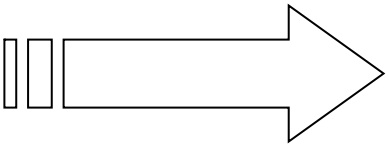
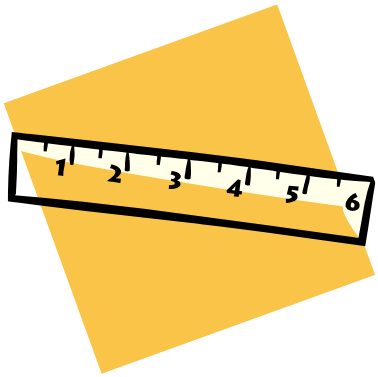


Extensions

The following projects are based on standards you will learn in sixth grade. They should be challenging for you at this point. Try them out and save your work along the way.



Project #17

Domain: Measurement and Data

Directions:

1. Every year you grow and change in many different ways. Get someone to help you measure and ask for help when needed.

   Measure your height to find out how tall you are:
   In feet & inches_____ In inches_____
   In meters _____ In meters & cm_____
   In millimeters _____
   Using non-standard measurement – you choose the tool to use to measure yourself (i.e., an eraser, paper clip, quarter, etc.) Make sure to include the unit along with your measurement.
   _____

2. Now complete the same measurements for 3 to 5 family members or friends.
3. Create a chart to record their information.
4. When you're finished, graph-to show all of your subjects' measurements (including your own).

5. Next, complete measurements for each of your subjects for the following:
   How much do you weigh? _____
   What is the circumference of your head? _____

6. Add this information to your chart as well.
7. Compare the information on your chart and make predictions about changes you might expect in the next few years based on the information you have recorded.

Project #18

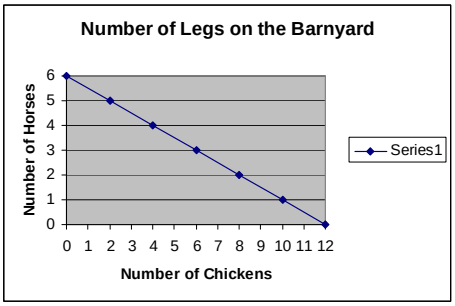
Domain: Operations and Algebraic Thinking

Directions:
1. Read the example below.
2. Create your own problem.
3. Include a graph and chart to explain the possible solutions to your problem.

Example:
Show the different combinations of chickens and horses in a barnyard where the total number of legs is 24.

Words	Expression or Equation
Multiply 2 legs by the number of chickens.	2c
Multiply 4 legs by the number of horses.	4h
The sum of the chicken legs and horse legs is 24.	2c + 4h = 24

A graph of this would show 6 combinations of chickens and horses. When there are 6 horses (6x 4 = 24) , there would be 0 chickens, When there are 12 chickens (12x 2= 24), there would be 0 horses.



Project #19

Domain: Number and Operations in Base Ten

Roller Coaster Challenge!

Directions:

1. Choose a picture of a roller coaster from the web site www.joyrides.com, that you think is fast, high, or cool.
2. Estimating the speed, height, length and duration of the ride.
3. Create your own "Roller Coaster Data Sheet" to record your estimates.
4. Then work to find and record the actual data from the Roller Coaster Database (http://www.rcdb.com) and record this information on your "Roller Coaster Data Sheet."
5. Compare the actual data for your coasters, noting which coaster is faster, higher, etc. by circling the greater measurement in each category.

***Challenge a parent or friend to compete with you to select the highest, fastest, etc. roller coasters. When you find the actual data, you receive a point for each coaster that you estimated correctly.

Project #20

Domain: Geometry

Directions:

1. Read the introduction and complete the problem below.
2. Draw a picture to show how you arrived at your solution.

Someone said, "A picture is worth a thousand words." Turning the words of a problem into a picture or a diagram can help you "see" the problem. By using the part of your brain that visualizes a situation or object, you may see relationships or information that helps you solve the problem. When someone tells you a story, try turning the words into a motion picture or a cartoon. When reading a description, try "seeing it in your mind's eye." If you can do these things, this strategy may be for you! Try using a picture or make a diagram to solve this problem:

In a cozy family restaurant in Diller, Indiana there are 12 square tables. Only one person can sit on each side of each table. What is the greatest number of people that can be seated if the tables are pushed end to end into one large rectangle?

Project #21

Domain: Measurement and Data

Directions:

1. Read the following, then complete the steps below.

   A baseball player's batting average compares a player's times at bat with the number of hits. To computer a batting average, divide the number of hits by the at bats. The result will be a decimal. The higher the decimal, the better the average.

   Here are some sample batting averages from the 1996 baseball season.

Batting Averages			
Player	**At Bats**	**Hits**	**Average**
Ken Griffey, Jr.	545	165	.303
Cal Ripken	640	178	.278
Juan Gonzalez	541	170	.314

   Based on this information, who do you think has the highest average?

   Now look in the sports section of your newspaper to find the batting averages of 5 players on your favorite team. Keep track of the players' at bats and hits for a week or a month. Compute the batting average using the formula above. Create a chart similar to the one above to record your answers.

   Compute the range, median, and mode of the statistics from your chart.