

## Georgia Mathematics Performance Standards

### Grade 6

By the end of grade six, students will understand the four arithmetic operations as they relate to positive rational numbers; convert between and compute with different forms of rational numbers; understand the concept of ratio and solve problems using proportional reasoning; understand and use line and rotational symmetry; determine the surface area and volume of solid figures; use variables to represent unknown quantities in formulae, algebraic expressions and equations; utilize data to make predictions; and determine the probability of a given event.

Instruction and assessment should include the use of manipulatives and appropriate technology. Topics should be represented in multiple ways including concrete/pictorial, verbal/written, numeric/data-based, graphical, and symbolic. Concepts should be introduced and used in the context of real world phenomena.

#### **Concepts/Skills to Maintain**

Operations with decimal fractions

Addition and subtraction of common fractions and mixed numbers with unlike denominators such as 2, 3, 4, 5, 6, 8, 10 and 12.

Modeling multiplication of common fractions

Modeling percent

Graphing data

Multiples and factors

Perimeter, capacity and area of geometric figures

Evaluating algebraic expressions

### **NUMBER AND OPERATIONS**

Students will understand the meaning of the four arithmetic operations as related to positive rational numbers and will apply these concepts and associated skills in real world situations.

**M6N1. Students will understand the meaning of the four arithmetic operations as related to positive rational numbers and will use these concepts to solve problems.**

- a. Apply factors and multiples.
- b. Decompose numbers into their prime factorization (Fundamental Theorem of Arithmetic).
- c. Determine the greatest common factor (GCF) and the least common multiple (LCM) for a set of numbers.
- d. Add and subtract fractions and mixed numbers with unlike denominators.
- e. Multiply and divide fractions and mixed numbers.
- f. Use fractions, decimals, and percents interchangeably.
- g. Solve problems involving fractions, decimals, and percents.

## **MEASUREMENT**

Students will understand how to determine the volume and surface area of solid figures. They will understand and use the customary and metric systems of measurement to measure quantities efficiently and to represent volume and surface area appropriately.

**M6M1. Students will convert from one unit to another within one system of measurement (customary or metric) by using proportional relationships.**

**M6M2. Students will use appropriate units of measure for finding length, perimeter, area and volume and will express each quantity using the appropriate unit.**

- a. Measure length to the nearest half, fourth, eighth and sixteenth of an inch.
- b. Select and use units of appropriate size and type to measure length, perimeter, area and volume.
- c. Compare and contrast units of measure for perimeter, area, and volume.

**M6M3. Students will determine the volume of fundamental solid figures (right rectangular prisms, cylinders, pyramids and cones).**

- a. Determine the formula for finding the volume of fundamental solid figures.
- b. Compute the volumes of fundamental solid figures, using appropriate units of measure.
- c. Estimate the volumes of simple geometric solids.
- d. Solve application problems involving the volume of fundamental solid figures.

**M6M4. Students will determine the surface area of solid figures (right rectangular prisms and cylinders).**

- a. Find the surface area of right rectangular prisms and cylinders using manipulatives and constructing nets.
- b. Compute the surface area of right rectangular prisms and cylinders using formulae.
- c. Estimate the surface areas of simple geometric solids.
- d. Solve application problems involving surface area of right rectangular prisms and cylinders.

## **GEOMETRY**

Students will further develop their understanding of plane and solid geometric figures, incorporating the use of appropriate technology and using this knowledge to solve authentic problems.

### **M6G1. Students will further develop their understanding of plane figures.**

- a. Determine and use lines of symmetry.
- b. Investigate rotational symmetry, including degree of rotation.
- c. Use the concepts of ratio, proportion and scale factor to demonstrate the relationships between similar plane figures.
- d. Interpret and sketch simple scale drawings.
- e. Solve problems involving scale drawings.

### **M6G2. Students will further develop their understanding of solid figures.**

- a. Compare and contrast right prisms and pyramids.
- b. Compare and contrast cylinders and cones.
- c. Interpret and sketch front, back, top, bottom and side views of solid figures.
- d. Construct nets for prisms, cylinders, pyramids, and cones.

## **ALGEBRA**

Students will investigate relationships between two quantities. They will write and solve proportions and simple one-step equations that result from problem situations.

### **M6A1. Students will understand the concept of ratio and use it to represent quantitative relationships.**

### **M6A2. Students will consider relationships between varying quantities.**

- a. Analyze and describe patterns arising from mathematical rules, tables, and graphs.
- b. Use manipulatives or draw pictures to solve problems involving proportional relationships.
- c. Use proportions ( $a/b=c/d$ ) to describe relationships and solve problems, including percent problems.
- d. Describe proportional relationships mathematically using  $y = kx$ , where  $k$  is the constant of proportionality.
- e. Graph proportional relationships in the form  $y = kx$  and describe characteristics of the graphs.
- f. In a proportional relationship expressed as  $y = kx$ , solve for one quantity given values of the other two. Given quantities may be whole numbers, decimals, or fractions. Solve problems using the relationship  $y = kx$ .
- g. Use proportional reasoning ( $a/b=c/d$  and  $y = kx$ ) to solve problems.

**M6A3. Students will evaluate algebraic expressions, including those with exponents, and solve simple one-step equations using each of the four basic operations.**

### **DATA ANALYSIS AND PROBABILITY**

Students will demonstrate understanding of data analysis by posing questions to be answered by collecting data. They will represent, investigate, and use data to answer those questions. Students will understand experimental and theoretical probability.

**M6D1. Students will pose questions, collect data, represent and analyze the data, and interpret results.**

- a. Formulate questions that can be answered by data. Students should collect data by using samples from a larger population (surveys), or by conducting experiments.
- b. Using data, construct frequency distributions, frequency tables, and graphs.
- c. Choose appropriate graphs to be consistent with the nature of the data (categorical or numerical). Graphs should include pictographs, histograms, bar graphs, line graphs, circle graphs, and line plots.
- d. Use tables and graphs to examine variation that occurs within a group and variation that occurs between groups.
- e. Relate the data analysis to the context of the questions posed.

**M6D2. Students will use experimental and simple theoretical probability and understand the nature of sampling. They will also make predictions from investigations.**

- a. Predict the probability of a given event through trials/simulations (experimental probability), and represent the probability as a ratio.
- b. Determine, and use a ratio to represent, the theoretical probability of a given event.
- c. Discover that experimental probability approaches theoretical probability when the number of trials is large.

**Terms/Symbols:** positive rational numbers, factors, multiples, decompose, prime numbers, prime factorization, Fundamental Theorem of Arithmetic, GCF, LCM, evaluate, surface area, metric system of measurement, customary system of measurement, proportional relationships, right rectangular prism, cylinder, pyramid, cone, geometric solid, net, geometric figures, line symmetry, rotational symmetry, similar plane figures, scale factor, scale drawings, relations, varying quantities, ratio, direct proportion, proportions, proportional reasoning, frequency distributions, pictographs, histograms, bar graphs, line graphs, circle graphs, line plot, frequency table, experimental probability, theoretical probability, sampling, event, random sample, population, non-routine word problems

## **Process Standards**

Each topic studied in this course should be developed with careful thought toward helping every student achieve the following process standards.

### **M6P1. Students will solve problems (using appropriate technology).**

- a. Build new mathematical knowledge through problem solving.
- b. Solve problems that arise in mathematics and in other contexts.
- c. Apply and adapt a variety of appropriate strategies to solve problems.
- d. Monitor and reflect on the process of mathematical problem solving.

### **M6P2. Students will reason and evaluate mathematical arguments.**

- a. Recognize reasoning and proof as fundamental aspects of mathematics.
- b. Make and investigate mathematical conjectures.
- c. Develop and evaluate mathematical arguments and proofs.
- d. Select and use various types of reasoning and methods of proof.

### **M6P3. Students will communicate mathematically.**

- a. Organize and consolidate their mathematical thinking through communication.
- b. Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.
- c. Analyze and evaluate the mathematical thinking and strategies of others.
- d. Use the language of mathematics to express mathematical ideas precisely.

### **M6P4. Students will make connections among mathematical ideas and to other disciplines.**

- a. Recognize and use connections among mathematical ideas.
- b. Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
- c. Recognize and apply mathematics in contexts outside of mathematics.

### **M6P5. Students will represent mathematics in multiple ways.**

- a. Create and use representations to organize, record, and communicate mathematical ideas.
- b. Select, apply, and translate among mathematical representations to solve problems.
- c. Use representations to model and interpret physical, social, and mathematical phenomena.

### **Reading Standard Comment**

After the elementary years, students are seriously engaged in reading for learning. This process sweeps across all disciplinary domains, extending even to the area of personal learning. Students encounter a variety of informational as well as fictional texts, and they experience text in all genres and modes of discourse. In the study of various disciplines of learning (language arts, mathematics, science, social studies), students must learn through reading the communities of discourse of each of those disciplines. Each subject has its own specific vocabulary, and for students to excel in all subjects, they must learn the specific vocabulary of those subject areas *in context*.

Beginning with the middle grades years, students begin to self-select reading materials based on personal interests established through classroom learning. Students become curious about science, mathematics, history, and literature as they form contexts for those subjects related to their personal and classroom experiences. As students explore academic areas through reading, they develop favorite subjects and become confident in their verbal discourse about those subjects.

Reading across curriculum content develops both academic and personal interests in students. As students read, they develop both content and contextual vocabulary. They also build good habits for reading, researching, and learning. The Reading Across the Curriculum standard focuses on the academic and personal skills students acquire as they read in all areas of learning.

### **MRC. Students will enhance reading in all curriculum areas by:**

- a. Reading in All Curriculum Areas
  - Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas
  - Read both informational and fictional texts in a variety of genres and modes of discourse
  - Read technical texts related to various subject areas
- b. Discussing books
  - Discuss messages and themes from books in all subject areas.
  - Respond to a variety of texts in multiple modes of discourse.
  - Relate messages and themes from one subject area to messages and themes in another area.
  - Evaluate the merit of texts in every subject discipline.
  - Examine author's purpose in writing.
  - Recognize the features of disciplinary texts.
- c. Building vocabulary knowledge
  - Demonstrate an understanding of contextual vocabulary in various subjects.
  - Use content vocabulary in writing and speaking.
  - Explore understanding of new words found in subject area texts.

- d. Establishing context
- Explore life experiences related to subject area content.
  - Discuss in both writing and speaking how certain words are subject area related.
  - Determine strategies for finding content and contextual meaning for unknown words.

## **Sixth Grade Tasks**

**Science Fair Task**  
**Factor and Multiple Task**  
**Tetromino Task**  
**Cube Task**  
**ABC Toy Company Task**  
**Cylinder Task**  
**Symmetry Task**  
**Similar Figure Task**  
**Algebra Tasks**  
**Basketball Task**  
**Dice Game Task**

### 6<sup>th</sup> Grade Performance Standards Tasks

Georgia Performance Standard		Science Fair	Factor and Multiple	Tetromino	Cube	Symmetry	Similar Figures	Cylinder	ABC Toy Company	Basketball	Dice Game	Algebra
M6N1a	Apply factors and multiples.		X									
M6N1b	Decompose numbers into their prime factorizations.		X									
M6N1c	Determine the GCF and LCM for a set of numbers.		X									
M6N1d	Add and subtract fractions and mixed numbers with unlike denominators.	X										
M6N1e	Multiply and divide fractions and mixed numbers.	X										
M6N1f	Use fractions, decimals, and percents interchangeably.	X										
M6N1g	Solve problems involving fractions, decimals, and percents.	X										
M6M1	Students will convert from one unit to another within one system of measurement by using proportional relationships.				X							
M6M2a	Measure length to the nearest half, fourth, eighth, and sixteenth of an inch.				X							
M6M2b	Select and use units of appropriate size and type to measure length, perimeter, area and volume.			X	X							
M6M2c	Compare and contrast units of measure for perimeter, area, and volume.			X	X			X	X			
M6M3a	Determine the formula for finding the volume of fundamental solid figures.								X			
M6M3b	Compute the volumes of fundamental solid figures, using appropriate units of measure.				X							
M6M3c	Estimate the volumes of simple geometric solids.				X			X				
M6M3d	Solve application problems involving the volumes of fundamental solid figures.				X			X				

Georgia Performance Standard		Science Fair	Factor and Multiple	Tetromino	Cube	Symmetry	Similar Figures	Cylinder	ABC Toy Company	Basketball	Dice Game	Algebra
M6M4a	Find the surface areas of right rectangular prisms and cylinders using manipulatives and constructing nets				X			X	X			
M6M4b	Compute the surface areas of right rectangular prisms and cylinders using formulae.				X			X	X			
M6M4c	Estimate the surface areas of simple geometric solids.				X			X				
M6M4d	Solve application problems involving surface areas of right rectangular prisms and cylinders.			X	X			X	X			
M6G1a	Determine and use lines of symmetry.					X						
M6G1b	Investigate rotational symmetry, including order of symmetry and degree of rotation.					X						
M6G1c	Use the concepts of ratio, proportion and scale factor to demonstrate the relationships between similar plane figures.						X					
M6G1d	Interpret and sketch simple scale drawings						X					
M6G1e	Solve problems involving scale drawings.						X					
M6G2a	Compare and contrast right prisms and pyramids.								X			
M6G2b	Compare and contrast cylinders and cones.								X			
M6G2c	Interpret and sketch front, back, top, bottom and side views of solid figures.								X			
M6G2d	Construct nets for prisms, cylinders, pyramids, and cones.								X			
M6A1	Students will understand the concept of ratio and use it to represent quantitative relationships.	X										
M6A2a	Analyze and describe patterns arising from mathematical rules, tables, and graphs.											X

Georgia Performance Standard		Science Fair	Factor and Multiple	Tetromino	Cube	Symmetry	Similar Figures	Cylinder	ABC Toy Company	Basketball	Dice Game	Algebra
M6A2b	Use manipulatives or draw pictures to solve problems involving proportional relationships.	X										
M6A2c	Use proportions ( $a/b=c/d$ ) to describe relationships and solve problems, including percent problems.	X										X
M6A2d	Describe proportional relationships mathematically using $y = kx$ , where $k$ is the constant of proportionality.											X
M6A2e	Graph proportional relationships in the form $y = kx$ and describe characteristics of the graphs.											X
M6A2f	In a proportional relationship expressed as $y = kx$ , solve for one quantity given values of the other two. Given quantities may be whole numbers, decimals, or fractions. Solve problems using the relationship $y = kx$ .											X
M6A2g	Use proportional reasoning ( $a/b=c/d$ and $y = kx$ ) to solve problems.											X
M6A3	Students will evaluate algebraic expressions, including those with exponents, and solve simple one-step equations using each of the four basic operations.											X
M6D1a	Formulate questions that can be answered by data. Students should collect data by using samples from a larger population (surveys), or by conducting experiments.									X	X	
M6D1b	Using data, construct frequency distributions, frequency tables, and graphs.									X	X	

Georgia Performance Standard		Science Fair	Factor and Multiple	Tetromino	Cube	Symmetry	Similar Figures	Cylinder	ABC Toy Company	Basketball	Dice Game	Algebra
M6D1c	Choose appropriate graphs to be consistent with the nature of the data (categorical or numerical). Graphs should include pictographs, histograms, bar graphs, line graphs, pie charts, and line plots.									X	X	
M6D1d	Use tables and graphs to examine variation that occurs within a group and variation that occurs between groups.									X		
M6D1e	Relate the data analysis to the context of the questions posed.									X		
M6D2a	Predict the probability of a given event through trials/simulations (experimental probability), and represent the probability as a ratio.										X	
M6D2b	Determine, and use a ratio to represent, the theoretical probability of a given event.										X	
M6D2c	Discover that experimental probability approaches theoretical probability when the number of trials is large.										X	
M6P1	Students will solve problems (using appropriate technology).											
M6P1a	Build new mathematical knowledge through problem solving.	X	X	X	X	X	X	X	X	X	X	X
M6P1b	Solve problems that arise in mathematics or other contexts.	X	X	X	X	X	X	X	X	X	X	X
M6P1c	Apply and adapt a variety of appropriate strategies to solve problems.	X	X	X	X	X	X	X	X	X	X	X
M6P1d	Monitor and reflect on the process of mathematical problem solving.	X	X	X	X	X	X	X	X	X	X	X
M6P2	Students will reason and evaluate mathematical arguments.											
M6P2a	Recognize reasoning and proof as fundamental aspects of mathematics.											
M6P2b	Make and investigate mathematical conjectures.		X	X	X	X		X	X	X	X	X

Georgia Performance Standard		Science Fair	Factor and Multiple	Tetromino	Cube	Symmetry	Similar Figures	Cylinder	ABC Toy Company	Basketball	Dice Game	Algebra
M6P2c	Develop and evaluate mathematical arguments and proofs.	X	X	X	X	X	X	X	X	X	X	X
M6P2d	Select and use various types of reasoning and methods of proof.	X	X	X	X	X	X	X	X	X	X	X
M6P3	Students will communicate mathematically..											
M6P3a	Organize and consolidate their mathematical thinking through communication.	X	X	X	X	X	X	X	X	X	X	X
M6P3b	Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.	X	X	X	X	X	X	X	X	X	X	X
M6P3c	Analyze and evaluate the mathematical thinking and strategies of others.	X			X	X				X		
M6P3d	Use the language of mathematics to express mathematical ideas precisely.	X	X	X	X	X	X	X	X	X	X	X
M6P4	Students will make connections among mathematical ideas and to other disciplines.											
M6P4a	Recognize and use connections among mathematical ideas.	X	X	X	X	X	X	X	X	X	X	X
M6P4b	Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.	X	X	X	X	X	X	X	X	X	X	X
M6P4c	Recognize and apply mathematics in contexts outside of mathematics.	X		X	X	X	X	X	X	X	X	X
M6P5	Students will represent mathematics in multiple ways.											
M6P5a	Create and use representations to organize, record, and communicate mathematical ideas.	X	X	X	X	X	X	X	X	X	X	X
M6P5b	Select, apply, and translate among mathematical representations to solve problems.	X	X	X	X	X	X	X	X	X	X	X
M6P5c	Use representations to model and interpret physical, social, and mathematical phenomena.	X	X	X	X	X	X	X	X	X	X	X

## Science Fair Task

Three middle schools are going to have a science fair in a gymnasium. The amount of space given to each school is based on the number of students participating. McKenzie Middle School has 100 participants, Wesley Middle School has 60 participants, and Thomas Middle School has 40 participants.

- a. Draw a rectangle that represents the floor of the gymnasium. Divide the rectangle to show the amount of space each school should get based on the number of students participating. Label each section: MM-McKenzie Middle, WM-Wesley Middle, or TM-Thomas Middle.
- b. What fraction of the space should each school get based on number of participants? Show how you know.
- c. Does McKenzie Middle get more space than the other two schools combined? Use fractions to explain.
- d. How many times more space does McKenzie Middle get than Thomas Middle? Show how you know.
- e. If the schools share the cost of the science fair based on the number of students, what percent of the cost should each school pay? Show how you figured these percentages.
- f. If the cost of the science fair is \$300.00, how much should each school pay based on the number of students? Tell how you know.
- g. Kita tried to figure out the difference in the amounts that Wesley Middle and Thomas Middle paid and got \$26,940. She knows that's too much. Help her find her error:

Cost for Wesley Middle – cost for Thomas Middle =

$$\begin{aligned} & \frac{60}{200} \times 300 - \frac{40}{200} \times 300 = \\ & \left( \frac{60}{200} \times 300 \right) - \frac{40}{200} \times 300 = \\ & \left( 90 - \frac{40}{200} \right) \times 300 = \\ & 89.8 \times 300 = \\ & 26,940 \end{aligned}$$

- h. What fraction of the cost should each school pay based on number of schools, rather than participants? Show how you know.

- i. Do you think it is more fair to charge the schools based on the number of schools or on the number of participants per school? How would you convince someone who disagrees?

Mathematics required by the task:

<i>Questions</i>	<i>Standards</i>	<i>Summary</i>
<i>a, b, f, h</i>	<i>M6A1</i>	<i>Understand the concept of ratio and use it to represent quantitative relationships.</i>
<i>f, h</i>	<i>M6A2c</i>	<i>Use proportions to describe relationships and solve problems.</i>
<i>c</i>	<i>M6N1d</i>	<i>Add and subtract fractions and mixed numbers with unlike denominators.</i>
<i>d</i>	<i>M6N1e</i>	<i>Multiply and divide fractions and mixed numbers.</i>
<i>e</i>	<i>M6N1g</i>	<i>Use fractions, decimals, and percentages interchangeably</i>
<i>f</i>	<i>M6N1h</i>	<i>Solve problems with fractions, decimals, and percents.</i>
<i>a-i</i>	<i>M6P1a</i>	<i>Build new mathematical knowledge through problem solving.</i>
	<i>M6P1b</i>	<i>Solve problems that arise in mathematics and in other contexts.</i>
	<i>M6P1c</i>	<i>Apply and adapt a variety of appropriate strategies to solve problems.</i>
	<i>M6P1d</i>	<i>Monitor and reflect on the process of mathematical problem solving.</i>
	<i>M6P2c</i>	<i>Develop and evaluate mathematical arguments and proofs.</i>
	<i>M6P2d</i>	<i>Select and use various types of reasoning and methods of proof.</i>
	<i>M6P3a</i>	<i>Organize and consolidate their mathematical thinking through communication.</i>
	<i>M6P3b</i>	<i>Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.</i>
	<i>M6P3c</i>	<i>Analyze and evaluate the mathematical thinking and strategies of others.</i>
	<i>M6P3d</i>	<i>Use the language of mathematics to express mathematical ideas precisely.</i>
	<i>M6P4a</i>	<i>Recognize and use connections among mathematical ideas.</i>
	<i>M6P4b</i>	<i>Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.</i>
	<i>M6P4c</i>	<i>Recognize and apply mathematics in contexts outside of mathematics.</i>
	<i>M6P5a</i>	<i>Create and use representations to organize, record, and communicate mathematical ideas.</i>
	<i>M6P5b</i>	<i>Select, apply, and translate among mathematical representations to solve problems.</i>
	<i>M6P5c</i>	<i>Use representations to model and interpret physical, social, and mathematical phenomena.</i>

Teacher Notes:

You may want to consider whether or not you allow technology on this problem. If students use technology and can explain all these answers, they still will have demonstrated the concepts behind the standards.

<b>Factor and Multiple Task</b>
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- a. What is the smallest number with 1, 2, and 3 as factors? Tell how you know it is the smallest number with those factors.
- b. Find a larger number with 1, 2, and 3 as factors. If possible, find additional numbers with 1, 2, and 3 as factors.
- c. What is the smallest number with 1, 2, 3, and 4 as factors? Tell how you know it is the smallest number with those factors.
- d. You could multiply 1, 2, and 3 to get the smallest number that has 1, 2, and 3 as factors. Could you multiply 1, 2, 3, and 4 to get the smallest number with all four as factors? If not, tell why not.
- e. Find the prime factorization of 24. The factors of 24 are 1, 2, 3, 4, 6, 8, 12, 24. Find their prime factorizations and compare them to the prime factorization of 24. What do you notice?
- f. The number 5 and another number less than 40 have a *common multiple* of 40. What could the other number be? Could there be other answers? If so, list as many as you can. Tell how you know.
- g. The number 5 and another number less than 40 have a *least common multiple* of 40. What could the other number be? Could it be more than one number? If so, list as many as you can. Tell how you know.
- h. The number 7 is a *factor* of 35 and of another number. What could the other number be? Could it be more than one number? If so, list as many as you can. Tell how you know.
- i. The number 7 is the *greatest common factor* of 35 and another number. What could the other number be? Could it be more than one number? If so, list as many as you can. Tell how you know.

Mathematics required by the task:

<i>Questions</i>	<i>Standards</i>	<i>Summary</i>
<i>a-d, f-i</i>	<i>M6N1a</i>	<i>Apply factors and multiples.</i>
<i>a-d, f-I</i>	<i>M6N1c</i>	<i>Determine the GCF and LCM.</i>
<i>e</i>	<i>M6N1b</i>	<i>Decompose numbers into their prime factorizations.</i>
<i>a-i</i>	<i>M6P1a</i>	<i>Build new mathematical knowledge through problem solving.</i>
	<i>M6P1b</i>	<i>Solve problems that arise in mathematics and in other contexts.</i>
	<i>M6P1c</i>	<i>Apply and adapt a variety of appropriate strategies to solve problems.</i>
	<i>M6P1d</i>	<i>Monitor and reflect on the process of mathematical problem solving.</i>
	<i>M6P2b</i>	<i>Make and investigate mathematical conjectures.</i>
	<i>M6P2c</i>	<i>Develop and evaluate mathematical arguments and proofs.</i>
	<i>M6P2d</i>	<i>Select and use various types of reasoning and methods of proof.</i>
	<i>M6P3a</i>	<i>Organize and consolidate their mathematical thinking through communication.</i>
<i>M6P3b</i>	<i>Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.</i>	

- M6P3d Use the language of mathematics to express mathematical ideas precisely.*
- M6P4a Recognize and use connections among mathematical ideas.*
- M6P4b Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.*
- M6P5a Create and use representations to organize, record, and communicate mathematical ideas.*

Notes to the Teacher:

These tasks can be done all at once, or separately. Students will see additional mathematical connections by grouping a-d, f-g, and h-i. Students may choose whether or not to use calculators. Students will still have to demonstrate the standards listed above whether they work with or without calculators.

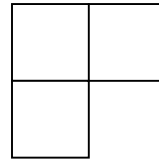
## Tetromino Task

### The task:

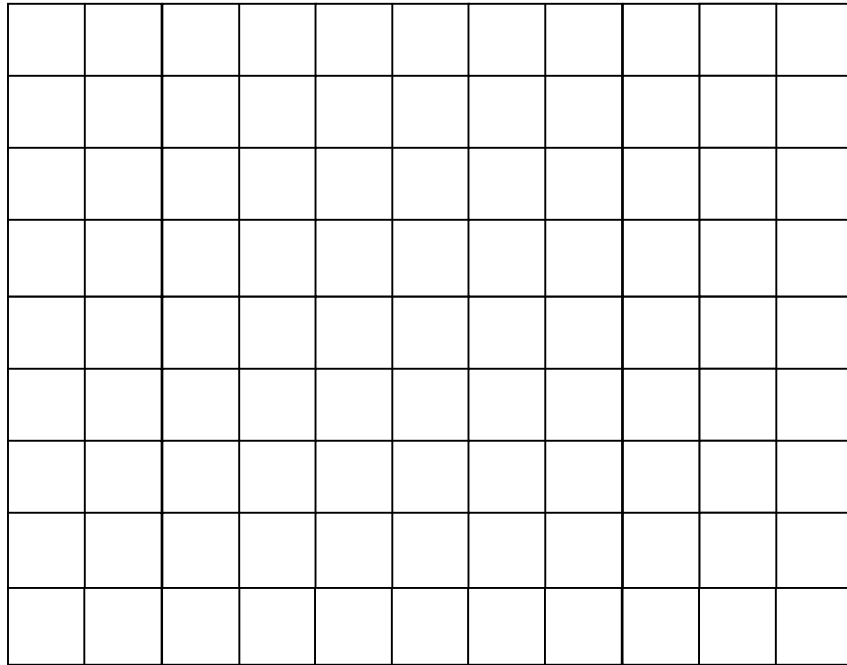
A polyomino is a polygon made from connecting congruent squares so that each square touches another on a complete side. A common example is a domino which is formed by connecting two congruent squares.



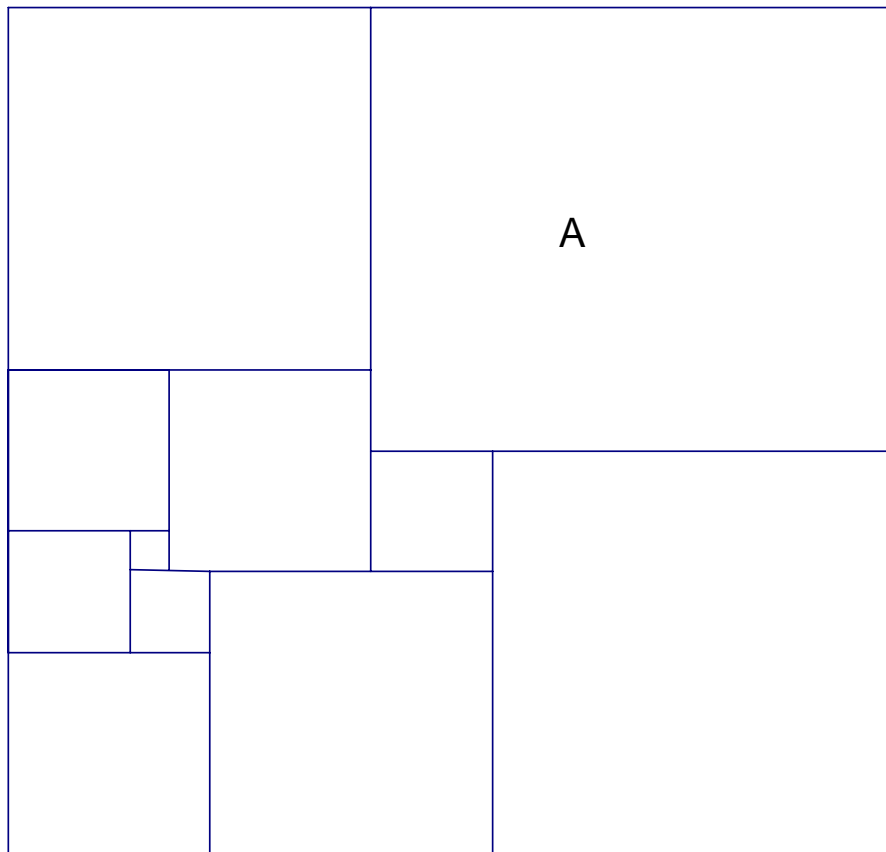
A triomino is formed by connecting three congruent squares. There are two possible ways to make a triomino. Notice that the each triomino can be flipped or turned to different positions. Think of them as game pieces that can be picked up and turned over.



- a) The electronic game Tetris© is based on tetrominoes each formed by four connecting congruent squares. There are five different tetrominoes. Use the grid shown to sketch the five different tetromino pieces.



- b) If each square measures 1 cm by 1 cm, what is the area of each tetromino?
- c) Based upon what you know about the area of each tetromino, what would you predict about the perimeter of each tetromino? Determine the perimeter of each tetromino to justify your prediction. What did you find? Was your prediction correct? Explain.
- d) If two different rectangles have the same area will they also have the same perimeter? If two different rectangles have the same perimeter will they also have the same area? Can two different rectangles have the same area and perimeter? Investigate each question and show how you were able to find a solution.
- e) A pentomino is a polygon formed by connecting five congruent squares. Use grid paper to draw the twelve pentomino shapes.
- f) Pictured below is a shape that has been cut into ten squares of various sizes and Region A. The smallest square measures 5 cm by 5 cm with the next largest adjacent square measuring twice its dimensions. Is Region A a square? Show how you know. Find the perimeter of the total shape.



Mathematics required by the task:

<i>Questions</i>	<i>Standards</i>	<i>Summary</i>
<i>b</i>	<i>M6M2b</i>	<i>Use appropriate units of measure for finding area.</i>
<i>c&amp;d</i>	<i>M6M2b</i> <i>M6M4d</i>	<i>Use appropriate units of measure for finding perimeter and area</i> <i>Solve application problems</i>
<i>d</i>	<i>M6M2c</i>	<i>Compare and contrast units of measure for perimeter, area, and volume.</i>
<i>f</i>	<i>M6M2b</i> <i>M6M4d</i>	<i>Use appropriate units of measure for finding perimeter and area</i> <i>Solve application problems</i>
<i>a-f</i>	<i>M6P1a</i> <i>M6P1b</i> <i>M6P1c</i>  <i>M6P1d</i>  <i>M6P2b</i> <i>M6P2c</i> <i>M6P2d</i> <i>M6P3a</i>  <i>M6P3b</i>  <i>M6P3d</i>  <i>M6P4a</i> <i>M6P4b</i>  <i>M6P4c</i>  <i>M6P5a</i>  <i>M6P5b</i>  <i>M6P5c</i>	<i>Build new mathematical knowledge through problem solving.</i> <i>Solve problems that arise in mathematics and in other contexts.</i> <i>Apply and adapt a variety of appropriate strategies to solve problems.</i> <i>Monitor and reflect on the process of mathematical problem solving.</i> <i>Make and investigate mathematical conjectures.</i> <i>Develop and evaluate mathematical arguments and proofs.</i> <i>Select and use various types of reasoning and methods of proof.</i> <i>Organize and consolidate their mathematical thinking through communication.</i> <i>Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.</i> <i>Use the language of mathematics to express mathematical ideas precisely.</i> <i>Recognize and use connections among mathematical ideas.</i> <i>Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.</i> <i>Recognize and apply mathematics in contexts outside of mathematics.</i> <i>Create and use representations to organize, record, and communicate mathematical ideas.</i> <i>Select, apply, and translate among mathematical representations to solve problems.</i> <i>Use representations to model and interpret physical, social, and mathematical phenomena.</i>

<b>Cube Task</b>
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The task:

- a) What is the volume of a cube whose edges each measure 3 centimeters? Estimate an answer and then find an exact answer. Be sure to use appropriate units in your answer. Show how you determined your answer.
- b) What is the surface area of a cube whose edges each measure 3 centimeters? Estimate an answer and then find an exact answer. Be sure to use appropriate units in your answer. Show how you determined your answer.
- c) A student claims that no matter what size a cube is, the number you get when you calculate its surface area is always twice as big as the number you get when you calculate its volume. Is this student correct? Why or why not?
- d) Find a cardboard box that is a rectangular prism. Measure the length, width, and height to the nearest eighth of an inch. Find its volume and surface area. Unfold it and examine its net.
- e) Construct the net for a rectangular prism whose volume is  $48 \text{ cm}^3$ .
- f) You can create an open-topped box by cutting four congruent squares out of the corners of a piece of paper and folding up the sides. Suppose you have a 20 cm x 30 cm sheet of centimeter graph paper. What size squares would you cut out to create a box with the greatest volume? Justify why your box has the greatest volume.
- g) Find the surface area of the box created in part (e). Explain how you determined the surface area.
- h) A 10 cm by 10 cm by 10 cm cube holds exactly one liter of water. Use proportions to determine how many milliliters of water a four-centimeter cube will hold.

Mathematics required by the task:

<i>Questions</i>	<i>Standards</i>	<i>Summary</i>
<i>a</i>	<i>M6M2b</i> <i>M6M3b</i>	<i>Use appropriate units of measure for volume.</i> <i>Compute volumes of solid figures.</i>
<i>b</i>	<i>M6M2b</i> <i>6M4b</i>	<i>Use appropriate units of measure for surface area.</i> <i>Compute surface area of solid figures.</i>
<i>a,b</i>	<i>M6M3c</i>	<i>Estimate the volumes of simple geometric solids.</i>
<i>d</i>	<i>M6M2a</i>	<i>Measure length to the nearest half, fourth, eighth, and sixteenth of an inch.</i>

	<i>M6N1d</i>	<i>Add and subtract fractions and mixed numbers with like and unlike denominators.</i>
	<i>M6N1e</i>	<i>Multiply and divide fractions and mixed numbers.</i>
<i>e&amp;f</i>	<i>M6M2b</i>	<i>Use appropriate units of measure for volume.</i>
	<i>M6M3b</i>	<i>Compute volumes of solid figures.</i>
<i>g</i>	<i>M6M2b</i>	<i>Use appropriate units of measure for surface area.</i>
	<i>M6M4</i>	<i>Compute the surface area of solid figures.</i>
<i>h</i>	<i>M6M1</i>	<i>Convert from one unit to another within one system of measurement by using proportional relationships.</i>
<i>c-g</i>	<i>M6M2c</i>	<i>Compare and contrast units of measure for perimeter, surface area, and volume.</i>
<i>f,h</i>	<i>M6M3d</i>	<i>Solve application problems involving the volumes of fundamental solid figures.</i>
<i>a-h</i>	<i>M6P1a</i>	<i>Build new mathematical knowledge through problem solving.</i>
	<i>M6P1b</i>	<i>Solve problems that arise in mathematics and in other contexts.</i>
	<i>M6P1c</i>	<i>Apply and adapt a variety of appropriate strategies to solve problems.</i>
	<i>M6P1d</i>	<i>Monitor and reflect on the process of mathematical problem solving.</i>
	<i>M6P2b</i>	<i>Make and investigate mathematical conjectures.</i>
	<i>M6P2c</i>	<i>Develop and evaluate mathematical arguments and proofs.</i>
	<i>M6P2d</i>	<i>Select and use various types of reasoning and methods of proof.</i>
	<i>M6P3a</i>	<i>Organize and consolidate their mathematical thinking through communication.</i>
	<i>M6P3b</i>	<i>Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.</i>
	<i>M6P3c</i>	<i>Analyze and evaluate the mathematical thinking and strategies of others.</i>
	<i>M6P3d</i>	<i>Use the language of mathematics to express mathematical ideas precisely.</i>
	<i>M6P4a</i>	<i>Recognize and use connections among mathematical ideas.</i>
	<i>M6P4b</i>	<i>Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.</i>
	<i>M6P4c</i>	<i>Recognize and apply mathematics in contexts outside of mathematics.</i>
	<i>M6P5a</i>	<i>Create and use representations to organize, record, and communicate mathematical ideas.</i>
	<i>M6P5b</i>	<i>Select, apply, and translate among mathematical representations to solve problems.</i>
	<i>M6P5c</i>	<i>Use representations to model and interpret physical, social, and mathematical phenomena.</i>

Teaching Notes:

Allow students to determine the most efficient way to solve the problems (mentally, paper/pencil, or technology), but consider that calculators may further student exploration of these concepts. Using calculators will allow students to try multiple solutions quickly and accurately.

<b>ABC Toy Company Task</b>
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The task:

- a) As an employee of the ABC Toy Company, your task is to design the most efficient package to house 24 identical blocks (cubes). You are supplied with 24 stacking cubes to explore the different ways the cubes can be put together and packaged in the shape of a rectangular prism. How many prisms can you form? How do you know you have found all the possible prisms?
- b) For each package built, determine the dimensions and calculate the surface area and volume. Record the data in a table.

Length	Width	Height	Surface Area	Volume

- c) Explain how you determined the surface area for each package.
- d) Identify which package you would recommend to the ABC Toy Company and justify your choice.
- e) Pretend that you are tutoring a 4<sup>th</sup> grade student. Explain what volume is. Use your table to show how you can use the length, width, and height to find the volume.
- f) Now that you have decided on your ideal package, draw a net (pattern) for the manufacturer to use to make the box.

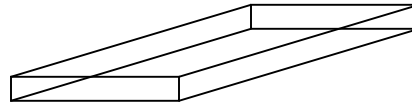
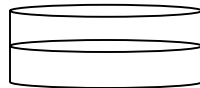
Mathematics required by the task:

<i>Questions</i>	<i>Standards</i>	<i>Summary</i>
<i>a</i>	<i>M6G2</i>	<i>Will further develop their understanding of solid figures.</i>
	<i>M6N1a</i>	<i>Apply factors and multiples.</i>
<i>b</i>	<i>M6M4a</i>	<i>Find the surface area of a right prism and cylinder using manipulatives and constructing nets.</i>
	<i>M6M4b</i>	<i>Compute the surface area of a right prism and cylinder using formulae.</i>
	<i>M6M4d</i>	<i>Solve application problems involving surface area of right prisms and cylinders.</i>
<i>e</i>	<i>M6M3a</i>	<i>Determine the formula for finding the volume of fundamental solid figures.</i>
<i>f</i>	<i>M6G2d</i>	<i>Construct nets for prisms, cylinders, pyramids, and cones.</i>
<i>a-f</i>	<i>M6P1a</i>	<i>Build new mathematical knowledge through problem solving.</i>
	<i>M6P1b</i>	<i>Solve problems that arise in mathematics and in other contexts.</i>
	<i>M6P1c</i>	<i>Apply and adapt a variety of appropriate strategies to solve problems.</i>
	<i>M6P1d</i>	<i>Monitor and reflect on the process of mathematical problem solving.</i>
	<i>M6P2b</i>	<i>Make and investigate mathematical conjectures.</i>
	<i>M6P2c</i>	<i>Develop and evaluate mathematical arguments and proofs.</i>
	<i>M6P2d</i>	<i>Select and use various types of reasoning and methods of proof.</i>
	<i>M6P3a</i>	<i>Organize and consolidate their mathematical thinking through communication.</i>
	<i>M6P3b</i>	<i>Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.</i>
	<i>M6P3d</i>	<i>Use the language of mathematics to express mathematical ideas precisely.</i>
	<i>M6P4a</i>	<i>Recognize and use connections among mathematical ideas.</i>
	<i>M6P4b</i>	<i>Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.</i>
	<i>M6P4c</i>	<i>Recognize and apply mathematics in contexts outside of mathematics.</i>
	<i>M6P5a</i>	<i>Create and use representations to organize, record, and communicate mathematical ideas.</i>
	<i>M6P5b</i>	<i>Select, apply, and translate among mathematical representations to solve problems.</i>
	<i>M6P5c</i>	<i>Use representations to model and interpret physical, social, and mathematical phenomena.</i>

## Cylinder Task

The task:

- a) Explain what is meant by surface area. What steps would you take to find the surface area of a cylinder?
- b) One of the major expenses in manufacturing a can is the amount of metal that goes into it. How many square centimeters of metal would be required to manufacture a can that has a diameter of 8 cm and a height of 20 cm? Estimate and then solve.
- c) Draw a net (pattern) for the manufacturer to use to make the can.
- d) Use your work in parts a – c to write a rule *in words* for finding the surface area of a cylinder. Now write your rule using letters, numbers and mathematical symbols (a formula).
- e) Michael bakes a round two-layer birthday cake that is to be covered with frosting on the top, sides, and in between the layers. Each layer has a height of 4 cm and diameter of 24 cm. The label on the can of frosting he bought claims that the contents will cover the top and sides of a one-layer rectangular sheet cake that is 32 cm by 22 cm by 4 cm. Will Michael have enough frosting? Show how you know.



Mathematics required by the task:

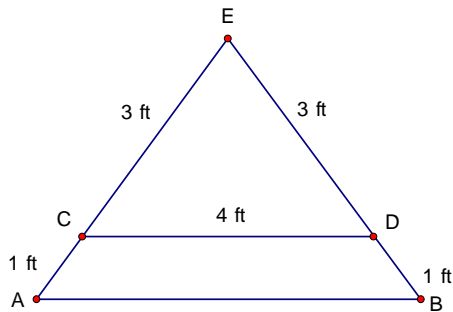
<i>Questions</i>	<i>Standards</i>	<i>Summary</i>
<i>a</i>	<i>M6M4</i>	<i>Determine surface area of solid figures.</i>
<i>b</i>	<i>M6M4</i>	<i>Determine surface area of solid figures.</i>
	<i>M6M4b</i>	<i>Compute the surface area of a cylinder using formulae.</i>
	<i>M6M3c</i>	<i>Estimate the volumes of simple geometric solids.</i>
	<i>M6M4d</i>	<i>Solve application problems.</i>
<i>c</i>	<i>M6M3d</i>	<i>Solve application problems involving the volume of fundamental solid figures.</i>
	<i>M6M4a</i>	<i>Find the surface area using manipulatives and nets.</i>
<i>d</i>	<i>M6M4</i>	<i>Determine surface area of solid figures.</i>
	<i>M6M4b</i>	<i>Compute the surface area of a cylinder using formulae.</i>
<i>e</i>	<i>M6M4</i>	<i>Determine surface area of solid figures.</i>
	<i>M6A3</i>	<i>Students will evaluate algebraic expressions, including those with exponents.</i>
<i>a-e</i>	<i>M6M2c</i>	<i>Compare and contrast units of measure for perimeter, area, and volume.</i>
	<i>M6P1a</i>	<i>Build new mathematical knowledge through problem solving.</i>
	<i>M6P1b</i>	<i>Solve problems that arise in mathematics and in other contexts.</i>

- M6P1c Apply and adapt a variety of appropriate strategies to solve problems.*
- M6P1d Monitor and reflect on the process of mathematical problem solving.*
- M6P2b Make and investigate mathematical conjectures.*
- M6P2c Develop and evaluate mathematical arguments and proofs.*
- M6P2d Select and use various types of reasoning and methods of proof.*
- M6P3a Organize and consolidate their mathematical thinking through communication.*
- M6P3b Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.*
- M6P3d Use the language of mathematics to express mathematical ideas precisely.*
- M6P4a Recognize and use connections among mathematical ideas.*
- M6P4b Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.*
- M6P4c Recognize and apply mathematics in contexts outside of mathematics.*
- M6P5a Create and use representations to organize, record, and communicate mathematical ideas.*
- M6P5b Select, apply, and translate among mathematical representations to solve problems.*
- M6P5c Use representations to model and interpret physical, social, and mathematical phenomena.*

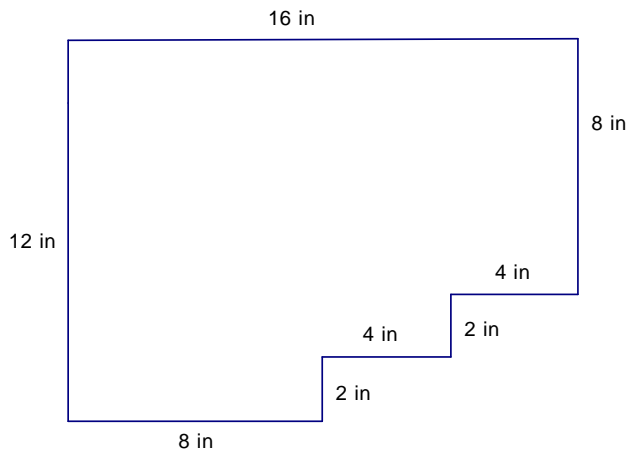
## Similar Figures

The task:

- a) Triangle ECD is similar to triangle EAB. What is the scale factor for the two triangles? Explain how you found the scale factor. Find side AB.



- b) Gregory is in the sixth grade and is working on a project having to do with agricultural use of land in South Georgia. He has a small copy of a map of a farm in his area but needs to make a much larger version on which he can record all accumulated data. The map he wants to enlarge is shown below.



He has decided that he wants the length of the northern boundary of the farm for the larger version to be 24 inches. How would you explain to him what he should do to find the lengths of the other sides so that the enlarged map is a scale drawing of the smaller one?

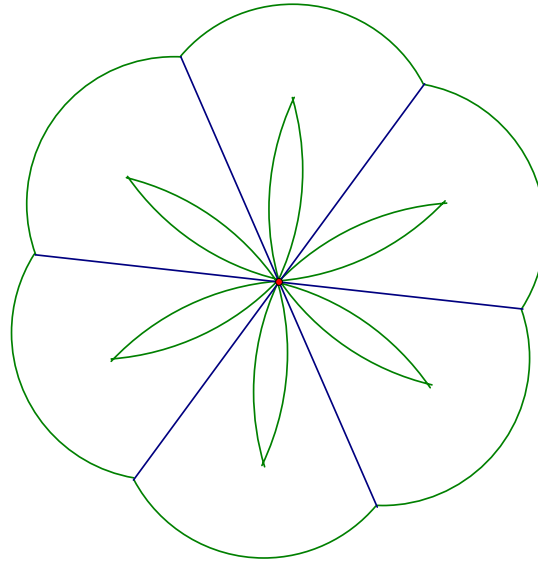
Mathematics required by the task:

<i>Questions</i>	<i>Standards</i>	<i>Summary</i>
<i>a</i>	<i>M6G1c</i>	<i>Use concepts of ratio, proportion and scale factor to demonstrate the relationships between similar plane figures.</i>
	<i>M6G1d</i>	<i>Interpret and sketch simple scale drawings.</i>
<i>b</i>	<i>M6G1d</i>	<i>Interpret and sketch simple scale drawings.</i>
	<i>M6G1e</i>	<i>Solve problems involving scale drawings.</i>
<i>a,b</i>	<i>M6P1a</i>	<i>Build new mathematical knowledge through problem solving.</i>
	<i>M6P1b</i>	<i>Solve problems that arise in mathematics and in other contexts.</i>
	<i>M6P1c</i>	<i>Apply and adapt a variety of appropriate strategies to solve problems.</i>
	<i>M6P1d</i>	<i>Monitor and reflect on the process of mathematical problem solving.</i>
	<i>M6P2c</i>	<i>Develop and evaluate mathematical arguments and proofs.</i>
	<i>M6P2d</i>	<i>Select and use various types of reasoning and methods of proof.</i>
	<i>M6P3a</i>	<i>Organize and consolidate their mathematical thinking through communication.</i>
	<i>M6P3b</i>	<i>Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.</i>
	<i>M6P3d</i>	<i>Use the language of mathematics to express mathematical ideas precisely.</i>
	<i>M6P4a</i>	<i>Recognize and use connections among mathematical ideas.</i>
	<i>M6P4b</i>	<i>Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.</i>
	<i>M6P4c</i>	<i>Recognize and apply mathematics in contexts outside of mathematics.</i>
	<i>M6P5a</i>	<i>Create and use representations to organize, record, and communicate mathematical ideas.</i>
	<i>M6P5b</i>	<i>Select, apply, and translate among mathematical representations to solve problems.</i>
	<i>M6P5c</i>	<i>Use representations to model and interpret physical, social, and mathematical phenomena.</i>

## Symmetry

The task:

- a) Does the figure below have line symmetry? If so, draw the lines of symmetry in the figure. Does the figure have rotational symmetry? List the degrees that the figure can turn and still look like the original.



- b) Find 3 letters of the alphabet (if possible) that have **only** one vertical line of symmetry.  
Find 3 letters of the alphabet (if possible) that have **only** one horizontal line of symmetry.  
Find 3 letters of the alphabet (if possible) that have **both** vertical and horizontal line symmetry.  
Find 3 letters of the alphabet (if possible) that have point symmetry ( $180^\circ$  rotational symmetry).
- c) Explain to a classmate how you can test a letter for each line of symmetry in part (b). Explain to a classmate how you can test a letter for point symmetry. Listen to his or her explanations and test them on the examples you found in part (b).
- d) Can you sketch a triangle that has exactly one line of symmetry? Exactly two? Exactly three? Justify your answers by sketching these triangles and showing the lines of symmetry.

Mathematics required by the task:

<i>Questions</i>	<i>Standards</i>	<i>Summary</i>
<i>a-c</i>	<i>M6G1a</i>	<i>Determine and use lines of symmetry.</i>
	<i>M6G1b</i>	<i>Investigate rotational symmetry, including degree of rotation.</i>
	<i>M6P1a</i>	<i>Build new mathematical knowledge through problem solving.</i>
	<i>M6P1b</i>	<i>Solve problems that arise in mathematics and in other contexts.</i>

- M6P1c Apply and adapt a variety of appropriate strategies to solve problems.*
- M6P1d Monitor and reflect on the process of mathematical problem solving.*
- M6P2d Select and use various types of reasoning and methods of proof.*
- M6P3a Organize and consolidate their mathematical thinking through communication.*
- M6P3b Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.*
- M6P3c Analyze and evaluate the mathematical thinking and strategies of others.*
- M6P3d Use the language of mathematics to express mathematical ideas precisely.*
- M6P4a Recognize and use connections among mathematical ideas.*
- M6P4b Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.*
- M6P4c Recognize and apply mathematics in contexts outside of mathematics.*
- M6P5a Create and use representations to organize, record, and communicate mathematical ideas.*
- M6P5b Select, apply, and translate among mathematical representations to solve problems.*
- M6P5c Use representations to model and interpret physical, social, and mathematical phenomena.*

Notes to the teacher:

- 1) Have the students design a logo for a company that has exactly a certain number of lines of symmetry or a certain degree of rotational symmetry or both.
- 2) Students should be able to name a polygon with a certain degree of rotational symmetry.
- 3) Use a dynamic geometry software package to demonstrate symmetry or let students use the software to create their own designs.

## Algebra Tasks

The tasks:

1. a. Determine the missing values in the function tables below.

<b>x</b>	<b>y</b>
1	3
2	6
3	9
4	
5	
6	

<b>x</b>	<b>y</b>
$\frac{1}{2}$	$\frac{1}{12}$
1	$\frac{1}{6}$
$\frac{3}{2}$	$\frac{1}{4}$
2	
$\frac{5}{2}$	
3	

<b>x</b>	<b>y</b>
0.1	0.04
0.2	0.08
0.3	0.12
0.4	
0.5	
0.6	

- b. Describe the pattern in each table.
- c. Write three equations for  $y$ , in terms of  $x$ , one for each set of data in the given tables.
- d. Graph the equations you determined in part (c). Determine the slope of each line you graphed.
- e. Write the set of ratios  $k = \frac{y}{x}$  using the  $x$  and  $y$  values in Table 1. Compare the ratios with the slope of the corresponding graph from part (d). Explain what you observe to a classmate. Do the same for the values in Table 2 and in Table 3.
2. Consider the tables below where the  $x$ - and  $y$ -values represent two quantities. In each table, do the quantities vary proportionally? Explain how you know.

<b>x</b>	5	4	3	2	1
<b>y</b>	10	8	6	4	2

<b>x</b>	50	40	30	20	10
<b>y</b>	5	4	3	2	1

<b>x</b>	1	2	3	4	5
<b>y</b>	1	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{4}$	$\frac{1}{5}$

- 3.
- Graph the following equations on the same coordinate plane.  

$$y = x, y = \frac{1}{2}x, y = \frac{1}{3}x, y = \frac{1}{4}x, y = \frac{1}{5}x$$
  - Graph the following equations on the same coordinate plane.  

$$y = x, y = 2x, y = 3x, y = 4x, y = 5x$$
  - The equations in parts (a) and (b) are in the general form  $y = kx$ . Describe the effect on the graph of  $y = kx$  when the values of  $k$  become smaller. Describe the effect on the graph of  $y = kx$  when the values of  $k$  become larger.
4. Suppose that the amount of bacteria in a petri dish doubles every day. Does the bacteria growth vary proportionally with the number of days that the bacteria grow? Justify your answer.
5. Suppose three-fourths of a can of paint covers two-thirds of a wall you want to paint. If  $x$  represents the amount of paint you need for the whole wall, write an equation that will allow you to find the amount of paint you need for the whole wall. Solve your equation for  $x$ .
6. Haley mixed  $3\frac{1}{2}$  cups of white paint with one cup of red paint to create pink paint. If Haley wants to make 10 cups of the same shade of pink, how many cups of white paint and how many cups of red paint will she need? Explain your reasoning.
7. If  $\frac{3}{4}$  of a cup of juice gives you 60% of your daily value of Vitamin C, what percent of your daily value of Vitamin C will you get by drinking  $\frac{1}{2}$  of a cup of juice? Justify your answer.

8. Place parentheses in each expression below so that when the expressions are evaluated you get two different numbers. Show how you got the two numbers.

$$4 \times 8 \div 4 \times 8$$

$$4 \times 8 \div 4 \times 8$$

9. Lee and Shayna both evaluated the following expression:  $9 \div 3^2 \times 2$ .  
Lee claims the answer is 2.

Shayna claims the answer is  $\frac{1}{2}$ .

Explain how each person determined their answer. Who is correct and why?

10.

- Write an equation involving the operation of addition in which the solution is  $x = 2$ .
- Write an equation involving the operation of subtraction in which the solution is  $x = 2$ .
- Write an equation involving the operation of multiplication in which the solution is  $x = 2$ .
- Write an equation involving the operation of division in which the solution is  $x = 2$ .

Mathematics required by the tasks:

<i>Questions</i>	<i>Standards</i>	<i>Summary</i>
1a	M6A2a	Analyze and describe patterns arising from mathematical rules, tables, and graphs.
1b	M6A2a	Analyze and describe patterns arising from mathematical rules, tables, and graphs.
1c	M6A2d	Describe proportional relationships mathematically using $y = kx$ , where $k$ is the constant of proportionality. M6A2f-In a proportional relationship expressed as $y = kx$ , solve for one quantity given values of the other two. Given quantities may be whole numbers, decimals, or fractions. Solve problems using the relationship $y = kx$ .
1d	M6A2e	Graph proportional relationships in the form $y = kx$ and describe characteristics of the graphs.
1e	M6A2a	Analyze and describe patterns arising from mathematical rules, tables, and graphs.
	M6A2e	Graph proportional relationships in the form $y = kx$ and describe characteristics of the graphs.

- 2 M6A2f In a proportional relationship expressed as  $y = kx$ , solve for one quantity given values of the other two. Given quantities may be whole numbers, decimals, or fractions. Solve problems using the relationship  $y = kx$ .
- 3a M6A2e Graph proportional relationships in the form  $y = kx$  and describe characteristics of the graphs.
- 3b M6A2e Graph proportional relationships in the form  $y = kx$  and describe characteristics of the graphs.
- 3c M6A2e Graph proportional relationships in the form  $y = kx$  and describe characteristics of the graphs.
- 4 M6A2c Use proportions  $\left(\frac{a}{b} = \frac{c}{d}\right)$  to describe relationships and solve problems, including percent problems.
- M6A2g Use proportional reasoning  $\left(\frac{a}{b} = \frac{c}{d}$  and  $y = kx\right)$  to solve problems
- 5 M6A2c Use proportions  $\left(\frac{a}{b} = \frac{c}{d}\right)$  to describe relationships and solve problems, including percent problems.
- M6A2g Use proportional reasoning  $\left(\frac{a}{b} = \frac{c}{d}$  and  $y = kx\right)$  to solve problems.
- 6 M6A2c Use proportions  $\left(\frac{a}{b} = \frac{c}{d}\right)$  to describe relationships and solve problems, including percent problems.
- M6A2g Use proportional reasoning  $\left(\frac{a}{b} = \frac{c}{d}$  and  $y = kx\right)$  to solve problems.
- 7 M6A2c Use proportions  $\left(\frac{a}{b} = \frac{c}{d}\right)$  to describe relationships and solve problems, including percent problems.
- M6A2g Use proportional reasoning  $\left(\frac{a}{b} = \frac{c}{d}$  and  $y = kx\right)$  to solve problems.
- 8 M6A3 Students will evaluate algebraic expressions, including those with exponents, and solve simple one-step equations using each of the four basic operations.
- 9 M6A3 Students will evaluate algebraic expressions, including those with exponents, and solve simple one-step equations using each of the four basic operations.

10	M6A3	Students will evaluate algebraic expressions, including those with exponents, and solve simple one-step equations using each of the four basic operations.
1-10	M6P1a	<i>Build new mathematical knowledge through problem solving.</i>
	M6P1b	<i>Solve problems that arise in mathematics and in other contexts.</i>
	M6P1c	<i>Apply and adapt a variety of appropriate strategies to solve problems.</i>
	M6P1d	<i>Monitor and reflect on the process of mathematical problem solving.</i>
	M6P2b	<i>Make and investigate mathematical conjectures.</i>
	M6P2d	<i>Select and use various types of reasoning and methods of proof.</i>
	M6P3a	<i>Organize and consolidate their mathematical thinking through communication.</i>
	M6P3b	<i>Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.</i>
	M6P3d	<i>Use the language of mathematics to express mathematical ideas precisely.</i>
	M6P4a	<i>Recognize and use connections among mathematical ideas.</i>
	M6P4b	<i>Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.</i>
	M6P4c	<i>Recognize and apply mathematics in contexts outside of mathematics.</i>
	M6P5a	<i>Create and use representations to organize, record, and communicate mathematical ideas.</i>
	M6P5b	<i>Select, apply, and translate among mathematical representations to solve problems.</i>
	M6P5c	<i>Use representations to model and interpret physical, social, and mathematical phenomena.</i>

## Basketball Task

### The task:

The statistics of three basketball players are shown below.

In the past 6 games, Dave has scored 12, 12, 6, 28, 4, & 12 points.

In the past 7 games, Joe has scored 3, 2, 2, 10, 16, 20, & 12 points.

In the past 6 games, Daniel has scored 16, 12, 13, 12, 9, & 12 points.

- a) Who is playing best so far? How can you use mathematics to compare these players? Make sure you justify your answer.
- b) You are hired as an assistant coach. The head coach wants to know who should play most in the next game. Use graphs and words to explain who you think would provide more scoring for the team.
- c) Compare your arguments with someone else's in the class. Do you both think the same player should play most? If you disagree, try to understand each other's thinking and then try to agree on which player should play most.
- d) Assuming that Dave and Joe maintain their same average points scored per game, what score would Daniel have to make in the next game to outscore Dave and Joe?

### **Mathematics required by the task:**

<i>Questions</i>	<i>Standards</i>	<i>Summary</i>
<i>a-c</i>	<i>M6D1</i>	<i>Students will formulate questions that can be answered by data.</i>
	<i>M6D1b</i>	<i>Using data, construct frequency distributions, frequency tables, and graphs.</i>
	<i>M6D1e</i>	<i>Relate the data analysis to the context of the questions posed.</i>
	<i>M6D1d</i>	<i>Use tables and graphs to examine variation that occurs within a group and variation that occurs between groups.</i>
<i>b</i>	<i>M6D1c</i>	<i>Choose appropriate graphs to be consistent with the nature of the data.</i>
<i>a-d</i>	<i>M6P1a</i>	<i>Build new mathematical knowledge through problem solving.</i>
	<i>M6P1b</i>	<i>Solve problems that arise in mathematics and in other contexts.</i>
	<i>M6P1c</i>	<i>Apply and adapt a variety of appropriate strategies to solve problems.</i>
	<i>M6P1d</i>	<i>Monitor and reflect on the process of mathematical problem solving.</i>
	<i>M6P2b</i>	<i>Make and investigate mathematical conjectures.</i>
	<i>M6P2c</i>	<i>Develop and evaluate mathematical arguments and proofs.</i>
	<i>M6P2d</i>	<i>Select and use various types of reasoning and methods of proof.</i>
<i>M6P3a</i>	<i>Organize and consolidate their mathematical thinking through communication.</i>	

- M6P3b Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.*
- M6P3c Analyze and evaluate the mathematical thinking and strategies of others.*
- M6P3d Use the language of mathematics to express mathematical ideas precisely.*
- M6P4a Recognize and use connections among mathematical ideas.*
- M6P4b Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.*
- M6P4c Recognize and apply mathematics in contexts outside of mathematics.*
- M6P5a Create and use representations to organize, record, and communicate mathematical ideas.*
- M6P5b Select, apply, and translate among mathematical representations to solve problems.*
- M6P5c Use representations to model and interpret physical, social, and mathematical phenomena.*

### **Notes to the Teacher**

Students could use a variety of methods for determining who is the “best” player. They will also have to clarify the question to explain what it means to be the “best” player. Ideally, their analysis would be most complete if they know how to calculate the mean, median, mode, standard deviation, and create line plots and box-and-whisker plots.

## Dice Game Task

### The task:

Michael, Janet, Kareta, and Chan are playing a game. Each person has chosen two special numbers between 2 and 12. Here are the numbers they chose:

Michael	7 and 8
Janet	5 and 10
Kareta	11 and 12
Chan	4 and 9

They each take turns rolling a pair of dice. Each person receives 8 points whenever the total number of dots on the two dice is equal to one of their special numbers. The winner is the first person to get more than 100 points.

1. Who do you think will win and why?
2. Play the game. Roll a pair of dice over and over again. Every time you roll, record the total of the dice and the number of points scored for each of the 4 people. Stop rolling when someone wins (makes more than 100 points). Who wins? Who would you expect to win if you played the game again? Why?
3. Make a graph or some display showing the experimental probabilities of rolling each total from 2 to 12. Using this information, for each person, Michael, Janet, Kareta, and Chan, calculate the experimental probability of rolling one of their special numbers.
4. Make another display, like the one you did in part 3, showing the theoretical probabilities of rolling each total from 2 to 12. Using this information, for each person, Michael, Janet, Kareta, and Chan, calculate the theoretical probability of rolling one of their special numbers.
5. Using the displays you made in part 3 and 4, compare theoretical probabilities with experimental probabilities. Are they different? How? Can you explain the reason for these differences?
6. What would you expect if you played the game again? Why?

### **Mathematics required by the task:**

<i>Questions</i>	<i>Standards</i>	<i>Summary</i>
1,2	M6D2a	<i>Predict the probability of a given event through trials/simulation.</i>
4	M6D2b	<i>Determine theoretical probability of a given event.</i>
3-5	M6D2c	<i>Discover that experimental probability approaches theoretical probability when the number of trials is large.</i>
1, 6	M6D1a	<i>Formulate questions that can be answered by data.</i>
4,5	M6D1b.	<i>Using data, construct frequency distribution, frequency tables and graphs.</i>
4,5	M6D1c.	<i>Choose appropriate graphs.</i>

- 1-6
- M6P1a* Build new mathematical knowledge through problem solving.
  - M6P1b* Solve problems that arise in mathematics and in other contexts.
  - M6P1c* Apply and adapt a variety of appropriate strategies to solve problems.
  - M6P1d* Monitor and reflect on the process of mathematical problem solving.
  - M6P2b* Make and investigate mathematical conjectures.
  - M6P2c* Develop and evaluate mathematical arguments and proofs.
  - M6P2d* Select and use various types of reasoning and methods of proof.
  - M6P3a* Organize and consolidate their mathematical thinking through communication.
  - M6P3b* Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.
  - M6P3d* Use the language of mathematics to express mathematical ideas precisely.
  - M6P4a* Recognize and use connections among mathematical ideas.
  - M6P4b* Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
  - M6P4c* Recognize and apply mathematics in contexts outside of mathematics.
  - M6P5a* Create and use representations to organize, record, and communicate mathematical ideas.
  - M6P5b* Select, apply, and translate among mathematical representations to solve problems.
  - M6P5c* Use representations to model and interpret physical, social, and mathematical phenomena.

Notes to the Teacher

The students must already be familiar with experimental and theoretical probability to complete this task.

Technology could be used in allowing the students to prepare their displays. Technology could also be used most effectively to simulate the rolling of the dice and allow the students to roll the dice a large number of times and observe how the experimental probability approaches the theoretical probability of rolling each sum.