

## **Gazebo Construction**

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**Class:** Math

**School:** Winburn

**Approximate Timeline:** 3 years

**School Level:** Middle School

**Area(s) of Core Content:** Mathematics

### **Organizer:**

What does it take to build a gazebo?

### **Targeted Standards:**

#### **Academic Expectation 1--Apply Communication and Math Skills:**

-1.5 - 1.9 Students use mathematical ideas and procedures to communicate, reason, and solve problems.

- ✓ -Select, apply, justify appropriate math procedures to solve real-life problems using rational numbers.
- ✓ -Model problem solving situations using oral, written, concrete, pictorial, graphic, simple algebraic methods.
- ✓ -Communicate the meanings of number, space, change, data, and measurement verbally, pictorially, symbolically, and concretely.

-1.16 Students use computers and other kinds of technology to collect, organize, and communicate information and ideas.

- ✓ -Integrate the use of a variety of technologies.
- ✓ -Expand knowledge by identifying and using technology for a specific purpose.

#### **Academic Expectation 2--Mathematics:**

-2.8 Students understand various mathematical procedures and use them appropriately and accurately.

- ✓ -Translate from concrete, pictorial, and verbal expressions to mathematical expressions.
- ✓ -Apply and justify computational methods.

-2.9 Students understand space and dimensionality concepts and use them appropriately and accurately.

- ✓ -Use attributes to classify and analyze regular and irregular figures in 2 and 3 dimensions.
- ✓ -Investigate symmetry, similarity, and congruence using concrete models and drawing.
- ✓ -Visualize different representations of 2 and 3-dimensional geometric figures.

- 2.10 Students understand measurement concepts and use measurements appropriately and accurately.
- ✓ -Extend the concepts of length, area, volume, mass, weight, capacity, time, angle, perimeter, money, circumference, and temperature using measurement tools and models.

**Academic Expectation 4--Responsible Group Membership:**

- 4.2 Students use productive team membership skills.
- ✓ -Use effective team skills to complete a task.

**Program of Studies--Middle School Mathematics:**

- M-6-NC-1 continue to develop number sense including fractions, decimals, and percents (including percents greater than 100% and improper fractions).
- M-6-NC-2 extend understanding of operations (+, -, x, ÷) to include fractions and decimals.
- M-6-NC-3 develop meaning of ratio (describe and compare two sets of data using ratios and appropriate notations: 3:5, 3/5, 3 to 5).
- M-6-NC-10 estimate and mentally compute using fractions and decimals.
- M-6-NC-12 compare, order, and convert between whole numbers, fractions, and decimals, using concrete materials, drawings or pictures, and mathematical symbols (<, >, =, order on a number line).
- M-6-GM-2 read and use measurement tools (e.g., rulers, scales).
- M-6-GM-4 estimate, compare, and convert units of measures for length, weight/mass, and volume/capacity within the U.S. customary system and within the metric system: a) length (e.g., parts of an inch, inches, feet, yards, miles, millimeter, centimeter, kilometer; b) weight/mass (e.g., pounds, tons, grams, kilograms); and c) volume/capacity (e.g., cups, pints, quarts, gallons, milliliters, liters). (The intent of this standard is for students to make ballpark comparisons and not to memorize conversion factors between U.S. and metric units.)
- M-6-GM-5 estimate and find angle measurement and segment measurements.
- M-6-GM-8 recognize regular polygons; special quadrilaterals including squares, rectangles, rhombuses, trapezoids, and parallelograms; and special triangles including acute, obtuse, scalene, and isosceles.
- M-6-GM-9 identify characteristics of lines (e.g., parallel, perpendicular).
- M-6-A-3 write and solve equations with one variable, using concrete and/or informal methods that model everyday situations.
- M-7-NC-4 apply meaning of ratio and proportion to problems.
- M-7-NC-7 extend concepts and application of operations with fractions and decimals to include percents.
- M-7-NC-8 compute percentages of numbers and use percentages in proportional reasoning.
- M-7-NC-10 solve proportions.
- M-7-NC-13 develop proportional thinking, rates, scaling, and similarity.

- M-7-GM-5 identify and classify characteristics of two-dimensional shapes, such as regular and irregular quadrilaterals, special triangles, and regular polygons.
- M-7-GM-6 identify characteristics of angles (e.g., adjacent, vertical, corresponding, interior, exterior).
- M-7-A-3 understand the concept of equations and inequalities using variables as they relate to everyday situations.
- M-7-A-5 use a variety of methods and representations to create and solve single-variable equations that may be applied to everyday situations.
- M-8-GM-1 discover and apply the Pythagorean theorem.
- M-8-GM-4 develop and apply proportionality and relationships between scale models and actual figures.
- M-8-GM-5 investigate transformations' congruence, proportionality, and similarity (e.g., enlargements, reductions, proportional triangles) in a coordinate plane.
- M-8-A-11 determine the slope and equation of a line by analyzing the line (e.g.,  $Y = mx + b$ ;  $m$  is rise/run,  $b$  is  $y$  - intercept).

#### Middle School Core Content--Mathematics:

- MA-M-1.1.1 Rational numbers (integers, fractions, decimals, percents)
- MA-M-1.1.3 Meaning of proportion (equivalent ratios)
- MA-M-1.2.1 Add, subtract, multiply, and divide rational numbers (fractions, decimals, percents, integers) to solve problems
- MA-M-1.2.2 Compute (e.g., estimate, use pencil and paper, use calculator, round, use mental math) large and small quantities and check for reasonable and appropriate computational results
- MA-M-1.2.3 Apply ratios, proportional reasoning, and percents (e.g., constant rate of change, unit pricing)
- MA-M-1.3.1 How whole numbers, natural numbers, integers, fractions, decimals, percents, and irrational numbers (square roots and  $p$  only) relate to each other (e.g., convert between forms of rational numbers, compare, order)
- MA-M-2.1.1 Basic geometric elements that include points, segments, rays, lines, angles, and planes
- MA-M-2.1.2 Two-dimensional shapes including circles, regular polygons, quadrilaterals (square, rectangle, rhombus, parallelogram, trapezoid), and triangles (acute, obtuse, right, equilateral, scalene, isosceles)
- MA-M-2.1.3 Common three-dimensional shapes including spheres, cones, cylinders, prisms (with polygonal bases), and pyramids (with polygonal bases)
- MA-M-2.1.4 Congruence, symmetry, and similarity
- MA-M-2.1.5 U.S. Customary and metric units of measurement
- MA-M-2.2.1 Identify characteristics (e.g., sides, vertices, angles, faces, edges, congruent parts) of two-dimensional and three-dimensional shapes
- MA-M-2.2.2 Use appropriate tools and strategies (e.g., combining and subdividing shapes) to find measures of both regular and irregular shapes
- MA-M-2.2.6 Estimate and determine measurement of angles
- MA-M-2.2.7 Use Pythagorean theorem to find hypotenuse

- MA-M-2.3.3 How proportional figures are related (scale drawings, similar figures)
- MA-M-4.1.1 Variables, equations, inequalities, and algebraic expressions
- MA-M-4.1.2 Functions (e.g., the relationship between time and cost of some long distance phone calls,  $y = 2x + 1$ ) through tables, graphs, verbal rules, and algebraic notations
- MA-M-4.2.2 Solve simple equations and inequalities
- MA-M-4.3.2 How the change in one variable affects the change in another variable (e.g., if rate remains constant, an increase in time results in an increase in distance)

### **Secondary Standards:**

#### **Academic 6--Integration of Knowledge:**

- 6.1 Students connect knowledge and experiences from different subject areas.
  - ✓ -Explain an event using knowledge and experiences from several subject areas.
- 6.2 Students use what they already know to acquire new knowledge, develop new skills, or interpret new experiences.
  - ✓ -Evaluate strategies used to relate new information to prior knowledge and experience.
- 6.3 Students expand their understanding of existing knowledge by making connections with new knowledge, skills, and experiences.
  - ✓ -Discover relationships among existing knowledge and new ideas, objects, and actions.

### **Essential Questions:**

1. What is a gazebo?
2. How do you identify and define geometric shapes and geometric terms?
3. What are the characteristics of two and three-dimensional figures and how can models and visual representations be created for them?
4. How do you use measurement tools to accurately construct two and three-dimensional figures?
5. How do you apply ratios and proportional reasoning to solve problems that involve scale models and full-scale construction?

### **Culminating Performance:**

6th - Students orally present their proposals for the construction of a gazebo using a blueprint created with Geometer's Sketchpad.

7th - Students build a gazebo model based on blueprints created in 6th grade and provide supportive evidence why it should be selected for construction in 8th grade.

8th - Students construct a gazebo based on the selected model developed in the 7th grade.

## Scoring Guide

### 6<sup>th</sup> grade Rubric

Criteria	4	3	2	1
Mathematical Reasoning	Uses complex and refined mathematical reasoning.	Uses effective mathematical reasoning	Some evidence of mathematical reasoning.	Little evidence of mathematical reasoning.
Mathematical Concepts	Explanation shows complete understanding of the mathematical concepts used to solve the problem(s).	Explanation shows substantial understanding of the mathematical concepts used to solve the problem(s).	Explanation shows some understanding of the mathematical concepts needed to solve the problem(s).	Explanation shows very limited understanding of the underlying concepts needed to solve the problem(s) OR is not written.
Blueprint	Plan is complete and accurate and can reasonably be constructed.	Plan is complete and accurate and may be constructed.	Plan is complete but contains design inaccuracies.	Plan is not complete and does not show accurate design.
Neatness and Organization	The work is presented in a neat, clear, organized fashion that is easy to read.	The work is presented in a neat, clear, organized fashion that is usually easy to read.	The work is presented in a neat, clear, organized fashion that may be hard to read at times.	The work appears sloppy and unorganized. It is hard to know what information goes together.
Oral Presentation	Explanation is detailed and clear.	Explanation is clear.	Explanation is difficult to understand but includes critical components.	Explanation is difficult to understand and is missing several components OR was not included.

7<sup>th</sup> grade Rubric:

Criteria	4	3	2	1
Mathematical Reasoning	Uses complex and refined mathematical reasoning.	Uses effective mathematical reasoning	Some evidence of mathematical reasoning.	Little evidence of mathematical reasoning.
Mathematical Concepts	Explanation shows complete understanding of the mathematical concepts used to solve the problem(s).	Explanation shows substantial understanding of the mathematical concepts used to solve the problem(s).	Explanation shows some understanding of the mathematical concepts needed to solve the problem(s).	Explanation shows very limited understanding of the underlying concepts needed to solve the problem(s) OR is not written.
Model	Model is complete and accurate and can reasonably be constructed.	Model is complete and accurate and may be constructed.	Model is complete but contains design inaccuracies.	Model is not complete and does not show accurate design.
Neatness and Organization	The work is presented in a neat, clear, organized fashion that is easy to read.	The work is presented in a neat, clear, organized fashion that is usually easy to read.	The work is presented in a neat, clear, organized fashion that may be hard to read at times.	The work appears sloppy and unorganized. It is hard to know what information goes together.
Oral Presentation	Explanation is detailed and clear.	Explanation is clear.	Explanation is difficult to understand but includes critical components.	Explanation is difficult to understand and is missing several components OR was not included.

8<sup>th</sup> Grade Rubric

Criteria	4	3	2	1
Mathematical Reasoning	Uses complex and refined mathematical reasoning.	Uses effective mathematical reasoning	Some evidence of mathematical reasoning.	Little evidence of mathematical reasoning.
Mathematical Concepts	Explanation shows complete understanding of the mathematical concepts used to solve the problem(s).	Explanation shows substantial understanding of the mathematical concepts used to solve the problem(s).	Explanation shows some understanding of the mathematical concepts needed to solve the problem(s).	Explanation shows very limited understanding of the underlying concepts needed to solve the problem(s) OR is not written.
Construction (group grade)	Great care taken in construction process so that the structure is neat, attractive and follows plans accurately.	Construction was careful and accurate for the most part, but 1-2 details could have been refined for a more attractive product.	Construction accurately followed the plans, but 3-4 details could have been refined for a more attractive product.	Construction appears careless or haphazard. Many details need refinement for a strong or attractive product.
Neatness and Organization	The work is presented in a neat, clear, organized fashion that is easy to read.	The work is presented in a neat, clear, organized fashion that is usually easy to read.	The work is presented in a neat, clear, organized fashion that may be hard to read at times.	The work appears sloppy and unorganized. It is hard to know what information goes together.
Teamwork (individual grade)	Student was an engaged partner, listening to suggestions of others and working cooperatively throughout lesson.	Student was an engaged partner but had trouble listening to others and/or working cooperatively.	Student cooperated with others, but needed prompting to stay on-task.	Student did not work effectively with others.

**Knowledge:**

angles, parallel lines, perpendicular lines, rays, segments, points, intersection, vertices, edges, faces, types of angles, two- and three-dimensional shapes, congruency, symmetry, similarity, construction terminology, measurement terminology

**Skills/Abilities:**

classify, organize, construct, Geometer's Sketchpad, compare and contrast, CAD software, measuring, predict, computation skills, construction skills, conversions, collaboration,

**Critical Resources:**

CAD, Geometer's Sketchpad, community resources, Internet, guest speakers, measuring tools, calculators

**Instructional/Assessment Activities:****Grade Six:**

## Topic One – Research Gazebo

- ✓ Objective: Students will be able to define and identify different shapes of gazebos.
- ✓ Description: Introduce how geometry is seen in everyday structures. Brainstorm where they see different and various geometric shapes. Use digital cameras to take pictures of these shapes and create a photo album in PowerPoint.
- ✓ Assessment: Final research; observation of student work

## Topic Two: Geometric Terminology

- ✓ Objective: Students will be able to define and identify basic geometric shapes and terms (points, lines, rays, segments, planes, angles, polygons)
- ✓ Description: Introduce basic geometric terms and shapes and Geometer's Sketchpad
- ✓ Assessment: Observation of student work, written test on terminology

## Topic Three: Measuring

- ✓ Objective: Students will be able to accurately measure angles and line segments.
- ✓ Description: Students will use a variety of measuring tools to measure and classify angles.

- ✓ Assessment: Connected Math

#### Topic Four: Blueprints

- ✓ Objective: Students will be able to create workable blueprints for a gazebo.
- ✓ Description: Students will use their knowledge to create a gazebo blueprint using designing software and measuring tools.
- ✓ Assessment: Blueprints

#### Topic Five: Presentation

- ✓ Objective: Students will be able to give an oral presentation of their blueprints.
- ✓ Description: Students will explain their blueprints and basis for construction of their proposed gazebo.
- ✓ Assessment: Oral Presentation

### **Grade Seven:**

#### Topic One: "Design of Your Room"

- ✓ Objective: Students will review basic geometric concepts and measuring skills in the design of their bedroom.
- ✓ Description: Students will measure their bedrooms, transpose it onto graph paper and identify basic geometric shapes and terms.
- ✓ Assessment: Blueprint of the room

#### Topic Two: Review real-world applications of fractions and decimals.

- ✓ Objective: Students will be able to apply fractions and decimals when given real-world situations.
- ✓ Description: Students will practice proportionality concepts through hands-on classroom activities.
- ✓ Assessment: Written test

#### Topic Three: Ratio and Proportions

- ✓ Objectives: Students will be able to recognize/define ratio and proportions in real-world situations.
- ✓ Description: Students will analyze blueprints created in sixth grade and use proportions to recreate them in a larger scale.
- ✓ Assessment: The revised blueprint

#### Topic Four: Gazebo Model Construction

- ✓ Objectives: Students will be able to construct a model based on their blueprints.
- ✓ Description: Students will use Popsicle sticks to create a model based on their blueprints.
- ✓ Assessment: The Popsicle gazebo model

#### Topic Five: Presentation

- ✓ Objectives: Students will be able to orally discuss their models.
- ✓ Description: Students will propose and defend the construction of their model.
- ✓ Assessment: Presentation

### **Grade Eight:**

#### Topic One: Review models and fundamental concepts/skills.

- ✓ Objectives: Students will discuss and evaluate proposed gazebo models.
- ✓ Description; Students will work in groups and critique the gazebo model, presenting reports to the class using a computer application of their choice. Students will review fundamental skills that were introduced in 6<sup>th</sup> and 7<sup>th</sup> grade.
- ✓ Assessment: Oral reports and a written test on fundamental concepts/skills.

#### Topic Two: Guest speaker

- ✓ Objectives: Students will be able to understand and apply basic construction concepts.
- ✓ Description: Prior to arrival of guest speaker, students will compile a list of proposed questions to ask of guest speaker from local community resource. The guest speaker will discuss basic aspects of construction techniques and answer proposed questions.
- ✓ Assessment: Students will write a synopsis of guest speaker's presentation and orally present in small groups.

#### Topic Three: Gazebo construction

- ✓ Objective: Students will successfully construct a gazebo.
- ✓ Description: Students will use the chosen model and construct a gazebo.
- ✓ Assessment: The complete gazebo