Georgia Standards of Excellence Curriculum Frameworks

Mathematics

GSE Grade 7

Unit 4: Geometry

Georgia Department of Education

Richard Woods, Georgia's School Superintendent

"Educating Georgia's Future"

Unit 4
Geometry

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OVERVIEW

The units in this instructional framework emphasize key standards that assist students to develop a deeper understanding of numbers. In this unit they will be engaged in using what they have previously learned about drawing geometric figures using rulers and protractor with an emphasis on triangles, students will also write and solve equations involving angle relationships, area, volume, and surface area of fundamental solid figures.
The challenges in this unit include understanding the geometric figures and solving equations involving geometric figures. The students also should be guided to realize how geometry works in real world situations. The Big Ideas that are expressed in this unit are integrated with such routine topics as estimation, mental and basic computation. All of these concepts need to be reviewed throughout the year.

Take what you need from the tasks and modify as required. These tasks are suggestions, something that you can use as a resource for your classroom.

STANDARDS ADDRESSED IN THIS UNIT

STANDARDS FOR MATHEMATICAL PRACTICE

1. Make sense of problems and persevere in solving them. Students make sense of the problems involving geometric measurements (area, volume, surface area, etc.) through their understanding of the relationships between these measurements. They demonstrate this by choosing appropriate strategies for solving problems involving real-world and mathematical situations.

2. Reason abstractly and quantitatively. In grade 7, students represent a wide variety of real world contexts through the use of real numbers and variables when working with geometric figures. Students contextualize to understand the meaning of the number or variable as related to a geometric shape. Students must challenge themselves to think of three dimensional shapes with only two dimensional representations of them on paper in some cases.

3. Construct viable arguments and critique the reasoning of others. Students are able to construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades.

4. Model with mathematics. Students are able to apply the geometry concepts they know to solve problems arising in everyday life, society and the workplace. This may include applying area and surface of 2-dimensional figures to solve interior design problems or surface area and volume of 3-dimensional figures to solve architectural problems.

5. Use appropriate tools strategically. Mathematically proficient students consider available tools that might include concrete models, a ruler, a protractor, or dynamic geometry software such as virtual manipulatives and simulations. When making mathematical models, they know

that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data.

6. Attend to precision. In grade 7, students continue to refine their mathematical communication skills by using clear and precise language in their discussions with others and in their own reasoning. Students determine quantities of side lengths represented with variables, specify units of measure, and label geometric figures accurately. Students use appropriate terminology when referring to geometric figures.

7. Look for and make use of structure. Mathematically proficient students look closely to discern a pattern or structure. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They can see complicated things as single objects or as being composed of several objects.

8. Look for and express regularity in repeated reasoning. Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts.

STANDARDS FOR MATHEMATICAL CONTENT

Draw, construct, and describe geometrical figures and describe the relationships between them.

MGSE7.G.2 Explore various geometric shapes with given conditions. Focus on creating triangles from three measures of angles and/or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle.

MGSE7.G.3 Describe the two-dimensional figures (cross sections) that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms, right rectangular pyramids, cones, cylinders, and spheres.

Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.

MGSE7.G.4 Given the formulas for the area and circumference of a circle, use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.

MGSE7.G.5 Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure.

MGSE7.G.6 Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

RELATED STANDARDS

From Unit 3
MGSE7.G.1 Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.

BIG IDEAS

Use freehand, ruler, protractor and technology to draw geometric shapes with give conditions. (7.G.2)
Construct triangles from 3 measures of angles or sides. (7.G.2)
Given conditions, determine what and how many type(s) of triangles are possible to construct. (7.G.2)
Describe the two-dimensional figures that result from slicing three-dimensional figures. (7.G.3)
Identify and describe supplementary, complementary, vertical, and adjacent angles. (7.G.5)
Use understandings of supplementary, complementary, vertical and adjacent angles to write and solve equations. (7.G.5)
Explain (verbally and in writing) the relationships between the angles formed by two intersecting lines. (7.G.5)
Solve mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms. (7.G.6)
Solve real-world problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms. (7.G.6)

ESSENTIAL QUESTIONS

- What are the characteristics of angles and sides that will create geometric shapes, especially triangles?
- How can attributes of specific shapes, symmetry, and angles be used to accurately describe the design of a mosaic pattern?
- How can angle and side measures help us to create and classify triangles?
- How can special angle relationships – supplementary, complementary, vertical, and adjacent – be used to write and solve equations for multi-step problems?
- How can the interior and exterior measures of polygons be used to write and solve equations for multi-step problems?
- How are angle relationships applied to similar polygons?
- How are the circumference, diameter, and pi related?
- How do we find the circumference of a circle?
- How are the areas of parallelograms and triangles related to the area of a rectangle?
- How can area be maximized when the perimeter is a fixed number?
- How is the formula for the area of a circle related to the formula for the area of a parallelogram?

- How do I apply the concepts of surface area and circumference to solve real-world problems?
- What two-dimensional figures can be made by slicing a cube by planes?
- What two-dimensional figures can be made by slicing: cones, prisms, cylinders, and pyramids by planes?
- How do you determine volume and surface area of a cube?
- How do you determine surface area of a cylinder? (Extension EQ)
- How can I use formulas to determine the volumes of fundamental solid figures?
- How can I estimate the surface area of simple geometric solids?
- How can I use surface areas of plane figures to derive formulas for the surface areas of solid figures?

CONCEPTS AND SKILLS TO MAINTAIN

It is expected that students will have prior knowledge/experience related to the concepts and skills identified below. It may be necessary to pre-assess in order to determine if time needs to be spent on conceptual activities that help students develop a deeper understanding of these ideas.

- number sense
- computation with whole numbers and decimals, including application of order of operations
- addition and subtraction of common fractions with like denominators
- measuring length and finding perimeter and area of rectangles and squares
- characteristics of 2-D and 3-D shapes
- angle measurement
- data usage and representations

FLUENCY

It is expected that students will continue to develop and practice strategies to build their capacity to become fluent in mathematics and mathematics computation. The eventual goal is automaticity with math facts. This automaticity is built within each student through strategy development and practice. The following section is presented in order to develop a common understanding of the ideas and terminology regarding fluency and automaticity in mathematics:

Fluency: Procedural fluency is defined as skill in carrying out procedures flexibly, accurately, efficiently, and appropriately. Fluent problem solving does not necessarily mean solving problems within a certain time limit, though there are reasonable limits on how long computation should take. Fluency is based on a deep understanding of quantity and number.
Deep Understanding: Teachers teach more than simply "how to get the answer" and instead support students' ability to access concepts from a number of perspectives. Therefore students are able to see math as more than a set of mnemonics or discrete procedures. Students demonstrate deep conceptual understanding of foundational mathematics concepts by applying them to new situations, as well as writing and speaking about their understanding.

Memorization: The rapid recall of arithmetic facts or mathematical procedures. Memorization is often confused with fluency. Fluency implies a much richer kind of mathematical knowledge and experience.
Number Sense: Students consider the context of a problem, look at the numbers in a problem, make a decision about which strategy would be most efficient in each particular problem. Number sense is not a deep understanding of a single strategy, but rather the ability to think flexibly between a variety of strategies in context.
Fluent students:

- flexibly use a combination of deep understanding, number sense, and memorization.
- are fluent in the necessary baseline functions in mathematics so that they are able to spend their thinking and processing time unpacking problems and making meaning from them.
- are able to articulate their reasoning.
- find solutions through a number of different paths.

For more about fluency, see: http://www.youcubed.org/wp-content/uploads/2015/03/FluencyWithoutFear-2015.pdf and: http://joboaler.com/timed-tests-and-the-development-of-math-anxiety/

SELECTED TERMS AND SYMBOLS

The following terms and symbols are often misunderstood. These concepts are not an inclusive list and should not be taught in isolation. However, due to evidence of frequent difficulty and misunderstanding associated with these concepts, instructors should pay particular attention to them and how their students are able to explain and apply them.

Students should explore these concepts using models and real life examples. Students should understand the concepts involved and be able to recognize and/or demonstrate them with words, models, pictures, or numbers.

The websites below are interactive and include a math glossary. Note – At the elementary level, different sources use different definitions. Please preview any website for alignment to the definitions given in the frameworks.

http://intermath.coe.uga.edu/dictnary/homepg.asp
Definitions and activities for these and other terms can be found on the Intermath website.

Visit http://intermath.coe.uga.edu or http://mathworld.wolfram.com to see additional definitions and specific examples of many terms and symbols used in grade 7 mathematics.

- **Adjacent Angle**
- **Circumference**
- **Complementary Angle**

- **Congruent**
- **Cross- section**
- **Irregular Polygon**
- **Parallel Lines**
- **Pi**
- **Regular Polygon**
- **Supplementary Angle**
- **Vertical Angles**

FORMATIVE ASSESSMENT LESSONS (FAL)

Formative Assessment Lessons are intended to support teachers in formative assessment. They reveal and develop students' understanding of key mathematical ideas and applications. These lessons enable teachers and students to monitor in more detail their progress towards the targets of the standards. They assess students' understanding of important concepts and problem solving performance, and help teachers and their students to work effectively together to move each student's mathematical reasoning forward.
More information on Formative Assessment Lessons may be found in the Comprehensive Course Guide.

SPOTLIGHT TASKS

A Spotlight Task has been added to each MGSE mathematics unit in the Georgia resources for middle and high school. The Spotlight Tasks serve as exemplars for the use of the Standards for Mathematical Practice, appropriate unit-level Georgia Standards for Excellence, and research-based pedagogical strategies for instruction and engagement. Each task includes teacher commentary and support for classroom implementation. Some of the Spotlight Tasks are revisions of existing Georgia tasks and some are newly created. Additionally, some of the Spotlight Tasks are 3-Act Tasks based on 3-Act Problems from Dan Meyer and Problem-Based Learning from Robert Kaplinsky.

3-ACT TASKS

A Three-Act Task is a whole group mathematics task consisting of 3 distinct parts: an engaging and perplexing Act One, an information and solution seeking Act Two, and a solution discussion and solution revealing Act Three.
More information along with guidelines for 3-Act Tasks may be found in the Comprehensive Course Guide.