Geometry

Secondary Mathematics Instructional Guide 2009-2010
GEOMETRY AB
(Grade 8, 9 or 10)
Prerequisite: Algebra 1AB

310401 Geometry A
310402 Geometry B

COURSE DESCRIPTION
The Geometry skills and concepts developed in this discipline are useful to all students. Aside from learning these skills and concepts, students will develop their ability to construct formal, logical arguments and proofs in geometric settings and problems. Although the curriculum is weighted heavily in favor of plane (synthetic) Euclidean geometry, there is room for placing special emphasis on coordinate geometry and its transformations.

An important point to make to students concerning proofs is that while the written proofs presented in class should serve as models for exposition, they should in no way be a model of how proofs are discovered. The perfection of the finished product can easily mislead students into thinking that they must likewise arrive at their proofs with the same apparent ease. Teachers need to make clear to their students that the actual thought process is usually full of false starts and that there are many zigzags between promising leads and dead ends. Only trial and error can lead to a correct proof. This awareness of the nature of solving mathematical problems might lead to a de-emphasis of the rigid requirements on the writing of two-column proofs.

Development of geometric intuition. The following geometric constructions are recommended to develop students’ geometric intuition. (In this context construction means “construction with straightedge and compass.”) It is understood that all of them will be proved at some time during the course of study. The constructions that students should be able to do are:

- Bisecting an angle
- Constructing the perpendicular bisector of a line segment
- Constructing the perpendicular to a line from a point on the line and from a point not on the line
- Duplicating a given angle
- Constructing the parallel to a line through a point not on the line
- Constructing the circumcircle of a triangle
- Dividing a line segment into $n$ equal parts
- Constructing the tangent to a circle from a point on the circle
- Constructing the tangents to a circle from a point not on the circle
- Locating the center of a given circle
- Constructing a regular $n$-gon on a given circle for $n = 3, 4, 5, 6$

Use of technology. The availability of good computer software makes the accurate drawing of geometric figures far easier. Such software can enhance the experience of creating the constructions described previously. In addition, the ease of making accurate drawings encourages the formulation and exploration of geometric conjectures. If students do have access to such software, the potential for a more intense mathematical encounter is certainly there.
COURSE SYLLABUS

The following are recurring standards in each unit of the course:

**Geometry 1.0** Students demonstrate understanding by identifying and giving examples of undefined terms, axioms, theorems, and inductive and deductive reasoning.

**Geometry 2.0** Students write geometric proofs, including proofs by contradiction.

**Geometry 3.0** Students construct and judge the validity of a logical argument and give counterexamples to disprove a statement.

**Geometry 16.0** Students perform basic constructions with a straightedge and compass, such as angle bisectors, perpendicular bisectors, and the line parallel to a given line through a point off the line.

**Geometry 17.0** Students prove theorems by using coordinate geometry, including the midpoint of a line segment, the distance formula, and various forms of equations of lines and circles.

**Unit 1**

**Recommended Focus Standards**

**Geometry 1.0** Students demonstrate understanding by identifying and giving examples of undefined terms, axioms, theorems, and inductive and deductive reasoning.

**Geometry 2.0** Students write geometric proofs, including proofs by contradiction.

**Geometry 3.0** Students construct and judge the validity of a logical argument and give counterexamples to disprove a statement.

**Geometry 7.0** Students prove and use theorems involving the properties of parallel lines cut by a transversal, the properties of quadrilaterals, and the properties of circles.

**Geometry 12.0** Students find and use measures of sides and of interior and exterior angles of triangles and polygons to classify figures and solve problems.

**Scope and Sequence**
This introductory unit helps students develop geometric sense by working through the foundations of geometric reasoning and developing geometric ideas connected to the study of polygons, angles and parallel lines. Students are provided with opportunities to perform constructions relating to these topics such as constructing the line parallel to a given line through a point off the line. Students are given opportunities to use reasoning (inductive and deductive), write proofs and disprove statements using logical arguments.

**Unit 2**

**Recommended Focus Standards:**

**Geometry 4.0** Students prove basic theorems involving congruence and similarity.

**Geometry 7.0** Students prove and use theorems involving the properties of parallel lines cut by a transversal, the properties of quadrilaterals, and the properties of circles.

**Geometry 14.0** Students prove the Pythagorean theorem.
**Scope and Sequence**
The unit begins with the concepts of triangle congruence and similarity. Students then progress to study the properties of quadrilaterals. The unit concludes with the study of the Pythagorean Theorem, specifically its proof. Relevant constructions can be included throughout the unit, such as constructing the circumcircle of a triangle, and students should be given every opportunity to develop logical reasoning skills and mathematical proofs as they apply to each new topic of study. For example, using proof by contradiction to prove conjectures based on the triangle inequality theorem and using coordinate geometry to prove conjectures about triangle congruence or quadrilaterals.

**Unit 3**

**Recommended Focus Standards:**

**Geometry 8.0** Students know, derive, and solve problems involving the perimeter, circumference, area, volume, lateral area, and surface area of common geometric figures.

**Geometry 9.0** Students compute the volumes and surface areas of prisms, pyramids, cylinders, cones, and spheres; and students commit to memory the formulas for prisms, pyramids, and cylinders.

**Geometry 10.0** Students compute areas of polygons, including rectangles, scalene triangles, equilateral triangles, rhombi, parallelograms, and trapezoids.

**Geometry 18.0** Students know the definitions of the basic trigonometric functions defined by the angles of a right triangle. They also know and are able to use elementary relationships between them. For example, \( \tan(x) = \frac{\sin(x)}{\cos(x)} \), and \( \sin^2(x) + \cos^2(x) = 1 \).

**Geometry 19.0** Students use trigonometric functions to solve for an unknown length of a side of a right triangle, given an angle and a length of a side.

**Scope and Sequence**
Students study special right triangles and trigonometric ratios. They then progress to a study of area, volume and surface area and investigate how changes in dimension affect perimeter, area and volume. Relevant constructions can be included throughout the unit. Students should be given every opportunity to develop logical reasoning skills and mathematical proofs as they apply to each new topic of study.

**Unit 4**

**Recommended Focus Standards**

**Geometry 7.0** Students prove and use theorems involving the properties of parallel lines cut by a transversal, the properties of quadrilaterals, and the properties of circles.

**Geometry 21.0** Students prove and solve problems regarding relationships among chords, secants, tangents, inscribed angles, and inscribed and circumscribed polygons of circles.

**Geometry 22.0** Students know the effect of rigid motions on figures in the coordinate plane and space, including rotations, translations, and reflections.

**Scope and Sequence**
Students study the properties of circles and their relationships with lines and polygons. Students also study Transformations, i.e., Rigid motion in the coordinate plane. Relevant constructions can be included throughout the unit; for example, constructing the tangent to a circle from a point not on the circle, and students should be given every opportunity to develop logical reasoning skills and mathematical proofs as they apply to each new topic of study.
REPRESENTATIVE PERFORMANCE OUTCOMES AND SKILLS
In this course, students will know and be able to:

- Identify and give examples of undefined terms, axioms, theorems, inductive and deductive reasoning
- Construct and judge the validity of a logical argument and give counterexamples to disprove a statement
- Write geometric proofs, including proofs by contradiction
- Prove basic theorems involving congruence and similarity
- Prove and use theorems involving the properties of parallel lines cut by a transversal, the properties of quadrilaterals and the properties of circles
- Find and use measures of sides and of interior and exterior angles of triangles and polygons to classify figures and solve problems
- Prove and solve problems regarding relationships among chords, secants, tangents, inscribed angles and inscribed and circumscribed polygons of circles
- Prove the Pythagorean Theorem
- Derive and solve problems involving perimeter, circumference, area, volume, lateral area and surface area of common geometric figures
- Computer areas of polygons
- Know the definitions of the basic trigonometric functions defined by the angles of a right triangle, and the elementary relationships between them
- Use trigonometric functions to solve for an unknown length of a side of a right triangle, given an angle and a length of a side
- Prove theorems involving coordinate geometry
- Know the effect of rigid motions on figures in the coordinate plane and space

ASSESSMENTS will include:

- Teacher designed standards-based quizzes and tests
- Projects and group tasks
- Teacher designed formative assessments
- Periodic Assessments

TEXTS/MATERIALS

- LAUSD Secondary Mathematics Instructional Guide
- Textbook: District approved materials
- Supplemental materials and resources
Developing Geometric Sense

Transitions from previous grades:  Coordinate Plane.  Equations of lines parallel and perpendicular to each other and a given line.  Supplementary, complementary, vertical, and adjacent angles.  Number patterns and inductive reasoning.  Disproving statements using counter examples.  Midpoints, angle bisectors, and the bisector of a segment.  Construction of the perpendicular bisector of a line segment  Use of the Pythagorean theorem

- Understand the foundations of Geometry
  1.0, 16.0, 17.0

- Understand parallel lines cut by transversals
  7.0, 16.0, 17.0

- Understand polygons and angles
  12.0, 13.0, 16.0

Logic, Reasoning and Proof: Standards 1.0, 2.0, 3.0
Using axioms, theorems, definitions and examples
Using inductive and deductive reasoning
Proof by contradiction
Constructing geometric proofs, logical arguments and counterexamples

- Understand and use basic geometric definitions
- Perform basic constructions
- Solve problems in the coordinate plane using the Distance and Midpoint formulas

- Construct the parallel to a line through a point not on the line
- Prove and use properties of parallel lines cut by a transversal
- Construct the perpendicular to a line from a point on the line and from a point not on the line
- Use slope to identify parallel and perpendicular lines in the coordinate plane

- Construct the bisector of an angle
- Construct an angle congruent to a given angle
- Solve problems using angle and side measures for triangles and polygons
- Prove relationships between angles in polygons
Amazing Amanda

Amanda claims to have an amazing talent.

“Draw any polygon. Don’t show it to me. Just tell me the number of sides it has and I can tell you the sum of its interior angles!”

Is Amanda’s claim legitimate? Does she really have an amazing gift? Or is it possible for anyone to do the same thing? In this lesson, you will investigate what predictions are possible.

Getting Started: Triangles

1) Is the sum of the interior angles of a triangle the same for every triangle, or is the sum different for different types of triangles (e.g., equilateral, isosceles, scalene?)

2) Complete the table:

<table>
<thead>
<tr>
<th>Polygon name</th>
<th># of sides</th>
<th>Sketch</th>
<th>Sum of interior angles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triangle</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Next Step: Investigating Polygons

In your groups investigate the sum of the interior angles of polygons with 4, 5, 6 and 7 sides:

- Divide the workload among group members. Each group member should find the sum of the interior angles of one of the new polygons.
- Use a straight-edge to draw your polygons. (Hint: Subdivide each polygon into non-overlapping triangles so you can use what you know about the sum of the angle measures of triangles to compute the sum of the interior angles of your polygon.)

Record your individual result in the table below:

<table>
<thead>
<tr>
<th>Polygon name</th>
<th># of sides</th>
<th>Sketch of polygon</th>
<th># of triangles inside</th>
<th>Sum of interior angles</th>
</tr>
</thead>
</table>

Now as a group, combine your results on the “group recording sheet” and answer questions 3, 4 and 5 and 6.
<table>
<thead>
<tr>
<th>Polygon name</th>
<th>Sketch of polygon</th>
<th># of sides</th>
<th># of triangles inside</th>
<th>Sum of interior angles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triangle</td>
<td></td>
<td>3</td>
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<td>7</td>
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</tr>
</tbody>
</table>

ADAPTED FROM THE PRISMA PROJECT. IFL & LAUSD © 2008
Questions:

3) What patterns do you notice in the table? Use complete sentences in your answer.

4) Is there a relationship between the number of sides of the polygon and the number of triangles inside the polygon? Explain using a complete sentence.

5) Is there a relationship between the number of sides of the polygon and the sum of the interior angles? Explain using a complete sentence.

6) If so, write an algebraic formula to describe this relationship.

\[ \text{Sum of the interior angles of a polygon with } n \text{ sides} = \]
Extension Questions: (Answer in full sentences and explain your reasoning for each question)

7) How many sides does a polygon have if the sum of its interior angles is 1980°?

8) Is it possible for the sum of the interior angles of a polygon to be 3000°? If so, how many sides would the polygon have?

9) What is the sum of the interior angles of a polygon with 100 sides?
# Geometry: Textbook Connections

*Prentice Hall Mathematics California Geometry*

## UNIT 1

<table>
<thead>
<tr>
<th>Topic</th>
<th>Standards</th>
<th>Book Sections</th>
</tr>
</thead>
</table>
| **Foundations of Geometry**  | **1.0 Students demonstrate understanding by identifying and giving examples of undefined terms, axioms and theorems, and inductive and deductive reasoning.** **16.0 Students perform basic constructions with a straightedge and compass, such as angle bisectors, perpendicular bisectors, and the line parallel to a given line through a point off the line.** **17.0 Students prove theorems by using coordinate geometry, including the midpoint of a line segment, the distance formula, and various forms of equations of lines and circles.** | **1.3 Points Lines and Planes**  
**1.4 Segments, Rays, Parallel Lines and Planes**  
**1.5 Measuring Segments**  
**1.6 Measuring Angles**  
**1.7 Basic Constructions**  
**1.8 The Coordinate Plane**  
**1.9 Perimeter, Circumference, and Area** |
| **Logic, Reasoning and Proof** | **1.0 Students demonstrate understanding by identifying and giving examples of undefined terms, axioms and theorems, and inductive and deductive reasoning.** **2.0 Students write geometric proofs, including proofs by contradiction.** **3.0 Students construct and judge the validity of a logical argument and give counterexamples to disprove a statement.**                                                                                                                                 | **1.1 Patterns and Inductive Reasoning**  
**2.1 Conditional Statements**  
**2.2 Bi-conditionals and Definitions**  
**2.3 Deductive Reasoning**  
**2.4 Reasoning in Algebra**  
**2.5 Proving Angles Congruent** |
| **Parallel Lines cut by a Transversal** | **7.0 Students prove and use theorems involving the properties of parallel lines cut by a transversal, the properties of quadrilaterals, and the properties of circles.** **16.0 Students perform basic constructions with a straightedge and compass, such as angle bisectors, perpendicular bisectors, and the line parallel to a given line through a point off the line.** **17.0 Students prove theorems by using coordinate geometry, including the midpoint of a line segment, the distance formula, and various forms of equations of lines and circles.** | **3.1 Properties of Parallel lines**  
**3.2 Proving Lines Parallel**  
**3.3 Parallel and Perpendicular Lines**  
**3.6 Lines in the Coordinate Plane**  
**3.7 Slopes of parallel and Perpendicular Lines**  
**3.8 Constructing Parallel and Perpendicular Lines** |
| **Polygons and Angles**       | **12.0 Students find and use measures of sides and of interior and exterior angles of triangles and polygons to classify figures and solve problems.** **13.0 Students prove relationships between angles in polygons by using properties of complementary, supplementary, vertical, and exterior angles.** **16.0 Students perform basic constructions with a straightedge and compass, such as angle bisectors, perpendicular bisectors, and the line parallel to a given line through a point off the line.** | **3.4 Parallel lines and the Triangle Sum Theorem**  
**3.5 The Polygon Angle Sum Theorem** |
# Geometry: Textbook Connections

## Holt California Geometry

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**17.0** Students prove theorems by using coordinate geometry, including the midpoint of a line segment, the distance formula, and various forms of equations of lines and circles | **1.1** Points, lines and planes  
**1.2** Measuring and Constructing Segments  
**1.3** Measuring and Constructing Angles  
**1.5** Using Formulas in Geometry  
**1.6** Midpoints and Distance in the Coordinate Plane |
| **Logic, Reasoning and Proof** | **1.0** Students demonstrate understanding by identifying and giving examples of undefined terms, axioms and theorems, and inductive and deductive reasoning  
**2.0** Students write geometric proofs, including proofs by contradiction.  
**3.0** Students construct and judge the validity of a logical argument and give counterexamples to disprove a statement. | **2.1** Using inductive reasoning to make conjectures  
**2.2** Conditional Statements  
**2.3** Using Deductive Reasoning to Verify Conjectures  
**2.4** Bi-conditional Statements and Definitions  
**2.5** Algebraic Proof  
**2.6** Geometric Proofs  
**2.7** Flowchart and Paragraph Proofs |
| **Parallel Lines cut by a Transversal** | **7.0** Students prove and use theorems involving the properties of parallel lines cut by a transversal, the properties of quadrilaterals, and the properties of circles.  
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**3.2** Angles Formed by Parallel Lines and Transversals  
**3.3** Proving lines Parallel  
**3.4** Perpendicular Lines  
**3.5** Slopes of Lines  
**3.6** Lines in the Coordinate Plane |
| **Polygons and Angles**        | **12.0** Students find and use measures of sides and of interior and exterior angles of triangles and polygons to classify figures and solve problems.  
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**4.1** Classifying Triangles  
**4.2** Angle Relationships in Triangles  
**6.1** Properties and Attributes of Polygons |
# Geometry: Textbook Connections

## Glencoe Geometry Concepts and Applications (California Edition)

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<td>1.1 Patterns and Inductive Reasoning 1.2 Points Lines and Planes 1.3 Postulates 1.4 Conditional Statements and their Converse 1.5 Tools of the trade 1.6 A Plan for Problem Solving 2.1 Real Numbers and Number Lines 2.2 Segments and Properties of Real Numbers 2.3 Congruent Segments 2.4 The Coordinate Plane 2.5 Midpoints 6.7 Distance on the Coordinate Plane 3.1 Angles 3.2 Angle Measure 3.3 The Angle Addition Postulate 3.4 Adjacent Angles and Linear pairs of Angles 3.5 Complementary and Supplementary Angles 3.6 Congruent Angles 3.7 Perpendicular lines 4.1 Parallel Lines and Planes 4.2 Parallel Lines and Transversals 4.3 Transversals and Corresponding Angles 4.4 Proving Lines Parallel (Must Include Q24 on page 167 to cover the Parallel Postulate) 4.5 Slope</td>
</tr>
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|------------------------|--------------------------------------------------------------------------------------------------|
|                        | 4.6 Equations of Lines  
7.2 Exterior Angle Theorem  
10.1 Naming Polygons  
10.2 Diagonals and Angle Measure  
15.1 Logic and Truth Tables  
15.2 Deductive Reasoning  
15.3 Paragraph Proofs (Example 2 on p645 and Q3, 4 and 5 on page 646)  
15.4 Preparing for Two-Column Proofs  
CH 15 Investigation, Indirect Proofs (Investigate Parts a, b and c on page 666) |

(Note: The construction of a line perpendicular to a given line through a point not on the line is not covered by this text)
1.0 Students demonstrate understanding by identifying and giving examples of undefined terms, axioms, theorems, and inductive and deductive reasoning.

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<table>
<thead>
<tr>
<th></th>
<th>Number of items on the CST</th>
<th>Number of Multiple Choice questions on the Assessment</th>
<th>Number of Constructed Response questions on the Assessment</th>
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<tbody>
<tr>
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</tr>
<tr>
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</tr>
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<td>3.0</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>7.0</td>
<td>5 2/3*</td>
<td>3</td>
<td></td>
</tr>
<tr>
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<td>5</td>
<td>5</td>
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</tr>
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<td>2</td>
<td>2</td>
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</tr>
<tr>
<td>16.0</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>17.0</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

*Fractional Values indicate rotated standards (e.g., 1/3 = rotated every three years)

Prepared by the LAUSD Secondary Mathematics Unit © 2008
Transitions from previous grades: Similarity and congruence of common geometric figures using the coordinate system Use of the Pythagorean Theorem and its converse to find the length of the missing side of a right triangle Ratios and proportions Roots and radicals Simple properties of common quadrilaterals and triangles Construction of congruent triangles

Understand triangle congruency and similarity
4.0, 5.0, 6.0, 16.0, 17.0

Understand the properties of quadrilaterals
7.0, 17.0

Understand the proof and use of the Pythagorean Theorem
14.0, 15.0

Standards 1.0, 2.0, 3.0
Using axioms, theorems, definitions and examples
Using inductive and deductive reasoning
Proof by contradiction
Constructing geometric proofs, logical arguments and counterexamples

- Prove congruence and similarity of triangles
- Coordinate proofs involving triangles
- Properties of segments of triangles
- Apply ratios and proportions to solving problems
- Use the triangle inequality theorem
- Construct the circumcircle of a triangle

- Prove and use properties of quadrilaterals (including proofs and problems using coordinates)
- Categorize quadrilaterals based on properties

- Prove the Pythagorean Theorem
- Use the Pythagorean Theorem to find missing sides and distance
Squaring Triangles

The picture on the right illustrates a famous mathematical relationship between the areas of the squares on the sides of a right triangle, the **Pythagorean Theorem**.

Although it is named after Pythagoras, a Greek mathematician who lived in the 6th century B.C., there is evidence that other ancient cultures, including the Chinese, Egyptians, Babylonians, and African societies, also knew about and used this relationship.

There are more than 300 different proofs of this theorem. In this lesson, you will reconstruct one of the best known proofs.

**Group Activity:**

**Getting Started:** the Pythagorean Theorem

- Individually, write down everything you know about the Pythagorean Theorem.
- Create a combined group list.
- Select one person to be the recorder.
- Group members take turns telling one thing they wrote down and how they know it is true.
- The recorder writes down only the statements that all the group members agree are true.
- Continue until all group members’ ideas have been discussed.

Record what you know about the Pythagorean Theorem in this box:
Investigation 1: Proving the Pythagorean Theorem

Consider the right triangle with legs $a$ and $b$, and hypotenuse $c$ in figure 1. You may assume that all of the triangles in figures 1, 2 and 3 are congruent.

![figure 1](image1)

![figure 2](image2)

![figure 3](image3)

It is your job to explain how these figures can be used to construct a geometric proof of the Pythagorean Theorem. Work in pairs to answer the questions below.

1) Look closely at figure 2:
   - What type of shape is shape $L$?
     - Explain why you know this is true.
     - What is the area of $L$?
   - What type of shape is shape $M$?
     - Explain why you know this is true.
     - What is the area of $M$?

2) Look closely at figure 3:
   - What type of shape is shape $N$?
     - Explain why you know this is true.
     - What is the area of $N$?

3) i. How many triangles are in figure 2?
   ii. How many triangles are in figure 3?

4) Compare your results for parts 1, 2 and 3. What conclusions can you make?
Group Activity

Writing a Proof: The Pythagorean Theorem

Compare your answers to questions 1 through 4 with everybody in your group. Together, use the information you’ve gathered to explain why the Pythagorean Theorem is true. (Note: you do not need to use a 2-column proof)
Extension Activity: Homework

Using the Pythagorean Theorem

You know from your prior work that it is not possible to represent irrational numbers precisely as either terminating or repeating decimals.

Surprisingly, however, it is possible to construct line segments that have lengths that are irrational numbers.

1. Find the lengths of segments a through k and write them on the diagram.

![Diagram with labeled segments a to k]

2. What pattern do you notice in the lengths of the hypotenuses of the right triangles?

   • What is the length of the hypotenuse of the 20th triangle?
   • The 100th triangle?
   • The nth triangle?

3. How could you use this method to locate \( \sqrt{2} \) on a number line?

   • \( \sqrt{3} \)?
   • \( \sqrt{5} \)?
   • The square root of any number that is not a perfect square?
Part 1

Geometry: The Bermuda Triangle

Concept Task: Coordinate Geometry

The Bermuda Triangle is a region of the northwestern Atlantic Ocean in which a number of aircraft and ships have disappeared. Some people have claimed that these disappearances are due to the paranormal, a suspension of the laws of physics, or activity by extraterrestrial beings. However, most official agencies state that this area is just as safe as any other. The triangle stretches from Miami (80° W, 24° N) to Bermuda (64° W, 32° N) and Puerto Rico (66° W, 18° N).

Jamal is going with his family on a ship from Miami to Bermuda, while at the same time Carla is traveling with her family from Miami to Puerto Rico. Jamal and Carla talk on their cell phones after two days and find that they are both halfway to their destinations.

a) With your group, use the grid provided to draw a map of the Bermuda Triangle, clearly labeling Miami, Bermuda and Puerto Rico and their coordinates.

b) What are the coordinates of each ship when Jamal talks to Carla? Explain how you found your answer.

Coordinates of Jamal’s Ship: (          ,          )   Coordinates of Carla’s ship: (        ,        )

Explanation:

c) How far has each ship traveled? Explain how you found your answer.

Distance Jamal’s Ship has traveled: __________  Distance Carla’s ship has traveled: __________

Explanation:

d) The distance you calculated above is measured in “degrees”. If each degree is equal to 60 miles, how many miles has Carla’s ship traveled?

e) How far apart are the two ships when Jamal talks to Carla?

f) How far apart will the two ships be at the end of their journeys?

g) What do you notice about your answers to part e) and f)? Provide an explanation.

Explanation:

CA Standard Geometry 17.0 Students prove theorems by using coordinate geometry, including the midpoint of a line segment, the distance formula, and various forms of equations of lines and circles.

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Part 2

Geometry: The Bermuda Triangle

Concept Task: Coordinate Geometry

At the same time that Jamal talks to Carla, an Unidentified Flying Object is spotted hovering just above the sea at a point exactly halfway between Bermuda and Puerto Rico.

a) What are the coordinates of the UFO? Coordinates: ( , , )

On your group’s graph, label Jamal’s ship (when he talks to Carla) as point A, Carla’s ship (when she talks to Jamal) as point B, Puerto Rico as point C, and the UFO as point D.

b) What is the shape defined by the points ABCD?

Shape ABCD:

c) Using coordinates, algebraically prove your conjecture from part b).

Algebraic proof of part (b):

d) Provide a geometric justification for part b)

Geometric justification:

CA Standard Geometry 17.0 Students prove theorems by using coordinate geometry, including the midpoint of a line segment, the distance formula, and various forms of equations of lines and circles.

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Geometry: The Bermuda Triangle

Concept Task: Coordinate Geometry
# Geometry: Textbook Connections

*Prentice Hall Mathematics California Geometry*

## UNIT 2

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<thead>
<tr>
<th>Topic</th>
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<td><em>2.0 Students write geometric proofs, including proofs by contradiction.</em></td>
<td>4.1 Congruent Figures</td>
</tr>
<tr>
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<td><em>4.0 Students prove basic theorems involving congruence and similarity</em></td>
<td>4.2 Triangle Congruence by SSS and SAS</td>
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<tr>
<td></td>
<td><em>5.0 Students prove that triangles are congruent or similar, and they are able to use the concept of corresponding parts of congruent triangles.</em></td>
<td>4.3 Triangle Congruence by ASA and AAS</td>
</tr>
<tr>
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<td><em>6.0 Students know and are able to use the triangle inequality theorem.</em></td>
<td>4.4 Using CPCTC</td>
</tr>
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<td><em>16.0 Students perform basic constructions with a straightedge and compass, such as angle bisectors, perpendicular bisectors, and the line parallel to a given line through a point off the line.</em></td>
<td>4.5 Isosceles and Equilateral Triangles</td>
</tr>
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<td><em>17.0 Students prove theorems by using coordinate geometry, including the midpoint of a line segment, the distance formula, and various forms of equations of lines and circles</em></td>
<td>4.6 Congruence in Right Triangles</td>
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<td></td>
<td></td>
<td>4.7 Using CPCTC</td>
</tr>
<tr>
<td><strong>Properties of Quadrilaterals</strong></td>
<td><em>7.0 Students prove and use theorems involving the properties of parallel lines cut by a transversal, the properties of quadrilaterals, and the properties of a circle.</em></td>
<td>5.1 Midsegments of a Triangle</td>
</tr>
<tr>
<td></td>
<td><em>17.0 Students prove theorems by using coordinate geometry, including the midpoint of a line segment, the distance formula, and various forms of equations of lines and circles</em></td>
<td>5.2 Bisectors in Triangles</td>
</tr>
<tr>
<td><strong>Proof and Use of the Pythagorean theorem</strong></td>
<td><em>14.0 Students prove the Pythagorean Theorem</em></td>
<td>5.3 Concurrent Lines, Medians and Altitudes</td>
</tr>
<tr>
<td></td>
<td><em>15.0 Students use the Pythagorean Theorem to determine distance and find missing lengths of sides of right triangles.</em></td>
<td>5.4 Inverses, Contrapositives and Indirect Reasoning</td>
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<tr>
<td></td>
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<td>5.5 Inequalities in Triangles</td>
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<td>7.1 Ratios and Proportions</td>
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<td>7.2 Similar Polygons</td>
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<td>7.3 Proving Triangles Similar</td>
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<tr>
<td></td>
<td></td>
<td>7.4 Similarity in Right Triangles</td>
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<td></td>
<td></td>
<td>7.5 Proportions in Triangles</td>
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<tr>
<td></td>
<td></td>
<td><em>(Note: The construction of a circumcircle is not covered by this text)</em></td>
</tr>
<tr>
<td></td>
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<td>6.1 Classifying in Quadrilaterals</td>
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<td>6.2 Properties of Parallelograms</td>
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<td>6.3 Proving that a Quadrilateral is a parallelogram</td>
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<td>6.4 Special Parallelograms</td>
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<td>6.5 Trapezoids and Kites</td>
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<td>6.6 Placing Figures on the Coordinate Plane</td>
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<td></td>
<td>6.7 Proofs Using Coordinate Geometry</td>
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# Geometry: Textbook Connections

**Holt California Geometry**

**UNIT 2**

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<td>4.0 Students prove basic theorems involving congruence and similarity</td>
<td>4.4 Triangle Congruence: SSS and SAS</td>
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<td></td>
<td>5.0 Students prove that triangles are congruent or similar, and they are able to use the concept of corresponding parts of congruent triangles.</td>
<td>4.5 Triangle Congruence: ASA, AAS and HL</td>
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<td>6.0 Students know and are able to use the triangle inequality theorem.</td>
<td>4.6 Triangle Congruence: CPCTC</td>
</tr>
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<td></td>
<td>16.0 Students perform basic constructions with a straightedge and compass, such as angle bisectors, perpendicular bisectors, and the line parallel to a given line through a point off the line.</td>
<td>4.7 Introduction to Coordinate Proof</td>
</tr>
<tr>
<td></td>
<td>17.0 Students prove theorems by using coordinate geometry, including the midpoint of a line segment, the distance formula, and various forms of equations of lines and circles</td>
<td>4.8 Isosceles and Equilateral Triangles</td>
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<td><strong>Properties of Quadrilaterals</strong></td>
<td>7.0 Students prove and use theorems involving the properties of parallel lines cut by a transversal, the properties of quadrilaterals, and the properties of a circle.</td>
<td>5.1 Perpendicular and Angle Bisectors</td>
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<td>17.0 Students prove theorems by using coordinate geometry, including the midpoint of a line segment, the distance formula, and various forms of equations of lines and circles</td>
<td>5.2 Bisectors of Triangles</td>
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<tr>
<td><strong>Proof and Use of the Pythagorean theorem</strong></td>
<td>14.0 Students prove the Pythagorean Theorem</td>
<td>5.3 Medians and Altitudes of triangles</td>
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<tr>
<td></td>
<td>15.0 Students use the Pythagorean Theorem to determine distance and find missing lengths of sides of right triangles.</td>
<td>5.4 The Triangle Mid-segment Theorem</td>
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<td>5.5 Indirect Proof and Inequalities in One Triangle</td>
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<td>7.1 Ratio and Proportion</td>
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<td>7.2 Ratios in Similar Polygons</td>
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<td>7.3 Triangle Similarity: AA, SSS, SAS</td>
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<td>7.4 Applying Properties of Similar Triangles</td>
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<td>7.5 Using Proportional Relationships</td>
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<td>6.2 Properties of Parallelograms</td>
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<td>6.3 Conditions for Parallelograms</td>
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<td>6.4 Properties for Special Parallelograms</td>
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<td>6.5 Conditions for Special Parallelograms</td>
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<td>6.6 Properties of Kites and Trapezoids</td>
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<td><strong>LAB</strong> Hands on Proof of the Pythagorean Theorem</td>
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<tr>
<td></td>
<td></td>
<td>5.7 The Pythagorean Theorem</td>
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# Geometry: Textbook Connections

**Glencoe Geometry Concepts and Applications (California Edition)**

## UNIT 2

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<td>2.0 Students write geometric proofs, including proofs by contradiction. 4.0 Students prove basic theorems involving congruence and similarity 5.0 Students prove that triangles are congruent or similar, and they are able to use the concept of corresponding parts of congruent triangles. 6.0 Students know and are able to use the triangle inequality theorem. 16.0 Students perform basic constructions with a straightedge and compass, such as angle bisectors, perpendicular bisectors, and the line parallel to a given line through a point off the line. 17.0 Students prove theorems by using coordinate geometry, including the midpoint of a line segment, the distance formula, and various forms of equations of lines and circles</td>
<td>5.4 Congruent Triangles 5.5 SSS and SAS 5.6 ASA and AAS 6.1 Medians 6.2 Altitudes and Perpendicular bisectors 6.3 Angle Bisectors of Triangles 6.4 Isosceles Triangles 6.5 Right Triangles 7.1 Segments, Angles and Inequalities 7.3 Inequalities Within a Triangle 7.4 Triangle Inequality Theorem 9.1 Using Ratios and Proportions 9.2 Similar Polygons 9.3 Similar Triangles 9.4 Proportional Parts and Triangles 9.5 Triangles and Parallel Lines 9.6 Proportional Parts and Parallel Lines 15.3 Paragraph Proofs (Example 1 on page 645 and Q6, 7, 8, 9, 10, 11 on page 646 and 647) 15.4 Preparing for Two-Column Proofs (Q11 on page 653) 15.5 Two-Column Proofs (Exercises 1, 3, 4, 6, 7, 10 on page 656, 657 and 658) 15.6 Coordinate Proofs (Exercises 12, 13, 14, 17, 19 on page 664) CH 15 Investigation, Indirect Proofs (Investigate Part h and Q2 on page 667)</td>
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<td>Properties of Quadrilaterals</td>
<td>7.0 Students prove and use theorems involving the properties of parallel lines cut by a transversal, the properties of quadrilaterals, and the properties of a circle. 17.0 Students prove theorems by using coordinate geometry, including the midpoint of a line segment, the distance formula, and various forms of equations of lines and circles</td>
<td>8.1 Quadrilaterals 8.2 Parallelograms 8.3 Tests for Parallelograms 8.4 Rectangles, Rhombi and Squares 8.5 Trapezoids 15.3 Paragraphs Proofs (Q12 on page 647) 15.5 Two-Column Proofs (Example 2 on page 656, Q4, 8 on page 657, Q13, 15, 16 on page 658) 15.6 Coordinate Proofs (Q6, 7, 8, 9 page 663, Q10, 11 15, 16, 18, 21, 22 page 664)</td>
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<td>Proof and Use of the Pythagorean theorem</td>
<td>14.0 Students prove the Pythagorean Theorem 15.0 Students use the Pythagorean Theorem to determine distance and find missing lengths of sides of right triangles.</td>
<td>6.6 The Pythagorean theorem (Note: The Proof of the Pythagorean Theorem – CA Standard 14.0 – is not covered by this text)</td>
</tr>
<tr>
<td>Standard</td>
<td>Description</td>
<td>CST</td>
</tr>
<tr>
<td>----------</td>
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<tr>
<td>1.0</td>
<td>Students demonstrate understanding by identifying and giving examples of undefined terms, axioms, theorems, and inductive and deductive reasoning.</td>
<td>2</td>
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<tr>
<td>2.0</td>
<td>Students write geometric proofs, including proofs by contradiction.</td>
<td>3</td>
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<tr>
<td>3.0</td>
<td>Students construct and judge the validity of a logical argument and give counterexamples to disprove a statement.</td>
<td>4</td>
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<tr>
<td>4.0</td>
<td>Students prove basic theorems involving congruence and similarity.</td>
<td>5</td>
</tr>
<tr>
<td>5.0</td>
<td>Students prove that triangles are congruent or similar, and they are able to use the concept of corresponding parts of congruent triangles.</td>
<td>2</td>
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<tr>
<td>6.0</td>
<td>Students know and are able to use the triangle inequality theorem.</td>
<td>1</td>
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<tr>
<td>7.0</td>
<td>Students prove and use theorems involving the properties of parallel lines cut by a transversal, the properties of quadrilaterals, and the properties of circles.</td>
<td>5 2/3*</td>
</tr>
<tr>
<td>14.0</td>
<td>Students prove the Pythagorean theorem.</td>
<td>1/3*</td>
</tr>
<tr>
<td>15.0</td>
<td>Students use the Pythagorean theorem to determine distance and find missing lengths of sides of right triangles.</td>
<td>2</td>
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<td>16.0</td>
<td>Students perform basic constructions with a straightedge and compass, such as angle bisectors, perpendicular bisectors, and the line parallel to a given line through a point off the line.</td>
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</tr>
<tr>
<td>17.0</td>
<td>Students prove theorems by using coordinate geometry, including the midpoint of a line segment, the distance formula, and various forms of equations of lines and circles.</td>
<td>3</td>
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*Fractional Values indicate rotated standards (e.g., 1/3 = rotated every three years) Prepared by the LAUSD Secondary Mathematics Unit © 2008
Trigonometry, Area and Volume

- **Transitions from previous grades:**
  - Area and volume of common geometric figures
  - Use of coordinate graphs to plot simple figures, determine related lengths and areas, and determine their image under translations and reflections
  - Ratios and proportions
  - Area of common geometric figures using the coordinate system
  - Circumference, radius, diameter, and pi

**Standards 1.0, 2.0, 3.0**
- Using axioms, theorems, definitions and examples
- Using inductive and deductive reasoning
- Proof by contradiction
- Constructing geometric proofs, logical arguments and counterexamples

**Understand the properties of right triangles and trigonometry**
- 16.0, 17.0, 18.0, 19.0, 20.0

**Understand, derive and apply area formulas**
- 8.0, 10.0, 11.0, 17.0

**Understand volume and surface area**
- 9.0, 11.0

- Use special right triangle properties. (45°, 45°, 90° and 30°, 60°, 90°)
- Know and use trigonometric ratios to solve problems involving right triangles (including right triangles on the coordinate plane)
- Compute area of triangles and quadrilaterals (including figures on the coordinate plane)
- Solve problems involving perimeter and area
- Derive and solve problems involving circumference and area
- Investigate how dimension changes affect perimeter and area
- Solve problems involving surface area
- Solve problems involving volume
- Investigate how dimension changes affect volume and surface area
Part A: You and your team are designing a new chocolate bar.

The wrapper for the chocolate bar, not including the ends, is a rectangle measuring 24cm by 12cm like the one in the diagram.

You need to decide between the following three designs:

- A cylinder
- A square prism
- A triangular prism with an equilateral triangle for a base

Question 1: Which design uses the least amount of chocolate? Provide a full mathematical explanation of your answer.

Note: You can assume that whatever shape you choose will be completely full of chocolate.

Question 2: Based on your work in Part A, what conclusions can you draw?
Provide a full mathematical explanation for each question listed below:

Part B: SUPER-SIZE me!

Your chocolate company also sells a chocolate bar called “Viva” that is 10cm long, 5cm wide and 2cm thick.

You have decided to make a super-size version of this bar. The Supersize bar will be twice as long, twice as wide, and twice as thick as the viva chocolate bar.

**Question 3:** How many viva chocolate bars contain the same amount of chocolate as one super-size bar?

**Question 4:** How many viva chocolate bar wrappers cover the same area as the wrapper of one super-size bar?

Now imagine that a new super-super-size bar is going to be three times as long, three times as wide and three times as thick.

**Question 5:** How many Viva chocolate bars contain the same amount of chocolate as one new super-super-size bar?

**Question 6:** How many viva chocolate bar wrappers cover the same area as the wrapper of one super-super-size bar?

**Question 7:** Based on your work on questions 3, 4, 5, and 6 what conclusions can you draw?

**Extension:** Using your conclusion from question 7, and without making any volume calculations, predict how many micro-bars (half the length, half the width, and half the height) could be made from one Viva chocolate bar.
# Geometry: Textbook Connections

## Prentice Hall Mathematics California Geometry

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<td>16.0 Students perform basic constructions with a straightedge and compass, such as angle bisectors, perpendicular bisectors, and the line parallel to a given line through a point off the line. 17.0 Students prove theorems by using coordinate geometry, including the midpoint of a line segment, the distance formula, and various forms of equations of lines and circles 18.0 Students know the definitions of the basic trigonometric functions defined by the angles of the right triangle. They also know and are able to use elementary relationships between them. For example, tan(x)=sin(x)/cos(x), and sin² x+cos² x = 1 19.0 Students use Trigonometric functions to solve for an unknown length of a side of a right triangle, given an angle and a length of a side. 20.0 Students know and are able to use angle and side relationships in problems with special right triangles, such as 30°, 60°, and 90° triangles and 45°, 45°, and 90° triangles.</td>
<td>8.2 Special Right Triangles 8.3 The Tangent Ratio 8.4 Sine and Cosine Ratio 8.5 Angles of Elevation and Depression</td>
</tr>
<tr>
<td>Derive and Apply Area Formulas</td>
<td>8.0 Students know, derive, and solve problems involving the perimeter, circumference, area, volume, lateral area, and surface area of common geometric figures. 10.0 Students compute areas of polygons, including rectangles, scalene triangles, equilateral triangle, rhombi, parallelograms, and trapezoids. 11.0 Students determine how changes in dimensions affect the perimeter, area, and volume of common geometric figures and solids.</td>
<td>10.1 Area of Parallelograms and Triangles 10.2 Area of Trapezoids, Rhombi and Kites 10.3 Area of Regular Polygons 10.4 Perimeters and Areas of Similar Figures 10.5 Trigonometry and Area 10.6 Circles and Arcs 10.7 Areas of Circles and Sectors</td>
</tr>
<tr>
<td>Volume and Surface Area</td>
<td>9.0 Students compute the volumes and surface areas of prisms, pyramids, cylinders, cones, and spheres; and students to memory the formulas for prisms, pyramids and cylinders. 11.0 Students determine how changes in dimensions affect the perimeter, area, and volume of common geometric figures and solids.</td>
<td>11.1 Space Figures and cross Sections 11.2 Surface Area of Prisms and Cylinders 11.3 Surface Area of Pyramids and Cones 11.4 Volume of Prisms and Cylinders 11.5 Volume of Pyramids and Cones 11.6 Surface Area of Volumes and Spheres 11.7 Areas and Volumes of Similar Solids</td>
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## Geometry: Textbook Connections

**Holt California Geometry**

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17.0 Students prove theorems by using coordinate geometry, including the midpoint of a line segment, the distance formula, and various forms of equations of lines and circles  
18.0 Students know the definitions of the basic trigonometric functions defined by the angles of the right triangle. They also know and are able to use elementary relationships between them. For example, \( \tan(x) = \frac{\sin(x)}{\cos(x)} \), and \( \sin^2 x + \cos^2 x = 1 \)  
19.0 Students use Trigonometric functions to solve for an unknown length of a side of a right triangle, given an angle and a length of a side.  
20.0 Students know and are able to use angle and side relationships in problems with special right triangles, such as 30°, 60°, and 90° triangles and 45°, 45°, and 90° triangles. | 5.8 Applying Special Right Triangles  
8.1 Explore Trigonometric Ratios  
8.2 Trigonometric Ratios  
8.3 Solving Right Triangles  
8.4 Angles of Elevation and Depression |
| **Derive and Apply Area Formulas** | 8.0 Students know, derive, and solve problems involving the perimeter, circumference, area, volume, lateral area, and surface area of common geometric figures.  
10.0 Students compute areas of polygons, including rectangles, scalene triangles, equilateral triangle, rhombi, parallelograms, and trapezoids.  
11.0 Students determine how changes in dimensions affect the perimeter, area, and volume of common geometric figures and solids. | 9.1 Developing Formulas for Triangles and Quadrilaterals  
9.2 Developing Formulas for Circles and Regular Polygons  
9.3 Composite Figures  
9.4 Perimeter and Area in the Coordinate Plane  
9.5 Effects of Changing Dimensions Proportionally |
| **Volume and Surface Area** | 9.0 Students compute the volumes and surface areas of prisms, pyramids, cylinders, cones, and spheres; and students to memory the formulas for prisms, pyramids and cylinders.  
11.0 Students determine how changes in dimensions affect the perimeter, area, and volume of common geometric figures and solids. | 10.1 Solid Geometry  
10.2 Representations of Three –Dimensional Figures  
10.3 Formulas in Three Dimensions  
10.4 Surface Area of Prisms and Cylinders  
10.5 Surface Area of Pyramids and Cones  
10.6 Volume of Prisms and Cylinders  
10.7 Volume of Pyramids and Cones  
10.8 Spheres |
## Geometry: Textbook Connections

**Glencoe Geometry Concepts and Applications (California Edition)**

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17.0 Students prove theorems by using coordinate geometry, including the midpoint of a line segment, the distance formula, and various forms of equations of lines and circles  
18.0 Students know the definitions of the basic trigonometric functions defined by the angles of the right triangle. They also know and are able to use elementary relationships between them. For example, $\tan(x) = \sin(x)/\cos(x)$, and $\sin^2 x + \cos^2 x = 1$  
19.0 Students use Trigonometric functions to solve for an unknown length of a side of a right triangle, given an angle and a length of a side.  
20.0 Students know and are able to use angle and side relationships in problems with special right triangles, such as 30°, 60°, and 90° triangles and 45°, 45°, and 90° triangles. | 13.1 Simplifying Square Roots  
13.2 45-45-90 Triangles  
13.3 30-60-90 Triangles  
13.4 Tangent Ratio  
13.5 Sine and Cosine Ratios  
15.6 Coordinate Proofs (Q13,17, 20 on page 664) |
| **Derive and Apply Area Formulas** | 8.0 Students know, derive, and solve problems involving the perimeter, circumference, area, volume, lateral area, and surface area of common geometric figures.  
10.0 Students compute areas of polygons, including rectangles, scalene triangles, equilateral triangle, rhombi, parallelograms, and trapezoids.  
11.0 Students determine how changes in dimensions affect the perimeter, area, and volume of common geometric figures and solids. | 9.7 Perimeters and Similarity  
10.3 Areas of Polygons  
10.4 Area of Triangles and trapezoids  
10.5 Areas of Regular Polygons  
CH 10 Investigation: How About That Pythagoras!  
11.1 Parts of a Circle  
11.5 Circumference of a Circle  
11.6 Area of a Circle |
| **Volume and Surface Area** | 9.0 Students compute the volumes and surface areas of prisms, pyramids, cylinders, cones, and spheres; and students to memory the formulas for prisms, pyramids and cylinders.  
11.0 Students determine how changes in dimensions affect the perimeter, area, and volume of common geometric figures and solids. | 12.1 Solid Figures  
12.2 Surface Area of Prisms and Cylinders  
12.3 Volume of Prisms and Cylinders  
12.4 Surface Area of Pyramids and Cones  
12.5 Volume of Pyramids and Cones  
12.6 Spheres  
12.7 Similarity of Solid Figures |
### Geometry: Assessment 3 Blueprint

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>Number of items on the CST</th>
<th>Number of Multiple Choice questions on the Assessment</th>
<th>Number of Constructed Response questions on the Assessment</th>
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<tbody>
<tr>
<td>1.0</td>
<td>Students demonstrate understanding by identifying and giving examples of undefined terms, axioms, theorems, and inductive and deductive reasoning.</td>
<td>2</td>
<td>Embedded</td>
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<tr>
<td>2.0</td>
<td>Students write geometric proofs, including proofs by contradiction.</td>
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<tr>
<td>3.0</td>
<td>Students construct and judge the validity of a logical argument and give counterexamples to disprove a statement.</td>
<td>4</td>
<td>1</td>
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<tr>
<td>8.0</td>
<td>Students know, derive, and solve problems involving the perimeter, circumference, area, volume, lateral area, and surface area of common geometric figures.</td>
<td>4</td>
<td>4</td>
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<tr>
<td>9.0</td>
<td>Students compute the volumes and surface areas of prisms, pyramids, cylinders, cones, and spheres; and students commit to memory the formulas for prisms, pyramids, and cylinders.</td>
<td>2</td>
<td>2</td>
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</tr>
<tr>
<td>10.0</td>
<td>Students compute areas of polygons, including rectangles, scalene triangles, equilateral triangles, rhombi, parallelograms, and trapezoids.</td>
<td>4</td>
<td>4</td>
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</tr>
<tr>
<td>11.0</td>
<td>Students determine how changes in dimensions affect the perimeter, area, and volume of common geometric figures and solids.</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>16.0</td>
<td>Students perform basic constructions with a straightedge and compass, such as angle bisectors, perpendicular bisectors, and the line parallel to a given line through a point off the line.</td>
<td>4</td>
<td>Embedded</td>
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</tr>
<tr>
<td>18.0</td>
<td>Students know the definitions of the basic trigonometric functions defined by the angles of a right triangle. They also know and are able to use elementary relationships between them. For example, $\tan x = \sin x / \cos x$, $\sin^2 x + \cos^2 x = 1$</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>19.0</td>
<td>Students use trigonometric functions to solve for an unknown length of a side of a right triangle, given an angle and a length of a side.</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>20.0</td>
<td>Students know and are able to use angle and side relationships in problems with special right triangles, such as 30°, 60°, and 90° triangles and 45°, 45°, and 90° triangles.</td>
<td>1</td>
<td>2</td>
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</tbody>
</table>

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Circles and Transformations

- **Transitions from previous grades:** Circumference, radius, diameter, and pi Coordinate system
  Use of coordinate graphs to plot simple figures, determine related lengths and areas, and determine their image under translations and reflections

**Standards 1.0, 2.0, 3.0**
Using axioms, theorems, definitions and examples
Using inductive and deductive reasoning
Proof by contradiction
Constructing geometric proofs, logical arguments and counterexamples

- Prove and solve problems about inscribed angles, chords, secants, tangents, inscribed and circumscribed polygons
- Construct the tangent to a circle from a point on the circle
- Construct the tangents to a circle from a point not on the circle
- Use construction to locate the center of a circle
- Solve problems using the equations and graphs of circles in the coordinate plane

- Rotate, translate, reflect, and stretch figures and objects

**C S T**
Understand the properties of circles
7.0, 16.0, 17.0, 21.0

Understand transformations
22.0
We first met Amanda in Unit 1 where she said “Draw any polygon. Don’t show it to me. Just tell me the number of sides it has and I can tell you the sum of its interior angles!” This time Amanda has another awesome talent!

“Given any two lines that intersect inside a circle, I can tell you the sum of the measures of the intercepted arcs, knowing only the angle between the lines”

Investigate Amanda’s claim, and find out how she’s able to make this prediction.

You will need: 1. Investigation Sheet and Angle Sheet (30°, 45°, 60° or 90°)

2. A paper cup (or Styrofoam cup)

3. A tape measure

4. A marker pen

5. A calculator

CA STANDARD: 21.0 Students prove and solve problems regarding relationships among chords, secants, tangents, inscribed angles, and inscribed and circumscribed polygons of circles.
Amanda has another awesome talent:

“Given any two lines that intersect inside a circle, I can tell you the sum of the measures of the intercepted arcs, knowing only the angle between the lines”

Using the circle above draw a diagram that represents Amanda’s new claim.
**Investigation Sheet**

**Instructions:**
1. Measure the circumference of your cup (in cm) with the tape measure.
2. Place your cup over the intersecting lines, making sure that point $E$ is inside or on the circle.
3. Using a marker pen or pencil, mark off both of the arcs intercepted by the angle.
4. Measure the lengths of the arcs (in cm) with the tape measure and record the measurement in the table.
5. Convert the arc length (in cm) into arc measure (in degrees) using the formula given below and calculate the sum of the arc measures.
6. Repeat the process 3 more times, each time placing the cup in a different position.
7. Once you have completed the table calculate the average value of the Arc Sum (column 5)

The circumference of the cup is __________ cm

<table>
<thead>
<tr>
<th>Arc 1 Length (cm)</th>
<th>Arc 2 Length (cm)</th>
<th>Arc 1 measure (degrees)</th>
<th>Arc 2 measure (degrees)</th>
<th>Sum of Arc measures (degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

**Formula:** \( \text{Arc Measure}^\circ = \frac{\text{Arc Length (cm)}}{\text{Circumference (cm)}} \times 360^\circ \)

**Average Arc Sum (Average of column 5) =**
After you and your partner have completed your investigation sheet, record your average value on the class chart. Examine the class data before answering the following questions.

1. With your partner discuss any patterns you notice on the class chart.

2. In your own words write a rule that summarizes your observations.

3. Re-write your rule from part 2 using the appropriate mathematical vocabulary.

4. Re-write your rule from part 3 as a formula using mathematical symbols.

CA STANDARD: 21.0 Students prove and solve problems regarding relationships among chords, secants, tangents, inscribed angles, and inscribed and circumscribed polygons of circles.
<table>
<thead>
<tr>
<th>Topic</th>
<th>Standards</th>
<th>Book Sections</th>
</tr>
</thead>
</table>
| **The Properties of Circles** | 7.0 Students prove and use theorems involving the properties of parallel lines cut by a transversal, the properties of quadrilaterals, and the properties of a circle. | 12.1 Tangent Lines  
12.2 Chords and Arcs  
12.3 Inscribed Angles  
12.4 Angle Measures and Segment Length  
12.5 Circles in the Coordinate Plane |
|                            | 16.0 Students perform basic constructions with a straightedge and compass, such as angle bisectors, perpendicular bisectors, and the line parallel to a given line through a point off the line. | (Note: The construction of a tangent to a circle from a given point is not covered by this text) |
|                            | 17.0 Students prove theorems by using coordinate geometry, including the midpoint of a line segment, the distance formula, and various forms of equations of lines and circles. |                                                                                  |
|                            | 21.0 Students prove and solve problems regarding relationships among chords, secants, tangents, inscribed angles, and inscribed and circumscribed polygons of circles. |                                                                                  |
| **Transformations**        | 22.0 Students know the effect of rigid motions on figures in the coordinate plane and space, including rotations, translation, and reflections. | 9.1 Translations  
9.2 Reflections  
9.3 Rotations  
9.4 Symmetry  
9.5 Dilations  
9.6 Composition of Reflections |
### Geometry: Textbook Connections

#### Holt California Geometry

**UNIT 4**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Standards</th>
<th>Book Sections</th>
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<tbody>
<tr>
<td><strong>The Properties of Circles</strong></td>
<td>7.0 Students prove and use theorems involving the properties of parallel lines cut by a transversal, the properties of quadrilaterals, and the properties of a circle. 16.0 Students perform basic constructions with a straightedge and compass, such as angle bisectors, perpendicular bisectors, and the line parallel to a given line through a point off the line. 17.0 Students prove theorems by using coordinate geometry, including the midpoint of a line segment, the distance formula, and various forms of equations of lines and circles. 21.0 Students prove and solve problems regarding relationships among chords, secants, tangents, inscribed angles, and inscribed and circumscribed polygons of circles.</td>
<td>11.1 Lines that Intersect Circles 11.2 Arcs and Chords 11.3 Sector Area and Arc Length 11.4 Inscribed Angles 11.5 Angle Relationships in Circles 11.6 Segment Relationships in Circles 11.7 Circles in the Coordinate Plane</td>
</tr>
<tr>
<td><strong>Transformations</strong></td>
<td>22.0 Students know the effect of rigid motions on figures in the coordinate plane and space, including rotations, translation, and reflections.</td>
<td>1.7 Transformations in the Coordinate Plane 12.1 Reflections 12.2 Translation 12.3 Rotations 12.4 Composition of Transformations 12.5 Symmetry 7.6 Dilations and Similarity in the Coordinate Plane 12.7 Dilations</td>
</tr>
<tr>
<td>Topic</td>
<td>Standards</td>
<td>Book Sections</td>
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<tr>
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<td>---------------------------------------------------------------------------</td>
<td>----------------------------------------------------</td>
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<tr>
<td>The Properties</td>
<td>7.0 Students prove and use theorems involving the properties of parallel</td>
<td>11.2 Arcs and Central Angles</td>
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<td>of Circles</td>
<td>lines cut by a transversal, the properties of quadrilaterals, and the</td>
<td>11.3 Arcs and Chords</td>
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<td>properties of a circle.</td>
<td>11.4 Inscribed polygons</td>
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<td>16.0 Students perform basic constructions with a straightedge and</td>
<td>14.1 Inscribed Angles</td>
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<td>compass, such as angle bisectors, perpendicular bisectors, and the line</td>
<td>14.2 Tangents to a Circle</td>
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<td>parallel to a given line through a point off the line.</td>
<td>14.3 Secant Angles</td>
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<td>17.0 Students prove theorems by using coordinate geometry, including</td>
<td>14.4 Secant-Tangent Angles</td>
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<td>the midpoint of a line segment, the distance formula, and various forms</td>
<td>14.5 Segment Measures</td>
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<td>of equations of lines and circles.</td>
<td>14.6 Equations of Circles</td>
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<td>21.0 Students prove and solve problems regarding relationships among</td>
<td>15.5 Two-Column Proofs (Q11, p658)</td>
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<tr>
<td></td>
<td>chords, secants, tangents, inscribed angles, and inscribed and</td>
<td></td>
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<td>circumscribed polygons of circles.</td>
<td>(Note: The construction of a tangent to a given</td>
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<td>circle, and using construction to find the center</td>
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<td></td>
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<td>of a circle are not covered by this text)</td>
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<td>22.0 Students know the effect of rigid motions on figures in the</td>
<td>16.3 Translations</td>
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<td>coordinate plane and space, including rotations, translation, and</td>
<td>16.4 Reflections</td>
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<td>16.5 Rotations</td>
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<td>16.6 Dilations</td>
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## Periodic Assessment Blueprint comparison to CST Blueprint

The table below shows the number of questions per standard on each of the LAUSD Geometry Periodic Assessments and compares this to the number of questions per standard listed on the CST blueprint. Rationales are listed below for each case (except standard 7.0) where there is a discrepancy between the figures.

<table>
<thead>
<tr>
<th>Standard</th>
<th>Periodic Assessment #1</th>
<th>Periodic Assessment #2</th>
<th>Periodic Assessment #3</th>
<th>Constructed Response</th>
<th>Periodic Assessment Total</th>
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</table>

**Note:** There is an extra question on standard 5.0 to fully cover all three aspects of the standard, triangle congruence, triangle similarity and the concept of corresponding parts of congruent triangles.

**Note:** Even though there are no multiple choice Periodic Assessment questions covering standard 14.0 (Proof of the Pythagorean Theorem), it is covered by the constructed response on PA 2.

***Note:** There is an extra question on standard 17.0 (Coordinate Geometry) to cover the foundational concepts of the midpoint/distance formula.

****Note:** There is an extra question on standard 20.0 (Special Right Triangles) in order to cover both cases 30-60-90 and 45-45-90

*****Note:** While the constructed response questions on assessments 2 and 3 nominally address standards that are lightly tested on the CST, they in actuality test a combination of standards but only one of these is listed for data collection purposes.