

SAN DIEGO CITY SCHOOLS

Instructional Module to Enhance the Teaching of

HARCOURT MATH

California Edition

GRADE 6

Module 10

Solid Figures

MODULE 10: UNIT 6: GEOMETRY AND SPACIAL REASONING

Chapter 19 – Solid Figures

KEY MATHEMATICAL CONCEPTS FOR GRADE SIX – BIG IDEAS:

By the end of grade six, students will:

- Master the four arithmetic operations with positive and negative whole numbers, positive fractions, and decimals. They accurately solve problems involving fractions, ratios, proportions, and percentages.
- Understand the concepts of mean, median and mode of data sets, and how to calculate the range. They analyze data and sampling processes for possible bias and misleading conclusions. They calculate the probabilities for compound events and understand the difference between independent and dependent events.
- Write verbal expressions and sentences as algebraic expressions and equations; they evaluate algebraic expressions, solve simple linear equations, and graph and interpret their results. They analyze and use tables, graphs, and rules to solve problems involving rates and proportions.
- **Deepen their understanding of the measurement of plane and solid shapes and use this understanding to solve problems.**



Key Mathematical Concepts for Module 10

- Identify, classify and compare quadrilaterals.
- Find a pattern and generalize a formula for the sum of angle measurement in polygons.
- Identify and classify solid figures.
 - Use nets of solid figures and solid figures constructed from the nets to gather data about similarities and differences between cones, cylinders, and polyhedrons (prisms and pyramids).
 - Analyze data to generalize classifications of solid figures.
- Draw and identify different views of solid figures from 3-dimensional and 2-dimensional representations.
- Use 2-dimensional views to build solid figures.
- Select and use appropriate problem solving strategies to solve problems involving solid figures.
- Use number of sides in the base to generalize number of edges and vertices for prisms and pyramids.
 - Represent generalizations in graphs, words, equations and tables.
 - Use the different representations of functions to explain and justify mathematical reasoning.

<u>Chapter 18: Plane Figures</u>	<u>Chapter 19: Solid Figures</u>
Lesson 18.2: Problem Solving Strategy: <i>Find a Pattern</i> Lesson 18.3: Quadrilaterals	Lesson 19.1: Types of Solid Figures Lesson 19.2: Different Views of Solid Figures Lesson 19.3: MATH LAB: Models of Solid Figures Lesson 19.4: Problem Solving Strategies

MODULE 10: UNIT 6: GEOMETRY AND SPACIAL REASONING
Chapter 18 - Plane Figures

DAY 1 - Lesson 18.2

LESSON FOCUS:	Problem Solving
CA STANDARD:	MR 1.3; MR 2.2; MR 3.3; (MG 1.0; MR 1.0; MR 1.1; MR 2.0; MR 3.2)
Purpose of Lesson: Math Background: TE p. 340A	At the end of the lesson students will be able to solve problems using the strategy <i>find a pattern</i> .
Warm-up/ Routine(s):	TE p. 340B; EARLY FINISHERS <i>Find A Pattern</i>
LAUNCH: <u>Books Closed</u> Copy the table on p. 340 onto board. This  Not this 	Sum of angle measurement in polygons (See Table p. 340 and examples of triangles inside the polygons.) <ul style="list-style-type: none"> • Sketch a quadrilateral on the board. Ask students how many triangles, with the three angles of each triangle located in the angles of the quadrilateral can be drawn inside of the quadrilateral. • "How does knowing the number of triangles inside of the quadrilateral help us to find the total number of degrees in the quadrilateral?" • Write 180° inside both triangles. Have the students sketch different quadrilaterals, not all parallelograms, and ones with no sides congruent. Have the students come up and draw in the triangles to show that all of the quadrilaterals, regardless of shape, can be divided into two triangles with their angles in the angles of the quadrilateral. • Students copy the chart from the board and record the number of triangles and sum of the angle measures for triangles and quadrilaterals only.
EXPLORE:	<ul style="list-style-type: none"> • Students gather data for the sum of angle measurements in other polygons. In addition to Pentagon and Hexagon, add Heptagon (7), Octagon (8), Nonagon (9), Decagon (10) and n-agon (any number of sides) with n as the number of sides for the generalizations in the table. • Students can predict the number of triangles for each polygon, but should verify with a sketch. The table group works together to test different sketches of the polygons; each student keeps an individual table. • Students use the table to find a pattern that can be used to find the sum of the angle measurement in a polygon with any number of sides. • Students write a rule in words for finding the sum of the angle measure for a polygon of any number of sides. They also represent the rule algebraically.
Practice:	<ul style="list-style-type: none"> • Discuss regular polygons (p. 340) • Add another column to the table: Regular Polygon: Measure of 1 angle • Use the formulas to complete the table.
SUMMARIZE/Closure	<ul style="list-style-type: none"> • Select students to write their rules in words and others to write the algebraic formula. <ul style="list-style-type: none"> • Class translates into words or into equivalent algebraic representation. (Use <i>Private Think Time</i> and partner talk to press all students to engage.) • Test the formulas for two or three of the polygons to verify that they work. • "How did you use the table to find a pattern?" • Use the formulas to complete the table for a regular polygon with 20 sides.
HOMEWORK:	p. 344 #1 or 2. Students should include explanation of reasoning and their <i>path to solution</i> .

MODULE 10: UNIT 6: GEOMETRY AND SPACIAL REASONING
Chapter 19 - Solid Figures

DAY 2 - Lesson 19.1 & 19.3 Modified

MATERIALS:	Scissors; tape; TR45 and TR47-55 (1 copy per group with the name of the figure cut from the bottom of each page)
LESSON FOCUS:	Types of Solid Figures
CA STANDARD:	MR 2.4
Purpose of Lesson: Math Background: TE p. 354A	At the end of the lesson students will be able to build and classify prisms and pyramids.
Warm-up/ Routine(s): <u>Book Closed</u> p. 342	QUICK REVIEW: p. 342: <i>Copy the figure on the board and ask students to determine the measure of the 5 angles, then explain their reasoning to a partner. After "Private Think Time", students may work with a partner.</i> Discuss reasoning,
LAUNCH: <u>Books Closed</u> Clarify that faces of the solid figure include the faces of the base(s). Lateral faces refer to all the faces that are not bases. TE p. 354B TR48	WRITING IN MATHEMATICS: TE p. 354B: Display web: <div style="text-align: center; margin: 10px 0;"> <pre> graph TD SF[Solid Figures] --- C([Cones]) SF --- CYL([Cylinders]) SF --- P([Polyhedrons]) P --- PR[Prisms] P --- PY[Pyramid] style PR stroke-dasharray: 5 5 style PY stroke-dasharray: 5 5 </pre> </div> <ul style="list-style-type: none"> • "What do we know from this chart?" (It is about kinds of solid figures; there are three kinds of solid figures; there are two kinds of polyhedrons, etc.) • Students explain how the web led them to their responses. Press for how position, shape and connecting lines aid in translation of a web. • Tell students that they will be classifying and building prisms and pyramids (add terms to the empty circles on the web). <p>The teacher displays Pentagonal Prism net, TR48, with "base" and "lateral face" labeled and explains that a net is a 2-dimensional figure that can be folded and taped to form a 3-dimensional solid figure.</p>

<p>EXPLORE: TR45, 47, 48 and 49</p> <p>For more scaffolding, see Special Needs: TE p. 360</p>	<ul style="list-style-type: none"> • TR45, 47, 48 and 49: Students <i>make mathematical observations</i> in their groups about the similarities and differences between the nets, <i>identify</i> the lateral faces and bases, and determine the total faces. • Whole class: <i>Chart</i> mathematical similarities and differences. • Using the name "Pentagonal Prism" on the displayed net as a model, students <i>name</i> the other three nets of prisms. • Groups <i>record mathematical observations</i> about the similarities and differences between the pyramid nets, TR52, 53 and 54. (Make sure to review the term <i>common vertex</i> if students are not using it to describe the triangular faces meeting at a point.) • Groups cut and tape all seven nets and form the polyhedrons.
<p>Practice: ALTERNATIVE TEACHING STRATEGY: TE p. 354B</p>	<ul style="list-style-type: none"> • <i>Explore</i> how prisms and pyramids are similar and different. • <i>To provide more scaffolding</i>, groups gather and organize data using the chart similar to the one from ALTERNATIVE TEACHING STRATEGY, TE p. 354B. <i>Substitute</i> the names of the seven figures they have constructed, and do not include cone, cylinder and cube.
<p>SUMMARIZE/Closure: pp. 355-356</p> <p>To increase engagement during discussion of key points, press students to talk with partners & groups before calling on individual students in the class discussion.</p>	<p><i>Discuss and test</i> the student generalizations of the classifications.</p> <ul style="list-style-type: none"> • Possible questions for ideas that don't come up in context: <ul style="list-style-type: none"> • <i>How</i> are all polyhedrons the same? • <i>What</i> makes a pyramid different from a prism? (In addition to the two bases, note that the bases must be congruent and parallel; taking a non-parallel slice from the top of a prism does not result in a prism.) • <i>What</i> determines the number of lateral faces on a prism or a pyramid? (The number of sides of the base) • <i>How</i> are the lateral faces of a prism different from the lateral faces of a pyramid? • <i>How</i> could I form a pyramid inside a prism? (See page 355). <p>p. 356, #17: (If students don't count the base as a face, clarify difference between lateral face and face.)</p>
<p>HOMEWORK</p>	<p>p. 356: #15, 16, 18 and #23-27</p>

MODULE 10: UNIT 6: GEOMETRY AND SPACIAL REASONING

Chapter 19 - Solid Figures

DAY 3 - Lesson 19.1 & 19.3 Modified

MATERIALS:	Scissors; tape; polyhedrons constructed on Day 1; TR56 and TR57
LESSON FOCUS:	Types of Solids
CA STANDARD:	MR 1.1; MR 3.2; MR 3.3
Purpose of Lesson: Math Background: TE p. 354A	At the end of the lesson students will be able to build and classify polyhedrons, cones and cylinders.
Warm-up/ Routine(s): p. 342	<p>Display the middle section showing the figures from the chart on p. 342:</p> <ul style="list-style-type: none"> "What is the same about all of these figures?" (Use the term quadrilateral.) <p>Display the first two columns of the chart:</p> <ul style="list-style-type: none"> Students make observations about each figure. (Scaffold with list of mathematical vocabulary to use to help them describe properties similar to those listed in the third column of the chart: congruent, right angles, parallel, perpendicular, opposite sides.)
LAUNCH: <u>Books closed</u> TE p. 354B	<p>WRITING IN MATHEMATICS: TE p. 354B:</p> <p>Display web:</p> <div style="text-align: center;"> <pre> graph TD SF[Solid Figures] --- C([Cones]) SF --- CY([Cylinders]) SF --- P([Polyhedrons]) P --- PR[Prisms] P --- PY[Pyramid] style PR stroke-dasharray: 5 5 style PY stroke-dasharray: 5 5 </pre> </div> <ul style="list-style-type: none"> Students use the polyhedrons from day one to review the similarities between the prisms and pyramids. Chart their observations of what makes a figure a polyhedron.
EXPLORE: TR56 and TR57 Reference: p. 360 TE p. 354B ALTERNATIVE TEACHING STRATEGY	<ul style="list-style-type: none"> Distribute cone and cylinder nets TR56 and TR57. <ul style="list-style-type: none"> How are the nets similar and different? Predict the resulting solid figures. Construct the figures. Discuss and record similarities and differences between the cone and the cylinder. Students add <i>cone</i> and <i>cylinder</i> data to their chart from Day 1. (ALTERNATIVE TEACHING STRATEGY, TE p. 354B)
Practice:	<ul style="list-style-type: none"> Discuss and record similarities and differences between cones and cylinders and the prisms and pyramids.
SUMMARIZE/Closure: See p. 355 TE p. 356	<p>Discuss and test the student generalizations of the classifications.</p> <ul style="list-style-type: none"> Fill in <i>cylinders</i> and <i>cones</i> on the <i>Solid Figures</i> web <ul style="list-style-type: none"> Possible questions for ideas that don't come up in context: <ul style="list-style-type: none"> "Why aren't cylinders and cones classified as polyhedrons?" "How is a cone similar to a pyramid?" "How could we form a cone inside a cylinder using the same base?" TE p. 356: Lesson Quiz 19.1: In addition to writing yes or no for #1 and 2, students explain why it is or is not a polyhedron.
HOMEWORK:	p.356: # 7-10 (Explain yes or no response for #7 & 8). Construct a net for a prism and a net for a pyramid, but don't cut them out. (Use grid paper.)

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Chapter 19 – Solid Figures

DAY 4 – Lesson 19.4 Modified: *May be a 2-day lesson*

MATERIALS:	Toothpicks, straws or coffee stirrers; clay; prisms and pyramids from Day 1
LESSON FOCUS:	Problem Solving Strategies
CA STANDARDS:	MR 1.1; MR 3.2; (MR 2.2)
Purpose Of Lesson: Math Background: TE p. 362A	At the end of the lesson students will be able to choose appropriate strategies to solve problems.
Warm-up/ Routine(s):	<p>p. 345: #23: Partner/pairs:</p> <ul style="list-style-type: none"> • Sketch the information given in the problem. • Record representation of reasoning and the “path to solution”.
LAUNCH: <u>Books Closed</u>	<ul style="list-style-type: none"> • Examine the polyhedron nets from homework assignment. Predict if they will or will not form a polyhedron. If not, explain why on the paper. • Groups have prisms and pyramids from Day 1: <ul style="list-style-type: none"> • Hold up a triangular prism and the beginning of a model using 3 toothpicks and one ball of clay. Ask students to determine the number of toothpicks and clay balls required to make a model of the prism. • Record predictions and discuss strategies. (Use the terms <i>vertices</i> and <i>edges</i> to describe the figure in relation to the number of toothpicks and clay balls.) • Display the following problem: <i>"Tamisha wants to make a model of a prism with a 20-sided polygon as its base. How many toothpicks and clay balls will she need?"</i> <ul style="list-style-type: none"> • Discuss strategies students bring up that they might use to solve the problem without building the figure. (Solve using models of prisms with fewer sides on the bases; find a pattern; make a table; predict and test.)
EXPLORE: <u>Books Closed</u> You may want to include the graph in the assignment here or save it until Practice or the next day.	<ul style="list-style-type: none"> • Students solve the problem using <i>Private Think Time</i> followed by group work: <i>"Tamisha wants to make a model of a prism with a 20-sided polygon as its base. How many toothpicks and clay balls will she need?"</i> <ul style="list-style-type: none"> • Write a rule in words and an equation for finding the total number of edges and vertices for a prism with any number of sides. • Scaffold by: <ul style="list-style-type: none"> • Encouraging struggling groups to record data gathered (from building models of prisms with fewer sides or from the paper models of prisms) in an organized table. • Asking questions that press students to look for patterns in the structure and the numbers that would allow them to determine total edges or vertices for a polygon with any number of sides.

<p>Practice:</p> <p>If there is not sufficient time for students to explore this, move this and the homework to a lesson for the next day. It is an opportunity for revisiting the concepts in Unit 9.</p>	<p>Graph the number of edges and vertices for prisms with different numbers of sides in the base (both on same graph):</p> <ul style="list-style-type: none"> • "Why is the three on the x-axis the first number that will result in any edges or sides?" • "What determines the total edges or vertices?" (Number of sides in the base polygon. Number of edges or vertices is dependent on the number of sides in the base.)
<p>SUMMARIZE/Closure:</p>	<p>Select students to share their solutions and strategies. (Be sure that through questioning, it is explicit that generalizing for toothpicks and clay balls is really number of edges and vertices.)</p> <ul style="list-style-type: none"> • Have students translate between the model, the table, the graph and the equation. <p>Optional Individual Assessment: Find the number of edges and vertices for a prism with 50 sides in its base.</p>
<p>HOMEWORK:</p> <p>Assign this only if there is understanding shown in the Summary/Closure, and students had adequate time to complete the graph.</p>	<ul style="list-style-type: none"> • <i>"After building the prism with a 20-sided polygon as its base, Tamisha modeled a pyramid with the same base. How many toothpicks and clay balls did she use?"</i> • Write a rule in words, a graph and an equation for finding the total number of edges and vertices for a prism/pyramid with any number of sides. <p>Alternate homework if this is a two-day lesson:</p> <ul style="list-style-type: none"> • p. 363, #3, 7, 9, and 10

MODULE 10: UNIT 6: GEOMETRY AND SPACIAL REASONING
Chapter 19 – Solid Figures

DAY 5 - Lesson 19.2 Modified

MATERIALS:	26 centimeter cubes per group of 4; centimeter graph paper; solid figures from Day 1; 2 cylinders per table (paper cylinder from Day 1 and a can or other cylinder); Overhead of CHALLENGE 18.3: TE p. 343
LESSON FOCUS:	Different Views of Solid Figures
CA STANDARD:	MR 2.4
Purpose of Lesson: Math Background TE p. 357A	At the end of the lesson students will be able to choose appropriate strategies to solve problems.
Warm-up/ Routine(s): p. 344 #9-14 CHALLENGE 18.3: TE p. 343	<ul style="list-style-type: none"> • p. 344 #9-14: Give the most exact name for the figure. • Time permitting: CHALLENGE 18.3: TE p. 343 (Make overhead)
LAUNCH: p. 357	<ul style="list-style-type: none"> • Introduce use of 2-D drawing with the example of car designers' use of computer-aided design from the top of page 357. • MATH LAB: Activity 1: p. 357 • Discuss strategies for sketching only lines and points that are visible from the direct view from top, side and front.
EXPLORE: p. 358	<ul style="list-style-type: none"> • Activity 2, p. 358: <ul style="list-style-type: none"> • Partners build the figure as teacher builds one. Use centimeter grid paper to draw the three views. Compare individual drawing with others in group. • Partners create new figures using no more than 13 cubes; sketch the three views. • Trade views with pair from another group and recreate the figure using the drawings of the three views.
Practice: p. 359	<ul style="list-style-type: none"> • Partners study Example 1, p. 357 as a model. • Draw the three views of a pyramid, a prism and a cone using the paper solid figures from Day 1. • p. 359: #15, 16 and 18
SUMMARIZE/Closure p. 359	<ul style="list-style-type: none"> • Select students to record their drawings on board for discussion. • Discuss strategies • ASSESS: DISCUSS and WRITE: TE p. 359
HOMEWORK	p. 359: MIXED REVIEW AND TEST PREP; #11, 12, 15, 16 and #21-25