



SAN DIEGO CITY SCHOOLS

Institute for Learning, Department of Mathematics

Instructional Module to Enhance the Teaching of

PRENTICE HALL

PRE-ALGEBRA

California Edition 2001

GRADE 7

Module 10

AREA and VOLUME

THE BIG IDEAS:

By the end of grade seven, students will:

- Know the properties of, and compute with, rational numbers by manipulating numbers and equations. Know and use different representations of fractional numbers (fractions, decimals, and percents) and are proficient at changing from one to another. Understand and use factoring of numerators and denominators and properties of exponents.

Note: Negative fractions are formally introduced and studied for the first time.

- Increase their facility with ratio and proportion, compute percents of increase and decrease, and compute simple and compound interest.
- Graph linear functions and understand the idea of slope and its relation to ratio. Solve simple linear equations and inequalities over the rational numbers.
- Know the Pythagorean theorem and solve problems in which they compute the length of an unknown side.

Note: The Pythagorean theorem is probably the first true theorem that the students will have seen.

- **Know how to compute surface area and volume of basic three-dimensional objects and understand how area and volume change with a change in scale.**
- Make conversions between different units of measurement. Know and use various forms of displays for data sets.

(Notes from Mathematics Framework for California Public Schools, Grade Seven, p. 149-152.)

Key Mathematical Concepts Addressed:

MODULE 10: Area and Volume (Chapter 10)

- MG 2.1 Use formulas to find area of basic two-dimensional figures and the surface area and volume of basic three-dimensional figures.
- MG 2.2 Estimate and compute area of more complex or irregular two- and three-dimensional figures by breaking the figures down into more basic geometric objects.
- MG 2.3 Understand the effects on surface area when side lengths are multiplied by a scale factor.
- ***MG 3.6 Identify elements of three-dimensional objects.**

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MODULE 10: Area and Volume

DAY 1: Lesson 10 - 1; pp. 504-507

LESSON FOCUS:	Area of Parallelograms
CA STANDARD:	MG 2.1, 2.2
Purpose of Lesson:	By the end of the lesson, students will be able to find areas of rectangles and have deepened understandings of parallelograms formed from them and how to find their areas.
Warm-up/ Routine(s): Ref. p. 499, #9, 10	Find the perimeter of: an equilateral triangle with a side measurement of 60 cm; a square with a side measurement of 60 cm. Talk with partner about your findings. What do you know about each shape?
LAUNCH: Ref. TE p. 504; Background for Lesson/Connect to Students' Lives	Area of a Rectangle: Have students use pattern block squares or square tiles to find area of 2-3 rectangles. Use geoboards, if available. If manipulatives are not available, have them draw rectangles on grid paper & find area. Share out strategies. This should be quick review - formula should emerge. If not, guide student conversation to realization of formula.
EXPLORE: Ref. p. 504; <i>Introducing the Concept</i> p. 505; Area of Parallelogram Materials needed: scissors; tape; 1 sheet inch grid paper per partner	Forming a Special Kind of Rectangle: Parallelogram Follow directions in <i>Introducing the Concept</i> using inch grid paper. Trace & cut rectangles: 3x4, 2x3, 1x3, 3x6. Mark right angles in each rectangle. Shade or highlight one length side & one width side for each. Record areas. Cut the 3x4 rectangle from vertex to vertex to form two right triangles. <u>Predict:</u> <i>Will the diagonal cut side be the same as the length of the original rectangle, longer or shorter? Compare diagonal cut side to the shaded length side. What did you find?</i> Tape triangles together to form a parallelogram. <i>What should the area be? How do you know? How could you prove it?</i> Notice where the right angles are - the shaded width side of the rectangle. Have students continue exploring with the remaining rectangles. <i>If the perimeter of a rectangle & the parallelogram formed from it is different, how can their area be the same?</i>
Practice: Ref p. 507, #24 a/b	Predict the area of a parallelogram that is formed in the same way from a 2x5 inch rectangle, a 4x5 in. rectangle. Explain to a partner your thinking.
SUMMARIZE:	As a class, share out findings from exploration. Guide students to realization of formula for area of parallelogram.
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework: p. 506	P. 506, #1, 2, 10-13. <i>If you were to cut these rectangles from vertex to vertex and form parallelograms with the right triangles, what would be the area of each parallelogram? How do you know?</i>

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MODULE 10: Area and Volume

DAY 2: Lesson 10 - 1; pp. 504-508

LESSON FOCUS:	Use formulas to find the area of parallelograms.
CA STANDARD:	MG 2.1, 2.2
Purpose of Lesson:	At the end of the lesson, students will be able to use the formula for finding area of parallelograms and the formula for area of a rectangle to compute the area of more complex, irregular figures.
Warm-up/ Routine(s):	Daily Skills Warm-Up, TE p. 504
LAUNCH: Continues from Launch of previous day. p. 504; <i>Introducing the Concept</i> Materials needed: scissors, tape, one sheet grid paper/partnership	Have students draw and cut rectangle of your choice. Label right angles & shade one width side as in Lesson Day 1. Find & record area. Instead of cutting into two equal right triangles, cut rectangle into two pieces one of which is a right triangle & the other is a trapezoid. Compare diagonal cut side to shaded length side. <i>What do you find?</i> Tape together to form parallelogram. Predict area. Find area. <i>What measurements of your parallelogram can you use to find this area?</i>
EXPLORE: p. 507	Have students work in partnerships cutting additional rectangles and repeating steps above to form parallelograms predicting and finding area. Each time note measurements being used to produce parallelogram area. How can formula for area of a rectangle help you find the area of irregular shapes? Partners explore p. 507, #20 or # 21. Share findings at table.
Practice:	p. 506, # 5, 6
SUMMARIZE:	As partners, table group & class, share findings from exploration. Formalize formulas for area of rectangles and parallelograms.
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework: pp. 507, 508	p. 507, # 23, <i>Estimation</i> and # 28, <i>Writing</i> . p. 508, #31-38, teacher selected problems from Mixed Review

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MODULE 10: Area and Volume

DAY 3: Lesson 10 - 2; pp. 509-513

LESSON FOCUS:	Area of triangles - computing area for complex figures
CA STANDARD:	MG 2.1, 2.2
Purpose of Lesson:	By the end of the lesson, students will be able to find formula for area of triangles and find area of an irregular shape that is the combination of rectangle & triangle.
Warm-up/ Routine(s):	TE p. 509; <i>Daily Skills Warm-Up, Lesson 10-2</i> Number Sense: Find Product, #1-4
LAUNCH: Reference TE p. 509; Background for Lesson	Provide students with parallelogram or have them use grid paper to cut out one. Find and record the area of the parallelogram. Draw a diagonal from vertex to vertex and cut to form two congruent triangles. Have students discuss how much of the original parallelogram each triangle equals (one half). <i>If this is true, then what should be the area of each triangle? What is happening to the base? To the height?</i>
EXPLORE: Reference p. 510, Example 2	Partners continue to explore as above with 2-3 more parallelograms. Challenge them to come up with a formula (or rule) for finding the area of a triangle. What if you had a triangle sitting on top of a rectangle? (Have students refer to photo of building p. 510.) How could you find the area of both the rectangle & the triangle?
Practice:	p. 510, TRY THIS # 3 p. 512, #1 - 3
SUMMARIZE:	Partner Talk/Write: <i>How is finding area of a triangle related to finding the area of a rectangle?</i> Share out thinking as a class. Guide conversation to development of formula for area of triangles.
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	p. 509, #1,2 p. 512, #8-10 p. 513, #26-28

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MODULE 10: Area and Volume

DAY 4: Lesson 10 - 2; pp. 509-513

LESSON FOCUS:	Find and use formulas for finding area of trapezoids. Find area of complex figures by breaking into basic figures.
CA STANDARD:	MG 2.1, 2.2
Purpose of Lesson:	Students will investigate trapezoids as combination of two triangles and find areas of triangles to compute area of trapezoid. By the end of the lesson, students will begin to develop formula for finding trapezoid area.
Warm-up/ Routine(s):	TE p. 505, After the Lesson transparency; Lesson Quiz Finding area of interior rectangle & parallelogram.
LAUNCH: p. 510, PART 2 Reference	Provide students with trapezoidal shape and label it as example in Part 2. Have students describe the trapezoid in mathematical terms, i.e. polygon, quadrilateral, parallelogram. <i>Does it have any right angles? What can you say about the angles? (Congruency, acute vs. obtuse angles, total number of degrees in the four angles?)</i> <i>Which sides are parallel? Identify these sides as bases.</i> Draw a diagonal from the two non-adjacent vertices. <i>Are these triangles congruent? Why/why not? How do you know?</i> Discuss with partner how you would go about finding the area of each triangle. Share out.
EXPLORE: p. 510, PART 2 Reference	Identify height & base of each triangle. <i>What measurement is different in each triangle?</i> Find areas for each triangle. <i>What is the area of the trapezoid?</i>
Practice:	p. 512, #12
SUMMARIZE:	Have students share thoughts about how to find area of trapezoids. Refer them to p. 510, PART 2 and walk through how formula is developed. Check it by comparing to what was found during the explore period. (Second check by using it on the practice problem.)
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	Use the formula as developed on p. 511 to solve for problems on p. 512; #5, 6, 11 and 14. p. 513; #17, 19, 21

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MODULE 10: Area and Volume

DAY 5: Lesson 10 - 3; pp. 514-519

LESSON FOCUS:	Finding area of a circle.
CA STANDARD:	MG 2.1, 2.2
Purpose of Lesson:	Students investigate relationship between parallelogram and circle and by the end of the lesson begin to develop formula for finding area of a circle.
Warm-up/ Routine(s): TE p. 514	Daily Skills Warm-Up, Lesson 10-3 Number Sense: Simplify & evaluate expressions.
LAUNCH:	Have students talk to one another about "Everything You Know About A Circle". Share out responses and record on chart paper. Question for clarity of thinking, making connections & vocabulary. Draw a circle & label as students share what they know. (If the concept of π does not arise, talk with students about the relationship between diameter & circumference. You might wish to demonstrate with string on a number of circular objects.)
EXPLORE: TE p. 514 p. 514, <i>Introducing the Concept</i> TE p. 515 Materials needed: Protractor, scissors	Follow directions for <i>Introducing the Concept</i> , p. 514. See <u>Introducing the Concept</u> notes in the margin of TE p. 514. After students have had time to explore relationship of circle with parallelogram, direct them to p. 514, PART 1 continuing to top of page 515 for development of formula. Share Teaching notes, PART 1, TE p. 515, margin.
Practice:	Using formula in Example 1, p. 515, do TRY THIS #7
SUMMARIZE:	Refer to the chart that was developed during Launch. As a class, share thinking: <i>What more do we know about circles? What more might we add or clarify?</i>
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	p. 517, #1-6

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MODULE 10: Area and Volume

DAY 6: Lesson 10 - 4; pp. 520-525

LESSON FOCUS:	Identify elements of three dimensional objects
CA STANDARD:	MG 3.5 MG 3.6 Key Standard
Purpose of Lesson:	By the end of the lesson, students identify common space figures and predict which figure may be formed from a net.
Warm-up/ Routine(s): Materials needed: Wooden cubes or multi-link cubes, dot paper	p. 520, <i>Three Views of an Object</i> - Introduce vocabulary, i.e. face, edge, vertex. Teacher/students build first object with three cubes on piece of paper. Label four sides of paper A,B,C,D. Talk with students about how it may be viewed and drawn depending upon viewpoint (side A, side B, top, etc). Draw on dot paper. Using cubes, build the next construction p. 520, EXAMPLE. Draw & discuss.
LAUNCH: pp. 520-521 TE p.521 Connecting to Students' Lives	Students build/draw views for #1. Build/draw #5. Move from these cubic three-dimensional buildings to the space figures presented on p. 521. Identify each figure - its bases, faces, etc. Make <u>connections</u> with where/how students might come into contact with these figures (ice cream cone, basketball <sphere>, canned foods <cylinder>).
EXPLORE: Materials needed: Cereal box; Quaker Oats or Salt container; Cone (made from paper circle or coffee filter)	Ask students to look at the cereal box and talk with one another about what it might look like if it were cut apart along one side and flattened out. <i>How many faces does it have? Edges? Vertices?</i> Share predictions. Invite a student to come forward and cut along one side of the box. Open it out and trace around its two-dimensional net on chart paper or white board. <i>How did it compare to predictions?</i> Mark folds to form net. Have another student fold it back into its three-dimensional shape. Repeat with Oats container (much easier to cut than salt container) (You can also cut label from soup can & talk about shape of top & bottom to form net.) & cone (see p. 524, #16-18) with the addition of asking students to <u>first sketch</u> what the net might look like. (If time allows, have students draw, cut and construct examples of the shapes.) ***Save containers for tomorrow's Launch!!
Practice:	p. 522, EXAMPLE 2, a & b; TRY THIS, #3, 4
SUMMARIZE:	<u>QUICKWRITE</u> or Discussion: <i>How are these solid figures different from drawings of two-dimensional geometric figures that lie in a plane?</i>
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework: TE p. 523	TE p. 523, <i>Challenge</i> , seven different nets for a cube - draw as many as you can!

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MODULE 10: Area and Volume

DAY 7: Lesson 10 - 5A-5; pp. 526-532

LESSON FOCUS:	Cross Section of Space Figures; Surface Area of Prisms, Cylinders
CA STANDARD:	MG 3.6 Key Standard MG 2.1, 2.3
Purpose of Lesson:	Students investigate cross sections formed by intersection of a plane and a solid and explore finding surface areas of rectangular prisms & cylinders.
Warm-up/ Routine(s):	TE p. 522, After the Lesson, Lesson Quiz transparency. Share different nets found to form cube (previous day's homework).
LAUNCH: TE p.527	Refer to <i>Connecting to Students' Lives</i> , TE p. 527 - Wrapping a Gift. Using flattened cereal box from previous day's lesson, ask students what you might do in order to determine how much wrapping paper it would take to cover it completely. Share thoughts as a class. If someone suggests measuring to find the area of each face, invite them with a partner to show how that might be done (get a best estimate). What would be different in finding surface area of the cylindrical container (Oats or salt container)?
EXPLORE: TE p. 526 Materials needed: Toothpicks, miniature marshmallows, orange	Refer to TE p. 526, <i>Math Background</i> <i>TE p. 526, Teaching Notes:</i> Student partners construct a cube and investigate intersection of a plane and solid. Refer to EXAMPLE, student page 526. Have students use a piece of paper or index card as the intersecting plane. Can they intersect their cube in three different ways as shown on p. 526? What makes these three intersections different?
Practice:	Ask students to look at the orange and describe the possible cross sections of a sphere (p. 526, #9).
SUMMARIZE:	EXIT SLIP: p. 526, #9 <i>What would cross sections of the salt container (cylinder) look like? How do you know?</i> Share thinking at table group/with class.
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	p. 530, #1-3, 8, 9 and 19.

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MODULE 10: Area and Volume

DAY 8: Lesson 10 - 6; pp. 533-537

LESSON FOCUS:	Surface Area: Pyramids, Cones
CA STANDARD:	MG 2.1, 2.3
Purpose of Lesson:	By the end of the lesson, students will have an understanding of how to find surface area of pyramids & cones
Warm-up/ Routine(s):	TE p. 503, Transparency 75, Surface Area of Prisms and Cylinders Use as <u>QUICKWRITE</u> (mini-assessment) or have students talk with one another about what they know about the nets of these two figures & finding their surface area.
LAUNCH: pp. 533-535	p. 533, Have students look at the picture of the structure at the entrance to the Louvre. Discuss the characteristics of a regular pyramid, reference p. 533, PART 1. Look at the drawing of the small square pyramid adjacent to EXAMPLE 1. Model how the formula is used to find the surface area. Go on to pp. 534 & 535 and call students attention to the different figures - each with its own unique formula for finding surface area. <i>What characteristics do cones and spheres have in common? How are they different? How do these differences affect their surface area formulas?</i>
EXPLORE: Pyramid Page (following)	Students work with partner to find the surface area of a square pyramid (net provided on next page). Have students cut out and form the square pyramid. Have them find the length of the base and the slant height of a face. Using the formula, determine the surface area of the figure. If time allows, provide partners with a coffee filter or paper circle and have them investigate how to construct & find the surface area of a cone.
Practice:	p. 533, TRY THIS, #1 p. 534, TRY THIS, #2 (Use friendlier numbers - height 40'; diameter 15')
SUMMARIZE:	Have students share their findings. Describe characteristics of a square pyramid, a cone.
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	p. 536, #1, 4, 5, 13 p. 537, Mixed Review, #21-23

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MODULE 10: Area and Volume

DAY 9: Lesson 10 - 7; pp. 538-541

LESSON FOCUS:	Volume: Prisms and Cylinders
CA STANDARD:	MG 2.1
Purpose of Lesson:	Students explore finding volume of prisms & cylinders and by the end of the lesson, make connections with volume of containers in real world settings.
Warm-up/ Routine(s):	TE p. 538, Daily Skills Warm-Up, 10-7 OR Transparency 76, TE p. 503 - Surface Area of a Pyramid (as review)
LAUNCH: TE p. 538 Materials needed: Variety of containers	Refer to TE p. 538, Background for Lesson/Connecting to Students' Lives. Display a number of different containers (liter of cola, half gallon milk carton, bag of pop corn, box of candy, etc.). Ask students how they would describe the volume (how much is contained within) each container and if they would be measured in the same units or differently. If you have second language students, they might discuss metric measure or another measure used in their country.
EXPLORE: TE p. 503 Materials needed: Cubes, may also build with multi-link cubes p. 539 Pie pans, rice or small beans (M&M's a favorite!)	TE p. 503, Transparency 77, Volume of a Prism, use to introduce concept. If you have small cubes, provide students with opportunities to first predict & then to find volume of 4-5 different rectangular prisms - if not, model & use formula. (Refer to p. 538.) EXAMPLE 2, p. 539, Discuss formula for area of cylinder and how it was derived. Pose this question to students: Which would have the greater volume, a cylindrical shape made from rolling a transparency sheet lengthwise (so that it is a long & narrow cylinder) or if the same transparency is rolled widthwise? Would the volume be the same? Allow for thought & discussion and then ask for a student pair to help you in discovering the answer. Roll transparency, tape together, place in a pie pan & fill with rice, beans or M&M's. Remove transparency cylinder saving amount of rice in pan. Roll transparency cylinder the other way. Place in pie pan & fill with the amount that was reserved from first cylinder. Discuss what happened/why? (Ahead of time, find measurements of the two cylinders.)
Practice:	Using measurements of the two cylinders. Use formula to find volume.
SUMMARIZE:	<u>QUICKWRITE:</u> <i>What is volume? Give two or more examples.</i>
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	p. 540, Check for Understanding, #1-6 or TE p. 541, Reteaching

MODULE 10: Area and Volume

DAY 10: Lesson 10 - 9; pp. 547-550

LESSON FOCUS:	Volume: Pyramids, Cones, and Spheres
CA STANDARD:	MG 2.1, 2.3
Purpose of Lesson:	By the end of the lesson, students have deepened understandings of how to find the volumes of pyramids, cones and spheres.
Warm-up/ Routine(s): TE pp. 546-547	TE p. 546, Test Taking Tips on Transparency, Working Backwards OR TE p. 547, Daily Skills Warm-Up transparency, #1 & #3.
LAUNCH: pp. 546-547 Reference PART 1, p. 547 Cylinder, Construct cone of same height & radius	<u>Before class</u> , construct a cone with the same height & radius as a cylinder. Check with science dept. for a graduated cylinder. Fill the cone with beans (M&M's). Have students predict how much of cylinder will be filled. Pour into cylinder. Have students confirm or re-evaluate their predictions. Repeat three times. (The volume of the cone is one-third the volume of the cylinder.) This same relationship is true for a pyramid and a prism with the same base and height. Refer to p. 547.
EXPLORE: pp. 547-548	<i>Ask students: If the formula for finding the volume of the cylinder is $Base \times Height$, what would the formula for finding the volume of the cone be?</i> Provide students with the Base & Height measurements of the cylinder & cone you used as your model. Work with students to use the radius measurement to find the Base. Using the formula for volume of a cylinder, have them find the volume of the graduated cylinder. Discuss what would need to be done to find the volume of the cone. Have students turn to p. 547 and look at EXAMPLE 1. Then turn to p. 548, EXAMPLE 2 for finding volume of a square pyramid Students work with partner to do TRY THIS, #1 and #2
Practice:	p. 549, Check for Understanding, #1 & #2.
SUMMARIZE:	<u>QUICKWRITE:</u> <i>What is the relationship between the volume of a cone and a cylinder?</i> Share thinking.
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	p. 549, #8-10 p. 550, #18

MODULE 10: Area and Volume

DAY 11: ASSESSMENT

LESSON FOCUS:	Assessment
CA STANDARD:	Key Standard: MG 3.6 MG 2.1, 2.2, 2.3, 3.5
Purpose of Lesson:	Assessment
Warm-up/ Routine(s):	p. 553, #9-11, name the space figures from their nets.
LAUNCH:	Assessment - Teacher choice
EXPLORE:	
Practice:	
SUMMARIZE:	<u>Reflective Writing:</u> In their math journals, have students reflect upon what they consider to be the key learnings - the BIG IDEAS - from this chapter. Invite them to ask any questions that they may have related to this unit of study.
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	TE p. 545, Enrichment

MODULE 10: Area and Volume

DAY 12: OPTIONAL, 10-8; pp. 542-545

LESSON FOCUS:	Reasoning Strategy: Make a Model
CA STANDARD:	MG 3.2, 3.5
Purpose of Lesson:	At the end of the lesson, students will be able to solve a problem by making a model.
Warm-up/ Routine(s):	TE p. 542, Daily Skills Warm-Up, students work with partner to draw diagram & solve.
LAUNCH: TE p. 542 pp. 542-543	TE p. 542, <i>Connecting to Students' Lives</i> , discuss with partner - share with table group. Read SAMPLE PROBLEM , Box Company. pp. 542-543, Follow Problem Solving Strategy & develop model as seen atop p. 543. As a class fill in table, #7.
EXPLORE: p. 544	p. 544, <i>Check for Understanding</i> , students work together to <u>explain</u> how to model each situation for #1 & #2. Design model for #3.
Practice:	p. 544, #5
SUMMARIZE:	Partner Talk/Write: Some problems lend themselves to solving by making a model. Make a list of some examples that you and your partner think can be solved this way. Tell what it is about each example that lends itself to making a model. Share thinking as a class.
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	pp. 544-545, #4, 6, 7, 8