



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 9

Spatial Thinking

KEY MATHEMATICAL CONCEPTS FOR GRADE SEVEN

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. **(Build understandings of basic geometric figures.)**

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

- Know how to compute the 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, p149-152.)

Key Mathematical Concepts Addressed:

MODULE 9: Spatial Thinking - Chapter 9

- **MG 3.1** Identify and construct basic elements of geometric figures by using a compass and a straightedge.
- **MG 3.2** Understand and use coordinate points graphs to plot simple figures, determine lengths and areas related to them, and determine their image under translations and reflections.
- ***MG 3.4 Key Standard - Demonstrate an understanding of conditions that indicate two geometrical figures are congruent and what congruence means about the relationships between the sides and angles of the two figures.**
- ***MG 3.6** Identify elements of three-dimensional geometric objects (e.g., diagonals of rectangular solids) and describe how two or more objects are related in space (e.g., skew lines, the possible ways three planes might intersect).

MODULE 9: Spatial Thinking

DAY 1: Lesson 9 – 1 pp. 442-447

LESSON FOCUS:	Points, Lines, and Planes
CA STANDARD:	MG 3.1 MG 3.6; Key Standard
Purpose of Lesson:	At the end of the lesson, students will be able to recognize and name basic geometric figures & build geometric vocabulary.
Warm-up/ Routine(s):	Number Sense: TE p. 442, Daily Skills Warm-Up, transparency
LAUNCH: TE p. 442	TE p. 442, <i>Connecting to Students' Lives</i> Students point out & name as many geometric figures that they can see in their classroom, on their way to school (What shape is a Stop sign? A Yield sign?), on the playing fields - a baseball diamond (rhombus), basketball (sphere), etc.
EXPLORE: p. 442, TE p. 442 p. 443	Have students play "Geometric Simon Says". Using their arms and hands have them demonstrate geometry vocabulary such as: Line (arms outstretched with index fingers extended to indicate never ending), line segment (arms extended with hands in fists to indicate beginning & ending points), ray (arms extended one hand in fist and one with index finger extended). . . angle, right angle, acute angle, obtuse angle, parallel lines, perpendicular lines. For those figures that some students are not certain of, have a classmate model and explain meaning or teacher models and explains. Review p. 442, Basic Figures Table and share TE p. 442, Background for the Lesson information. Discuss Figures in EXAMPLE 1, p. 443.
Practice:	p. 443, TRY THIS, #1-3
SUMMARIZE:	Play second round of "Geometric Simon Says" to review vocabulary and "physically" develop understanding. <i>TABLE TALK:</i> <i>What is the difference between a line, a ray and a line segment?</i>
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	p. 445, #1-3, #8 p. 446 #34-37

MODULE 9: Spatial Thinking

DAY 2: Lesson 9 – 1 pp. 442-447

LESSON FOCUS:	Points, Lines, and Planes
CA STANDARD:	MG 3.1 MG 3.6; Key Standard
Purpose of Lesson:	At the end of the lesson, students will be able to recognize intersecting lines, parallel lines, and skew lines.
Warm-up/ Routine(s):	Play "Geometric Simon Says" with previous day's vocabulary
LAUNCH: p. 443	Have students use arms to show an angle. Introduce term "intersect" and identify the point at which their arms meet as the intersection point. Have students use arms to demonstrate parallel lines. Have them look for parallel lines that they see in classroom, on way to school, in sports Introduce term "skew". Use diagram Part 2, p. 443, to demonstrate an example of skew lines. <i>Can they use their arms to make skew lines?</i>
EXPLORE: p. 444	Have students work with partner. Examine frame of a room photo p. 444, EXAMPLE 2. Use as a model to answer TRY THIS, p. 444, #4-6. Have partners use EXAMPLE 3 as a model and do TRY THIS, p. 444 #7. Share drawings with others at table group.
Practice:	Draw a picture that has parallel lines. Add a line segment that intersects the parallel lines. Label the intersection points. Share pictures at table.
SUMMARIZE:	Discussion question: <i>Why can you not draw two truly skew lines on a piece of paper?</i> (Refer to TE 445, Challenge) Talk with partner, then share out with table and with class.
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	p. 445, #4-6, 13-15, p. 447, #43, a, b, c, d, e In your neighborhood, name a pair of parallel streets; intersecting streets.

MODULE 9: Spatial Thinking

DAY 3: Lesson 9 – 2 pp. 448-453

LESSON FOCUS:	Drawing and Measuring Angles Angle Relationships and Parallel Lines
CA STANDARD:	MG 3.1 MG 3.4; Key Standard
Purpose of Lesson:	At the end of the lesson, students will be able to identify adjacent & vertical angles and relationships of angles formed by parallel lines.
Warm-up/ Routine(s):	Share results for homework problem p. 447, #43, Map <i>What neighborhood streets did they identify as parallel; intersecting?</i>
LAUNCH: p. 448 9-2A p. 449	For students with limited experience in using a protractor, p. 448, 9-2A might be a good starting point. Reference p. 449, add vocabulary to "Geometric Simon Says" activity: adjacent angles: elbow to wrist; vertical angles: arms crossed; supplementary angles: arms outstretched 180° with neck & head as intersecting line; complementary angles: arms at 90° with neck & head as intersecting line. PART 1: Connect vocabulary with drawings p. 449. Note: Write <i>the measurement of $\angle 1$</i> as: $m \angle 1$.
EXPLORE: Refer to p. 450, EXAMPLE 1 & 2 p. 451	p. 450, EXAMPLE 1: Have students construct a vertical angle and label angles 1-4. Model using protractor to find an angle and how to use that measurement to find its supplementary angle. p. 450, EXAMPLE 2: Construct a line intersected by two parallel lines - label angles 1-8. Identify the congruent corresponding and congruent alternate interior angles. p. 451, TRY THIS: Students solve and construct the diagram.
Practice:	p. 452, #1, 10 a & b
SUMMARIZE:	Pose question to the class: <i>"What's the difference between complementary angles and supplementary angles?"</i> Students might demonstrate physically (<i>Geometric Simon Says</i> style), draw a diagram or explain verbally.
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	p. 452, #6, 8, 11 p. 453, #16, 17 Error Analysis, #19 - 23, 27

MODULE 9: Spatial Thinking

DAY 4: Lesson 9 – 3 pp. 454-458

LESSON FOCUS:	Classifying Polygons
CA STANDARD:	MG 2.1
Purpose of Lesson:	At the end of the lesson, students will be able to classify polygons & quadrilaterals and be able to write and use the formula for perimeter of regular polygons.
Warm-up/ Routine(s):	Discuss responses for Error Analysis homework problem, p. 453, #17 OR "Geometric Simon Says" activity
LAUNCH: TE p. 454, p. 454 pp. 455-456	Reference TE p. 454, <i>Background for the Lesson</i> . Ask students to show physically with their hands or arms what an acute, obtuse, right angle would look like. Have students look at the triangles p. 454, PART 1, and try to make connections between the angles and the triangles shown. Discuss characteristics of equilateral, isosceles and scalene triangles. p. 455-456, PART 2: Use pattern blocks to introduce examples of quadrilaterals, regular polygons and hexagon.
EXPLORE: Materials needed: Pattern blocks, ruler	p. 456, REAL WORLD EXAMPLE, Introduce gazebo problem and discuss how one would write a formula to find the perimeter of the shape. Provide each table group with one or two of each kind of pattern block. Ask students to think about formulas for finding perimeter of each shape. <i>Will any of the formulas be the same? Why? Why not?</i> <i>Can you name the kinds of angles in each block?</i> Have students trace around each block. Students work as partners to write formulas to find the perimeter of each shape and name the angles. If time allows, use ruler to measure length of side/s and find the perimeter of each shape.
Practice:	p. 457, #1 - 4
SUMMARIZE:	Students share findings from exploration period.
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	p. 457, #16, 17 Design a *flag made up of at least three different geometric figures. (*Additional Resource: Foundations for Algebra, Yr. 1, pp. 137)

MODULE 9: Spatial Thinking

DAY 5: Lesson 9 – 3A pp. 458-459

LESSON FOCUS:	Angles of a Polygon
CA STANDARD:	MG 2.1, 2.4, 3.2
Purpose of Lesson:	At the end of the lesson, students will be able to find the sum of the measures of the angles of a polygon.
Warm-up/ Routine(s):	p. 458, <i>Reasoning</i> (In blue box on right) Students talk with partner - share thinking as a class. <i>Are all squares rectangles? All rectangles squares?</i>
LAUNCH: TE p. 459, Refer to Math Background & Teaching Notes	p. 459, Draw the diagram of parallel lines with interior triangle (transversal) as shown in example on p. 459. Model reasoning for how to identify angles. Do EXAMPLE (mid-page 459) using diagram of hexagon with whole class.
EXPLORE: p. 459	p. 459, Have students <u>draw</u> an example for #1 (quadrilateral) and #3 (octagon). Then have them find the sum of the measures of the angles. Solve for #2 and #4. Challenge students to do #5 - write a formula. <i>Do they see a pattern in their results for # 1 - 4?</i> If they are unable to get to the formula, give them the following situation: <i>Two students think they have found the formula. Sam says that he thinks it is $s = 180n$ but Tina says she's thinks it is $s = 180(n-2)$. Which is correct? Explain your thinking.</i>
Practice:	p. 459, #6
SUMMARIZE:	Share student thinking for problem #5. Share out with the class.
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	p. 458, MIXED REVIEW, #29 - 32, Justify Each Step (bottom of page)

MODULE 9: Spatial Thinking

DAY 6: Lesson 9 – 4 pp. 460-463

LESSON FOCUS:	REASONING STRATEGY: Draw A Diagram
CA STANDARD:	MG 3.1
Purpose of Lesson:	At the end of the lesson, students will be able to solve a problem by drawing a diagram.
Warm-up/ Routine(s):	Share student thinking from homework, p. 459, #7 OR TE p. 460, <i>Daily Skills Warm-Up, 9-4.</i>
LAUNCH: p. 460	CHECK OUT THE CAR DESIGN p. 460!! p. 460, EXAMPLE: Present question about octagon. Have students talk with a partner about a "plan" to enter the problem. Students share at table & with class. Draw octagon and diagonals from vertex A (see diagram bottom of p. 460). Have students suggest ways to organize information (see table p. 461 as one example).
EXPLORE: p. 461 p. 462 Material needed: Chart paper	Students continue finding the diagonals from each vertex and record their results. Find total of diagonals for the shape. Give each table group a different problem to solve and put on chart paper. Students work with a partner and then share with table group to draw their diagram and chart final solution. Problems p. 462, #1, 2, 4, 5, 8, 11
Practice:	p. 462, #3, <i>Geometry</i>
SUMMARIZE:	QUICKWRITE: <i>How does drawing a diagram help in problem solving?</i> OR Table groups share charts from Explore.
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	p. 463, #14 - 16 p. 463, MIXED REVIEW, #21, 23, 25, 26 OR TE p. 462, Daily Cumulative Review

MODULE 9: Spatial Thinking

DAY 7: Lesson 9 – 5 pp. 464-468

LESSON FOCUS:	Congruence
CA STANDARD:	MG 3.4; Key Standard
Purpose of Lesson:	At the end of the lesson, students will be able to identify corresponding parts of congruent triangles and determine whether triangles are congruent.
Warm-up/ Routine(s):	TE p. 464, <i>Daily Skills Warm-Up, 9-5</i> ; Similar Triangles
LAUNCH: TE p. 464 Materials needed: Plastic straws, string, ruler	P. 464, <i>Introducing the Concept, #1 & 2</i> , form triangles with straws and string. PART 1, Introduce terms "congruent", "corresponding". Identify with their triangles. PART 2, Identify triangles by using sides and angles. ("Reflection" may arise in conversation - demonstrate with triangle constructions.)
EXPLORE: p. 467 Materials needed: 1/2 inch dot or graph paper	Repeat as above forming equilateral triangles. Cut three straw lengths 6 cm each and tie together with 20 cm length of string. Compare sides and angle to the first triangle construction. <i>Are there any congruent sides? Congruent angles? How do you know?</i> Introduce mini-project: Triangle Quilt Square Design a 6 inch square quilt piece using ONLY triangle shapes. See picture, p. 467, #35. Name the congruent triangles in your design.
Practice:	p. 465, TRY THIS, #4
SUMMARIZE:	Share triangle quilt design constructions from Explore with a partner. As a table group, identify congruent triangles present in the designs. Partner Talk/Write: Students name the congruent triangles in the quilt square, p. 467, #35.
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	p. 466, #5, 8, 11, 14; p. 467, #24, 32

MODULE 9: Spatial Thinking

DAY 8: Lesson 9 – 6 pp. 469-473

LESSON FOCUS:	Circles
CA STANDARD:	AF 3.4; Key Standard MG 3.1
Purpose of Lesson:	At the end of the lesson, students will be able to find circumferences and make circle graphs (review from Data Analysis study, first module).
Warm-up/ Routine(s):	TE p. 469, <i>Daily Skills Warm-Up, 9-6, Radius/Diameter of a Circle</i>
LAUNCH: p. 469 Materials needed: Several circular objects, string, ruler, chart paper, calculator	p. 469, <i>Introducing the Concept</i> Number each circular object and place on tables throughout the classroom. Prepare chart as seen on p. 469. Model how to use string to find diameter and circumference of one of the numbered circular objects. Record on class chart. Student partners prepare a chart on notebook paper to record their findings.
EXPLORE: Appendix: Additional Resources for Exploration of Circle; <i>Circle Construction;</i> <i>Magic Circle</i>	Each partnership begins with a different numbered circular item. When they have completed measurements for an item and recorded on their paper, they look at class chart. If that item has not yet been recorded on class chart, they do so and then move on to another available item. Continue measuring and recording until class chart has been completed and students have had several opportunities to investigate the relationship between diameter and circumference. As a class, calculate the ratio for each object. (If time runs out, this calculation can occur the next day.)
Practice:	p. 470, See EXAMPLE 1, do TRY THIS #6 - 8
SUMMARIZE:	<u>Exit Slip:</u> Explain your thinking (conjectures) about the relationship between diameter and circumference of a circle.
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	p. 471, TRY THIS, #10, Circle graph p. 472, #1, 3, 6 p. 473, #23

MODULE 9: Spatial Thinking

DAY 9: Lesson 9 – 7 pp. 474-478

LESSON FOCUS:	Constructions
CA STANDARD:	MG 3.1 MG 3.4: Key Standard
Purpose of Lesson:	At the end of the lesson, students will be able to construct a segment or angle congruent to a given segment or angle.
Warm-up/ Routine(s):	TE p. 474, <i>Daily Skills Warm-Up, 9-7, Congruent Figures</i>
LAUNCH: TE p. 474 pp. 474-475 Materials needed: Compass, ruler	TE p. 474, <i>Background for the Lesson and Connecting to Students' Lives</i> Lead students through constructions on pp. 474-475, EXAMPLES 1 & 2.
EXPLORE: p. 475 & p. 477 Appendix: Additional Resource for Compass Construction, Reference Foundations for Algebra, Yr. 2	Students do constructions #1 - 4, p. 477, Check Understanding and p. 475, TRY THIS, #2.
Practice:	p. 477, #7, 8
SUMMARIZE:	QUICKWRITE: Describe how to use a compass to construct congruent line segments.. Share out thinking with the class.
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	p. 477, # 18, Open-ended, Create a design

MODULE 9: Spatial Thinking

DAY 10: Lesson 9 – 7 pp. 475-478

LESSON FOCUS:	Constructions
CA STANDARD:	MG 3.1 MG 3.4; Key Standard
Purpose of Lesson:	At the end of the lesson, students will be able to construct segment bisectors and angle bisectors.
Warm-up/ Routine(s):	Number Sense: Select from Routine Bank
LAUNCH: p. 475 Materials needed: Compass, ruler	p. 475, PART 2 Lead students through construction of EXAMPLES 3 & 4. Model your thinking aloud as you complete each construction.
EXPLORE: pp. 476, 477	Students continue constructing figures: p. 476, TRY THIS, constructions #3 & #4. p. 477, Check for Understanding, #5 & #6.
Practice:	p. 477, #9, 10
SUMMARIZE:	Partner/Table Talk: Discuss when you might see real world examples of these figures. <i>What does the term "bisect" mean?</i> Share out thinking as a class.
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	p. 477, #11 - 13 p. 478, MIXED REVIEW, #22, 23, 27 OR TE p. 478, Reteaching

MODULE 9: Spatial Thinking

DAY 11: Lesson 9 – 8 pp. 479-483

LESSON FOCUS:	Translations
CA STANDARD:	MG 3.2, 3.5
Purpose of Lesson:	To describe and graph translations
Warm-up/ Routine(s):	TE p. 479, <i>Daily Skills Warm-Up, 9-8</i> , Graph Coordinate Points
LAUNCH: pp. 479, 480 TE p. 479 Materials needed: Pattern blocks, graph paper	Demonstrate translation using pattern blocks as described at top of p. 479. TE p. 479, <i>Connecting to Students' Lives</i> , (see chessboard picture, p. 480). Try to draw out other examples - can be seen in tile patterns, t-shirts designs that repeat logos, tessellated designs, etc. Have students draw with you as you complete figure in EXAMPLE 1, bottom of p. 479. Make connections with EXAMPLE 2 & 3 on p. 480. Find rule.
EXPLORE: p. 480	Have students construct triangle PQR from EXAMPLE 3, p. 480 and its translation. This time use R to find the rule. p. 480, TRY THIS, #3. Students make constructions of their own design and show translation. Can they write the rule?
Practice:	p. 481, #5, 8 (For graph solutions, see T 770)
SUMMARIZE:	p. 482, #33, <i>Error Analysis</i> Discuss with table group - share with class.
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	p. 483, #36, a & b, Draw Three Dimensional Figures OR TE p. 483, Reteaching or Practice

MODULE 9: Spatial Thinking

DAY 12: Lesson 9 – 9 pp. 485-488

LESSON FOCUS:	Symmetry and Reflections
CA STANDARD:	MG 3.2
Purpose of Lesson:	At the end of the lesson, students will be able to identify a line of symmetry and graph a reflection of a geometric figure.
Warm-up/ Routine(s):	TE p. 485, <i>Daily Skills Warm-Up</i> , 9-9, Graph a Line
LAUNCH: TE p. 485 p. 485 TE p. 486, Extension	TE p. 485, <i>Connecting to Students' Lives</i> , discussion - make connection to <i>Background for the Lesson</i> . Have students look at the photos on p. 485 and begin to identify lines of symmetry. (Also look at posters, pictures in classroom.) <i>Ask : How many lines of symmetry does a circle have? Explain your thinking.</i> (Infinite number)
EXPLORE: TE 486 p. 486 Materials needed: Graph paper, ruler, pattern blocks	p. 486, EXAMPLE 2, use pattern blocks to demonstrate reflection over y - axis. Demonstrate when $y = 2$ (Refer to EXAMPLE 3). Have students do constructions p. 486, TRY THIS, #3 & 4 (For solutions, see T 771).
Practice:	p. 487, #1 - 3
SUMMARIZE:	Table groups discuss difference between translation and reflection. <i>Can students provide an example of each?</i> Share out thinking/examples as a class - teacher charts responses.
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	p. 487, #10, 11, 14, 16, 20 (For solutions, see T 771.)

MODULE 9: Spatial Thinking

DAY 13: Lesson 9 – 10 pp. 490-493

LESSON FOCUS:	Rotations
CA STANDARD:	MG 3.2
Purpose of Lesson:	At the end of the lesson, students will be able to graph rotations and identify rotational symmetry.
Warm-up/ Routine(s):	QUICKWRITE: p. 487, #21, Writing <i>Will a reflection of an angle have a different measure than the original angle? Explain why or why not.</i>
LAUNCH: TE p. 490 pp. 490, 491	TE p. 490, <i>Connecting to Students' Lives</i> , students give examples. Support understandings with <i>Background for the Lesson</i> . Use PART 1, <i>Teaching Notes</i> - model on overhead. Have students stand and make turns of 90°, 180°, 270°, etc. Connect to graph p. 490, EXAMPLE 1, and flower photo, p. 491, EXAMPLE 2.
EXPLORE: p. 491 Materials needed: Pattern blocks	Discuss p. 491, TRY THIS, #2, 3, 4 as a class. Students investigate rotational symmetry of pattern blocks. Trace each block. Tell whether it has rotational symmetry and if so, the angle of rotation. Using Pattern Blocks, make a design then create its rotation. Show it to someone at your table. Can they identify its angle of rotation?
Practice:	p. 492, #1 - 3
SUMMARIZE:	Partner Talk/Write: p. 493, <i>Error Analysis</i> (bottom of page) Share thinking at tables & as a class.
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	p. 492, # 8-11 p. 493, #19 - 22, 28

MODULE 9: Spatial Thinking

DAY 14: Chapter 9, pp. 442-500

LESSON FOCUS:	ASSESSMENT: Spatial Thinking
CA STANDARD:	Key Standards: AF 3.4, MG 3.4, 3.6 MG 2.1, 3.1, 3.2, 3.5
Purpose of Lesson:	To assess student understandings of Spatial Thinking
Warm-up/ Routine(s):	Number Sense: Teacher's Choice
LAUNCH:	Assessment - Teacher's Choice
EXPLORE:	Following assessment, students share mini-project, Quilt Square, Day 7 OR p. 494 Introduce Tessellations, p. 494 and have students begin a mini-project of tessellated design.
Practice:	Tessellations
SUMMARIZE:	Have students write reflections in math notebooks about something they learned in this chapter or something they have questions about relating to this chapter of study.
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	p. 493, MIXED REVIEW, #30 - 36 (For solutions, see T 773.)

APPENDIX

MODULE 9