



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 13

**Nonlinear Functions
& Polynomials**

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KEY MATHEMATICAL CONCEPTS FOR GRADE SEVEN - 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 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: Chapter 13, Nonlinear Functions and Polynomials

- AF 1.2 Evaluate variable expressions.
- **AF 1.3 Add & subtract variable expressions; simplify using the Distributive property; use Distributive property to multiply binomials.**
- AF 3.1 Graph nonlinear functions.
- AF 3.2 Plot values for volumes of cubes with various edge lengths.
- MG 1.1 Compare measures in the metric system.
- MR 1.1 Analyze number patterns to determine sequences.
- MR 2.2 Apply strategies from simpler problems to more complex problems.

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MODULE 13: Nonlinear Functions and Polynomials

DAY 1: Lesson 13 - 1; pp. 664-668

LESSON FOCUS:	Arithmetic Sequences
CA STANDARD:	MR 1.1
Purpose of Lesson:	At the end of the lesson, students will be able to describe number patterns with arithmetic sequences.
Warm-up/	TE p. 664. Daily Skills Warm-Up
LAUNCH: Ref. TE p. 664; Connect to Students' Lives	Have students talk with one another about any patterns or sequences that they know in their daily lives. Share out a few examples with the whole class.
EXPLORE: Books closed Reference: p. 664;	p. 664, Introducing the Concept: Option A or Option B <i>"Which would you rather have? Why?"</i> Students work with a partner to develop a table for Option A and for Option B. Partners must decide which option would be the "best deal" and explain their reasoning. (What happens after the tenth day?) Push students to explain what is happening from term to term in each sequence and how this makes a difference in the outcome.
Practice: p. 665	p. 665, EXAMPLE 2, work with partner to solve. TE p. 665, <i>Build Understanding:</i> <i>On which day will the runner run 4 miles? How do you know? (8th day)</i> Write a rule to describe the sequence.
SUMMARIZE:	Have students do TRY THIS, p. 665, #4 and discuss how they are able to "predict" what the next term will be. <i>What is the common difference?</i> <i>Will the pattern ever end?</i>
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework: p. 667	p. 667, Check Understanding, #1-4, #12-15, #21 & 23

MODULE 13: Nonlinear Functions and Polynomials

DAY 2: Lesson 13 - 1; pp. 664-668

LESSON FOCUS:	Geometric and Other Sequences
CA STANDARD:	MR 1.1
Purpose of Lesson:	At the end of the lesson, students will be able to describe number patterns with geometric sequences
Warm-up/ Routine(s):	Ref. TE p. 664 Daily Skills Warm-Up Transparency, 13-1, #1-3 only. Extending a Pattern - Write a Rule for a Pattern
LAUNCH: Books closed: p. 665	Write pattern from p. 665, EXAMPLE 3 on board. Have students work with a partner to try to solve. Ask students how this pattern is different than those in the Warm-Up Introduce vocabulary: common ratio vs common difference
EXPLORE: Books closed: p. 666	Write the three sequences on board from EXAMPLE 4, p. 666. (Mix up the order to make it more interesting.) Challenge students to find the next three terms and decide which is arithmetic and which is geometric and which doesn't fit either category and WHY. Have partner design three sequences of their own: one arithmetic, one geometric and one that is neither. (Collect & use as future Warm-Ups!)
Practice:	p. 666, TRY THIS, #8-11
SUMMARIZE: p. 667, #40, <i>Writing</i>	Journal Writing: The first two numbers of a sequence are 4 and 8. <i>Can you predict what the next term will be? Why or why not? What would the common difference be?</i> <i>If each term in a sequence is multiplied by the same amount, we call that the common ratio. What would the common ratio be in example above?</i> Share at table & as a class.
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework: pp. 667, 668	p. 667, #28-39 p. 668, #49 p. 668, Mixed Review: #50-52, Finding Circumference

MODULE 13: Nonlinear Functions and Polynomials

DAY 3: Lesson 13 - 2; pp. 669-672

LESSON FOCUS:	Graphing Nonlinear Functions
CA STANDARD:	AF 3.1, 3.2
Purpose of Lesson:	At the end of the lesson, students will begin to build an understanding about how to graph quadratic functions and absolute value functions.
Warm-up/ Routine(s):	TE p. 669, Daily Skills Warm-Up OR Use some of the sequences from student exploration on the previous day.
LAUNCH: p. 669, TE p. 669	p. 669, <i>Introducing the Concept</i> , # 1 & 2 TE p. 669, Refer to <i>Introducing the Concept</i> (margin) and <i>Connecting to Students' Lives</i> . Discuss EXAMPLES 2 AND 3.
EXPLORE: pp. 669, 670	p. 669, 670, TRY THIS, #3-4, #5-6, #7-8 Assign different table groups to different problems. Have them develop their table of ordered pairs and graph their results on large graphing paper. Post around room. <i>What do they notice about graphs of absolute value functions vs quadratic functions?</i>
Practice:	p. 671, #1-4
SUMMARIZE:	Student realizations and comments from Exploration
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	TE p. 672, Enrichment OR p. 671, #9-11, #12, 16, 20

MODULE 13: Nonlinear Functions and Polynomials

DAY 4: Lesson 13 - 3; pp. 673-676

LESSON FOCUS:	Exponential Growth and Decay
CA STANDARD:	MR 2.2
Purpose of Lesson:	At the end of the lesson, students will begin to build an understanding of how to use tables, rules and graphs with functions modeling growth and decay.
Warm-up/ Routine(s): TE p. 673 TE p. 663	TE p. 673, Daily Skills Warm-Up, #1-3 . . . #4 & 5, ask students how these equations differ from the ones they were using the previous day. <i>Can they predict what kind of graph will result? (Linear) How do they know?</i> TE p. 663, Transparency #88 is also a good representation of linear & quadratic equations with their respective graphs.
LAUNCH: Textbooks closed TE p. 673	p. 673, EXAMPLE 1, pose the "warren of rabbits" problem to the students. Have them begin to develop a table (organizational help may be necessary). Graph the results. Discuss what happened with each successive value of x . Refer to TE p. 673, <i>Background for the Lesson</i> .
EXPLORE: Textbooks closed p. 674	p. 674, provide students with the information found under the photo of the x-ray. Help them to begin to develop a table that would show results after 30 hours. Have students graph the results. Discuss the difference between the tables and the graphs. Have students turn to p. 674 and look at EXAMPLES 2 and 3. Discuss the two graphs.
Practice:	p. 674, TRY THIS, #2 & 3
SUMMARIZE:	Partner Talk/Write: <i>What are some similarities/differences between these two types of functions?</i> <i>Why do you think the graphs grow as they do?</i>
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	p. 675, #1-3, #7-9, #10-13

MODULE 13: Nonlinear Functions and Polynomials

DAY 5: Lesson 13 - 4; pp. 678-681

LESSON FOCUS:	Polynomials
CA STANDARD:	AF 1.2
Purpose of Lesson:	At the end of the lesson, students will be able to identify polynomials and begin to build an understanding of how to evaluate polynomials.
Warm-up/ Routine(s):	TE p. 678, Daily Skills Warm-Up OR P. 676, Checkpoint 1, sequences #1-3
LAUNCH: Books closed: pp. 678, 679	TE p. 678, <i>Connecting to Students' Lives</i> Ask students the difference between a <i>bicycle</i> and a <i>tricycle</i> . Discuss the meaning of the prefixes. What is a <i>monorail</i> ? Have you ever ridden on one? What is a <i>trilogy</i> ? Have you ever read one? p. 678, Examine the table at the bottom of the page. p. 679, do TRY THIS, #5, 6, 8.
EXPLORE: p. 679	p. 679, EXAMPLE 4, introduce the Real-World Connection problem. Have students substitute 4 for t in the equation and solve. Students work collaboratively in partnerships to solve p. 679, TRY THIS, #9-12.
Practice:	p. 680, #1-6
SUMMARIZE:	QUICKWRITE: In your own words, explain to someone who was absent how to determine which polynomial is a monomial, binomial or a trinomial.
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	p. 680, #22, 24, 26, 28, #30-37

MODULE 13: Nonlinear Functions and Polynomials

DAY 6: Lesson 13 - 5; pp. 684-688

LESSON FOCUS:	Adding and Subtracting Polynomials
CA STANDARD:	Key Standard: AF 1.3
Purpose of Lesson:	At the end of the lesson, students will build an understanding about how to add and subtract polynomials and solve problems involving area and volume.
Warm-up/ Routine(s):	p. 681, #42, Test Prep OR TE p. 663, Transparency #89, Naming Polynomials
LAUNCH: Books closed TE p. 684, <i>Connecting to Students' Lives</i> Helpful Materials: Algebra tiles, Teaching Transparency Bk., p. 16 Reference, p. 661E	TE p. 684, <i>Connecting to Students' Lives</i> , discuss combining like terms. Use overhead Algebra Tiles to model adding & subtracting polynomials (you may have an algebra kit - if not, overhead tiles are available in your Teaching Transparency Book, p. 16). For a model, reference p. 661E, Lessons 13-5 & 13-6.
EXPLORE: p. 687 p. 688	Draw a few of the geometric shapes found on p. 687, #29-34. Have students help you find ways to determine the perimeter for the shape. Model how that would be written as a polynomial. Ask students: "If I knew that the perimeter of the square was $12x$, how would I find the length of one side?" Repeat for the rectangular shape. Students work together to find the missing lengths of the shapes on p. 688, #39-44. You might give each table a different shape to explore.
Practice:	p. 685, TRY THIS, #8 & 9.
SUMMARIZE:	Share findings from Explore. <i>How do we take what we know to find what is unknown? What knowledge do we have to have about the geometric shapes?</i>
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework: p. 686	p. 686, Check Understanding, #1, 2, #5-8, #9, 30, 33 OR TE p. 688, ENRICHMENT

MODULE 13: Nonlinear Functions and Polynomials

DAY 7: Lesson 13 - 6; pp. 689-692

LESSON FOCUS:	Multiplying a Polynomial by a Monomial
CA STANDARD:	Key Standard: AF 1.3
Purpose of Lesson:	At the end of the lesson, students will build an understanding of how to use an area model for multiplication and to write a polynomial as the product of a monomial and a polynomial.
Warm-up/ Routine(s):	p. 687, #35, Error Analysis OR TE p. 689. Daily Skills Warm-Up, Simplify Expressions
LAUNCH: TE p.689 p. 689 Student texts closed	TE p. 689, refer to <i>Background for the Lesson</i> , discuss with students. Use algebra tiles to show area model for finding product of a monomial & a polynomial (see p. 689, PART 1).
EXPLORE: p. 689 p. 690	Give students the measurements for the garden in EXAMPLE 1, p. 689. Have them work with a partner to find the area of the garden. Compare results and discuss at tables/whole class. Review EXAMPLE 2, p. 690, and have students cross out each term in the polynomial as they multiply it. (TE p. 690, see suggestions in <i>Build Understanding</i> and <i>Error Prevention</i> to aid students.) Students do p. 690, TRY THIS, #3. Compare results and discuss.
Practice: p. 690	p. 690, TRY THIS, #4
SUMMARIZE:	Partner Talk/Write: <i>If you multiply a monomial by a polynomial, what is the relationship between the original monomial and the product of the multiplication? (The original monomial is a factor of the product.)</i> (Make a simpler problem to see the relationship.)
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	p. 691, #1-10, even or odd numbers, #41 & 42

MODULE 13: Nonlinear Functions and Polynomials

DAY 8: Lesson 13 - 7; pp. 694-697

LESSON FOCUS:	Multiplying Binomials
CA STANDARD:	Key Standard: AF 1.3
Purpose of Lesson:	At the end of the lesson, students will build an understanding about how to use models in multiplying binomials and multiply two binomials.
Warm-up/ Routine(s):	TE p. 694, Daily Skills Warm-Up OR TE p. 690, AFTER THE LESSON, Lesson Quiz (transparency)
LAUNCH: p. 694 TE p. 663	Use algebra tiles to model multiplying binomials, see p. 694, EXAMPLE 1. Use Transparency 90, TE p. 663, as another area model example. Have students talk to one another to verbalize what they have just seen you model. Share out their thinking.
EXPLORE: p. 694 TE p. 694	Model your thinking using Distributive Property, p. 694, EXAMPLE 2. Again have students talk with one another about the manner in which you multiplied to find the product. TE p. 694, <i>Background for the Lesson</i> , share "FOIL" method with students. Students work as partners to do p. 695, TRY THIS, #3 & 4.
Practice:	p. 695, <i>Different Ways to Solve a Problem</i> , #1 & 2. Discuss with partner. Explain your thinking.
SUMMARIZE:	QUICKWRITE: Explain the similarities between multiplying two binomials and multiplying a polynomial by a monomial.
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	p. 696, #7-9, 14, 16 p. 697, <i>Checkpoint 2</i> , #5-8

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MODULE 13: Nonlinear Functions and Polynomials

DAY 9: Lesson 13 - 8; pp. 699-702

LESSON FOCUS:	Reasoning Strategy
CA STANDARD:	MR 3.3
Purpose of Lesson:	At the end of the lesson, students will be able to solve a problem using multiple strategies.
Warm-up/ Routine(s):	TE p. 697, ENRICHMENT, make an overhead. Use the top part of the page to demonstrate the "interesting pattern" that occurs in the product when two binomials are multiplied together.
LAUNCH: Student texts closed p. 699	Have students work with a partner to solve the instructions for building a kite situation posed on p. 699, SAMPLE PROBLEM. After they have had some time to enter into the problem, read the questions beginning on p. 699. Discuss the plan of drawing a visual picture or diagram. Ask if someone could do so on the white board - if no one volunteers, guide students in directing you to draw a visual representation. Again allow time (if needed) for students to write an equation and solve. Discuss results.
EXPLORE: pp. 701, 702	pp. 701-702, assign tables different problems to solve. Have them include an explanation about why they choose the strategy they used. These can be done on chart paper and posted in the room to share or on transparencies for students to share.
Practice:	p. 702, Mixed Review, #22
SUMMARIZE:	Discuss: <i>What are some deciding points/clues in a problem that lead you to choose a particular strategy?</i>
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	p. 697, #9-13 p. 702, Mixed Review, #16-21

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DAY 10: Chapter 13: ASSESSMENT

LESSON FOCUS:	ASSESSMENT
CA STANDARD:	
Purpose of Lesson:	ASSESSMENT
Warm-up/ Routine(s):	TE p. 699, Daily Skills Warm-Up
LAUNCH:	
EXPLORE:	
Practice:	P. 706, Simplify Products, #47-55, Use Multiple Strategies, #62-63
SUMMARIZE:	Discuss the differences between linear functions and nonlinear functions. Give examples.
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	TE p. 702, ENRICHMENT