Algebra 2 Connections

Introduction and Overview

Algebra 2 Connections is the third in a five-year sequence of college preparatory mathematics courses offered by CPM Educational program. The course aims to apply and extend what students have learned in previous mathematics courses by focusing students on looking at multiple representations of functions and relations and on finding connections among the ideas they are studying. Students in Algebra 2 will continue to use problem solving strategies, questioning, investigating, and explaining in conjunction with their knowledge of the connections among algebra, geometry and functions to analyze problems and formulate solutions. Throughout the course, they will also use these strategies to extend their current knowledge by making new connections. Students will:

- Visualize, express, interpret and graph functions (and their inverses, in many cases) and some relations. Given the graph, students will be able to represent the relation or function with an equation, including those that can be classified in the following families:

linear	exponential	sine, cosine, tangent	circles
quadratic	absolute value	simple rational	ellipses
other polynomial	logarithmic	square root	hyperbolas

- Use variables to represent relations from tables, graphs, verbally stated problems, and geometric diagrams and recognize the interconnection between these multiple representations;

- Use variables to represent quantities and to generalize relationships and understand that equations and inequalities can be tested by substitutions of numbers for the variables;

- Solve any real linear or quadratic equation in one variable, some mixed systems in two variables, and linear systems of equations in three or more variables;

- Use order and equivalence properties of algebra to rewrite algebraic expressions and equations in more useful forms;

- Construct convincing arguments to support or prove assertions and to communicate mathematical ideas clearly using appropriate vocabulary;

- Apply the use of multiple algebraic representations to solve problems presented as real world situations or simulations from such subject areas as economics, biology, chemistry and physics; and,

- Use counting methods and probability to solve problems, investigate algebraic representations of conic sections, find sums of arithmetic and geometric series, including infinite geometric series, solve trigonometric equations and prove trigonometric identities. Teacher select from among these topics after the core chapters.

The course is structured around problems and investigations that build conceptual understanding of algebra topics. Students become comfortable with using general equations to represent functions and relations as well as with interpreting general equations to describe a situation. In particular, they develop the connections between and among the various core ideas of the course. Students are encouraged to investigate, form conjectures, and then justify their thinking to develop their reasoning skills.

The course uses a multiple representations approach to investigating new topics. Students use graphs, contexts or situations, tables and symbolic representations of information to investigate functions and relations. By using each of these representations, students develop experience with multiple entry points into a problem and have the chance to apply their knowledge of one representation to build understanding of others. Students focus on identifying the connections and interrelationships among these representations to find new ways of looking at problems.

Lessons are structured for students to actively collaborate by working in study teams. The text provides structured roles for each student to support their active participation in learning mathematics. During class time, students work in these teams on challenging problems that introduce new material. In several circumstances, an investigation or challenge is presented with a "Your Task" statement and "Further Guidance" structure. These activities are designed to provide teachers with the freedom to decide how structured or open they want the lesson to be for their students.

The homework in the "Review & Preview" section of each lesson reinforces skills and concepts learned in the lesson, as well as practices and enriches previously introduced material and prepares students for upcoming topics. The homework problems also allow students to apply concepts and skills in new contexts and to deepen their understanding by solving the same type of problem in different ways. CPM provides homework support through Hotmath (www.hotmath.com) and also provides teachers with the answers to problems. There is a "Parent Guide with Extra Practice" available in booklet form and at the CPM web site: www.cpm.org.

Algebra 2 Connections Goals for Students

Based on the foregoing description of the course mathematical content, the course also has goals for student growth in mathematical reasoning, communication, and making connections. Students will grow in their ability to:

- Pose mathematical questions, such as *"What if...?,"* meaningfully and appropriately;
- Make conjectures and test their validity;
- Appreciate algebra as a connected, systematic branch of mathematics.
- Recognize opportunities to use algebraic representations to solve problems from both mathematical and real or realistic situations;
- Recognize equivalence among algebraic representations that may allow substitution of one expression or variable for another;
- Analyze and critique an argument presented as justification;
- Communicate mathematical understanding effectively and formulate complete, logical arguments to support conclusions; and
- Exhibit creativity and perseverance in mathematical problem solving, and monitor their work to determine when an approach is not working and a new direction is needed.

Course Outline of Major Content Strands

This course contains several content threads that extend through multiple chapters and help to highlight connections between ideas. Chapter 1 begins by introducing the graphing calculator, building procedures for successful participation in study teams, and anticipating two major themes of the course: investigating functions and relations and modeling data. Chapter 2 continues this development with a focus on generalizing arithmetic and geometric sequences. Chapter 3 focuses on representing the family of exponential functions with graphs, tables, equations and applied situations.

Chapter 4 focuses on modeling non-linear data and developing general equations for a variety of functions and relations. Students learn to transform graphs of several parent functions including parabolas, hyperbolas, square roots, exponentials, cubics, and absolute values. Students review their strategies for solving equations and looking at those solutions in multiple representations in Chapter 5. They extend these strategies to use them with inequalities and systems of inequalities. Chapters 6 and 7 introduce students to inverses of the functions they have previously investigated, including exponentials, logarithms, and matrices. These seven chapters, and usually Chapter 9, which explores polynomial functions along with real and complex roots, comprise the core of most Algebra 2 courses. Teachers select from the remaining chapters—probability and counting, conic sections, series, and two that cover trigonometry—to complete the year.

Throughout the course, students develop five mathematical Ways of Thinking: investigating, generalizing, justifying, choosing a strategy and reversing. Students are encouraged to notice the thinking processes they engage in as they solve problems and to reflect on how those processes may be useful in broad contexts.

The concept of generalizing and representing abstractly are at the heart of an advanced algebra course. This course emphasizes a three-step procedure of investigating, generalizing and justifying. The investigations are often quite open-ended, encouraging students to be more creative and therefore more motivated. This approach requires the teacher to listen carefully to a wide variety of student ideas in order to guide and support their formulation of substantive conjectures.

Structure of the Course

Chapters are divided into sections that are organized around core topics. Within each section, lessons include activities, challenging problems, investigations, and practice problems. Teacher notes for each lesson include a "suggested lesson activity" section with ideas for lesson *introduction*, specific tips and strategies for lesson *implementation* to clearly convey core ideas, and a means for bringing the lesson to *closure*.

Core ideas are synthesized in "Math Notes" boxes for students. These notes are placed in a purposeful fashion, often falling several lessons after the initial introduction of a concept. This allows students to explore and build deeper understanding of an idea before they are presented with a formal definition or an algorithm. "Math Notes" include specific vocabulary definitions and instructions about notation, and occasionally interesting extensions or real-world applications of mathematical concepts. "Learning Log" reflections appear periodically at the end of lessons to allow students to synthesize what they know and identify areas that need additional explanation.