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QualityCore®

Algebra II

Course Description and Syllabus

ACT®

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Description

One participant in the *On Course for Success* (2004) study, an Algebra II teacher, described Algebra II as a course in which "students must practice algebra, discuss it, share it with fellow students, and write about algebra in order to best learn it and internalize it." That teacher's description of Algebra II fairly summarizes what the National Research Council (2002) identifies as necessary in any rigorous mathematics course:

- An awareness that process teaches content and vice versa
- An environment that fosters questioning, investigation, and collaboration
- An emphasis upon higher-order reasoning, relevant learning, and logical thinking

In other words, to develop a deep understanding of mathematics, students must practice, collaborate, and communicate what they learn. In Algebra II, students learn when they engage in a dynamic process of generalizing what they know, proving those generalizations true, predicting logical outcomes from those generalizations, and, finally, discovering new ways to represent the world with mathematics. The process develops students' deep understanding and increases their chances for success.

Algebra II extends students' exploration of number systems from real to complex numbers. The understanding students developed, in both Algebra I and Geometry, of linear expressions, equations, and inequalities is expanded in Algebra II to include quadratic equations and inequalities; polynomials; rational and radical expressions, equations, and functions; exponential and logarithmic functions; and trigonometric and periodic functions. Just as Algebra I introduces students to mathematical relationships through multiple representations of data, Algebra II strengthens the tools they have to analyze that data by exploring probability, sequences, and series and by introducing matrices. To help develop their analytic skills further, a rigorous course also trains students in the use of tools, such as graphing calculators and spreadsheets, that help them to study and explore multiple representations of functions. Most importantly, a rigorous course encourages students to rely upon problem-solving strategies and to use precise mathematical language to communicate their ideas. In other words, it emphasizes the skills that students need to think logically and critically.

One distinguishing mark of a rigorous course is its relevant approach to the field. Some topics, for example, are explored via the natural progression from Algebra I to Calculus. If in Algebra I students discovered that a linear rate of change could be graphed on the standard (x,y) coordinate plane, a rigorous Algebra II course builds upon the concept of modeling change by introducing students to exponential growth and decay and periodic curves such as sine waves, all of which are further explored in Trigonometry and Precalculus. The concepts students learn in Algebra II also have long histories and diverse applications. For example, Fibonacci's sequence, which was originally developed as an algebraic solution to a population model, has applications in natural science, aesthetics and design, and—as the key to several puzzles in Dan Brown's novel *The Da Vinci Code* (2003)—popular literature. Inviting students to investigate the history of algebra, as a rigorous course does, deepens their awareness of the value of mathematics to the world.

A rigorous Algebra II course also connects algebra to students' lives by emphasizing real-world problems. By rooting the course in concrete applications of mathematics, real-world problems

help to reinforce fundamental mathematical concepts and to teach the significance of algebra itself. A problem that requires students to create, graph, and justify an equation that models the rate at which a regular dosage of a drug is filtered by the kidneys from a patient's bloodstream (National Council of Teachers of Mathematics [NCTM], 2000, p. 303) emphasizes the value both of multiple representations of a concept and of precise language when justifying mathematical relationships. It also underscores how algebra is needed in order to comprehend the very real problem of prescribing correct dosages, which pharmacologists, pharmacists, physicians, and patients face every day. A problem that asks students, first, to describe a data table that depicts the number of minutes of daylight per day in Chicago in a particular year, then to represent the verbal description symbolically, and finally to extrapolate from that data a graph that approximates the amount of daylight per day Chicago experiences every year (NCTM, 2000, p. 298) encourages them to connect verbal and symbolic representations of physical events to abstract representations. Simultaneously, they explore the concept of periodicity and gain confidence in using patterns to predict real events. As students are solving increasingly complex real-world problems, they are developing, through language and with tables, graphs, sketches, and symbols, sophisticated methods of representing real-world phenomena. They are also learning both the content of the course and the processes of mathematical thinking.

Because students achieve deep understanding of algebra when they are empowered and responsible for their learning, how a teacher facilitates learning is as important as real-world relevance. Daily practice of routine skills hones their ability to recall basic concepts. Students also learn to think deeply, to conjecture, and to justify claims they make. When solving an economic linear programming problem, for example, students might be asked to predict the value of the maximum profit when there is a change in the constraints. Then, they would verify their predictions by setting up equations to test the possible values permitted by the constraints. The teacher might then build upon students' understanding, inviting them to reinterpret what they have learned by complicating and recasting the problem in a new context. Such a process ensures that students' learning is both constructive and recursive. Moreover, in a rigorous course significant class time is spent developing higher-order reasoning such as analyzing and interpreting information and generalizing from patterns. Teachers facilitate these skills with games, models, and other strategies. They encourage students to explore, both as a class and in groups, algebraic concepts and plausible solutions to problems. Teachers also assign projects that require students to plan strategically and reason through complex, multifaceted problems. Allowing students to test their ideas and to learn from their own and each other's errors helps them to consider their own understanding and to internalize the logical thinking that algebra requires.

A rigorous Algebra II course further engages students through reading and writing. An assignment in which students compare and contrast, using the language of the discipline, different mathematical representations of the same pattern or event both emphasizes the value of critical exploration and encourages students to communicate their findings to others. When students keep class notebooks, they learn to take clear, precise notes that allow them to understand mathematical terminology and strategies used to solve various types of problems. They also learn to revise the notes they have taken to reflect later learning. In addition, journaling encourages students to develop their understanding of mathematical reasoning. In such ways, teachers empower students by engaging them in learning strategies that solidify their conceptual understanding.

As students learn, a rigorous course takes advantage of a variety of ways to check for understanding. With preassessments, question-and-answer sessions, in-class activities, presentations, homework assignments, quizzes, tests, and culminating projects, teachers discover students' misconceptions as well as what they know and are learning. As teachers

assess students' work, they discover areas in which instruction may need to be modified in order to better meet students' needs. They also identify students who may need extra help. In a rigorous Algebra II course, in other words, teachers adjust dynamically to the needs of both the students and the material. Meanwhile, students not only receive ample feedback from the teacher, but also they respond to each other's work and check each other's understanding. They show each other how to solve problems and discover together how to understand course concepts. In the process, students take responsibility for their learning.

A rigorous course emphasizes a variety of instructional and assessment strategies because its goal is to help students become independent learners, critical thinkers, and problem solvers. Through in-class assignments as well as homework, students have numerous opportunities to apply the concepts or principles they are learning. In a unit that investigates sequences, for instance, students might develop a multimedia project that explores number patterns in the world around them. Throughout the unit, they would be encouraged to interpret the patterns as thoroughly as possible by representing and explaining them in multiple ways. Students thus explore algebraic concepts thoroughly, solidifying both the processes and the reasons behind those processes into a deep understanding of algebra.

From relevant instruction that sets high standards and enables students to achieve those standards to interactive and progressive instruction and assessment, a rigorous Algebra II course is a vibrant learning environment. By emphasizing the fundamentals of algebra and encouraging investigation, collaborative learning, problem-solving, and reasoning, the course places students in the best position to succeed.

Model Course Syllabus—Algebra II

On Course for Success (2004) revealed that rigorous Algebra II syllabi share several important characteristics. Not only do they describe the course and identify the content it will cover, but also they outline policies to which teachers and students are held accountable. This model syllabus is a composite drawn from the syllabi studied in *On Course for Success.* As a model, it is addressed to students and should be used as a general guideline, adapted according to a particular district's, school's, or teacher's policies.

Course Overview

Welcome to Algebra II! In this course, we will explore and interpret real-world problems as well as patterns and their representations (expressions, equations, graphs). We will also explain mathematical relationships verbally and symbolically. We will use technology, such as graphing calculators, that will help you analyze data and recognize patterns more easily.

Throughout Algebra II, we will build a mathematical foundation that will make connections among mathematical concepts, across disciplines, and in everyday experiences. The course will help prepare you both for your future mathematics courses and for your future careers. If you bring to class your curiosity and willingness to work hard, then I promise this mathematical journey will reward all you put into it!

Prerequisites

- Understanding properties of real numbers and the correct order of operations
- Multiplying monomials and binomials
- Factoring of trinomials in the form of $ax^2 + bx + c$

- Solving one-variable inequalities and equations
- Solving systems of two linear equations
- Understanding standard and slope-intercept form of linear equations given two points, a point and the slope, or the graph of an equation
- Graphing linear equations based on tables of values, *x*- and *y*-intercepts, or slope-intercept form
- Finding the distance and midpoint between two points in the standard (*x*,*y)* coordinate plane
- Finding the sides or angles of right triangles using sine, cosine, and tangent ratios
- Inductive and deductive reasoning

Course Content

- Exploring the Skills and Strategies Underlying Mathematics: Mathematical Processes
- Establishing Number Sense and Operation Skills: Foundations
- First-Degree Expressions, Equations, and Inequalities
- First-Degree Graphs, Relations, and Functions
- Quadratic Equations and Inequalities
- Quadratic Graphs, Relations, and Functions
- Conic Sections
- Polynomial Expressions and Equations
- Polynomial Functions
- Rational and Radical Expressions, Equations, and Functions
- Exponential and Logarithmic Functions
- Trigonometric and Periodic Functions
- Data Relations, Probability, and Statistics
- Sequences and Series
- Matrices

Course Materials

You will need to bring the following materials with you to class each day:

- Textbook
- Pencils, erasers, and marking pens
- Loose-leaf paper and binder (Class Notebook)
- Ruler that has both inches and metric measurements
- Graphing calculator
- Graph paper
- Colored pencils

Course Policies

Absences and Makeup Work: When you return from an absence, you are responsible for the following:

- Turning in any homework that was due the day(s) of your absence
- Reading the textbook section or other material that was used as a resource during your absence
- Getting the homework assignment(s) you missed and updating your class notebook.
- Turning in your makeup work

According to school policy, you have as many days as you were absent to turn in missed assignments. However, you should turn in at least one makeup assignment as well as the current assignment each day until you are caught up. If you are absent only on a test day, a note from your parents will be required and you will be expected to make up the test on the day you return to class. If you are absent any more days, you will have as many days as you were absent to make up the test. Makeup tests must be taken outside of regular class time.

Class Participation: At times we will all be algebra teachers; therefore, be willing to share your ideas with others and to support your reasoning to help each other understand new ways to solve problems. In other words, participate fully in all class activities. Be "on the court" playing the game, not "in the stands" watching what is going on.

Special Projects: We will be using projects to explore extended problems that are relevant to us and have real-world connections. For every project I assign, I will provide a scoring rubric that identifies and explains the important components of each project.

Classroom Rules/Expectations: Algebra II is a lab in which problems are solved in the same ways that mathematicians and other professionals who use mathematics solve problems. Therefore, you will be expected to act like professionals:

- Be responsible for your work. Bring supplies and homework every day.
- Be in your assigned seat ready to work when the tardy bell rings.
- Seek additional help if a topic seems difficult or requires alternative approaches to assist in your understanding.

Homework Policy: Homework will be assigned almost every school day (including over weekends) in order to allow you to explore and practice what you are learning. Most homework has one or more of the following purposes:

- *Practice* reinforces the learning of material already presented in class and helps you master specific skills.
- *Preparation* provides supporting information—history, skills, definitions—for what's forthcoming; it will help when new material is covered in class.
- *Extension* or elaboration involves the transfer of previously learned skills to new situations.
- *Integration* asks you to apply skills and concepts to produce a single product.

I will make every effort to communicate the purpose of homework assignments to you.

Unless otherwise specified, homework will be due the following school day at the beginning of the period. For all homework:

- Show all calculations and work, even if you do it in your head or on a calculator.
- Explain your reasoning at the conclusion of each solved problem.
- When you get stuck on a problem, solve it as far as you can, then write a short explanation of your difficulty.
- Review the textbook discussion of new topics prior to beginning any homework assignment.
- Use your class notebook as a resource.
- Late assignments will be accepted, but a penalty will be incurred.
- No homework or makeup work will be accepted after a test day.

In addition, be proactive about creating study groups, using outside resources such as dictionaries and websites, and discussing problems with each other and with me: any and all of these strategies can help you understand the concepts we will be studying more thoroughly.

Grading Policy

Grade Distribution: Quarter grades will be calculated as follows: 40% will be determined by tests and projects, 20% by quizzes, 20% by assignments, 10% by investigations and projects, and 10% by class notebooks. Eighty percent of a semester's grades will be determined by an average of two quarters' grades; the remaining 20% will be determined by the semester exam.

Types of Assessments: Tests will be given every 2–3 weeks. Quizzes will be given every 3–4 days. Projects will be assigned throughout the course. For all assignments, I will provide a rubric or explain the expectations. Several projects will be assigned throughout the course of the year.

Progress Reports: Every 2–3 weeks, you will be advised of your progress and given a partial grade.

Course Procedures

Work Requirements: A heading should be in the upper right-hand corner of the page and should consist of the following:

- Your name
- Course name and period number
- Date
- Page(s) and problem numbers when using the textbook

Class Notebook: You will be required to keep a notebook (or binder) containing definitions, explanations, and examples given in class; paperwork; investigations and other long-term projects; quizzes (which are valuable in studying for tests) and tests; and a journal. Your notebook will be turned in for a grade. It should be organized, and each section should be labeled. For example:

- Notes (includes vocabulary)
- Homework (in chronological order)
- Investigations and Projects
- Quizzes and Tests (in chronological order)
- Journal

Signature(s): Discuss this course syllabus with your parent(s) or guardian(s). You were given two copies—the blue one is for you and a parent/guardian to sign, and the yellow one is for you to keep. Please sign and return the blue copy to me by (insert date). I am looking forward to working with you this year.

I, _____ (Student), have read, understand, and accept the Algebra II course syllabus and course expectations.

I, _____ (Parent/Guardian), have read, understand, and accept the Algebra II course syllabus and course expectations.

_____ _____

(Student Signature) (Parent/Guardian Signature)

Personal Statement

If you are having difficulties with any of the topics covered in this course, see me as soon as possible. Times when I am available for extra help are included below. In addition, keep the following thoughts in mind:

- When you worry, "I can't do it," tell yourself, "I can do it, and I just need to figure it out."
- You can always ask for help.
- Set goals every week and recognize your accomplishments.
- Bring a positive attitude and a smile to class.

Additional Information

Extra Help: Get extra help when you need it. I am usually available after school on Mondays and Wednesdays from 2:40 p.m.–3:30 p.m. I will be happy to schedule extra help sessions for anyone who requests them.

Contact Information:

- School telephone/voice mail:
- Best time to reach me directly:
- School e-mail address:

References

ACT, Inc., and The Education Trust. (2004). *On course for success: A close look at selected high school courses that prepare all students for college.* Iowa City, IA: Author.

Brown, D. (2003). *The Da Vinci code.* New York: Doubleday.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics.* Reston, VA: The National Council of Teachers of Mathematics, Inc.

National Research Council. (2002). *Learning and understanding: Improving advanced study of mathematics and science in U.S. high schools.* Washington, D.C.: National Academy.

