Introduction to Algebra

Course Overview

Algebra I is a one-year course intended for students in grades 8 and 9. The course takes students through developing the tools and concepts that are central to the powerful abstraction and generalization that are made possible with algebra.

- Variables
- Grouping Symbols
- Introduction to Sets
- Equations
- Translating Words into Symbols
- Translating Sentences into Equations
- Translating Problems into Equations
- A Problem-Solving Plan
- Number Lines
- Opposites and Absolute Value

Course Outline

Working with Real Numbers

There are many different kinds of numbers. Negative numbers, positive numbers, integers, fractions, and decimals are just a few of the many groups of numbers. What do these varieties of numbers have in common? They all obey the rules of arithmetic. They can be added, subtracted, multiplied, and divided.

- Basic Assumptions
- Addition on a Number Line
- Rules for Addition
- Subtracting Real Numbers
- The Distributive Property
- Rules for Multiplication
- Problem Solving: Consecutive Integers
- The Reciprocal of a Real Number
- Dividing Real Numbers

Solving Equations and Problems, Part 1

A family tree shows you how people in your family are related to each other. A map can show you how various cities are related to each other. An equation describes how various quantities are related to each other. Once you have an equation, you may find a solution that will help you solve a real-world problem.

- Transforming Equations: Addition and Subtraction, Part 1
- Transforming Equations: Addition and Subtraction, Part 2
- Transforming Equations: Multiplication and Division, Part 1
- Transforming Equations: Multiplication and Division, Part 2
- Using Several Transformations, Part 1
- Using Several Transformations, Part 2

Solving Equations and Problems, Part 2

The Greek mathematician Diophantus is often called "the father of algebra." His book *Arithmetica* described the solutions to 130 problems. He did not discover all of these solutions himself, but he did collect many solutions that had been found by Greeks, Egyptians, and Babylonians before him. Some people of long ago obviously enjoyed doing algebra. It also helped them—and can help you—solve many real-world problems.

- Using Equations to Solve Problems, Part 1
- Using Equations to Solve Problems, Part 2
- Equations with the Variable on Both Sides
- Problem Solving: Using Charts
- Cost, Income, and Value Problems
- Proof in Algebra
- Inductive and Deductive Reasoning
- Reasoning: Counterexamples

Polynomials

Just as a train is built from linking railcars together, a polynomial is built by bringing terms together and linking them with plus or minus signs. You can perform basic operations on polynomials in the same way that you add, subtract, multiply, and divide numbers.

- Exponents
- Adding and Subtracting Polynomials, Part 1
- Adding and Subtracting Polynomials, Part 2
- Multiplying Monomials
- Powers of Monomials
- Multiplying Polynomials by Monomials
- Multiplying Polynomials
- Transforming Formulas
- Rate-Time-Distance Problems, Part 1
- Rate-Time-Distance Problems, Part 2
- Area Problems
- Problems Without Solutions

Factoring Polynomials, Part 1

A *polynomial* is an expression that has variables that represent numbers. A number can be factored, so you should be able to factor a polynomial, right? Sometimes you can and sometimes you can't. Finding ways to write a polynomial as a product of factors can be quite useful.

- Factoring Integers

- Dividing Monomials
- Monomial Factors of Polynomials
- Multiplying Binomials Mentally
- Differences of Two Squares
- Squares of Binomials

Factoring Polynomials, Part 2
When can a trinomial be factored? Why would anyone want to factor one in the first place? Once you get the hang of factoring polynomials, you can use factoring to help you solve many problems.
- Factoring Patterns, Part 1
- Factoring Patterns, Part 2
- Factoring Patterns, Part 3
- Factoring by Grouping
- Using Several Methods of Factoring
- Solving Equations by Factoring
- Using Factoring to Solve Problems

Fractions
A fraction always has a number in the numerator and in the denominator. However, those numbers can actually be expressions that represent numbers, which means you can do all sorts of interesting things with fractions. Fractions with variable expressions in the numerator and denominator can help you solve many kinds of problems.
- Simplifying Fractions
- Multiplying Fractions
- Dividing Fractions
- Least Common Denominators
- Adding and Subtracting Fractions
- Mixed Expressions
- Polynomial Long Division
- Hypothesis and Conclusion
- Sometimes, Always, and Never

Applying Fractions, Part 1
What do a scale drawing, a bicycle's gears, and a sale at the local store all have in common? They all present problems that can be solved using equations with fractions.
- Ratios, Part 1
- Ratios, Part 2
- Proportions, Part 1
- Proportions, Part 2
- Equations with Fractional Coefficients
- Dimensional Analysis
- Fractional Equations, Part 1
- Fractional Equations, Part 2

Applying Fractions, Part 2
Math is a useful tool for all kinds of scientists. Scientists must be precise in measuring things. With exponents, you can describe a very small distance, such as the width of a hair. With exponents, you can also describe very large distances, such as the distance between two planets.
- Percents, Part 1
- Percents, Part 2
- Percent Problems
- Mixture Problems
- Work Problems
- Negative Exponents
- Scientific Notation

Introduction to Functions, Part 1
A solar cell is a little machine that takes in solar energy and puts out electricity. A mathematical function is a machine that takes in a number as an input and produces another number as an output.
- Equations in Two Variables
- Points, Lines, and Their Graphs
- Slope of a Line
- The Slope-Intercept Form of a Linear Equation
- Parallel and Perpendicular Lines
- Determining an Equation of a Line
- The Point-Slope Form of a Linear Equation

Introduction to Functions, Part 2
There are many kinds of functions. Some have graphs that look like lines, while others have graphs that are curvy like a parabola. Functions can take other forms as well. Not every function has a graph that looks like a line or a parabola or even has an equation. The important thing to remember is that if you put any valid input into a function, you will get a single result out of it.
- Functions Defined by Tables and Graphs
- Functions Defined by Equations, Part 1
- Functions Defined by Equations, Part 2
- Linear and Quadratic Functions
- Relations: Domain and Range
- Direct Variation, Part 1
- Direct Variation, Part 2
- Inverse Variation

Systems of Linear Equations
When two people meet, they often shake hands or say "hello" to each other. Once they start talking to each other, they can find out what they have in common. What happens when two lines meet? Do they say anything? Probably not, but whenever two lines meet, you know they have at least one point in common. Finding the point at which they meet can help you solve problems in the real world.
- The Graphing Method
- The Substitution Method
- Solving Problems with Two Variables

- The Addition-or-Subtraction Method, Part 1
- The Addition-or-Subtraction Method, Part 2
- Multiplication with the Addition-or-Subtraction Method
- Wind and Current Problems, Part 1
- Wind and Current Problems, Part 2
- Puzzle Problems, Part 1
- Puzzle Problems, Part 2

Inequalities

Every mathematician knows that 5 is less than 7, but when is $y < x$? An inequality symbol can be used to describe how one number compares to another. It can also indicate a relationship between values.

- Order of Real Numbers
- Solving Inequalities
- Solving Problems Involving Inequalities
- Sets: Union and Intersection
- Solving Combined Inequalities
- Absolute Value in Open Sentences
- Absolute Values of Products in Open Sentences
- Graphing Linear Inequalities
- Systems of Linear Inequalities

Rational and Irrational Numbers

Are rational numbers very levelheaded? Are irrational numbers hard to reason with? Not really, but rational and irrational numbers have things in common and things that make them different.

- Properties of Rational Numbers
- Decimal Forms of Rational Numbers
- Rational Square Roots
- Irrational Square Roots
- Square Roots of Variable Expressions
- The Pythagorean Theorem
- Multiplying, Dividing, and Simplifying Radicals
- Adding and Subtracting Radicals
- Indirect Reasoning

Quadratic Functions

Solving equations can help you find answers to many kinds of problems in your daily life. Linear equations usually have one solution, but what about quadratic equations? How can you solve them and what do the solutions look like?

- Quadratic Equations with Perfect Squares
- Completing the Square
- The Quadratic Formula
- Graphs of Quadratic Equations: The Discriminant
- Methods of Solution
- Solving Problems Involving Quadratic Equations

Probability and Statistics

Statistics is the study of collecting, analyzing, interpreting, and presenting data. Since data are everywhere, statistics is a very important field of mathematics. Similarly, probability is the study of how likely events are. Statistics can help you understand probability and probability can help you understand data.

- Sample Spaces and Events
- Probability, Part 1
- Probability, Part 2
- Calculating Statistics
- Frequency Distributions
- Statistical Graphs
- Sampling, Part 1
- Sampling, Part 2

Geometry

Since Geometry is all about special figures and relationships, many people think that Algebra has little to do with it. This couldn't be further from the truth. Algebra and Geometry are topics that are intertwined since the language of Algebra can describe geometrical relationships and geometrical objects can illustrate algebraic relationships.

- Points, Lines, and Angles
- Pairs of Angles
- Triangles, Part 1
- Triangles, Part 2
- Similar Triangles
- Area
- Volume
- Scale