

- Completing the Square
- The Quadratic Formula
- Graphs of Quadratic Functions

#### Unit 4: Undoing Functions and Moving Them Around

Students explore inverses of functions in compositions, determine graphs of inverses of functions, and learn to use the horizontal line test to determine if the inverse of a function is a function. They explore how graphs can be shifted without changing their shapes, and the relationship between the change in an equation and the shift of its graph.

- Inverses
- Graphs of Inverses
- Shifting Functions
- Stretching Functions Vertically

#### Unit 5: Polynomial Functions II

Students learn to identify, evaluate, graph, and write polynomial functions. They review algebraic factoring and the Quadratic Formula, learn about imaginary and complex numbers, and learn the technique of synthetic division to divide polynomials. Additionally, they learn to apply the remainder and factor theorems, the rational roots theorem, and conjugate theorems for radical and complex numbers.

- What Is a Polynomial?
- Factoring (Reviewed)
- Imaginary Numbers
- Synthetic Division
- Factoring Polynomials Completely

#### Unit 6: Semester Wrap-Up

Students review the first semester content and take the semester exam.

- Review
- Exam

### SEMESTER TWO

#### Unit 1: Rational Expressions and Equations

Students explore the relationship between ratio and proportion, and learn to add, subtract, multiply, and divide rational expressions. They learn how to derive the golden ratio from rational expressions using the Quadratic Formula. They explore inverse variation, graphs of rational functions, and charts identifying asymptotes and zeros.

- Proportions
- Rational Expressions
- Simplifying Rational Expressions
- Multiplying and Dividing Rational Expressions
- Adding and Subtracting Rational Expressions
- Finding the Golden Ratio
- Inverse Variation
- Rational Functions
- Vertical Asymptotes
- Graphing Rational Functions



## Unit 2: Radical Expressions and Equations

Students learn to identify, add, subtract, multiply, and divide radicals, and to factor out perfect squares. Students solve real-world problems involving applications of radical equations. They learn to add and subtract complex numbers, to multiply complex numbers using the FOIL method, and to divide complex numbers by converting them into fractions.

- Basics of Radicals
- Multiplying and Dividing Radicals
- Adding and Subtracting Radicals
- Rationalizing Denominators
- Solving Radical Equations
- Rational Exponents
- Complex Numbers

## Unit 3: Exponents, Logarithms, and Their Graphs

Students discover how the exponential function can be used to describe situations in the real world and experiment with situations requiring the base  $e$ , such as exponential decay and logistic growth. They define the logarithmic function in terms of its relationship with the exponential function. They learn to apply multiplication and division laws of exponents to exponential and logarithmic equations.

- Exponential Functions
- Examples and Applications of Exponential Functions
- Graphs of Exponential Functions
- Logarithmic Functions
- Graphs of Logarithmic Functions
- Properties of Exponents and Logarithms
- Solving Exponential Equations
- Solving Logarithmic Equations

## Unit 4: Sequences and Series

Students explore arithmetic and geometric sequences, learning the concept of series as a sum of terms in a sequence and finding sums of finite arithmetic and geometric series. They also learn to describe requirements for and find sums of infinite geometric series.

- Finding Patterns
- Arithmetic Sequences
- Geometric Sequences
- Applications of Number Sequences
- Number Series



### **Unit 5: Data Analysis and Probability**

Students review basic data analysis and probability. They learn about the measures of center—mode, median, and mean—and the measures of spread—range and standard deviation. They learn how to produce box, whisker, and scatter plots. Students explore common sampling techniques and learn how to design and carry out an experiment.

- Review of Basic Data Analysis
- Review of Basic Probability
- Advanced Counting Principles
- Conditional and Compound Probability
- Data Gathering and Inferential Statistics
- Random Variables
- Two-Variable Data
- Experimental Design

### **Unit 6: Semester Wrap-Up**

Students review the second semester content and take the final exam.

- Review
- Exam



# MTH312: Business and Consumer Math

Students learn mathematical skills relevant to everyday life, such as balancing a checkbook, calculating net pay, budgeting expenses, making cost comparisons, buying and renting a home, and finding the cost of operating a motor vehicle. Students also explore business topics, including borrowing money, investing, and calculating business profits and losses. The course guides students toward logical thinking and problem solving to help them make good decisions about money and finance. Through projects and activities, students apply their skills and knowledge to real-life situations.

**COURSE LENGTH:** One semester

**MATERIALS:** None

**PREREQUISITES:** MTH112 or MTH113: Pre-Algebra (or equivalent) recommended, but not required

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## UNIT 1: MATH REVIEW

### Lesson 1: Whole Numbers and Decimals

**Topic 1:** Review of Whole Numbers and Decimals

**Lesson Activities:**

- Self-Check Review Problems

### Lesson 2: Order of Operations

**Topic 1:** Review of Order of Operations

**Lesson Activities:**

- Self-Check Review Problems

### Lesson 3: Fractions

**Topic 1:** Review of Fractions

**Lesson Activities:**

- Self-Check Review Problems

### Lesson 4: Percents

**Topic 1:** Review of Percents

**Lesson Activities:**

- Self-Check Review Problems

## UNIT 2: EARNING AN INCOME

### Lesson 1: Gross Pay

**Topic 1:** Calculating Gross Wages

**Topic 2:** Gross Pay Applications



**Lesson Activities:**

- Self-Check Review Problems
- Lesson/Quiz Review

**Lesson Assignments and Assessments:**

- Lesson 1 Quiz

**Lesson 2: Net Pay**

**Topic 1:** Calculating Net Wages

**Topic 2:** Net Pay Applications

**Lesson Activities:**

- Self-Check Review Problems
- Lesson/Quiz Review

**Lesson Discussion:**

- Topic: Federal Insurance Contributions Act (FICA)

**Lesson Assignments and Assessments:**

- Notebook: Earning an Income
- Lesson 2 Quiz

**Unit Assignments and Assessments:**

- Notebook: Earning an Income Project

**UNIT 3: BANKING & CREDIT****Lesson 1: Banking Basics**

**Topic 1:** Checking and Savings Accounts

**Topic 2:** Check Register/Balancing

**Lesson Activities:**

- Self-Check Review Problems
- Lesson/Quiz Review

**Lesson Assignments and Assessments:**

- Lesson 1 Quiz

**Lesson 2: Loans and Credit Cards**

**Topic 1:** What Are Loans?

**Topic 2:** How Credit Cards Work

**Topic 3:** Loan/Credit Card Applications

**Lesson Activities:**

- Self-Check Review Problems
- Lesson/Quiz Review

**Lesson Assignments and Assessments:**

- Lesson 2 Quiz

**Lesson 3: Credit Problems**

**Topic 1:** Personal Credit Problems

**Topic 2:** Business Credit Problems

**Topic 3:** Credit Problem Applications

**Lesson Activities:**

- Self-Check Review Problems
- Lesson/Quiz Review

**Lesson Discussion:**

- Topic: Bankruptcy

**Lesson Assignments and Assessments:**

- Notebook: Banking and Credit
- Lesson 3 Quiz

**Unit Assignments and Assessments:**

- Notebook: Banking and Credit Project

**UNIT 4: BUDGETING AND MAJOR EXPENSES****Lesson 1: Developing a Budget**

**Topic 1:** Fixed and Flexible Expenses

**Topic 2:** Budgeting

**Lesson Activities:**

- Self-Check Review Problems
- Lesson/Quiz Review

**Lesson Assignments and Assessments:**

- Lesson 1 Quiz



## **Lesson 2: Buying and Renting Living Space**

**Topic 1:** Buying Living Space

**Topic 2:** Renting Living Space

**Topic 3:** Business Space

### **Lesson Activities:**

- Self-Check Review Problems
- Lesson/Quiz Review

### **Lesson Discussion:**

- Topic: Home-Based Business

### **Lesson Assignments and Assessments:**

- Notebook: Budgeting Major Expenses
- Lesson 2 Quiz

## **Lesson 3: Transportation**

**Topic 1:** Motor Vehicle Depreciation

**Topic 2:** Vehicle Purchasing and Leasing

**Topic 3:** Vehicle Costs

### **Lesson Activities:**

- Self-Check Review Problems
- Lesson/Quiz Review

### **Lesson Assignments and Assessments:**

- Lesson 3 Quiz

### **Unit Assignments and Assessments:**

- Notebook: Budgeting Major Expenses Project

## **UNIT 5: PERSONAL CONSIDERATIONS**

### **Lesson 1: Utility Costs**

**Topic 1:** Energy Costs

**Topic 2:** Water Costs

**Topic 3:** Telephone Costs

### **Lesson Activities:**

- Self-Check Review Problems
- Lesson/Quiz Review

**Lesson Discussion:**

- Topic: Long-Distance Phone Service

**Lesson Assignments and Assessments:**

- Notebook: Personal Considerations
- Lesson 1 Quiz

**Lesson 2: Consumer Considerations**

**Topic 1:** Nutrition Labels

**Topic 2:** Dining In or Out

**Topic 3:** Taxes and Gratuities

**Topic 4:** Counting Back Change

**Lesson Activities:**

- Self-Check Review Problems
- Lesson/Quiz Review

**Lesson Assignments and Assessments:**

- Lesson 2 Quiz

**Unit Assignments and Assessments:**

- Notebook: Personal Considerations Project

**UNIT 6: BUSINESS CONSIDERATIONS****Lesson 1: Business Analysis**

**Topic 1:** Measures of Central Tendency

**Topic 2:** Probability

**Topic 3:** Graphs

**Topic 4:** Economic Statistics

**Lesson Activities:**

- Self-Check Review Problems
- Lesson/Quiz Review

**Lesson Assignments and Assessments:**

- Lesson 1 Quiz



## **Lesson 2: Business Calculations**

**Topic 1:** Profit and Loss

**Topic 2:** Series Discounts

**Topic 3:** Pricing for Profit

**Topic 4:** Finding the Break-Even Point

**Topic 5:** Sales Record

### **Lesson Activities:**

- Self-Check Review Problems
- Lesson/Quiz Review

### **Lesson Discussion:**

- Topic: New Product Questions

### **Lesson Assignments and Assessments:**

- Notebook: Business Considerations
- Lesson 2 Quiz

### **Unit Assignments and Assessments:**

- Notebook: Business Considerations Project

## **UNIT 7: MANAGING MONEY**

### **Lesson 1: Insurance**

**Topic 1:** Life Insurance

**Topic 2:** Health Insurance

**Topic 3:** Property Insurance

**Topic 4:** Automobile Insurance

### **Lesson Activities:**

- Self-Check Review Problems
- Lesson/Quiz Review

### **Lesson Assignments and Assessments:**

- Lesson 1 Quiz



## **Lesson 2: Investments**

**Topic 1:** Bonds

**Topic 2:** Stocks

**Topic 3:** Retirement

### **Lesson Activities:**

- Self-Check Review Problems
- Lesson/Quiz Review

### **Lesson Discussion:**

- Topic: Stock Market Crashes

### **Lesson Assignments and Assessments:**

- Notebook: Managing Money
- Lesson 2 Quiz

### **Unit Assignments and Assessments:**

- Notebook: Managing Money Project





# MTH113: Pre-Algebra

In this course, students take a broader look at computational and problem-solving skills while learning the language of algebra. Students translate word phrases and sentences into mathematical expressions; analyze geometric figures; solve problems involving percentages, ratios, and proportions; graph different kinds of equations and inequalities; calculate statistical measures and probabilities; apply the Pythagorean theorem; and explain strategies for solving real-world problems. Online lessons provide demonstrations of key concepts, as well as interactive problems with contextual feedback. A textbook supplements the online material.

Compared to MTH112, this course has a more rigorous pace as well as more challenging assignments and assessments. It also covers additional topics such as scientific notation, geometric congruence, systems of linear equations, and trigonometric ratios that are not covered in MTH112.

**COURSE LENGTH:** Two semesters

**MATERIALS:** *Pre-Algebra: A Reference Guide and Problem Sets*

**PREREQUISITES:** K<sup>12</sup> Pre-Algebra A, MTH102: Math Foundations, or equivalent

**NOTE:** Students who have already succeeded in K<sup>12</sup> middle school Pre-Algebra B should not enroll in this course.

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## SEMESTER ONE

### Unit 1: The Basics

Let's start at the very beginning; it's a very good place to start. Just as you need to know basic grammar and vocabulary as you begin to learn any language, you need to know some basic building blocks as you begin to learn algebra.

- Semester Introduction
- Order of Operations
- Variable Expressions
- Writing Expressions for Word Phrases
- Comparing Expressions
- Replacement Sets
- Related Equations
- Solving Problems

### Unit 2: Addition and Subtraction

If you have two oranges and a friend gives you three oranges, how many do you have? If you then give four oranges to your friend, how many are you left with? This sort of addition and subtraction problem with passing fruit back and forth is the type of simple math you have done since you were very young. When you expand your addition and subtraction skills to negative numbers and decimals, you can solve many more complicated problems.

- Integers on a Number Line
- Adding Integers
- Subtracting Integers
- Discuss: Integers
- Decimals on a Number Line
- Adding Decimals
- Subtracting Decimals

- Addition and Subtraction Properties
- Equations Involving Addition and Subtraction
- Addition and Subtraction Applications

### Unit 3: Multiplication and Division

Isaac Newton's third law of motion is often paraphrased as "for every action, there is an equal and opposite reaction." Just as forces come in pairs, so can mathematical operations. Multiplication and division are inverse operations. They undo each other and can both be used to solve many types of problems.

- Multiplying Integers and Decimals
- Dividing Integers and Decimals
- Multiplication and Division Properties
- Rounding and Estimation
- Equations Involving Multiplication and Division
- Multiplication and Division Applications

### Unit 4: Fractions

Every fraction can be written as a decimal, and every decimal can be written as a fraction. As a result, you could do just about all math with only fractions or only decimals, but decimals are used for certain applications just as fractions are used for others. For example, carpenters use fractions and mixed numbers quite a bit. Anybody building a house or a deck deals with lots of fractions.

- Equivalent Fractions
- Multiplying Fractions
- Dividing Fractions
- Discuss: Fractions
- Common Denominators
- Adding and Subtracting Fractions
- Working with Mixed Numbers
- Multiplying and Dividing Mixed Numbers
- Equations with Fractions

### Unit 5: Combined Operations

Many yachts can be powered by the wind, by a gas engine, or by both. A hybrid automobile can run on gasoline or electric power. These combinations are very powerful. Combining addition or subtraction with multiplication or division is powerful as well. You can use equations and expressions with mixed operations to solve many complex problems.

- The Distributive Property
- Like Terms
- Expressions with Mixed Operations
- Equations with Mixed Operations
- Error Analysis
- Inequalities



## Unit 6: Number Properties

Astronomers study things that are very, very far away. For example, the Horsehead Nebula is about 14,000 trillion kilometers away. At the other extreme, molecular geneticists study things that are very, very small. A double helix of DNA has a diameter of about one nanometer (a billionth of a meter). With exponents, you can describe very great or very small distances.

- Positive Exponents
- Factors and Primes
- GCF and Relative Primes
- Negative Exponents
- Powers of Ten
- Scientific Notation

## Unit 7: Geometry Basics

Shapes such as polygons and circles provide us with shelter, art, and transportation. Some artists use geometric shapes in their art, but most painters and photographers use rectangular frames to surround their art. Look at any art museum, and you will see triangles, rectangles, and other polygons in the structure of the building and in the artwork inside.

- Points, Lines, and Planes
- Rays and Angles
- Parallel Lines and Transversals
- Discuss: Shapes
- Triangles
- Polygons
- Circles
- Transformations
- Congruence

## Unit 8: Semester Review and Test

- Semester Review
- Semester Test

## SEMESTER TWO

### Unit 1: Ratio, Proportion, and Percent

Model builders use ratios and percents to describe how their models compare to real objects. They can use proportions to figure out the length of every item in the model.

- Semester Introduction
- Ratio
- Proportion
- Discuss: Ratio and Proportion
- Percents, Fractions, and Decimals
- Similarity and Scale
- Working with Percent
- Percent of Increase or Decrease
- Simple Interest

## Unit 2: Analytic Geometry

A pilot uses numbers to locate the airport she is flying to. An air traffic controller uses numbers on a radar screen to locate each airplane approaching the airport. Without a system of locating points, airplanes would have a hard time getting anywhere safely.

- Points on the Plane
- Two-Variable Equations
- Linear Equations and Intercepts
- Slope, Part 1
- Slope, Part 2
- Problem Solving
- Functions, Part 1
- Functions, Part 2
- Systems of Linear Equations

## Unit 3: Perimeter and Area

You can find geometric shapes in art. Whether determining the amount of leading or the amount of glass for a piece of stained-glass art, stained-glass artists need to understand perimeter and area to solve many practical problems.

- Types of Polygons
- Perimeter
- Areas of Rectangles and Triangles
- Discuss: Measurement
- Special Quadrilaterals
- Areas of Special Quadrilaterals
- Circumference
- Areas of Circles

## Unit 4: Square Roots and Right Triangles

Since ancient times, people have used right triangles to survey land and build structures. Even before Pythagoras was born, the relationship between the side lengths of a right triangle has been essential to anyone building just about any structure, including pyramids, houses, skyscrapers, and bridges.

- Rational Square Roots
- Irrational Square Roots
- The Pythagorean Theorem
- The Distance Formula
- Special Types of Triangles
- Trigonometric Ratios

## Unit 5: Solid Figures

Gas-powered engines are driven by little explosions that move pistons up and down in cylinders. When you add up the volume of all the cylinders, you get the displacement of the engine. For instance, each cylinder in a four-cylinder, 1000 cc engine has a volume of 250 cubic centimeters. Engineers and mechanics must accurately compute volume when they build or maintain engines.

- Volume and Capacity
- Volumes of Prisms and Cylinders



- Discuss: Volume
- Volumes of Pyramids and Cones
- Surface Area
- Surface Areas of Prisms and Cylinders

### **Unit 6: Counting and Probability**

How many apples have mass between 100 and 200 grams? How many are bruised? How many are not yet ripe? Checking every single apple would probably be pretty impractical, but if you understand probability and sampling, you could make a good estimate.

- Counting Principles
- Permutations
- Combinations
- Probability
- Mutually Exclusive Events
- Samples and Prediction

### **Unit 7: Statistics**

Data are everywhere. When you look at a group of people, you could use many numbers to describe them. How tall are they? How long is their hair? How old are they? What is their gender? What color are their eyes? Statistics helps you make sense of data.

- Graphs
- Measures of Center
- Stem-and-Leaf Plots
- Box-and-Whisker Plots
- Frequency Tables and Histograms

### **Unit 8: Semester Review and Test**

- Semester Review
- Semester Test





# MTH123: Algebra I

Students develop algebraic fluency by learning the skills needed to solve equations and perform manipulations with numbers, variables, equations, and inequalities. They also learn concepts central to the abstraction and generalization that algebra makes possible. Students learn to use number properties to simplify expressions or justify statements; describe sets with set notation and find the union and intersection of sets; simplify and evaluate expressions involving variables, fractions, exponents, and radicals; work with integers, rational numbers, and irrational numbers; and graph and solve equations, inequalities, and systems of equations. They learn to determine whether a relation is a function and how to describe its domain and range; use factoring, formulas, and other techniques to solve quadratic and other polynomial equations; formulate and evaluate valid mathematical arguments using various types of reasoning; and translate word problems into mathematical equations and then use the equations to solve the original problems.

Compared to MTH122, this course has a more rigorous pace as well as more challenging assignments and assessments. It also covers additional topics such as number, cost, and mixture problems. Also included are translating functions, higher degree roots (such as cube roots and fourth roots), and using more difficult factoring techniques that are not covered in MTH122.

**COURSE LENGTH:** Two semesters

**MATERIALS:** *Algebra I: A Reference Guide and Problem Sets*

**PREREQUISITES:** K<sup>12</sup> Pre-Algebra B, MTH113: Pre-Algebra, or equivalent

**NOTE:** Students who have already succeeded in K<sup>12</sup> middle school Algebra 1 should not enroll in this course.

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## SEMESTER ONE

### Unit 1: Algebra Basics

The English word algebra and the Spanish word *algebrista* both come from the Arabic word *al-jabr*, which means “restoration.” A barber in medieval times often called himself an *algebrista*. The *algebrista* also was a bonesetter who restored or fixed bones. Mathematicians today use algebra to solve problems. Algebra can find solutions and “fix” certain problems that you encounter.

- Semester Introduction
- Expressions
- Variables
- Translating Words into Variable Expressions
- Equations
- Translating Words into Equations
- Replacement Sets
- Problem Solving

### Unit 2: Properties of 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.

- Number Lines
- Sets
- Comparing Expressions
- Number Properties



- Distributive Property
- Algebraic Proof
- Opposites and Absolute Value

### Unit 3: Operations 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.

- Addition
- Subtraction
- Multiplication
- Reciprocals and Division
- Applications: Number Problems

### Unit 4: Solving Equations

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.

- Addition and Subtraction Equations
- Multiplication and Division Equations
- Multiple Transformations
- Variables on Both Sides of an Equation
- Transforming Formulas
- Estimating Solutions
- Cost Problems

### Unit 5: Solving 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.

- Inequalities
- Solving Inequalities
- Combined Inequalities
- Absolute Value Equations and Inequalities
- Applications: Inequalities

### Unit 6: Applying Fractions

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
- Proportions
- Percents
- Applications: Percents
- Applications: Mixture Problems

## Unit 7: Linear Equations and Inequalities

You've probably heard the phrase, "That's where I draw the line!" In algebra, you can take this expression literally. Linear functions and their graphs play an important role in the never-ending quest to model the real world.

- Equations in Two Variables
- Graphs
- Lines and Intercepts
- Slope
- Slope-Intercept Form
- Point-Slope Form
- Parallel and Perpendicular Lines
- Equations from Graphs
- Applications: Linear Models
- Graphing Linear Inequalities
- Inequalities from Graphs

## Unit 8: Systems of 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.

- Systems of Equations
- Substitution Method
- Linear Combination
- Linear Combination with Multiplication
- Applications: Systems of Linear Equations
- Systems of Linear Inequalities

## Unit 9: Semester Review and Test

- Semester Review
- Semester Test

## SEMESTER TWO

### Unit 1: Relations and Functions

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. There are many kinds of functions. Some have graphs that look like lines, while others have graphs that curve like a parabola. Functions can take other forms as well. Not every function has a graph that looks like a line or a parabola. Not every function 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.

- Semester Introduction
- Relations
- Functions
- Function Equations
- Absolute Value Functions
- Direct Linear Variation

- Quadratic Variation
- Inverse Variation
- Translating Functions

## Unit 2: Rationals, Irrationals, and Radicals

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.

- Rational Numbers
- Terminating and Repeating Numbers
- Square Roots
- Irrational Numbers
- Evaluating and Estimating Square Roots
- Radicals with Variables
- Roots of Equations
- The Pythagorean Theorem
- Higher Roots

## Unit 3: Working with 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.

- Overview of Polynomials
- Adding and Subtracting Polynomials
- Multiplying Monomials
- Multiplying Polynomials by Monomials
- Multiplying Polynomials
- The FOIL Method

## Unit 4: Factoring Polynomials

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
- Factoring Common Factors
- Dividing Polynomials by Monomials
- Factoring Perfect Squares
- Factoring Differences of Squares
- Factoring Quadratic Trinomials
- Factoring Quadratic Trinomials,  $a \neq 1$
- Factoring Completely
- Finding Roots of Equations



### Unit 5: Quadratic Equations

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?

- Solving Perfect Square Equations
- Completing the Square
- The Quadratic Formula
- Solving Quadratic Equations
- Equations and Graphs: Roots and Intercepts
- Applications: Area Problems
- Applications: Projectile Motion

### Unit 6: Rational Expressions

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 Rational Expressions
- Multiplying Rational Expressions
- Dividing Rational Expressions
- Like Denominators
- Adding and Subtracting Rational Expressions

### Unit 7: Logic and Reasoning

Professionals use logical reasoning in a variety of ways. Just as lawyers use logical reasoning to formulate convincing arguments, mathematicians use logical reasoning to formulate and prove theorems. Once you have mastered the uses of inductive and deductive reasoning, you will be able to make and understand arguments in many areas.

- Reasoning and Arguments
- Hypothesis and Conclusion
- Forms of Conditional Statements
- Inductive and Deductive Reasoning
- Analyzing and Writing Proofs
- Counterexample

### Unit 8: Semester Review and Test

- Semester Review
- Semester Test



# MTH203: Geometry

Students learn to recognize and work with geometric concepts in various contexts. They build on ideas of inductive and deductive reasoning, logic, concepts, and techniques of Euclidean plane and solid geometry and develop an understanding of mathematical structure, method, and applications of Euclidean plane and solid geometry. Students use visualizations, spatial reasoning, and geometric modeling to solve problems. Topics of study include points, lines, and angles; triangles; right triangles; quadrilaterals and other polygons; circles; coordinate geometry; three-dimensional solids; geometric constructions; symmetry; the use of transformations; and non-Euclidean geometries.

**COURSE LENGTH:** Two semesters

**MATERIALS:** *Geometry: A Reference Guide*; a drawing compass, protractor, and ruler

**PREREQUISITES:** MTH123: Algebra I, or equivalent

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## SEMESTER ONE

### Unit 1: An Introduction

Even the longest journey begins with a single step. Any journey into the world of geometry begins with the basics. Points, lines, segments, and angles are the foundation of geometric reasoning. This unit provides you with basic footing that will lead to an understanding of geometry.

- Semester Introduction
- Basic Geometric Terms and Concepts
- Measuring Length
- Measuring Angles
- Bisectors and Line Relationships
- Relationships between Triangles and Circles
- Transformations
- Using Algebra to Describe Geometry

### Unit 2: Methods of Proof and Logic

Professionals use logical reasoning in a variety of ways. Just as lawyers use logical reasoning to formulate convincing arguments, mathematicians use logical reasoning to formulate and prove theorems. With definitions, assumptions, and previously proven theorems, mathematicians discover and prove new theorems. It's like building a defense, one argument at a time. In this unit, you will learn how to build a defense from postulates, theorems, and sound reasoning.

- Reasoning, Arguments, and Proof
- Conditional Statements
- Compound Statements and Indirect Proof
- Definitions and Biconditionals
- Algebraic Logic
- Inductive and Deductive Reasoning



### Unit 3: Polygon Basics

You can find polygons in many places: artwork, sporting events, architecture, and even in roads. In this unit, you will discover symmetry, work with special quadrilaterals, and work with parallel lines and slopes.

- Polygons and Symmetry
- Quadrilaterals and Their Properties
- Parallel Lines and Transversals
- Converses of Parallel Line Properties
- The Triangle Sum Theorem
- Angles in Polygons
- Midsegments
- Slope

### Unit 4: Congruent Polygons and Special Quadrilaterals

If two algebraic expressions are equivalent, they represent the same value. What about geometric shapes? What does it mean for two figures to be equivalent? A pair of figures can be congruent the same way that a pair of algebraic expressions can be equivalent. You will learn, use, and prove theorems about congruent geometric figures.

- Congruent Polygons and Their Corresponding Parts
- Triangle Congruence: SSS, SAS, and ASA
- Isosceles Triangles and Corresponding Parts
- Triangle Congruence: AAS and HL
- Using Triangles to Understand Quadrilaterals
- Types of Quadrilaterals
- Constructions with Polygons
- The Triangle Inequality Theorem

### Unit 5: Perimeter, Area, and Right Triangles

If you have a figure, you can take many measurements and calculations. You can measure or calculate the distance around the figure (the perimeter or circumference), as well as the figure's height and area. Even if you have just a set of points, you can measure or calculate the distance between two points.

- Perimeter and Area
- Areas of Triangles and Quadrilaterals
- Circumference and Area of Circles
- The Pythagorean Theorem
- Areas of Special Triangles and Regular Polygons
- Using the Distance Formula
- Proofs and Coordinate Geometry

### Unit 6: Semester Review and Test

- Semester Review
- Semester Test



## SEMESTER TWO

### Unit 1: Three-Dimensional Figures and Graphs

One-dimensional figures, such as line segments, have length. Two-dimensional figures, such as circles, have area. Objects we touch and feel in the real world are three-dimensional; they have volume.

- Semester Introduction
- Solid Shapes and Three-Dimensional Drawing
- Lines, Planes, and Polyhedra
- Prisms
- Coordinates in Three Dimensions
- Equations of Lines and Planes in Space

### Unit 2: Surface Area and Volume

Every three-dimensional figure has surface area and volume. Some figures are more common and useful than others. You probably see pyramids, prisms, cylinders, cones, and spheres every day. In this unit, you will learn how to calculate the surface area and volume of several common and useful three-dimensional figures.

- Surface Area and Volume
- Surface Area and Volume of Prisms
- Surface Area and Volume of Pyramids
- Surface Area and Volume of Cylinders
- Surface Area and Volume of Cones
- Surface Area and Volume of Spheres
- Three-Dimensional Symmetry

### Unit 3: Similar Shapes

A map of a city has the same shape as the original city, but the map is much, much smaller. A mathematician would say that the map and the city are similar. They have the same shape but are different sizes.

- Dilations and Scale Factors
- Similar Polygons
- Triangle Similarity
- Side-Splitting Theorem
- Indirect Measurement and Additional Similarity Theorems
- Area and Volume Ratios

### Unit 4: Circles

You probably know what a circle is and what the radius and diameter of a circle represent. However, a circle can have many more figures associated with it. Arcs, chords, secants, and tangents all provide a rich set of figures to draw, measure, and understand.

- Chords and Arcs
- Tangents to Circles
- Inscribed Angles and Arcs
- Angles Formed by Secants and Tangents
- Segments of Tangents, Secants, and Chords
- Circles in the Coordinate Plane



### Unit 5: Trigonometry

Who uses trigonometry? Architects, engineers, surveyors, and many other professionals use trigonometric ratios such as sine, cosine, and tangent to compute distances and understand relationships in the real world.

- Tangents
- Sines and Cosines
- Special Right Triangles
- The Laws of Sines and Cosines

### Unit 6: Beyond Euclidian Geometry

Some people break rules, but mathematicians are usually very good at playing by them. Creative problem-solvers, including mathematicians, create new rules, and then play by their new rules to solve many kinds of problems.

- The Golden Rectangle
- Taxicab Geometry
- Graph Theory
- Topology
- Spherical Geometry
- Fractal Geometry
- Projective Geometry
- Computer Logic

### Unit 7: Semester Review and Test

- Semester Review
- Semester Test



# MTH303: Algebra II

This course builds upon algebraic concepts covered in Algebra I and prepares students for advanced-level courses. Students extend their knowledge and understanding by solving open-ended problems and thinking critically. Topics include conic sections, functions and their graphs, quadratic functions, inverse functions, and advanced polynomial functions. Students are introduced to rational, radical, exponential, and logarithmic functions; sequences and series; and data analysis.

**COURSE LENGTH:** Two semesters

**MATERIALS:** None

**PREREQUISITES:** MTH123: Algebra I and MTH203: Geometry

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## SEMESTER ONE

### Unit 1: Conic Sections

Students learn about conic sections that are points or lines and curved conic sections, including circles, ellipses, hyperbolas, and parabolas. They learn how to graph conic sections, how to use algebraic reasoning to create equations, and how to solve real-world problems.

- What Is a Conic Section?
- Geometry of Conic Sections
- Circles
- Ellipses
- Hyperbolas
- Parabolas
- Nonlinear Systems of Equations
- Nonlinear Inequalities

### Unit 2: Functions, Relations, and Their Graphs

Students explore real-world situations regarding input and output, and learn how to graph equations and differentiate between functions and relations. They learn to estimate and calculate domains and ranges of functions and to compose complicated functions from simpler ones. Students learn to express situations in function notation, calculate domains and ranges, and solve compositions.

- How Many Outputs?
- Functions and Relations
- Domain and Range
- Composition of Functions
- Solving Problems with Composition

### Unit 3: Quadratic Functions

Students learn how to factor trinomials, distinguish quadratic from non-quadratic equations, and apply the Zero Product Rule to factored equations. They explore the Quadratic Formula and how factors of quadratic polynomials relate to x-intercepts of graphs of quadratic functions.

- Factoring  $x^2+bx+c$
- Factoring  $ax^2+bx+c$
- Special Cases

- Solving Quadratic Equations
- Completing the Square
- The Quadratic Formula
- Graphs of Quadratic Functions

#### Unit 4: Undoing Functions and Moving Them Around

Students explore inverses of functions in compositions, determine graphs of inverses of functions, and learn to use the horizontal line test to determine if the inverse of a function is a function. They explore how graphs can be shifted without changing their shapes and the relationship between the change in an equation and the shift of its graph.

- Inverses
- Graphs of Inverses
- Shifting Functions
- Stretching Functions Vertically

#### Unit 5: Polynomial Functions II

Students learn to identify, evaluate, graph, and write polynomial functions. They review algebraic factoring and the Quadratic Formula, learn about imaginary and complex numbers, and learn the technique of synthetic division to divide polynomials. Additionally, they learn to apply the remainder and factor theorems, the rational roots theorem, and conjugate theorems for radical and complex numbers.

- What Is a Polynomial?
- Factoring (Reviewed)
- Imaginary Numbers
- Synthetic Division
- Factoring Polynomials Completely

#### Unit 6: Semester Wrap-Up

Students review the first semester content and take the semester exam.

- Review
- Exam

### SEMESTER TWO

#### Unit 1: Rational Expressions and Equations

Students explore the relationship between ratio and proportion and learn to add, subtract, multiply, and divide rational expressions. They learn how to derive the golden ratio from rational expressions using the Quadratic Formula. They explore inverse variation, graphs of rational functions, and charts identifying asymptotes and zeros.

- Proportions
- Rational Expressions
- Simplifying Rational Expressions
- Multiplying and Dividing Rational Expressions
- Adding and Subtracting Rational Expressions
- Finding the Golden Ratio
- Inverse Variation
- Rational Functions
- Vertical Asymptotes
- Graphing Rational Functions

## Unit 2: Radical Expressions and Equations

Students learn to identify, add, subtract, multiply, and divide radicals, and to factor out perfect squares. Students solve real-world problems involving applications of radical equations. They learn to add and subtract complex numbers, to multiply complex numbers using the FOIL method, and to divide complex numbers by converting them into fractions.

- Basics of Radicals
- Multiplying and Dividing Radicals
- Adding and Subtracting Radicals
- Rationalizing Denominators
- Solving Radical Equations
- Rational Exponents
- Complex Numbers

## Unit 3: Exponents, Logarithms, and Their Graphs

Students discover how the exponential function can be used to describe situations in the real world and experiment with situations requiring the base  $e$ , such as exponential decay and logistic growth. They define the logarithmic function in terms of its relationship with the exponential function. They learn to apply multiplication and division laws of exponents to exponential and logarithmic equations.

- Exponential Functions
- Examples and Applications of Exponential Functions
- Graphs of Exponential Functions
- Logarithmic Functions
- Graphs of Logarithmic Functions
- Properties of Exponents and Logarithms
- Solving Exponential Equations
- Solving Logarithmic Equations

## Unit 4: Sequences and Series

Students explore arithmetic and geometric sequences, learning the concept of series as a sum of terms in a sequence, and finding sums of finite arithmetic and geometric series. They also learn to describe requirements for and find sums of infinite geometric series.

- Finding Patterns
- Arithmetic Sequences
- Geometric Sequences
- Applications of Number Sequences
- Number Series

## Unit 5: Data Analysis and Probability

Students review basic data analysis and probability. They learn about the measures of center—mode, median, and mean—and the measures of spread—range and standard deviation. They learn how to produce box, whisker, and scatter plots. Students explore common sampling techniques and learn how to design and carry out an experiment.

- Review of Basic Data Analysis
- Review of Basic Probability
- Advanced Counting Principles
- Conditional and Compound Probability



- Data Gathering and Inferential Statistics
- Random Variables
- Two-Variable Data
- Experimental Design

### **Unit 6: Semester Wrap-Up**

Students review the second semester content and take the final exam.

- Review
- Exam





# MTH403: Pre-Calculus/Trigonometry

Pre-calculus weaves together previous study of algebra, geometry, and functions into a preparatory course for calculus. The course focuses on the mastery of critical skills and exposure to new skills necessary for success in subsequent math courses. Topics include linear, quadratic, exponential, logarithmic, radical, polynomial, and rational functions; systems of equations; and conic sections in the first semester. The second semester covers trigonometric ratios and functions; inverse trigonometric functions; applications of trigonometry, including vectors and laws of cosine and sine; polar functions and notation; and arithmetic of complex numbers. Cross-curricular connections are made throughout the course to calculus, art, history, and a variety of other fields related to mathematics.

**COURSE LENGTH:** Two semesters

**MATERIALS:** A Texas Instruments T1-84 Plus graphing calculator

**PREREQUISITES:** Success in MTH203: Geometry and MTH303: Algebra II

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## SEMESTER ONE

### Unit 1: Functions

In mathematics, a function is a fundamental concept, as basic to mathematics as sentences are to language. In this unit, students learn to communicate about functions using a mathematical vocabulary of symbols, equations, graphs, tables of numbers, and words. They learn to explain what a mathematical function is, describe functions in terms of their domain and range, solve problems that involve linear and other special functions, and combine two or more functions to create new functions.

- What Is a Function?
- Graphing Functions
- Linear Functions
- Arithmetic Sequences and Series
- Linear Equations and Inequalities
- Linear Systems
- Arithmetic of Functions

### Unit 2: Quadratic Functions

Students explore important characteristics of quadratic functions. They learn to graph them, use their properties to solve equations, and model real-world situations with them.

- Forms of Quadratic Functions
- Graphing Quadratic Functions
- Transformations
- Solving Quadratic Equations
- Applications of Quadratic Functions

### Unit 3: Polynomial and Rational Functions

Students explore interesting characteristics of polynomial and rational functions. They learn to classify them, perform operations with them, use their properties to solve equations, and model real-world situations with them.

- Polynomial Expressions
- Dividing Polynomials
- Solving Polynomial Equations
- Graphing Polynomial Functions
- Rational Functions



#### Unit 4: Exponential and Logarithmic Functions

Students sharpen their skills in working with exponents and radicals, see new applications of exponential functions, and learn to undo exponential functions with logarithmic functions.

- Exponents and Radicals
- Exponential Functions
- Geometric Sequences
- Introduction to Logarithms
- Graphs of Logarithmic Functions
- Applications of Logarithms

#### Unit 5: Conic Sections

Conic sections are real-life phenomena that are found in architecture, space, nature, and more. Students explore how and where they occur as they progress through this unit, learning about four conic sections—circles, ellipses, hyperbolas, and parabolas.

- Introduction to Conic Sections
- Ellipses
- Hyperbolas
- Parabolas
- Systems of Conic Sections

#### Unit 6: Semester Review

Students review what they have learned and take the semester exam.

- Review
- Exam

### SEMESTER TWO

#### Unit 1: Right Triangles

During the next several units, students build their understanding of trigonometry and learn to apply it to many kinds of problems. In this unit, they learn some of the basic vocabulary and concepts that are the building blocks of trigonometry.

- Right Triangles
- Angles and Radians
- Trigonometric Ratios and the Unit Circle

#### Unit 2: Trigonometric Functions

Students focus on the algebraic and graphical properties of the trigonometric functions and how to transform them. Their predictable behavior makes them easy to graph and manipulate.

- Graphs of Sine and Cosine
- Graphs of Other Functions
- Simple Transformations of Sinusoids
- General Transformations of Periodic Graphs



### Unit 3: Working with Trigonometric Functions

Students learn the foundational skills to solve trigonometric equations analytically or with the assistance of a calculator. They investigate some of the simpler applications of these techniques.

- Inverse Trigonometric Functions
- Solving Trigonometric Equations
- Modeling Simple Harmonic Motion

### Unit 4: Trigonometric Identities

The study of trigonometry provides an opportunity to investigate mathematical statements involving trigonometric functions. Students learn the important distinction between a mathematical identity and a mathematical equation and practice proving identities and solving equations.

- Identities and Proof
- Trigonometric Identities
- Applications of Identities

### Unit 5: Applications of Trigonometry

Students see that solving an oblique triangle can actually be a matter of “seeing” a right triangle that is aligned with it and that familiar trigonometric identities and formulas that worked for right triangles can be altered to derive techniques that work for oblique triangles.

- Law of Cosines
- Law of Sines
- Vectors

### Unit 6: Complex Numbers

Students learn to plot points and express coordinates in the polar coordinate system; convert between polar and rectangular coordinates; graph polar equations; and add, subtract, multiply, and divide complex numbers in both polar and rectangular coordinate systems. They learn to calculate powers of complex numbers using De Moivre’s theorem, to calculate roots of complex numbers, and to understand roots of unity and their graphical interpretation.

- Polar Coordinates
- Graphs of Polar Functions
- Polar Form of Complex Numbers
- Arithmetic of Complex Numbers
- Powers and Roots of Complex Numbers

### Unit 7: Semester Review

Students review what they have learned and take the semester exam.

- Review
- Exam



# BUS030: Personal Finance (Elective)

Students learn about different aspects of personal economics and finance in a virtual neighborhood setting. Topics include spending plans and borrowing decisions; career planning; and investing, insurance, and other financial services. Students complete activities and projects to apply the knowledge they gain to their own lives. This course may meet the needs of most students requiring financial skills or economics credit.

**COURSE LENGTH:** One semester

**MATERIALS:** None

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## UNIT 1: Making a Spending Decision

- Introduction
- What should I think about?
- What are my options?
- What would I be giving up?
- Which option is best?
- Is there another way to decide which option is best?
- How do others decide?
- How much is enough?
- Can I practice deciding how much is enough?
- What did I learn in this unit?

## UNIT 2: Making a Borrowing Decision

- Introduction
- How can I borrow money?
- What do I need to know about a credit card?
- How do credit cards work?
- How do I get a credit card?
- How do people use their credit cards?
- What do I need to know about a loan?
- How do loans work?
- How do I get a loan?
- What are the advantages and disadvantages of using credit?
- What does credit really cost me?
- Why are interest rates so varied?
- Where can I get credit?
- What do I need to watch out for?
- What did I learn in this unit?

## UNIT 3: Making a Spending Plan

- Introduction
- Why do I need a plan?
- What are the steps for making a spending plan?
- What makes up my financial information?
- How do I prioritize among my expenses?

- Will knowing my priorities help me set goals?
- What kinds of goals should I set?
- How can I plan to reach my goals?
- I have my goals and objectives—what do I do with them?
- Am I ready to make my spending plan?
- What are some common budgeting methods?
- What can I do when my situation changes?
- What did I learn in this unit?

#### **UNIT 4: Making a Career Decision**

- Introduction
- Isn't it too early to think about my career?
- How does my education affect my earnings?
- How does more education cost me?
- Can someone with less education earn more than someone with more education?
- What skills are in high demand?
- What other factors will influence how much I earn?
- What will tomorrow's working world be like?
- What kind of career am I suited for, based on my skills & interests?
- How can I get those careers?
- What did I learn in this unit?

#### **Part 1 Assessment**

#### **UNIT 5: Building and Maintaining Credit**

- Introduction
- What's important in order to get credit?
- Does how I act financially really matter?
- How can I keep a good credit rating?
- Are there different kinds of credit?
- How do credit givers figure out how much interest they charge?
- What happens if I am irresponsible with credit or just can't pay what I owe?
- What did I learn in this unit?

#### **UNIT 6: Understanding Insurance**

- Introduction
- What exactly is insurance?
- Why does insurance exist?
- What kinds of insurance are there?
- How are my risks covered by owning insurance?
- What really happens when I make a claim to my insurance company?
- Is there any way to reduce the amount that insurance costs me?
- How do I go about getting insurance?
- Can I have too much insurance?
- What did I learn in this unit?



## UNIT 7: Understanding the Economy

- Introduction
- What is my standard of living?
- What are forces that can affect my standard of living?
- What economic trends happen in the United States that affect my standard of living?
- How do people tell how the economy is doing?
- Do government actions influence inflation and deflation?
- Can't we just print more money or take some out of circulation?
- What are other ways my standard of living is controlled?
- What can I do to maintain my standard of living?
- What did I learn in this unit?

## UNIT 8: Using Financial Services

- Introduction
- What can a financial institution do for me?
- What kinds of accounts do banks offer?
- Where do I get money to deposit?
- Why would I want a checking account?
- How do I open and start my checking account?
- How do I write checks to get my money?
- What's important to remember when writing checks?
- Are there other ways to get money from my checking account?
- How can I keep track of my checking account?
- How do I balance my checking account?
- Why would I want to save?
- What other services does my financial institution give me?
- What is the relationship between savers, banks and borrowers?
- How do I choose a financial institution?
- What did I learn in this unit?

## UNIT 9: Saving and Investing

- Introduction
- Why do I need to think about saving now?
- What are some guidelines for saving?
- How can a savings plan help me?
- How can my money grow?
- Is investing different than saving?
- How can I invest my money?
- Why would I want to invest my money?
- Isn't it too early to think about retirement?
- What kinds of retirement options do I have?
- What did I learn in this unit?

## Part 2 Assessment





# MTH124: Honors Algebra I

This course prepares students for more advanced courses while they develop algebraic fluency, learn the skills needed to solve equations, and perform manipulations with numbers, variables, equations, and inequalities. They also learn concepts central to the abstraction and generalization that algebra makes possible. Students learn to use number properties to simplify expressions or justify statements; describe sets with set notation and find the union and intersection of sets; simplify and evaluate expressions involving variables, fractions, exponents, and radicals; work with integers, rational numbers, and irrational numbers; and graph and solve equations, inequalities, and systems of equations. They learn to determine whether a relation is a function and how to describe its domain and range; use factoring, formulas, and other techniques to solve quadratic and other polynomial equations; formulate and evaluate valid mathematical arguments using various types of reasoning; and translate word problems into mathematical equations and then use the equations to solve the original problems.

This course includes all the topics in MTH123, but has more challenging assignments and includes more optional challenge activities. Each semester also includes an independent honors project.

**COURSE LENGTH:** Two semesters

**MATERIALS:** *Algebra I: A Reference Guide and Problem Sets*

**PREREQUISITES:** Success in previous math course and a teacher/counselor recommendation

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## SEMESTER ONE

### Unit 1: Algebra Basics

The English word algebra and the Spanish word *algebrista* both come from the Arabic word *al-jabr*, which means “restoration.” A barber in medieval times often called himself an *algebrista*. The *algebrista* also was a bonesetter who restored or fixed bones. Mathematicians today use algebra to solve problems. Algebra can find solutions and “fix” certain problems that you encounter.

- Semester Introduction
- Expressions
- Variables
- Translating Words into Variable Expressions
- Equations
- Translating Words into Equations
- Replacement Sets
- Problem Solving

### Unit 2: Properties of 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.

- Number Lines
- Sets
- Comparing Expressions
- Number Properties
- Distributive Property
- Algebraic Proof
- Opposites and Absolute Value

### Unit 3: Operations 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.

- Addition
- Subtraction
- Multiplication
- Reciprocals and Division
- Applications: Number Problems

### Unit 4: Solving Equations

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.

- Addition and Subtraction Equations
- Multiplication and Division Equations
- Multiple Transformations
- Variables on Both Sides of an Equation
- Transforming Formulas
- Estimating Solutions
- Cost Problems

### Unit 5: Solving 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.

- Inequalities
- Solving Inequalities
- Combined Inequalities
- Absolute Value Equations and Inequalities
- Applications: Inequalities

### Unit 6: Applying Fractions

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
- Proportions
- Percents
- Applications: Percents
- Applications: Mixture Problems



## Unit 7: Linear Equations and Inequalities

You've probably heard the phrase, "That's where I draw the line!" In algebra, you can take this expression literally. Linear functions and their graphs play an important role in the never-ending quest to model the real world.

- Equations in Two Variables
- Graphs
- Lines and Intercepts
- Slope
- Slope-Intercept Form
- Point-Slope Form
- Parallel and Perpendicular Lines
- Equations from Graphs
- Applications: Linear Models
- Graphing Linear Inequalities
- Inequalities from Graphs

## Unit 8: Systems of 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.

- Systems of Equations
- Substitution Method
- Linear Combination with Multiplication
- Applications: Systems of Linear Equations
- Systems of Linear Inequalities

## Unit 9: Semester Review and Test

- Semester Review
- Semester Test

## Unit 10: Honors Project

Each student taking Algebra I Honors will complete an independent project each semester for which the teacher will determine the due dates and milestones. This is a project that goes above and beyond the regular course work and counts as a significant percentage of the course grade.

## SEMESTER TWO

### Unit 1: Relations and Functions

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. There are many kinds of functions. Some have graphs that look like lines, while others have graphs that curve like a parabola. Functions can take other forms as well. Not every function has a graph that looks like a line or a parabola. Not every function 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.

- Semester Introduction
- Relations

- Functions
- Function Equations
- Absolute Value Functions
- Direct Linear Variation
- Quadratic Variation
- Inverse Variation
- Translating Functions

## Unit 2: Rationals, Irrationals, and Radicals

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.

- Rational Numbers
- Terminating and Repeating Numbers
- Square Roots
- Irrational Numbers
- Evaluating and Estimating Square Roots
- Radicals with Variables
- Roots of Equations
- The Pythagorean Theorem
- Higher Roots

## Unit 3: Working with 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.

- Overview of Polynomials
- Adding and Subtracting Polynomials
- Multiplying Monomials
- Multiplying Polynomials by Monomials
- Multiplying Polynomials
- The FOIL Method

## Unit 4: Factoring Polynomials

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
- Factoring Common Factors
- Dividing Polynomials by Monomials
- Factoring Perfect Squares
- Factoring Differences of Squares
- Factoring Quadratic Trinomials
- Factoring Quadratic Trinomials,  $a \neq 1$

- Factoring Completely
- Finding Roots of Equations

### Unit 5: Quadratic Equations

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?

- Solving Perfect Square Equations
- Completing the Square
- The Quadratic Formula
- Solving Quadratic Equations
- Equations and Graphs: Roots and Intercepts
- Applications: Area Problems
- Applications: Projectile Motion

### Unit 6: Rational Expressions

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 Rational Expressions
- Multiplying Rational Expressions
- Dividing Rational Expressions
- Like Denominators
- Adding and Subtracting Rational Expressions

### Unit 7: Logic and Reasoning

Professionals use logical reasoning in a variety of ways. Just as lawyers use logical reasoning to formulate convincing arguments, mathematicians use logical reasoning to formulate and prove theorems. Once you have mastered the uses of inductive and deductive reasoning, you will be able to make and understand arguments in many areas.

- Reasoning and Arguments
- Hypothesis and Conclusion
- Forms of Conditional Statements
- Inductive and Deductive Reasoning
- Analyzing and Writing Proofs
- Counterexample

### Unit 8: Semester Review and Test

- Semester Review
- Semester Test

### Unit 9: Honors Project

Each student taking Algebra I Honors will complete an independent project each semester for which the teacher will determine the due dates and milestones. This is a project that goes above and beyond the regular course work and counts as a significant percentage of the course grade.





# MTH500: AP<sup>®</sup> Calculus

This course is the equivalent of an introductory college-level calculus course. Calculus helps scientists, engineers, and financial analysts understand the complex relationships behind real-world phenomena. Students learn to evaluate the soundness of proposed solutions and apply mathematical reasoning to real-world models. Students also learn to understand change geometrically and visually (by studying graphs of curves), analytically (by studying and working with mathematical formulas), numerically (by seeing patterns in sets of numbers), and verbally. Students prepare for the AP<sup>®</sup> Exam and further studies in science, engineering, and mathematics.

**COURSE LENGTH:** Two semesters

**MATERIALS:** A Texas Instruments T1-84 Plus graphing calculator

**PREREQUISITES:** Success in MTH203: Geometry, MTH303: Algebra II, MTH403: Pre-Calculus/Trigonometry, and a teacher/counselor recommendation

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## SEMESTER ONE

### Unit 1: Pre-Calculus Review

Students go over questions from a pre-course assessment, so they can make up for any gaps in their math knowledge.

### Unit 2: Bridge to Calculus

Students prepare to study calculus by reviewing some basic precalculus concepts from algebra and trigonometry. They learn what calculus is, why it was invented, and what it's used for.

- Intro to Calculus
- Functions
- Graphical Symmetry
- Patterns in Graphs: Parameters

### Unit 3: Limits and Continuity

This unit addresses Topic I: Functions, Graphs, and Limits of the College Board's Calculus AB topic outline. Students learn two important concepts that underlie all of calculus: limits and continuity. Limits help students understand differentiation (the slope of a curve) and integration (the area inside a curved shape). Continuity is an important property of functions.

- Limits and Continuity
- Asymptotic and Unbounded Behavior
- Continuous Functions

### Unit 4: Derivatives

This unit addresses Topic II: Derivatives of the College Board's Calculus AB topic outline. Students learn how to calculate a derivative, the slope of a curve at a specific point. They learn techniques for finding derivatives of algebraic functions (such as  $y = x^2$ ) and trigonometric functions (such as  $y = \sin x$ ).

- Derivatives at a Point
- Computing Derivatives
- Derivative as a Function
- Higher-Order Derivatives
- Chain Rule and Implicit Differentiation



## Unit 5: Rates of Change

This unit focuses on Second Derivatives and Applications of Derivatives within Topic II: Derivatives of the College Board's Calculus AB topic outline. Students learn how to use calculus to model and analyze changing aspects of our world. They review the semester content and take the semester exam.

- Extrema and Optimization
- Tangent and Normal Lines
- Rates of Change
- Related Rates
- Rectilinear Motion
- Semester Wrap-Up (Review and Exam)

## SEMESTER TWO

### Unit 1: The Integral and the Fundamental Theorem of Calculus

This unit focuses on Topic III: Integrals in the College Board's Calculus AB topic outline. Students learn numerical approximations to definite integrals, interpretations and properties of definite integrals, the Fundamental Theorem of Calculus, and techniques of antidifferentiation. They learn how to find areas of curved shapes.

- Area under a Curve
- Definite Integrals
- Antiderivatives
- The Fundamental Theorem of Calculus

### Unit 2: Applications of the Integral

This unit focuses on Topic III: Integrals in the College Board's Calculus AB topic outline. Students learn to use integrals and antiderivatives to solve problems.

- Area
- Volume
- Other Applications of the Definite Integral

### Unit 3: Inverse and Transcendental Functions

This unit focuses on Topic II: Derivatives and Topic III: Integrals in the College Board's Calculus AB topic outline. Students learn to calculate and use derivatives, antiderivatives, and integrals of exponential functions (such as  $y = 3^x$  where the input variable is an exponent), logarithmic functions (the inverses of exponential functions), and inverse trigonometric functions (such as  $y = \secant(x)$ ).

- Inverse Functions
- Review of Logarithmic and Exponential Functions
- Computation of Derivatives for Some Transcendental Functions
- Integrals of Some Transcendental Functions



#### **Unit 4: Separable Differential Equations and Slope Fields**

This unit focuses on Topic II: Derivatives of the College Board's Calculus AB topic outline, specifically, on Equations Involving Derivatives. Students investigate differential equations, and solve the equations using a technique called "separating the variables."

- Separable Differential Equations
- Exponential Growth and Decay and Related Applications

#### **Unit 5: AP Exam Review and Final Exam**

Students review what they have learned, and become more familiar with AP-type questions in preparation for the AP Exam.

- Calculus as a Cohesive Whole
- Review of Topics
- Practice Final Exams



# MTH510: AP<sup>®</sup> Statistics

This course is the equivalent of an introductory college-level course. Statistics—the art of drawing conclusions from imperfect data and the science of real-world uncertainties—plays an important role in many fields. Students collect, analyze, graph, and interpret real-world data. They learn to design and analyze research studies by reviewing and evaluating examples from real research. Students prepare for the AP<sup>®</sup> Exam and for further study in science, sociology, medicine, engineering, political science, geography, and business.

**COURSE LENGTH:** Two semesters

**MATERIALS:** A Texas Instruments T1-84 Plus graphing calculator

**PREREQUISITES:** Success in MTH303: Algebra II and a teacher/counselor recommendation

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## SEMESTER ONE

### Unit 1: Describing Data

Students take a pre-course assessment to be sure they are ready for the challenge of AP Statistics. They explore what statistics is, how it can be used, and how it's misused. They learn some basic statistics terminology, and look at the difference between counts and measures and the difference between descriptive and inferential statistics.

- What Is Statistics?
- Displaying Distributions with Graphs
- Describing Distributions Using Numbers
- Five-Number Summaries
- More on Describing Distributions

### Unit 2: The Normal Distribution

Students learn about the normal distribution and the normal curve—a display of a normal distribution on a graph; the normal curve presents the normal distribution in a form that statisticians can use as a tool in inferential statistics. This unit addresses items in Topic III (The normal distribution) in the College Board's AP Statistics topic outline.

- Introduction to the Normal Distribution
- Standardized Scores
- Determining If a Data Set Is Normal

### Unit 3: Bivariate Data

Students learn how statistics can be used to study how one variable affects another—for instance, do people who spend more years in school earn more money? Do people who take an experimental drug suffer fewer heart attacks? To answer questions like these, researchers need to gather data on two variables and then examine the data to see how the variables might be related. This unit addresses items in Topic I (Exploring bivariate data; Exploring categorical data: frequency tables) in the College Board's AP Statistics topic outline.

- Introduction to Bivariate Data
- The Least-Squares Regression Line
- The Correlation Coefficient
- Influential Points and Outliers
- Transformations to Achieve Linearity
- Categorical Bivariate Data: Two-Way Tables

### Unit 4: Planning a Study

Students look at some of the most important issues in data gathering. They learn how this can make them smarter consumers of data; when they hear or read about studies, they will be able to determine whether or not they are valid. This unit addresses Topic II (Planning a Study) in the College Board's AP Statistics topic outline.

- Methods of Data Collection—Experiments and Studies
- Methods of Data Collection—Surveys

### Unit 5: Probability

Students look at probability, which is vital for inferential statistics. They determine how likely it is that a sample really represents the population as a whole through proper sampling techniques and the laws of probability. This unit addresses items in Topic III (Law of large numbers; Addition rule, multiplication rule, conditional probability, and independence; Discrete random variables; Mean and standard deviation of a random variable) in the College Board's AP Statistics topic outline. Students review what they have learned and take the semester exam.

- What Is Probability?
- Introduction to the Basic Rules of Probability
- More on Conditional Probabilities and the Probabilities of Combined Events
- Probability Distributions
- Means and Variances of Random Variables
- Review and Exam

## SEMESTER TWO

### Unit 1: Binomials and Distributions

Students start to work with sampling distributions, which are distributions of possible sample means. This unit addresses items in Topic III (Sampling distribution of a sample proportion; Sampling distribution of a sample mean; Central Limit Theorem) in the College Board's AP Statistics topic outline.

- Introduction to Inferential Statistics
- Binomial Distributions
- Geometric Distribution
- Sampling Distributions: Means and Proportions

### Unit 2: Introduction to Inference

Students look at concepts of sampling, probability, and distributions and are introduced to processes that researchers use to do statistical inference. This unit addresses items in Topic IV (The meaning of a confidence interval; Large sample confidence interval for a mean; Logic of significance testing; Large sample test for a mean) in the College Board's AP Statistics topic outline.

- Confidence Intervals for Means
- Statistical Significance and *P*-Value
- Significance and Hypothesis Testing: Means
- Errors in Hypothesis Testing

### Unit 3: $t$ Distribution for Means

Students review and reinforce many concepts that they may already know about statistical inference, learning a new dimension that's vital to anyone doing inferential statistics in the real world. This unit addresses items in Topic IV (Large sample confidence interval for a difference between two means;  $t$  distribution; Single-sample  $t$  procedures; Two-sample  $t$  procedures) in the College Board's AP Statistics topic outline.

- Confidence Intervals and Hypothesis Testing for a Single Mean
- Confidence Intervals for the Difference between Two Means
- Confidence Intervals and Hypothesis Tests for Two Independent Samples

### Unit 4: Inference for Proportions

Students learn the basics of how to infer a population proportion based on a sample. This unit addresses items in Topic IV (Confidence intervals and significance tests for proportions and the differences between two proportions) in the College Board's AP Statistics topic outline.

- Confidence Intervals and Hypothesis Tests for a Single Population Proportion
- The Difference between Two Proportions

### Unit 5: Inference for Tables and Least-Squares

Students build on what they've learned about analyzing bivariate sample data. They go beyond looking at the sample and make inferences about the population. This unit addresses items in Topic IV (Statistical Inference: Confirming Models) in the College Board's AP Statistics topic outline.

- One-Way Tables: Chi-Square for Goodness-of-Fit
- Two-Way Tables: Chi-Square for Association or Independence
- Inference for the Least-Squares Line

### Unit 6: Final Preparation for the AP Statistics Exam

Students review what they have learned and take the final exam.

- General Preparation Strategies
- Strategies and Practice for Multiple-Choice and Free-Response Questions
- Putting It Together: Practice Exam and Mixed Practice
- Final Exam





# SCI102: Physical Science

Students explore the relationship between matter and energy by investigating force and motion, the structure of atoms, the structure and properties of matter, chemical reactions, and the interactions of energy and matter. Students develop skill in measuring, solving problems, using laboratory apparatuses, following safety procedures, and adhering to experimental procedures. Students focus on inquiry-based learning, with hands-on laboratory investigations making up half of the learning experience.

**COURSE LENGTH:** Two semesters

**MATERIALS:** *Physical Science: A Laboratory Guide*; materials for laboratory experiments

**PREREQUISITES:** K<sup>12</sup> middle school Physical Science, or equivalent

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## SEMESTER ONE

### Unit 1: Matter and Energy

In this unit, students learn about the depth of physical science, the relationship between matter and energy, and scientific methods. Students use scientific methods in a laboratory setting and demonstrate their results through graphing.

- Semester Introduction
- Dimensions: Distance, Time, and Mass
- Matter, Energy, and the Scientific Method
- Creating and Analyzing Graphs
- Laboratory: Drop and Bounce 1
- Laboratory: Drop and Bounce 2

### Unit 2: Forces and Motion

In this unit, students study Newton's three laws of motion, and they demonstrate those laws in a hands-on laboratory and in online simulations. Students also learn to define *acceleration* and *force*.

- Describing and Measuring Motion
- Acceleration
- Forces
- Laboratory: Drop and Bounce Revisited
- Newton's First Law of Motion
- Newton's Second Law of Motion
- Newton's Third Law of Motion
- Laboratory: Mass in Motion 1
- Laboratory: Mass in Motion 2

### Unit 3: Application of Forces

Students explore friction, gravity, and force in this unit. They begin to understand the concept of vectors and learn to describe force in terms of vectors.

- Friction
- Gravity
- Gravity and Motion
- Forces and Vectors



- Laboratory: Net Force 1
- Laboratory: Net Force 2

#### Unit 4: Fluid Forces

An understanding of fluid forces is important to the study of physical science. In this unit, students observe and graph how shape influences movement through a fluid. They learn to define density and understand its relationship to buoyancy. Students relate the concept of pressure to buoyancy. Students learn to describe Pascal's and Bernoulli's principles.

- Pressure
- Buoyancy
- Laboratory: Density and Buoyancy 1
- Laboratory: Density and Buoyancy 2
- Pascal's Principle
- Bernoulli's Principle
- Laboratory: Shapes and Fluid Forces 1
- Laboratory: Shapes and Fluid Forces 2

#### Unit 5: Energy

Energy has a profound effect on our physical environment. In this unit, students first develop a firm basis for understanding changes in energy and identifying potential and kinetic energy. Designing a thermos in a laboratory provides the basis for the development of students' understanding of how heat moves. As in other units, students' understanding of facts stems from their mastery of the big ideas of physical science.

- Energy
- Energy Change
- Potential and Kinetic Energy
- Laboratory: Pendulum 1
- Laboratory: Pendulum 2
- Laboratory: Elasticity 1
- Laboratory: Elasticity 2
- Heat Energy
- How Energy Moves
- Laboratory: Heat Transfer 1
- Laboratory: Heat Transfer 2
- Laboratory: Design a Thermos 1
- Laboratory: Design a Thermos 2

#### Unit 6: Work

Work and the ability to do work are the focus of this unit. Students explore the properties of a simple machine. They learn the factors that influence force. In their exploration, they also determine the effect of pulleys and levers—two simple machines.

- Work
- Simple Machines and Mechanical Advantage
- Power
- Laboratory: Levers 1
- Laboratory: Levers 2
- Laboratory: Pulleys 1
- Laboratory: Pulleys 2



### Unit 7: Waves

The properties of waves and the effects of waves on physical systems are the focus of this unit. Students explore the different kinds of waves, and they learn the factors that influence waves. Students learn to define *frequency*, *wavelength*, and *pitch*. Finally, students learn to demonstrate and explain the Doppler effect.

- Introduction to Waves
- Properties of Waves
- Wave Energy
- Transverse and Longitudinal Waves
- Laboratory: Waves 1
- Laboratory: Waves 2
- Sound
- Frequency, Wavelength, and Pitch
- Laboratory: Doppler Effect 1
- Laboratory: Doppler Effect 2

### Unit 8: Light

In this unit, students thoroughly explore the concept of light. They study the speed of light and how it is determined, the properties of the electromagnetic spectrum, and color. They learn to define *reflection* and *refraction*, and describe their characteristics.

- Light
- Speed of Light
- Reflection and Refraction
- Electromagnetic Spectrum
- Color

### Unit 9: Electricity

Electricity and magnetism are the focus of this unit. Students explore electricity and magnetism as they build an electric motor. They learn the components that make up circuits.

- Electricity and Magnetism
- Laboratory: Electric Motor 1
- Laboratory: Electric Motor 2
- Circuits

### Unit 10: Semester Review and Test

- Semester Review
- Semester Test

## SEMESTER TWO

### Unit 1: Nature of Matter

The difference between matter and energy is the focus of this unit. Students examine the classification of matter, the nature of energy, and viscosity. In their laboratory, they demonstrate knowledge of these concepts through observation and data reporting.

- Semester Introduction
- Nature of Matter
- Classification of Matter
- Matter and Energy
- Laboratory: Viscosity 1
- Laboratory: Viscosity 2

### Unit 2: States of Matter

Phase changes are a tangible way to understand the states of matter. In this unit, students observe phase changes. In their observation, they examine the properties of heat and energy. By the end of this unit, students have a solid knowledge of thermodynamics.

- States of Matter
- Matter Changes State
- Kinetic Theory of Matter
- Laboratory: Evaporation 1
- Laboratory: Evaporation 2
- Laboratory: Phase Change 1
- Laboratory: Phase Change 2
- Laws of Thermodynamics
- Heat Energy and Matter
- Laboratory: Endothermic Process 1
- Laboratory: Endothermic Process 2

### Unit 3: Gas Laws

The environment is made up of gases. Students examine the laws that govern gases, paying particular attention to the effects of pressure, temperature, and volume. The gas laws are demonstrated in the laboratory.

- Gases
- Pressure, Temperature, and Volume
- Introduction to the Gas Laws
- Laboratory: Gas Laws 1
- Laboratory: Gas Laws 2

### Unit 4: Atoms

Students gain a firm basis for understanding the atom and its characteristics. Students look at the atom in greater detail, including the atomic model, atomic number, atomic mass, and atomic nucleus. Building on the big ideas of the atom, students develop a strong central basis for understanding radioactive dating, fusion, and fission.

- Atoms
- Atomic Model
- Atomic Number

- Atomic Mass
- Nucleus of the Atom
- Radioactivity
- Radioactive Dating
- Fusion and Fission

### Unit 5: Elements

Students explore the properties of elements and the placement of elements in the periodic table. They begin to understand why an element is placed where it is in the table and draw conclusions about that element based on its location. They demonstrate an understanding of metals and nonmetals and the nature of compounds.

- Elements
- Periodic Table 1
- Periodic Table 2
- Properties of Metals and Nonmetals
- Elements and Compounds

### Unit 6: Mixtures

Students learn to identify mixtures and solutions, and differentiate between certain kinds of solutions. They demonstrate a working knowledge of solubility in their laboratory.

- Introduction to Mixtures
- Introductions to Solutions
- Laboratory: Mixtures 1
- Laboratory: Mixtures 2
- Laboratory: Solubility 1
- Laboratory: Solubility 2
- Factors That Influence Solubility

### Unit 7: Bonds

The focus of this unit is bonding: the configuration of electrons and different kinds of bonds. Understanding bonding is essential to a study of physical science. In addition to giving students a firm understanding of bonding, this unit prepares students for understanding what happens in chemical reactions.

- Electron Configurations
- Valence Electrons
- Ionic Bonds
- Covalent Bonds
- Polar Covalent Bonds and Electronegativity
- Hydrogen Bonding and Metallic Bonding

### Unit 8: Chemical Reactions

The focus of this unit is an understanding of chemical reactions. Students observe chemical reactions and draw conclusions about what happened in those reactions. They apply their knowledge of bonding as they balance chemical equations. Students also explore solutions chemistry.

- Introduction to Chemical Reactions
- Laboratory: Chemical Reactions 1



- Laboratory: Chemical Reactions 2
- Laboratory: Copper-Plating Solution 1
- Laboratory: Copper-Plating Solution 2
- Chemical Reactions Explained
- How to Balance a Chemical Equation
- Solution Chemistry

### Unit 9: Acids and Bases

In this unit, students focus on acid and base reactions. They start out learning the definition of acid and base. They learn to explain and use the pH scale and describe the properties of acids and bases. Students observe acid–base reactions and learn the importance of buffers.

- Acids
- Bases
- pH Scale
- Acid and Base Reaction
- Buffers
- Laboratory: Acid Neutralization 1
- Laboratory: Acid Neutralization 2

### Unit 10: Organic Chemistry

Students explore the field of organic chemistry through a thorough exploration of the four macromolecules: proteins, carbohydrates, lipids, and nucleic acids. They study the functional groups that make up those compounds.

- Organic Chemistry
- Functional Groups
- Macromolecules

### Unit 11: Semester Review and Test

- Semester Review
- Semester Test





# SCI112: Earth Science

In this course, students focus on geology, oceanography, astronomy, weather, and climate. Students follow a program of online study days that alternate with review-and-assessment days. Lessons include extensive animations, hands-on laboratory activities, reference book study, and collaborative activities with virtual classmates.

**COURSE LENGTH:** Two semesters

**MATERIALS:** *Earth Science: A Reference Guide*; materials for laboratory experiments

**PREREQUISITES:** K<sup>12</sup> middle school Earth Science, or equivalent

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## SEMESTER ONE

### Unit 1: Earth Science and Systems

Earth Science is one of the most fascinating topics in all the sciences, and students learn about its place among the sciences in this unit. Students explore what Earth Science is, study aspects of scientific methods, and use those methods in a laboratory setting.

- Semester Introduction
- Why Study Earth Science?
- Spheres as Earth Systems
- Review: Why Study Earth Science and Earth Systems
- Laboratory: Topographical Maps
- Earth Systems and Interactions
- Review: Earth Systems and Interactions
- Laboratory: Modeling Earth Science Processes 1
- Laboratory: Modeling Earth Science Processes 2

### Unit 2: Dynamic Earth

Students confront Earth as a dynamic planet; in many ways, it is more active than any other planet in our solar system. The core idea of plate tectonics, its effect on the Earth's history, and its current geological activity helps students make sense of our world. Knowledge of the origin and distribution of volcanoes and earthquakes helps students make even greater sense of Earth's dynamic nature.

- Introduction to Plate Tectonics
- Pangaea and Continental Drift
- Moving Plates
- Review: Plate Tectonics
- Where Earthquakes and Volcanoes Occur
- Review: Earthquakes and Volcanoes Occur
- Structure of Earth's Interior
- Review: Structure of Earth's Interior
- Laboratory: Hawaiian Island Chain
- How Earthquakes Happen
- Review: How Earthquakes Happen
- Locating Earthquakes
- Laboratory: Earthquake Epicenter
- How Volcanoes Form



- Review: Earthquakes and Volcanoes
- Mountain Building
- Review: Mountain Building

### Unit 3: Composition of the Earth

Study of the minerals and rocks that comprise Earth is students' most tangible way to engage in the nature of the Earth's structure. In this unit, students tackle the nature of rocks, their origin, distribution, and transformation.

- Minerals on Earth
- Mineral Properties
- Review: Minerals
- Rocks and Their Mineral Composition
- Review: Rocks and Their Mineral Composition
- Three Kinds of Rocks
- Review: Three Kinds of Rocks
- Laboratory: Rocks and Minerals 1
- Laboratory: Rocks and Minerals 1
- The Rock Cycle
- Review: The Rock Cycle

### Unit 4: Geological History

The history of Earth is told in its rocks—how the planet was formed and what changes it has gone through. Students study changes that have taken place in Earth's long history, examining geological time and the changes in living things over time.

- Earth's History
- The Fossil Record
- Review: History and Fossil Record
- Age of Geologic Features
- Earth's History Written in Rocks
- Review: Geological Features and Earth's History
- Laboratory: Interpreting Geologic History, Day 1
- Laboratory: Interpreting Geologic History, Day 2

### Unit 5: Earth's Atmosphere

The structure of our atmosphere has a profound effect on Earth and its living things. In this unit, students first develop a firm basis for understanding how the sun's energy is the basis for many of the characteristics of our atmosphere. Knowledge of how the sun's energy is used provides the basis for understanding wind and global circulation of air.

- Layers in the Atmosphere
- Composition of the Atmosphere
- Review: Atmosphere
- Laboratory: Barometer 1
- Laboratory: Barometer 2
- The Sun and Energy
- Solar Radiation
- Review: Sun and Solar Radiation
- Temperature and Air Pressure
- Review: Temperature and Air Pressure

- Air Circulation Patterns 1
- Air Circulation Patterns 2
- Review: Air Circulation
- Laboratory: Energy Absorption/Reflection 1
- Laboratory: Energy Absorption/Reflection 2

### Unit 6: Weather 1

The origin of weather and its effects on earth systems and on human life are the focus of student learning in this unit. Students explore what it means to gather weather data and work with weather maps. They learn the factors that influence weather, cloud formation, and storm development.

- What Makes the Weather?
- Review: What Makes the Weather?
- Gathering Weather Data
- Weather Maps
- Review: Weather Maps and Data
- Laboratory: Weather Map Interpretation 1
- Laboratory: Weather Map Interpretation 2
- Cloud Formation
- How Storms Develop
- Review: Clouds and Storms

### Unit 7: Semester Review and Test

- Semester Review
- Semester Test

## SEMESTER TWO

### Unit 1: Weather 2

The difference between climate and weather is the focus of learning in this unit. Students examine climatic zones, cloud formation, and relative humidity. Students explore the different biomes on Earth and the results that the greenhouse effect will have on Earth's environment. Students confront the issue of climate change.

- Semester Introduction
- Climate vs. Weather
- What Influences the Weather?
- Review: Climate and Weather Influences
- Laboratory: Cloud Formation
- Laboratory: Relative Humidity
- The Greenhouse Effect
- Greenhouse Effect Analyses
- Review: Greenhouse Effect
- Climate Change
- Patterns of Climate Change
- Review: Climate Change
- Laboratory: Temperature of Water and Soil 1
- Laboratory: Temperature of Water and Soil 2

## Unit 2: Oceans

The oceans of the world give our Earth a unique characteristic among the planets in our solar system. In this unit, students explore Earth's water, learn about the properties of ocean water, and see how the physical and biological characteristics of oceans make our planet unique.

- Oceans of the World
- Chemistry of the Oceans
- Review: Oceans and Chemistry
- Physical Properties of Seawater
- Review: Physical Properties of Seawater
- Laboratory: Ocean Water Density 1
- Laboratory: Ocean Water Density 2
- Ocean Currents
- Review: Ocean Currents
- Ocean Conditions and Life
- Review: Ocean Conditions and Life
- Laboratory: Ocean Floor Sediments 1
- Laboratory: Ocean Floor Sediments 2

## Unit 3: Cycles on Earth

The materials that make up Earth are continuously being recycled. Important nutrients for living things, as well as the components of rock and minerals, are circulated through Earth systems over time. Students examine these nutrient cycles, paying particular attention to carbon and water. The concept of a dynamic and ever-changing Earth is reinforced in this unit.

- Biogeochemical Cycles
- Review: Biogeochemical Cycles
- Carbon Cycle
- Life and the Carbon Cycle
- Review: Carbon Cycle
- Laboratory: Dissolved Oxygen 1
- Laboratory: Dissolved Oxygen 2
- Water Cycle
- Review: Water Cycle

## Unit 4: Astronomy

By this point in the Earth Science curriculum, students have a firm basis for understanding Earth and its characteristics. Students now look at Earth in the broader context of its place in the solar system, the Milky Way, and the universe. Building on the "big ideas" of astronomy, students develop a strong central basis for understanding Earth within the larger context of space.

- The Sun
- The Earth–Moon–Sun System
- Review: Sun and The Earth–Moon–Sun System
- Laboratory: Solar Energy
- The Moon's Influence
- Review: The Moon's Influence
- Earth Movement and Seasons
- Review: Earth Movement and Seasons



- Laboratory: Earth, Moon, Sun Motion
- Laboratory: Sunrise and Sunset
- Origin of the Solar System
- Features of the Solar System
- Review: Origin and Features of the Solar System
- The Planets
- Review: The Planets
- Electromagnetic Spectrum
- Light: A Tool for Astronomy
- Review: Electromagnetic Spectrum and Light
- Distances in Space
- Review: Distances in Space
- Life Cycle of a Star
- Review: Life Cycle of a Star
- What's a Galaxy?
- The Big Bang Theory
- Review: Galaxies and Life Cycle of a Star

### **Unit 5: Earth's Resources**

With all that students have learned about Earth, they are able now to confront some practical aspects of Earth and how humans use its resources. Where are we headed with regard to those resources needed to sustain modern society? What is and what should be our relationship to fossil fuels, water resources, and issues regarding changes in human populations?

- Earth's Natural Resources
- Renewable vs. Nonrenewable Resources
- Review: Resources
- Environmental Issues
- Review: Environmental Issues
- Laboratory: Air Pollution Watch
- Water Resources
- Review: Water Resources
- Humans and the Environment
- Conservation
- Review: Humans and Conservation

### **Unit 6: Semester Review and Test**

- Semester Review
- Semester Test



# SCI202: Biology

In this course, students focus on the chemistry of living things: the cell, genetics, evolution, the structure and function of living things, and ecology. Students follow a program of online study days alternating with review-and-assessment days. Lessons include extensive animations, hands-on laboratory activities, reference book study, and collaborative activities with virtual classmates.

**COURSE LENGTH:** Two semesters

**MATERIALS: BIOLOGY:** *A Reference Guide*; materials for laboratory experiments, including a compound microscope

**PREREQUISITES:** K<sup>12</sup> middle school Life Science, or equivalent

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## SEMESTER ONE

### Unit 1: The Science of Biology

Students explore biology as one of the sciences and confront the concepts of scientific methods. After exploring scientific processes as they apply to biology, students examine what “life” means as they investigate the characteristics that all living things share. Students then look at the importance of energy, what kinds of energy are significant when considering living things, and the relationship of structures of living things to their functions.

- Semester Introduction
- Biology and Scientific Methods
- Scientific Processes 1
- Scientific Processes 2
- Review: Scientific Processes
- The Characteristics of Life 1
- The Characteristics of Life 2
- The Characteristics of Life 3
- Review: Characteristics of Life
- Laboratory: Using a Microscope
- Energy and Life
- Review: Energy and Life
- Structure and Function
- Review: Structure and Function

### Unit 2: The Chemistry of Life

Students explore the chemical basis for life by examining the most important groups of organic compounds: carbohydrates, proteins, lipids, and nucleic acids. Students then examine water and how it is important for living things. In each case, students focus on the relationship of the molecular structure of compounds to its function in living things.

- Chemistry Review
- Chemical Bonds
- Review: Chemical Bonds
- Carbon and Life
- Review: Carbon and Life
- Water
- Review: Water



- Laboratory: Investigating Biological Compounds 1
- Laboratory: Investigating Biological Compounds 2
- Simple Carbohydrates
- Complex Carbohydrates
- Review: Carbohydrates
- Lipids
- Review: Lipids
- Amino Acids and Proteins
- Proteins as Enzymes
- Review: Proteins
- Nucleic Acids
- Review: Nucleic Acids
- ATP
- Review: ATP

### Unit 3: Cell Biology

Students now are able to begin looking at the structure and function of living things. They begin with an exploration of the cell. They confront the structure of the cell, its membranes and organelles. In particular, they look at the processes by which cells gather and make energy available, focusing on the activities of the mitochondrion and the chloroplast. Students then proceed to look at cellular reproduction and study the processes of meiosis and mitosis.

- The Cell and Life
- Cell Structure
- Cell Organelles
- Review: Cell Life, Structure, and Organelles
- Two Types of Cells
- Review: Two Types of Cells
- Cell Membrane Structure
- Movement Across Membranes
- Review: Cell Structure and Movement
- Laboratory: Determining the Rate of Diffusion 1
- Laboratory: Determining the Rate of Diffusion 2
- Chemical Energy and Life
- Review: Chemical Energy
- Respiration and Photosynthesis
- Review: Respiration and Photosynthesis
- Laboratory: The Rate of Photosynthesis 1
- Laboratory: The Rate of Photosynthesis 2
- Reproduction and Development
- Mitosis
- Review: Reproduction, Development and Mitosis
- Laboratory: Observing Mitosis
- Cell Differentiation
- Review: Cell Differentiation
- Cell Specialization
- Review: Cell Specialization



- Sexual Reproduction
- Meiosis I
- Meiosis II
- Review: Sexual Reproduction and Meiosis

#### **Unit 4: Mendelian Genetics**

Students learn about the work of Gregor Mendel as a way of studying modern genetics. They perform genetic crosses and begin to see how traits are inherited. As they examine Mendelian genetics more closely, they see the relationship between inheritance and chromosomes and between genes and alleles. This unit prepares students to go deeper into genetics at the molecular level. Then students learn how the process of proteins synthesis is controlled, a process called gene expression.

- The Work of Gregor Mendel
- Mendelian Inheritance
- Review: Mendel and Mendelian Inheritance
- Laboratory: Genetic Crosses 1
- Laboratory: Genetic Crosses 2
- Chromosomes and Genes
- Genes and Alleles
- Review: Chromosomes, Genes, and Alleles
- Proteins Express DNA
- Review: Proteins Express DNA

#### **Unit 5: Semester Review and Test**

- Semester Review
- Semester Test

### **SEMESTER TWO**

#### **Unit 1: Molecular Genetics**

The chemical basis for genetics is one of the cornerstones of modern biology. In this unit, students explore the relationship between DNA, RNA, and proteins—and what this has to do with genes and inheritance. After establishing a firm basis in molecular genetics, students are able to understand modern applications of genetics, including biotechnology and genetic engineering.

- Semester Introduction
- DNA, RNA, and Proteins
- Structure of DNA
- Review: Structure of DNA
- Structures of RNA
- Review: Structures of RNA
- DNA Replication
- Review: DNA Replication
- Laboratory: Modeling DNA
- Laboratory: Modeling DNA Replication
- DNA Makes RNA
- Review: DNA Makes RNA
- RNA Makes Protein



- Review: RNA Makes Protein
- The Genetic Code
- Review: The Genetic Code

## Unit 2: Evolution

Evolution is the central organizing principle of biology. Students learn about the concept of evolution and the underlying principles of natural selection. Once they have mastered the fundamental principles, they learn how modern evolution is a science that includes gene changes over time as the underlying mechanism for evolution.

- Evolution and Biology
- Evolution of Populations
- Review: Evolution Biology and Populations
- Variation in Populations
- Types of Natural Selection
- Review: Variation and Types of Natural Selection
- Evidence for Evolution 1
- Evidence for Evolution 2
- Evolution and Earth History
- Review: Evidence for Evolution and Earth History
- Laboratory: Process of Natural Selection 1
- Laboratory: Process of Natural Selection 2
- Genetic Basis of Evolution
- Review: Genetic Basis for Evolution
- Classification and Taxonomy
- Modern Classification
- Review: Classification, Taxonomy
- Laboratory: Dichotomous Key

## Unit 3: Systems of Living Things

Students learn about the structure and function of living things by examining systems of living things, focusing on human biology. They explore the digestive, respiratory, nervous, reproductive, and muscular systems and see how these systems aid in responding to the organism's environment.

- Getting Energy
- Review: Getting Energy
- Digestion in Humans
- Laboratory: Human Digestion Actions 1
- Review: Digestion in Human
- Laboratory: Human Digestion Actions 2
- Oxygen and the Human Body
- Review: Oxygen and the Human Body
- Human Nervous System
- Review: Human Nervous System
- Muscular Systems
- Review: Muscular Systems
- How Muscles Contract

- Review: How Muscles Contract
- Laboratory: Chicken Muscles 1
- Laboratory: Chicken Muscles 2
- Fern Reproduction
- Review: Fern Reproduction
- Human Reproduction
- Review: Human Reproduction
- Human Immune Response 1
- Human Immune Response 2
- Review: Human Immune Response

#### **Unit 4: Ecology and the Environment**

As students have moved through this curriculum, they have learned about living things, their structure, and functions. In this unit, they confront organisms in relationship to their environments. Students study living things and the ecosystems in which they live, examining both the biotic and abiotic components of the world in which organisms exist.

- Ecosystems
- Biomes
- Review: Ecosystems and Biomes
- Energy Flow in Ecosystems
- Food Chains and Food Webs
- Review: Energy Flow, Food Chains, and Webs
- Succession
- Review: Succession
- Laboratory: Patterns of Succession
- Laboratory: The Effects of Acidity on Seed Germination 1
- Water and Nitrogen Cycles
- Review: Water and Nitrogen Cycles
- Laboratory: Fixation in Root Nodules 1
- Laboratory: Fixation in Root Nodules 2
- Laboratory: The Effects of Acidity on Seed Germination 2

#### **Unit 5: Semester Review and Test**

- Semester Review
- Semester Test



# SCI302: Chemistry

This course includes direct online instruction and related assessments, used with a problem-solving book. Students follow a program of online study days that alternate with review-and-assessment days. Instructions for hands-on labs are included, for which K<sup>12</sup> provides all lab materials that cannot easily be found in the home. The course surveys all key areas, including atomic structure, chemical bonding and reactions, solutions, stoichiometry, thermochemistry, organic chemistry, and nuclear chemistry.

**COURSE LENGTH:** Two semesters

**MATERIALS:** *Chemistry: Problems and Solutions; Chemistry: A Laboratory Guide*; K<sup>12</sup>-provided laboratory materials; common household materials for labs

**PREREQUISITES:** K<sup>12</sup> middle school Physical Science or SCI102: Physical Science

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## SEMESTER ONE

### Unit 1: The Study of Chemistry

Students explore chemistry as one of the sciences and confront concepts of matter, energy, the metric system, and scientific methods. Students examine the relationship of matter and energy, including learning about classification of matter. To prepare students for solving chemistry problems throughout the course, students learn about the metric system, significant figures, and the scientific method as applied in chemistry research.

- Semester Introduction
- Chemistry and Society
- Matter and Energy
- Review: Matter
- Pure Substances
- Mixtures
- Review: Substances
- Laboratory: Paper Chromatography 1
- Laboratory: Paper Chromatography 2
- Properties of Substances
- Problem Solving in Chemistry
- Review: Properties and Problems
- Metric System: Base Units
- Metric System: Derived Units
- Review: Metric System
- Graphing
- Scientific Method and Chemistry
- Review: Graphing and Scientific Method

### Unit 2: Atomic Structure

This unit introduces students to the atom and examines changing perspectives of the nature of the atom throughout history. In following a historical story, students learn about the parts of the atom and its properties such as atomic number, atomic mass, and electron arrangement. This unit prepares students for the periodic table.

- Early Theories of the Atom
- The Nuclear Atom



- Review: The Atom
- Laboratory: Properties of Substances 1
- Laboratory: Properties of Substances 2
- Atomic Number and Mass Number
- Ions
- Isotopes and Atomic Mass
- Review: Aspects of the Atom
- The Bohr Atom

### Unit 3: The Periodic Table

With a basis in matter and the structure of the atom, students now turn their attention to the organization of atoms and elements and their graphic representation as a periodic table. The properties of the periodic table are defined, and then students examine trends that are brought out by the arrangement of atoms according to atomic number. Students study elements by learning about metals and other classes of elements.

- Atomic Number and the Periodic Law
- The Periodic Table
- Trends within the Periodic Table
- Review: Periodic Table
- Metals
- Nonmetals
- Review: Metals and Nonmetals
- Laboratory: Reaction of Metals 1
- Laboratory: Reaction of Metals 2
- Metalloids
- Inner Transition Metals
- Review: Metalloids and Transition Metals

### Unit 4: Chemical Bonding

Atoms form bonds. In the first part of this unit, students learn about different types of bonds, principally ionic and covalent bonds. This unit focuses on recognizing why and how bonds form and the naming of the substances involved. Included in this unit are examinations of those intermolecular forces that result in hydrogen bonds.

- Monatomic Ions
- Polyatomic Ions
- Review: Ions
- The Ionic Bond and Salts
- Properties of Ionic Compounds
- Review: Ionic Compounds
- Laboratory: Salts: Precipitation Reactions 1
- Laboratory: Salts: Precipitation Reactions 2
- The Covalent Bond and Molecules
- Lewis Structures
- Van der Waals Forces
- Review: Atomic Bonding

## Unit 5: Chemical Reactions

Bonding is now firmly established, so students can progress to learning how bonds break and form in chemical reactions. Different types of chemical reactions are explored in both direct instruction and hands-on laboratory experiences. Students learn the fundamentals of products and reactions and learn to balance equations to show that mass is conserved as change happens in these reactions.

- The Conservation of Mass
- Balancing Chemical Equations
- Review: Chemical Equations
- Types of Reactions 1
- Types of Reactions 2
- Review: Chemical Reactions
- Laboratory: Chemical Reactions 1
- Laboratory: Chemical Reactions 2

## Unit 6: Stoichiometry

Now that students understand the basics of chemical reactions and the ability to balance chemical equations, it is possible for them to apply this knowledge to real-world situations. Stoichiometry is the study of determining the yields of chemical reactions, given the masses of some parts of the chemical equation. Mastering this allows students to solve problems similar to those that confront chemists in industrial production.

- Stoichiometry and Its Uses
- Mole-Number Relationships
- Review: Stoichiometry
- Mole-Mass Relationships
- Mole-Volume Relationships
- Review: Moles
- Moles and Chemical Equations
- Calculating Yields of Reactions
- Laboratory: Stoichiometry of Chemical Reactions 1
- Laboratory: Stoichiometry of Chemical Reactions 2

## Unit 7: Semester Review and Test

- Semester Review
- Semester Test

## SEMESTER TWO

### Unit 1: States of Matter

The study of gases, liquids, and solids not only tells us of their properties, but gives us a strong basis for understanding how matter is organized and how it behaves. Students closely examine how a volume of gas behaves under changing conditions of pressure and temperature. Students also investigate some of the properties of liquids and solids, and relate all three states of matter using phase diagrams.

- Semester Introduction
- The Behavior of Gases
- Gas Laws
- Review: Gases

- Laboratory: Gas Laws 1
- Laboratory: Gas Laws 2
- The Ideal Gas Law
- Absolute Zero
- Review: Ideal Gas Law
- Some Properties of Liquids
- Some Properties of Solids
- Review: Liquids and Solids

## Unit 2: Solutions

Much of chemistry involves understanding solutions, in which a solute is placed in a solvent. The properties of the resulting solution can be understood by examining the interactions between the parts of a solution. Students learn the various ways to describe the concentration of solution and how to separate the component substances.

- Solutions
- The Dissolving Process
- Review: Solutions and Dissolving
- Laboratory: Factors Affecting Solution Formation 1
- Laboratory: Factors Affecting Solution Formation 2
- Molarity and Mole Fraction
- Molality and Mass Percent
- Review: Molarity and Molality
- Colligative Properties
- Separating Solutions

## Unit 3: Acids and Bases

Most students entering chemistry have some experience with acids and bases from everyday life. In this unit, after examining the properties of acids and bases, students analyze different definitions of acids and bases that have been developed since the time of Arrhenius. They learn how to solve problems dealing with the strength of acids and bases. Students gain practical experience working with acids and bases in a laboratory setting, including doing titrations.

- Properties of Acids and Bases
- Types of Acids and Bases
- Review: Acids and Bases
- Measuring Acids and Bases
- Buffers and Titration
- Review: Measuring pH
- Laboratory: Titration: Testing Water Quality 1
- Laboratory: Titration: Testing Water Quality 2

#### Unit 4: Chemical Thermodynamics

A vital part of the study of matter is learning about the energy associated with both chemical and physical changes. The study of energy in chemical systems is called chemical thermodynamics. It involves understanding that energy is conserved during chemical reactions and also when substances change from gas to liquids to solids—and back again. Overarching all this content is the law of conservation of energy.

- The Conservation of Energy
- Measuring the Flow of Heat
- Review: Thermal Energy
- Laboratory: Heat Transfer 1
- Laboratory: Heat Transfer 2
- Specific Heat
- Writing Thermochemical Equations
- Review: More Aspects of Heat

#### Unit 5: Reaction Rate and Equilibrium

In the previous unit, students developed a basic understanding of the role of energy in chemistry and how it applied to certain processes. In this unit, students examine the role of energy in two important chemical phenomena: reaction rates and system equilibria. Based on an understanding of collision theory, students develop a “big idea” understanding of why chemical reactions do and do not occur.

- Reaction Rates and Energy of Activation
- Factors Affecting Reaction Rates
- Review: Reaction Rates
- Laboratory: Reaction-Rate Factors 1
- Laboratory: Reaction-Rate Factors 2
- Equilibrium
- Le Chatelier’s Principle
- Review: Equilibrium

#### Unit 6: Electrochemistry

In this unit, students conduct a systematic study of the electrochemical processes. They learn the basics of the conversion of electrical energy to chemical energy and vice versa. They examine voltaic cells with a hands-on activity. Students also study batteries and electrolytic cells.

- Electrochemical Processes
- Voltaic Cell
- Review: Electrochemistry
- Laboratory: Electroplating 1
- Laboratory: Electroplating 2
- Dry Cells
- Electrolytic Cells
- Review: Electrochemical Cells



### Unit 7: Organic Chemistry

As students move through this curriculum, they learn about chemicals and their relationship to living things. In this unit, they conduct a systematic study of carbon-based compounds as they study organic chemistry and biochemistry. First, they confront some types of organic compounds and learn about schemes for naming them. Students then turn their attention to biochemistry, including an examination of carbohydrates, fats, and proteins.

- Hydrocarbons and Other Organic Chemicals
- Laboratory: Modeling Organic Compounds
- Polymers
- Review: Hydrocarbons and Polymers
- Carbohydrates and Fats
- Proteins and Nucleic Acids
- Review: Biochemistry

### Unit 8: Nuclear Chemistry

The reactions that form the basis of the study of classical chemistry are those involving relationships between electrons of reactants and products. Nuclear chemistry, however, is a branch of chemistry that deals with the atomic nucleus, its particles, and forces. Students learn about radioactivity, transmutation of elements, and aspects of nuclear fission and fusion. In addition, students become aware of the uses of nuclear chemistry in the modern world.

- Forces within the Nucleus
- Radioactivity and Half-Life
- Review: Nuclear Forces
- Laboratory: Calculating Half-Life
- Transmutation of Elements
- Nuclear Fission and Fusion
- Review: Nuclear Chemistry

### Unit 9: Semester Review and Test

- Semester Review
- Semester Test





# SCI203: Biology

This course, for students who have been introduced to biology topics in middle school, focuses on topics in cell chemistry and biology, genetics, evolution, the biology of living things, and ecology. Students use a combination of online instruction with animations, hands-on laboratory activities, reference book study, and collaborative activities with virtual classmates. This course prepares students to take AP® Biology or any beginning-level college biology course.

**COURSE LENGTH:** Two semesters

**MATERIALS:** *Biology: A Reference Guide*; materials for laboratory experiments, including a compound microscope

**PREREQUISITES:** K<sup>12</sup> middle school Life Science, or equivalent

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## SEMESTER ONE

### Unit 1: The Science of Biology

Students explore biology as one of the sciences and confront the concepts of scientific methods. After exploring scientific processes as they apply to biology, students examine what “life” means as they investigate the characteristics that all living things share. Students then look at the importance of energy, what kinds of energy are significant when considering living things, and the relationship of structures of living things to their functions.

- Semester Introduction
- Biology and Scientific Methods
- Scientific Processes 1
- Scientific Processes 2
- Laboratory: Using a Microscope
- The Characteristics of Life 1
- The Characteristics of Life 2
- The Characteristics of Life 3
- Energy and Life
- Structure and Function

### Unit 2: The Chemistry of Life

Students explore the chemical basis for life by examining the most important groups of organic compounds: carbohydrates, proteins, lipids, and nucleic acids. Students then examine water and how it is important for living things. In each case, students focus on the relationship of the molecular structure of compounds to its function in living things.

- Chemistry Review
- Chemical Bonds
- Carbon and Life
- Organic Compounds and Trace Elements
- Ions in Living Things
- Useful Chemicals from Living Things
- Water
- Laboratory: Investigating Biological Compounds 1
- Laboratory: Investigating Biological Compounds 2
- Simple Carbohydrates
- Complex Carbohydrates

- Lipids
- Amino Acids and Proteins
- Levels of Protein Structure
- Proteins as Enzymes
- Nucleic Acids
- ATP

### Unit 3: Cell Biology

Students now are able to begin looking at the structure and function of living things. They begin with an exploration of the cell. They confront the structure of the cell, its membranes and organelles. In particular, they look at the processes by which cells gather and make energy available, focusing on the activities of the mitochondrion and the chloroplast. Students then proceed to look at cellular reproduction and study the processes of meiosis and mitosis.

- The Cell and Life
- Cell Structure
- Cell Organelles
- Two Types of Cells
- Cell Membrane Structure
- Movement Across Membranes
- Passive Transport
- Active Transport
- Laboratory: Determining the Rate of Diffusion 1
- Laboratory: Determining the Rate of Diffusion 2
- Glycolysis and Fermentation
- The Krebs Cycle
- The Electron Transport System
- Light and Photosynthesis
- Photosynthesis and Glucose
- Chemical Energy and Life
- Respiration and Photosynthesis
- Laboratory: The Rate of Photosynthesis 1
- Laboratory: The Rate of Photosynthesis 2
- Reproduction and Development
- Mitosis
- Laboratory: Observing Mitosis
- Cell Differentiation
- Cell Specialization
- Sexual Reproduction
- Meiosis I
- Meiosis II

#### Unit 4: Mendelian Genetics

Students learn about the work of Gregor Mendel as a way of studying modern genetics. They perform genetic crosses and begin to see how traits are inherited. As they examine Mendelian genetics more closely, they see the relationship between inheritance and chromosomes and between genes and alleles. This unit prepares students to go deeper into genetics at the molecular level.

- The Work of Gregor Mendel
- Mendelian Inheritance
- Laboratory: Genetic Crosses 1
- Laboratory: Genetic Crosses 2
- Pedigrees
- Laboratory: Gene Mapping
- Chromosomes and Genes
- Genes and Alleles
- Genetic Variation

#### Unit 5: Molecular Genetics

The chemical basis for genetics is one of the cornerstones of modern biology. In this unit, students explore the relationship between DNA, RNA, and proteins—and what this has to do with genes and inheritance. After establishing a firm basis in molecular genetics, students are able to understand modern applications of genetics, including biotechnology and genetic engineering.

- DNA, RNA, and Proteins
- Structure of DNA
- Structures of RNA
- DNA Replication
- Transcription
- Laboratory: Modeling DNA
- Laboratory: Modeling DNA Replication
- DNA Makes RNA
- RNA Makes Protein
- The Genetic Code

#### Unit 6: Semester Review and Test

- Semester Review
- Semester Test

### SEMESTER TWO

#### Unit 1: Gene Expression

In this unit, students explore the process by which the DNA–RNA relationship builds proteins. Then students learn how the process of proteins synthesis is controlled, a process called gene expression. Students then are able to understand modern applications of genetics, including biotechnology and genetic engineering.

- Semester Introduction
- Proteins Express DNA
- How Proteins Work
- Gene Expression 1



- Gene Expression 2
- Biotechnology
- Genetic Engineering

## Unit 2: Evolution

Evolution is the central organizing principle of biology. Students learn about the concept of evolution and the underlying principles of natural selection. Once they have mastered the fundamental principles, they learn how modern evolution is a science that includes gene changes over time as the underlying mechanism for evolution.

- Evolution and Biology
- Evolution of Populations
- Multiplying Variation in Populations
- Types of Natural Selection
- History of Evolutionary Thought
- Evidence for Evolution 1
- Evidence for Evolution 2
- Evolution and Earth History
- Laboratory: Process of Natural Selection 1
- Laboratory: Process of Natural Selection 2
- Genetic Basis of Evolution
- The Hardy-Weinberg Equation
- Geographic Isolation
- Genetic Isolation

## Unit 3: Survey of Living Things 1

Students learn about the structure and function of living things by examining three representative organisms: a flatworm, a fern, and a human. In doing so, students examine processes such as digestion and respiration—comparing and contrasting how living things obtain food, break down food, eliminate waste, and obtain and use oxygen.

- Classification and Taxonomy
- Modern Classification
- Laboratory: Dichotomous Key
- Viruses and Prokaryotes
- Protists and Fungi
- Animals
- Plants
- Three Representative Organisms
- Getting Energy
- Digestion
- Digestion in Humans
- Laboratory: Human Digestion Actions 1
- Waste Removal
- Laboratory: Human Digestion Actions 2
- Waste Removal in Humans
- Obtaining Oxygen
- Oxygen and the Human Body

#### Unit 4: Survey of Living Things 2

Students continue their examination of living things, focusing on three representative organisms. They explore the nervous and muscular systems and see how these systems aid in responding to the organism's environment. Students then examine various aspects of reproduction among living things and finish with a study of defense.

- How Organisms Monitor Their Environments
- Human Nervous System
- Feedback Mechanisms
- How Living Things Respond to Their Environments
- Muscular Systems
- How Muscles Contract
- Laboratory: Chicken Muscles 1
- Laboratory: Chicken Muscles 2
- Fern Reproduction
- Flatworm Reproduction
- Human Reproduction
- How Organisms Defend Themselves
- Human Immune Response 1
- Human Immune Response 2
- Plant Defenses

#### Unit 5: Ecology and the Environment

As students have moved through this curriculum, they have learned about living things, their structure, and functions. In this unit, they confront organisms in relationship to their environments. Students study living things and the ecosystems in which they live, examining both the biotic and abiotic components of the world in which organisms exist.

- Individuals and Populations
- Communities
- Ecosystems
- Ecosystem Stability
- Biomes
- Biodiversity
- Energy Flow in Ecosystems
- Food Chains and Food Webs
- Succession
- Laboratory: Patterns of Succession
- Changes in Ecosystems
- Water and Nitrogen Cycles
- Carbon and Oxygen Cycles
- Laboratory: Fixation in Root Nodules 1
- Laboratory: Fixation in Root Nodules 2
- Laboratory: The Effects of Acidity on Seed Germination 1
- Natural Resources
- Environmental Challenges





- Global Temperatures
- Pollution
- Laboratory: The Effects of Acidity on Seed Germination 2

#### **Unit 6: Semester Review and Test**

- Semester Review
- Semester Test



# SCI203: Biology

This course, for students who have been introduced to biology topics in middle school, focuses on topics in cell chemistry and biology, genetics, evolution, the biology of living things, and ecology. Students use a combination of online instruction with animations, hands-on laboratory activities, reference book study, and collaborative activities with virtual classmates. This course prepares students to take AP® Biology or any beginning-level college biology course.

**COURSE LENGTH:** Two semesters

**MATERIALS:** *Biology: A Reference Guide*; materials for laboratory experiments, including a compound microscope

**PREREQUISITES:** K<sup>12</sup> middle school Life Science, or equivalent

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## SEMESTER ONE

### Unit 1: The Science of Biology

Students explore biology as one of the sciences and confront the concepts of scientific methods. After exploring scientific processes as they apply to biology, students examine what “life” means as they investigate the characteristics that all living things share. Students then look at the importance of energy, what kinds of energy are significant when considering living things, and the relationship of structures of living things to their functions.

- Semester Introduction
- Biology and Scientific Methods
- Scientific Processes 1
- Scientific Processes 2
- Laboratory: Using a Microscope
- The Characteristics of Life 1
- The Characteristics of Life 2
- The Characteristics of Life 3
- Energy and Life
- Structure and Function

### Unit 2: The Chemistry of Life

Students explore the chemical basis for life by examining the most important groups of organic compounds: carbohydrates, proteins, lipids, and nucleic acids. Students then examine water and how it is important for living things. In each case, students focus on the relationship of the molecular structure of compounds to its function in living things.

- Chemistry Review
- Chemical Bonds
- Carbon and Life
- Organic Compounds and Trace Elements
- Ions in Living Things
- Useful Chemicals from Living Things
- Water
- Laboratory: Investigating Biological Compounds 1
- Laboratory: Investigating Biological Compounds 2
- Simple Carbohydrates
- Complex Carbohydrates

- Lipids
- Amino Acids and Proteins
- Levels of Protein Structure
- Proteins as Enzymes
- Nucleic Acids
- ATP

### Unit 3: Cell Biology

Students now are able to begin looking at the structure and function of living things. They begin with an exploration of the cell. They confront the structure of the cell, its membranes and organelles. In particular, they look at the processes by which cells gather and make energy available, focusing on the activities of the mitochondrion and the chloroplast. Students then proceed to look at cellular reproduction and study the processes of meiosis and mitosis.

- The Cell and Life
- Cell Structure
- Cell Organelles
- Two Types of Cells
- Cell Membrane Structure
- Movement Across Membranes
- Passive Transport
- Active Transport
- Laboratory: Determining the Rate of Diffusion 1
- Laboratory: Determining the Rate of Diffusion 2
- Glycolysis and Fermentation
- The Krebs Cycle
- The Electron Transport System
- Light and Photosynthesis
- Photosynthesis and Glucose
- Chemical Energy and Life
- Respiration and Photosynthesis
- Laboratory: The Rate of Photosynthesis 1
- Laboratory: The Rate of Photosynthesis 2
- Reproduction and Development
- Mitosis
- Laboratory: Observing Mitosis
- Cell Differentiation
- Cell Specialization
- Sexual Reproduction
- Meiosis I
- Meiosis II

#### Unit 4: Mendelian Genetics

Students learn about the work of Gregor Mendel as a way of studying modern genetics. They perform genetic crosses and begin to see how traits are inherited. As they examine Mendelian genetics more closely, they see the relationship between inheritance and chromosomes and between genes and alleles. This unit prepares students to go deeper into genetics at the molecular level.

- The Work of Gregor Mendel
- Mendelian Inheritance
- Laboratory: Genetic Crosses 1
- Laboratory: Genetic Crosses 2
- Pedigrees
- Laboratory: Gene Mapping
- Chromosomes and Genes
- Genes and Alleles
- Genetic Variation

#### Unit 5: Molecular Genetics

The chemical basis for genetics is one of the cornerstones of modern biology. In this unit, students explore the relationship between DNA, RNA, and proteins—and what this has to do with genes and inheritance. After establishing a firm basis in molecular genetics, students are able to understand modern applications of genetics, including biotechnology and genetic engineering.

- DNA, RNA, and Proteins
- Structure of DNA
- Structures of RNA
- DNA Replication
- Transcription
- Laboratory: Modeling DNA
- Laboratory: Modeling DNA Replication
- DNA Makes RNA
- RNA Makes Protein
- The Genetic Code

#### Unit 6: Semester Review and Test

- Semester Review
- Semester Test

### SEMESTER TWO

#### Unit 1: Gene Expression

In this unit, students explore the process by which the DNA–RNA relationship builds proteins. Then students learn how the process of proteins synthesis is controlled, a process called gene expression. Students then are able to understand modern applications of genetics, including biotechnology and genetic engineering.

- Semester Introduction
- Proteins Express DNA
- How Proteins Work
- Gene Expression 1



- Gene Expression 2
- Biotechnology
- Genetic Engineering

### Unit 2: Evolution

Evolution is the central organizing principle of biology. Students learn about the concept of evolution and the underlying principles of natural selection. Once they have mastered the fundamental principles, they learn how modern evolution is a science that includes gene changes over time as the underlying mechanism for evolution.

- Evolution and Biology
- Evolution of Populations
- Multiplying Variation in Populations
- Types of Natural Selection
- History of Evolutionary Thought
- Evidence for Evolution 1
- Evidence for Evolution 2
- Evolution and Earth History
- Laboratory: Process of Natural Selection 1
- Laboratory: Process of Natural Selection 2
- Genetic Basis of Evolution
- The Hardy-Weinberg Equation
- Geographic Isolation
- Genetic Isolation

### Unit 3: Survey of Living Things 1

Students learn about the structure and function of living things by examining three representative organisms: a flatworm, a fern, and a human. In doing so, students examine processes such as digestion and respiration—comparing and contrasting how living things obtain food, break down food, eliminate waste, and obtain and use oxygen.

- Classification and Taxonomy
- Modern Classification
- Laboratory: Dichotomous Key
- Viruses and Prokaryotes
- Protists and Fungi
- Animals
- Plants
- Three Representative Organisms
- Getting Energy
- Digestion
- Digestion in Humans
- Laboratory: Human Digestion Actions 1
- Waste Removal
- Laboratory: Human Digestion Actions 2
- Waste Removal in Humans
- Obtaining Oxygen
- Oxygen and the Human Body



## Unit 4: Survey of Living Things 2

Students continue their examination of living things, focusing on three representative organisms. They explore the nervous and muscular systems and see how these systems aid in responding to the organism's environment. Students then examine various aspects of reproduction among living things and finish with a study of defense.

- How Organisms Monitor Their Environments
- Human Nervous System
- Feedback Mechanisms
- How Living Things Respond to Their Environments
- Muscular Systems
- How Muscles Contract
- Laboratory: Chicken Muscles 1
- Laboratory: Chicken Muscles 2
- Fern Reproduction
- Flatworm Reproduction
- Human Reproduction
- How Organisms Defend Themselves
- Human Immune Response 1
- Human Immune Response 2
- Plant Defenses

## Unit 5: Ecology and the Environment

As students have moved through this curriculum, they have learned about living things, their structure, and functions. In this unit, they confront organisms in relationship to their environments. Students study living things and the ecosystems in which they live, examining both the biotic and abiotic components of the world in which organisms exist.

- Individuals and Populations
- Communities
- Ecosystems
- Ecosystem Stability
- Biomes
- Biodiversity
- Energy Flow in Ecosystems
- Food Chains and Food Webs
- Succession
- Laboratory: Patterns of Succession
- Changes in Ecosystems
- Water and Nitrogen Cycles
- Carbon and Oxygen Cycles
- Laboratory: Fixation in Root Nodules 1
- Laboratory: Fixation in Root Nodules 2
- Laboratory: The Effects of Acidity on Seed Germination 1
- Natural Resources
- Environmental Challenges



- Global Temperatures
- Pollution
- Laboratory: The Effects of Acidity on Seed Germination 2

#### **Unit 6: Semester Review and Test**

- Semester Review
- Semester Test



# SCI303: Chemistry

This course gives students a solid basis to move on to more advanced courses. The course surveys all key areas, including atomic structure, chemical bonding and reactions, solutions, stoichiometry, thermochemistry, organic chemistry, and nuclear chemistry. Instructions for hands-on labs are included, for which K<sup>12</sup> provides all lab materials that cannot easily be found in the home.

**COURSE LENGTH:** Two semesters

**MATERIALS:** *Chemistry: Problems and Solutions; Chemistry: A Laboratory Guide*; K<sup>12</sup>-provided laboratory materials; common household materials for labs

**PREREQUISITES:** Satisfactory completion of either K<sup>12</sup> middle school Physical Science or SCI102: Physical Science

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## SEMESTER ONE

### Unit 1: The Study of Chemistry

Students explore chemistry as one of the sciences and confront concepts of matter, energy, the metric system, and scientific methods. Students examine the relationship of matter and energy, including learning about classification of matter. To prepare students for solving chemistry problems throughout the course, students learn about the metric system, significant figures, and the scientific method as applied in chemistry research.

- Semester Introduction
- Chemistry and Society
- Matter and Energy
- Pure Substances
- Mixtures
- Laboratory: Paper Chromatography 1
- Laboratory: Paper Chromatography 2
- Properties of Substances
- Problem Solving in Chemistry
- Metric System: Base Units
- Metric System: Derived Units
- Graphing
- Scientific Method and Chemistry

### Unit 2: Atomic Structure

This unit introduces students to the atom and examines changing perspectives of the nature of the atom throughout history. In following a historical story, students learn about the parts of the atom and its properties such as atomic number, atomic mass, atomic orbitals, and electron arrangement. To ensure the most current understanding of the atom, students examine the quantum theory of the atom and its use in understanding atomic spectra. This unit prepares students for the periodic table.

- Early Theories of the Atom
- The Nuclear Atom
- Atomic Number and Mass Number
- Ions
- Isotopes and Atomic Mass
- Laboratory: Properties of Substances 1
- Laboratory: Properties of Substances 2

- The Bohr Atom
- Electron Orbitals
- The Quantum Atom and Atomic Spectra

### Unit 3: The Periodic Table

With a basis in matter and the structure of the atom, students now turn their attention to the organization of atoms and elements and their graphic representation as a periodic table. The properties of the periodic table are defined, and then students examine trends that are brought out by the arrangement of atoms according to atomic number. Students study elements by learning about metals and other classes of elements.

- Atomic Number and the Periodic Law
- The Periodic Table
- Electron Arrangement Patterns
- Trends within the Periodic Table
- Metals
- Nonmetals
- Laboratory: Reaction of Metals 1
- Laboratory: Reaction of Metals 2
- Metalloids
- Inner Transition Metals

### Unit 4: Chemical Bonding

Atoms form bonds. In the first part of this unit, students learn about different types of bonds, principally ionic and covalent bonds. This unit focuses on recognizing why and how bonds form and the naming of the substances involved. Included in this unit are examinations of metallic bonding and of intermolecular forces that result in hydrogen bonds.

- Monatomic Ions
- Polyatomic Ions
- The Ionic Bond and Salts
- Properties of Ionic Compounds
- Naming Ionic Compounds
- Laboratory: Salts: Precipitation Reactions 1
- Laboratory: Salts: Precipitation Reactions 2
- Bonding in Metals
- The Covalent Bond and Molecules
- Lewis Structures
- Molecular Shapes
- Van der Waals Forces

### Unit 5: Chemical Reactions

Bonding is now firmly established, so students can progress to learning how bonds break and form in chemical reactions. Different types of chemical reactions are explored in both direct instruction and hands-on laboratory experiences. Students learn the fundamentals of products and reactions and learn to balance equations to show that mass is conserved as change happens in these reactions.

- The Conservation of Mass
- Balancing Chemical Equations
- Combustion Reactions



- Synthesis Reactions
- Decomposition Reactions
- Oxidation-Reduction Reactions
- Single Displacement Reactions
- Double Displacement Reactions
- Laboratory: Chemical Reactions 1
- Laboratory: Chemical Reactions 2

### Unit 6: Stoichiometry

Now that students understand the basics of chemical reactions and the ability to balance chemical equations, it is possible for them to apply this knowledge to real-world situations. Stoichiometry is the study of determining the yields of chemical reactions, given the masses of some parts of the chemical equation. Mastering this allows students to solve problems similar to those that confront chemists in industrial production.

- Stoichiometry and Its Uses
- Mole-Number Relationships
- Mole-Mass Relationships
- Mole-Volume Relationships
- Moles and Chemical Equations
- Laboratory: Stoichiometry of Chemical Reactions 1
- Laboratory: Stoichiometry of Chemical Reactions 2
- Calculating Yields of Reactions
- Percent Yield

### Unit 7: Semester Review and Test

- Semester Review
- Semester Test

## SEMESTER TWO

### Unit 1: States of Matter

The study of gases, liquids, and solids not only tells us of their properties, but gives us a strong basis for understanding how matter is organized and how it behaves. Students closely examine how a volume of gas behaves under changing conditions of pressure and temperature. Students also investigate some of the properties of liquids and solids, and relate all three states of matter using phase diagrams.

- Semester Introduction
- The Behavior of Gases
- Boyle's Law
- Charles's Law
- Gay-Lussac's Law
- Laboratory: Gas Laws 1
- Laboratory: Gas Laws 2
- The Ideal Gas Law
- Absolute Zero
- Dalton's Law of Partial Pressures
- Graham's Law of Effusion



- Phase Diagrams
- Some Properties of Liquids
- Some Properties of Solids

## Unit 2: Solutions

Much of chemistry involves understanding solutions, in which a solute is placed in a solvent. The properties of the resulting solution can be understood by examining the interactions between the parts of a solution. Students learn the various ways to describe the concentration of solution and how to separate the component substances.

- Solutions
- The Dissolving Process
- Laboratory: Factors Affecting Solution Formation 1
- Laboratory: Factors Affecting Solution Formation 2
- Molarity and Mole Fraction
- Molality and Mass Percent
- Colligative Properties
- Separating Solutions

## Unit 3: Acids and Bases

Most students entering chemistry have some experience with acids and bases from everyday life. In this unit, after examining the properties of acids and bases, students analyze different definitions of acids and bases that have been developed since the time of Arrhenius. They learn how to solve problems dealing with the strength of acids and bases. Students gain practical experience working with acids and bases in a laboratory setting, including doing titrations.

- Properties of Acids and Bases
- Arrhenius Acids and Bases
- Bronsted-Lowery and Lewis Acids and Bases
- Measuring Acids and Bases
- Buffers and Titration
- Laboratory: Titration: Testing Water Quality 1
- Laboratory: Titration: Testing Water Quality 2
- Strength of Acids and Bases

## Unit 4: Chemical Thermodynamics

A vital part of the study of matter is learning about the energy associated with both chemical and physical changes. The study of energy in chemical systems is called chemical thermodynamics. It involves understanding that energy is conserved during chemical reactions and also when substances change from gas to liquids to solids—and back again. Overarching all this content is the law of conservation of energy.

- The Conservation of Energy
- Measuring the Flow of Heat
- Laboratory: Heat Transfer 1
- Laboratory: Heat Transfer 2
- Specific Heat
- Changes in Enthalpy
- Writing Thermochemical Equations
- Heat during Changes of State
- Hess's Law

### Unit 5: Reaction Rate and Equilibrium

In the previous unit, students developed a basic understanding of the role of energy in chemistry and how it applied to certain processes. In this unit, students examine the role of energy in two important chemical phenomena: reaction rates and system equilibria. Based on an understanding of collision theory, students develop a “big idea” understanding of why chemical reactions do and do not occur.

- Reaction Rates and Energy of Activation
- Factors Affecting Reaction Rates
- Laboratory: Reaction-Rate Factors 1
- Laboratory: Reaction-Rate Factors 2
- Collision Theory
- Equilibrium
- Le Chatelier’s Principle
- Spontaneous Reactions
- Entropy and Free Energy

### Unit 6: Electrochemistry

In this unit, students conduct a systematic study of the electrochemical processes. They learn the basics of the conversion of electrical energy to chemical energy and vice versa. They examine voltaic cells with a hands-on activity. Students also study batteries and electrolytic cells.

- Electrochemical Processes
- Voltaic Cells
- Laboratory: Electroplating 1
- Laboratory: Electroplating 2
- Dry Cells
- Electrolytic Cells

### Unit 7: Organic Chemistry

As students move through this curriculum, they learn about chemicals and their relationship to living things. In this unit, they conduct a systematic study of carbon-based compounds as they study organic chemistry and biochemistry. First, they confront some types of organic compounds and learn about schemes for naming them. Students then turn their attention to biochemistry, including an examination of carbohydrates, fats, and proteins.

- Hydrocarbons and Other Organic Chemicals
- Laboratory: Modeling Organic Compounds
- Polymers
- Carbohydrates and Fats
- Proteins and Nucleic Acids



### Unit 8: Nuclear Chemistry

The reactions that form the basis of the study of classical chemistry are those involving relationships between electrons of reactants and products. Nuclear chemistry, however, is a branch of chemistry that deals with the atomic nucleus, its particles, and forces. Students learn about radioactivity, transmutation of elements, and aspects of nuclear fission and fusion. In addition, students become aware of the uses of nuclear chemistry in the modern world.

- Forces within the Nucleus
- Radioactivity and Half-Life
- Laboratory: Calculating Half-Life
- Transmutation of Elements
- Nuclear Fission and Fusion

### Unit 9: Semester Review and Test

- Semester Review
- Semester Test



# SCI403: Physics

Students use quantitative concepts and tools to explore the physical world as they learn to use the language of mathematics to investigate natural phenomena. Topics of study include the conservation of mass and energy, the conservation of momentum, waves, fields, and the interactions of matter and energy.

**COURSE LENGTH:** Two semesters

**MATERIALS:** None

**PREREQUISITES:** MTH303: Algebra II and MTH403: Pre-Calculus/Trigonometry

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## SEMESTER ONE OUTLINE

### UNIT 1: MOTION

#### Lesson 1: Motion in a Straight Line

**Topic 1:** Early Studies and Theories of Motion

**Topic 2:** Galileo's Experiments

**Topic 3:** The Language of Motion: Defining Speed, Acceleration, Velocity, and Gravity

**Topic 4:** Mathematics of Uniformly Accelerated Motion

#### Lesson Activities:

- Self-check Lab: Accelerated Motion

#### Lesson Assignments and Assessments:

- Lesson Review and Self-check Quiz

#### Lesson 2: Newton's Laws

**Topic 1:** Newton's First Law of Motion–Inertia

**Topic 2:** Newton's Second Law of Motion–Acceleration

**Topic 3:** Newton's Third Law of Motion–Action and Reaction

**Topic 4:** Vectors

**Topic 5:** Support Force

**Topic 6:** Friction

#### Lesson Activities:

- Self-check Lab: Sponge Compression
- Self-check Lab: Newton's First Law of Motion
- Self-check Lab: Friction Demonstration

- Virtual Lab: Fluid Friction in the Air
- Self-check Lab: Blow the Football

#### **Lesson Assignments and Assessments:**

- Notebook: Lab Safety
- Notebook: Fluid Friction in the Air Lab Report
- Lesson Review and Self-check Quiz

#### **Unit Assignments and Assessments:**

- Notebook: Motion
- Unit 1 Exam

## **UNIT 2: OTHER TYPES OF MOTION**

### **Lesson 1: Motion in Two Dimensions**

**Topic 1:** Projectile Motion

**Topic 2:** Horizontal Projectiles

**Topic 3:** Circular Motion

**Topic 4:** Universal Gravitation

#### **Lesson Activities:**

- Self-check Lab: Traveling a Circular Path

#### **Lesson Assignments and Assessments:**

- Lesson Review and Self-check Quiz

### **Lesson 2: Momentum**

**Topic 1:** Defining Momentum

**Topic 2:** Conservation of Momentum

**Topic 3:** Rotational Motion and Torque

**Topic 4:** Center of Gravity

**Topic 5:** Inertia of Rotation

#### **Lesson Activities:**

- Self-check Lab: Conservation of Momentum
- Self-check Lab: Finding Your Center of Gravity
- Self-check Lab: Levers
- Virtual Lab: Can Races

#### **Lesson Assignments and Assessments:**

- Lesson Review and Self-check Quiz





### **Unit Assignments and Assessments:**

- Unit 2 Exam

## **UNIT 3: ENERGY AND RELATIVITY**

### **Lesson 1: Energy**

**Topic 1:** Work

**Topic 2:** Power

**Topic 3:** Energy

**Topic 4:** Machines

### **Lesson Activities:**

- Self-check Lab: Muscle Up!
- Virtual Lab: Pulley Systems

### **Lesson Assignments and Assessments:**

- Notebook: Pulley Systems Lab Report
- Lesson Review and Self-check Quiz

### **Lesson 2: Theory of Relativity**

**Topic 1:** Review of Newton's Laws

**Topic 2:** Frame of Reference

**Topic 3:** Special Relativity

**Topic 4:** The Twin Paradox

**Topic 5:** Length Contraction

**Topic 6:** Relativistic Laws of Motion

**Topic 7:** Mass–Energy Equivalence

**Topic 8:** General Theory of Relativity

### **Lesson Assignments and Assessments:**

- Lesson Review and Self-check Quiz

### **Unit Assignments and Assessments:**

- Notebook: Energy and Relativity
- Unit 3 Exam



## **UNIT 4: PROPERTIES OF MATTER**

### **Lesson 1: Properties of Matter–Solids**

**Topic 1:** Solid Structures

**Topic 2:** Properties of Solids

**Topic 3:** Cohesion

**Topic 4:** Elasticity

**Topic 5:** Scaling

#### **Lesson Activities:**

- Self-check Lab: Stretch
- Virtual Lab: Why Does an Elephant Have Big Ears?

#### **Lesson Assignments and Assessments:**

- Notebook: Why Does an Elephant Have Big Ears Lab Report
- Lesson Review and Self-check Quiz

### **Lesson 2: Properties of Matter–Liquids**

**Topic 1:** Nature of Liquids

**Topic 2:** Cohesion, Adhesion, and Surface Tension

**Topic 3:** Pressure

**Topic 4:** Pascal's Law

**Topic 5:** Buoyancy

#### **Lesson Activities:**

- Self-check Lab: Sink or Swim

#### **Lesson Assignments and Assessments:**

- Lesson Review and Self-check Quiz

### **Lesson 3: Properties of Matter–Gases**

**Topic 1:** General Properties of Gases

**Topic 2:** Gases in the Atmosphere

**Topic 3:** Boyle's Law

**Topic 4:** Balloons

**Topic 5:** Bernoulli's Principle

**Topic 6:** Suction

**Lesson Activities:**

- Self-check Lab: Changing the Pressure of Gas

**Lesson Assignments and Assessments:**

- Lesson Review and Self-check Quiz

**Unit Assignments and Assessments:**

- Unit 4 Exam

**UNIT 5: HEAT****Lesson 1: Temperature and Heat**

**Topic 1:** Temperature

**Topic 2:** Temperature Vs. Heat

**Topic 3:** Specific Heat

**Topic 4:** Mechanical Equivalent of Heat

**Lesson Activities:**

- Self-check Lab: Specific Heat of an Unknown Metal

**Lesson Assignments and Assessments:**

- Lesson Review and Self-check Quiz

**Lesson 2: Transmission of Heat**

**Topic 1:** Expansion in Solids

**Topic 2:** Expansion of Fluids

**Topic 3:** Conduction

**Topic 4:** Convection

**Topic 5:** Radiation

**Topic 6:** Newton's Law of Cooling

**Topic 7:** The Greenhouse Effect

**Lesson Activities:**

- Self-check Lab: Cooling Off

**Lesson Assignments and Assessments:**

- Lesson Review and Self-check Quiz
- Notebook: Heat



### **Lesson 3: Change of State**

**Topic 1:** Evaporation

**Topic 2:** Condensation

**Topic 3:** Boiling

**Topic 4:** Freezing and Melting

**Topic 5:** Freezing Point Depression

**Topic 6:** Regelation

**Topic 7:** Energy and Changes of State

#### **Lesson Activities:**

- Virtual Lab: Boil Water with an Ice Cube
- Self-check Lab: Melting Away

#### **Lesson Assignments and Assessments:**

- Notebook: Boil Water with an Ice Cube Lab Report
- Lesson Review and Self-check Quiz

#### **Unit Assignments and Assessments:**

- Unit 5 Exam

## **SEMESTER TWO OUTLINE**

### **UNIT 1: WAVES**

#### **Lesson 1: Wave Motion**

**Topic 1:** Vibrations

**Topic 2:** Pendulums

**Topic 3:** Harmonic Motion

**Topic 4:** Wave Description

**Topic 5:** Wave Speed

**Topic 6:** Wave Behavior

**Topic 7:** Refraction and Interference

**Topic 8:** Standing Waves and Diffraction

**Topic 9:** Motion Relative to Wave Motion

**Lesson Activities:**

- Self-check Lab: Sound Barrier
- Virtual Lab: Wave Behavior

**Lesson Discussion:**

- Topic: Sound Barrier Lab

**Lesson Assignments and Assessments:**

- Notebook: Speed of Sound
- Notebook: Wave Behavior Lab Report
- Lesson Review and Self-check Quiz

**Lesson 2: Sound**

**Topic 1:** Vibrations and Sound

**Topic 2:** Loudness

**Topic 3:** Pitch

**Topic 4:** Forced Vibration and Resonance and Music Vs. Noise

**Lesson Assignments and Assessments:**

- Lesson Review and Self-check Quiz

**Unit Assignments and Assessments:**

- Unit 1 Exam Review
- Unit 1 Exam

**UNIT 2: LIGHT****Lesson 1: Properties of Light**

**Topic 1:** Early Concepts of Light

**Topic 2:** Speed of Light

**Topic 3:** Light Travels in Straight Lines

**Topic 4:** Transmission of Light

**Topic 5:** Illumination

**Topic 6:** Polarization

**Lesson Activities:**

- Self-check Lab: Shadows
- Self-check Lab: Area of Illumination
- Self-check Lab: Polarized Light



**Lesson Discussion:**

- Topic: Shadows Lab
- Topic: Area of Illumination Lab
- Topic: Polarized Light Lab

**Lesson Assignments and Assessments:**

- Lesson Review and Self-check Quiz
- Notebook: Light and Sound

**Lesson 2: Reflection and Refraction**

**Topic 1:** Reflection

**Topic 2:** Plane Mirrors

**Topic 3:** Curved Mirrors

**Topic 4:** Concave and Convex Mirrors

**Topic 5:** More About Concave and Convex Mirrors

**Topic 6:** Refraction and Internal Reflection

**Topic 7:** Atmospheric Refraction

**Topic 8:** Dispersion of Light

**Topic 9:** Lenses

**Topic 10:** Vision and Eyesight: Anatomy, Function, Defects, and Limitations of the Eye

**Lesson Activities:**

- Self-check Lab: Visions Through a Plane Mirror
- Self-check Lab: Images
- Self-check Lab: Converging Lenses

**Lesson Discussion:**

- Topic: Visions Through a Plane Mirror Lab
- Topic: Images Lab
- Topic: Converging Lenses Lab

**Lesson Assignments and Assessments:**

- Lesson Review and Self-check Quiz
- Notebook: Light and Sound



### **Lesson 3: Color, Diffraction, and Interference**

**Topic 1:** The Physics of Color

**Topic 2:** Color in Nature

**Topic 3:** Diffraction

**Topic 4:** Interference

**Topic 5:** Light—What is it?

**Topic 6:** Quantum Physics

#### **Lesson Activities:**

- Virtual Lab: Projecting Light Through Filters
- Self-check Lab: Mixing Colors

#### **Lesson Discussion:**

- Topic: Mixing Colors Lab

#### **Lesson Assignments and Assessments:**

- Notebook: Projecting Light Through Filters Lab Report
- Lesson Review and Self-check Quiz

#### **Unit Assignments and Assessments:**

- Unit 2 Exam Review
- Unit 2 Exam

## **UNIT 3: ELECTRICITY**

### **Lesson 1: Electrostatics**

**Topic 1:** Electrical Forces and Charges

**Topic 2:** Coulomb's Law

**Topic 3:** Lightning

**Topic 4:** Electric Fields

**Topic 5:** Electric Potential Energy

#### **Lesson Activities:**

- Virtual Lab: A Charged Laboratory

#### **Lesson Assignments and Assessments:**

- Notebook: A Charged Laboratory Lab Report
- Lesson Review and Self-check Quiz
- Notebook: Electricity



## **Lesson 2: Electrical Circuits**

**Topic 1:** Electric Current Terminology

**Topic 2:** Ohm's Law

**Topic 3:** Electric Power

**Topic 4:** Parts of an Electric Circuit–Kirchoff's First and Second Laws

**Topic 5:** Electrical Safety

**Topic 6:** Direct and Alternating Current

**Topic 7:** Electric Circuits

**Topic 8:** Series Circuits

**Topic 9:** Parallel Circuits

### **Lesson Activities:**

- Self-check Lab: Resistance
- Self-check Lab: Series and Parallel

### **Lesson Discussion:**

- Topic: Resistance Lab
- Topic: Series and Parallel Lab

### **Lesson Assignments and Assessments:**

- Lesson Review and Self-check Quiz

### **Unit Assignments and Assessments:**

- Unit 3 Exam Review
- Unit 3 Exam

## **UNIT 4: MAGNETISM, ELECTRICITY, AND NUCLEAR PHYSICS**

### **Lesson 1: Relationship of Magnetism and Electricity**

**Topic 1:** Magnetic Poles and Fields

**Topic 2:** The Earth as a Magnet

**Topic 3:** Electric Currents and Magnetic Fields

**Topic 4:** Meters, Generators, and Motors

**Topic 5:** Transformers and Power Transmission

**Lesson Activities:**

- Virtual Lab: Magnetic Fields
- Self-check Lab: Electromagnets

**Lesson Discussion:**

- Topic: Electromagnets Lab

**Lesson Assignments and Assessments:**

- Notebook: Magnetic Fields Lab Report
- Lesson Review and Self-check Quiz

**Lesson 2: The Atom Unraveled****Topic 1:** The Atom**Topic 2:** Early Models of the Atom**Topic 3:** Radioactivity**Topic 4:** Nuclear Fission**Topic 5:** Nuclear Fusion**Topic 6:** The Atom and the Quantum**Topic 7:** Explanations for the Structure of the Atom**Topic 8:** Werner Heisenberg's Uncertainty Principle**Topic 9:** Conclusion**Lesson Activities:**

- Self-check Lab: Half-life of Isotopes
- Self-check Lab: Probability

**Lesson Discussion:**

- Topic: Half-life of Isotopes Lab
- Topic: Probability Lab

**Lesson Assignments and Assessments:**

- Lesson Review and Self-check Quiz
- Notebook: Circuits and Magnetism

**Unit Assignments and Assessments:**

- Unit 4 Exam Review
- Unit 4 Exam



# SCI010: Environmental Science (Elective)

This course provides an overview of the nature of ecosystems, energy flow, and the inter-relationships of biology, geology, and chemical cycles. Students explore issues in population studies, environmental pollution, and the organization and dynamics of ecological communities. Specific topics include scientific habits of the mind; the application of scientific knowledge, methodology, and historical context to solve problems; the use of laboratory technologies; earth dynamics; the influence of technology on environmental quality; conservation practices; biodiversity; environmental planning and waste management; environmental monitoring and policy; sustainable use of public land; characteristics of populations; biotic and abiotic environmental factors; and energy production technologies.

**COURSE LENGTH:** Two semesters

**MATERIALS:** Common household materials for labs

**PREREQUISITES:** Success in previous high school science course and a teacher/counselor recommendation

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## MODULE 1: IN THE BEGINNING

### Unit 1: Learning the Basics

#### Lesson 1: Identifying Main Environmental Factors

Students will consider what makes up the environment, learn the main factors that are needed to understand the environment in a logical manner, and realize the importance of the human factor on the environment.

#### Lesson 2: The Scientific Method

Students will learn one method of scientific problem solving, discover the steps of the scientific method, and experiment with the scientific method.

#### Lesson 3: Environmental Specialists

Students will learn about the many types of specific specialists and identify which scientists work in various environments.

#### Lesson 4: Observation and Record Keeping - Past and Present

Students will explore how different civilizations have recorded the environments around them through the centuries, learn how environmental scientists record their observations, and discover ways that they can record information about the environment.

#### Lesson 5: Historic Environmental Accidents and Scientific Methods

Students will discover the challenges scientists face when emergencies occur and realize the effects of accidental contamination on the environment.

### Unit 2: Starting Off Small

#### Lesson 1: Biotic versus Abiotic

Students will define and differentiate abiotic and biotic and learn the basic differences between biotic and abiotic objects.

#### Lesson 2: Earth Divisions

Students will study the divisions of the Earth and their locations, and see how each division contributes to the environment.



### **Lesson 3: Hierarchy of Biology**

Students will discover the way life is organized from the tiniest parts of an organism to the largest forms of life and explore the importance of listing and classifying organisms.

## **Unit 3: Group Behavior**

### **Lesson 1: Population versus Community**

Students will gain a better understanding of the differences between population and community, and learn the names of various groups of animals.

### **Lesson 2: Biodiversity**

Students will explore how life forms adapt to their surroundings, discover how diverse organisms can be, and learn about Charles Darwin and his theory of natural selection.

## **MODULE 2: CHANGES IN THE EARTH'S PROCESSES**

### **Unit 1: Pollution and Environmental Invaders**

#### **Lesson 1: Domestic vs. Wild**

Students will explore the differences between domestic and wild plants and animals, discover how domestication has improved the way humans live, and consider the concept of selective breeding.

#### **Lesson 2: Environmental Invaders**

Students will learn about the delicate balance between organisms and their surroundings, consider the introduction of new life forms in America and how they affect the already existing populations, and explore the ways of controlling the effects of new organisms in a community.

#### **Lesson 3: The Water Cycles**

Students will discover the stages of the water cycle and explore how water and the various stages of the water cycle impact everyday life.

#### **Lesson 4: Acid Rain**

Students will learn where acid rain comes from, discover how acid rain affects the environment, and consider ways to prevent acid rain in the future.

#### **Lesson 5: Ground Water Pollution**

Students will examine sources of ground pollution, explore the importance of ground water and fresh water, and consider how the water we drink is affected by pollution.

### **Unit 2: The Carbon Cycle**

#### **Lesson 1: The Carbon Cycle**

Students will learn about the carbon cycle – how carbon is circulated through the environment, discover how carbon relates to people, plants, and animals, and explore the processes in plants and animals that use carbon.

#### **Lesson 2: The "Greenhouse Effect" And Global Warming**

Students will gain a better understanding of how the carbon cycle is affected by pollution, discover the role carbon plays in both good and harmful processes on Earth, and consider the concepts of global warming and the "greenhouse effect."

**Lesson 3: Air Pollution**

Students will explore how air pollution is affecting every part of the globe, discover the main air pollution issues, and consider ways to improve air quality.

**Unit 3: The Food Chain****Lesson 1: The Food Chain**

Students will learn about the food chain, discover how nature dictates food choices, and understand the importance of the food chain.

**Lesson 2: Food Chain Pollution**

Students will discover how the food chain is affected by pollution, examine the difficulties of repairing damage to the food chain, and realize how invader species can affect the food chain.

**MODULE 3: BECOME AN ACTIVIST!****Unit 1: The Government****Lesson 1: Policies and Agencies**

Students will learn about the departments and agencies that the United States has established to monitor specific issues in the environment, and discover how the different agencies overlap focus on issues and work together to find solutions to problems in the environment.

**Lesson 2: Recent Policy Changes and Energy Issues**

Students will explore the government's new energy legislation and what it means for individuals and companies, consider the supply and demand of energy, and discover the advantages and disadvantages of the new laws.

**Lesson 3: Local Environmental Agencies**

Students will learn about the Environmental Protection Agency and how it works to make the environment clean and safe, explore the laws that the EPA has developed to prevent further harm to the environment, and discover how local government works with the EPA to regulate pollution in cities and towns.

**Lesson 4: International Environmental Concerns**

Students will discover environmental problems that affect the planet and its species, explore how deforestation creates even greater problems with global warming, and consider the efforts some make to clean up the environment and the lack of effort by others.

**Unit 2: Them and Us****Lesson 1: Environmental Groups and Regulatory Violations**

Students will discover various environmental groups that work to improve the environment and explore how environmental groups take different approaches to pollution and its control.

**Lesson 2: Planning Conservation**

Students will discover the ways people are saving energy in their homes and consider how older homes can be more energy efficient.



### **Unit 3: Waste Not, Want Not**

#### **Lesson 1: Waste Management**

Students will learn about the entire process of waste management and explore the different classes of waste processing.

#### **Lesson 2: Composting**

Students will learn about the process of composting biodegradable materials and discover the benefits of composting and how it can help reduce waste in landfills.

#### **Lesson 3: Space Waste**

Students will discover the growing problems faced by waste in space, realize the damage space waste can cause, and explore methods of cleaning up space waste.

### **Unit 4: Beep! Beep!**

#### **Lesson 1: Transportation Challenges**

Students will discover the importance of the trucking industry, consider ways to make trucking transportation safer, and learn about the laws that govern the trucking industry.

## **MODULE 4: THIS LAND IS YOUR LAND**

### **Unit 1: Zap!**

#### **Lesson 1: Standard Electric Energy Production Methods**

Students will discover the basic theory of generating electricity, explore different ways to generate electricity, and consider ways power plants can harm the environment.

#### **Lesson 2: New Energy Production Methods**

Students will explore new designs for safely producing power and discover how energy sources are harnessed to produce power.

#### **Lesson 3: Fuel Production and Transport Problems**

Students will discover the basic steps of oil production and explore the ways the environment may be affected by oil drilling.

### **Unit 2: Old McDonald Had a Farm...E-I-E-I-O!**

#### **Lesson 1: United States Agriculture**

Students will explore the world's need for farmers, discover the many diverse crops grown in the United States, understand why farmland is being sold and developed into new homes and businesses, and consider the need to preserve our nation's farmlands.

#### **Lesson 2: Modern Agriculture and New Technology**

Students will learn about new technology in agriculture, discover how these technologies are helping and hurting today's farmers, and explore what can be done to help American farmers keep their land.

#### **Lesson 3: Less Pesticides and More IPM**

Students will discover integrated pest management techniques and explore how using IPM can help save crops in an environmentally-friendly way.