Prealgebra 1

Lesson 1

Arithmetic Rules, Day 1

- Rigorous rules for addition and multiplication
- Longer, more complicated sums
- Gauss's clever summation technique

Lesson 2

Arithmetic Rules, Day 2

- Reciprocals
- Rigorous definition of division to set the stage for fractions

Lesson 3

Exponents and Exponent Laws

- Squares and higher powers
- Products and quotients of powers
- Power of a power

Lesson 4

Non-positive Exponents

- Zero as an exponent
- Negative exponents
- Extension of exponent laws to non-positive exponents

Lesson 5

Multiples and Divisibility

- Principles of multiples
- Divisibility tests for 2, 3, 4, 5, 6, 8, 9

Lesson 6

Primes and Prime factorization

- Primes and composites
- Prime factorization
- Problem-solving with prime factorizations
- Infinitude of primes

Lesson 7

Least Common Multiple (LCM) and Greatest Common Divisor (GCD)

- Common multiples and common divisors
- Definition of LCM and GCD
- Application of prime factorizations to LCM and GCD

Lesson 8

Fractions, Day 1

- Formal definition of fractions
- Fraction multiplication and division
- Fraction simplification

Lesson 9

Fractions, Day 2

- Fraction comparison
- Fraction addition and subtraction
- Word problems with fractions

Lesson 10

Linear Equations

- Expressions and Equations
- Expression simplification
- One- and two-step linear equations
- Basic word problems

Lesson 11

Advanced Linear Equations and Word Problems

- Complicated linear equations
- More complex word problems
- Linear equations with no solution or with infinitely many solutions

Lesson 12

Inequalities

- Principles of inequalities
- Inequalities on the number line
- Linear inequalities
- Word problems with inequalities

Lesson 13

Decimal Arithmetic

- Definition of decimals
- Decimal addition, subtraction, multiplication, and division
- Decimal comparison

Lesson 14

Decimals and Fractions

- Decimal approximation
- Conversion between decimals and fractions
- Rational numbers and their decimal representation

Lesson 15

Ratio and Proportion

- Definition of ratio and proportion
- Proportional thinking
- Part-to-part and part-to-whole problem-solving
- Word problems with ratios and proportions

Lesson 16

Conversion, Speed, and Other Rates

- Units and conversion factors
- Relationship between speed, distance, and time
- Joint work, relative speed, and average speed

Prealgebra 2

Lesson 1
Introduction to Percents

- Definition of percent
- Relationships among percents, fractions, and decimals
- Percents of numbers
- Basic percent word problems

Lesson 2
Percent Increase and Decrease

- More percent word problems
- Percentage increase and decrease

Lesson 3
Squares and Square Roots

- Definition of square root
- Equations with square roots
- Non-integer square roots

Lesson 4
Arithmetic with Square Roots

- Products and quotients of square roots
- Simplification of square roots
- Sums and differences of square roots

Lesson 5
Angles and Parallel Lines

- Angle measurement
- Parallel lines

Lesson 6
Angles in Polygons

- Angles in a triangle
- Angles in other polygons

Lesson 7
Perimeter and Area

- Segments and perimeter
- Rectangle and right triangle area

Lesson 8

More Triangles and Circles

- Triangle area
- Circumference of a circle
- Area of a circle
- Unusual areas

Lesson 9

Pythagorean Theorem

- Pythagorean Theorem fundamentals
- Pythagorean triples

Lesson 10

Special Triangles

- Challenging Pythagorean Theorem problems
- 30-60-90 and 45-45-90 triangles

Lesson 11

Quadrilaterals

- Types of quadrilaterals
- Quadrilateral area

Lesson 12

Basic Statistics

- Average (mean)
- Averages as a balancing act
- Median, mode, and range

Lesson 13

Statistics, Graphs, and Charts

- Limits of basic statistics
- Types of graphs and charts

Lesson 14

Counting as Arithmetic

- Numbers in lists
- Venn diagrams
- Multiplication principle
- Casework

Lesson 15

Counting and Probability

- Pairs
- Introduction to probability

Lesson 16

Problem-Solving Strategies

- Find a pattern
- Make a list
- Draw a picture
- Work backwards

Introduction to Algebra A

Lesson 1

Follow the Rules

- Rules of arithmetic
- Distribution and factoring with numbers
- Exponent rules

Lesson 2

Fractional Exponents, Radicals, and Variables

- Fractional exponents and radicals
- Variables in expressions
- Simplifying expressions

Lesson 3

Variables and Expressions

- Distribution and factoring with variables
- Expressions with fractions
- Expressions with radicals

Lesson 4

Linear Equations

- Solving linear equations
- Word problems

Lesson 5

More Variables

- Evaluating expressions with multiple variables
- Manipulating expressions

Lesson 6

Linear Equations with Multiple Variables

- Basic manipulations
- Substitution and Elimination
- Word Problems

Lesson 7

Ratio and Percent

- Ratios
- Parts and wholes
- Percentages and arithmetic with percents

Lesson 8

More Ratios and Proportion

- Working with units
- Direct and inverse proportion
- Joint proportion

Lesson 9

Common Errors and Challenging Problems

- Exponents do not distribute over addition
- Extraneous solutions and dividing by zero
- Difficult problems

Lesson 10

Graphing Lines (Part 1)

- Cartesian plane
- Distance between two points
- Graphs of equations
- Going from lines to equations

Lesson 11

Graphing Lines (Part 2) and Introduction to Inequalities

- Perpendicular and parallel lines
- How graphing relates to systems of equations
- Inequality manipulation and interval notation

Lesson 12

Graphing Inequalities

- Two variable inequalities
- Graphing to solve inequalities
- Optimization and linear programming

Lesson 13

Quadratic Equations (Part 1)

- Distributing

- Factoring

Lesson 14
Special Factorizations

- Vieta’s formulas
- Difference of squares
- Sum and difference of cubes

Lesson 15
Simon's Favorite Factoring Trick and Complex Numbers

- Completing the rectangle
- Introduction to complex numbers and arithmetic

Lesson 16
Quadratic Equations (Part 2)

- Completing the square
- The quadratic formula

Introduction to Algebra B

Lesson 1
Factorization

- Factoring quadratics
- Sums and products of roots of a quadratic

Lesson 2
Quadratics and Complex Numbers

- Simon's favorite factoring trick
- Introduction to complex numbers

Lesson 3
Completing the Square and the Quadratic Formula

- Completing the square
- Proving the quadratic formula

Lesson 4
Graphing Quadratics

- Parabolas
- Circles

Lesson 5
Quadratic Inequalities

- Quadratic inequalities
- Beyond quadratics

Lesson 6
Optimizing Quadratics and AM-GM Inequality

- Quadratic optimization
- The AM-GM inequality

Lesson 7
Functions

- What is a function?
- Adding, subtracting, multiplying, and dividing functions

Lesson 8

Composition and Inverses

- Function composition
- Inverse functions

Lesson 9

Graphing Functions

- Transformations
- Graphs of inverse functions

Lesson 10

Polynomials

- What is a polynomial?
- Adding and multiplying polynomials

Lesson 11

Exponential Functions

- Compound interest
- Logarithms

Lesson 12

Special Functions Part 1

- Radicals
- Absolute value

Lesson 13

Special Functions Part 2

- Floor and ceiling
- Rational functions
- Piecewise-defined functions

Lesson 14

Sequences & Series Part 1

- Arithmetic sequences
- Arithmetic series
- Geometric sequences

Lesson 15

Sequences & Series Part 2

- Geometric series
- Telescoping series

Lesson 16

Challenging Problems Day

- Self-similarity
- Symmetry

Introduction to Geometry

Lessons

1	Angles
2	Triangle Angles and Congruent Triangles
3	Isosceles & Equilateral Triangles, Perimeter, and Area
4	Similar Triangles
5	Similar Triangles and Right Triangles
6	More Right Triangles!
7	Special Parts of a Triangle
8	Special Parts of a Triangle, Continued!
9	Quadrilaterals
10	More Quadrilaterals
11	Polygons
12	Geometric Inequalities
13	Introduction to Circles
14	Circles and Angles
15	Tangents
16	Power of a Point
17	3D Geometry Part 1

18	3D Geometry Part 2
19	Transformations
20	Analytic Geometry
21	More Analytic Geometry
22	Basic Trigonometry
23	Problems!
24	More Problems!

Introduction to Counting & Probability

Lesson 1

Lists, Venn Diagrams, Addition, Multiplication

- Counting Lists of Numbers
- Counting with Addition and Subtraction
- Permutations

Lesson 2

Casework, Constructions, and Restriction

- Casework
- Complementary Counting
- Constructive Counting
- Counting with Restrictions

Lesson 3

Overcounting and Combinations

- Permutations with Repeated Elements
- Counting Pairs of Items
- Counting with Symmetries
- Combinations
- Combinatorial Identities

Lesson 4

Combinations and Distinguishability

- Paths on a Grid
- Distinguishability

Lesson 5

Challenging Problems Day

- Applications of Lessons 1-4

Lesson 6

Introduction to Probability

- Definition of Probability
- Counting Techniques in Probability

Lesson 7

Probability and Arithmetic

- Probability and Addition
- Complementary Probability
- Probability and Multiplication
- Probability and Dependent Events

Lesson 8

Geometric Probability, Think About It!, and Expected Value

- Using Symmetry in Problem-Solving
- Probability Using Lengths
- Probability Using Areas
- Definition of Expected Value
- Problem-Solving with Expected Value

Lesson 9

Pascal's Triangle and Identities

- Constructing Pascal's Triangle
- Pascal's Triangle as Combinations
- More Combinatorial Identities

Lesson 10

Distributions and The Hockey Stick Identity

- Distributions
- Sticks and Stones
- The Hockey Stick Identity

Lesson 11

The Binomial Theorem

- Proving the Binomial Theorem
- Applying the Binomial Theorem to Problems
- The Binomial Theorem in Identities

Lesson 12

Challenging Problems Day 2

- Applications of Lessons 6-11

Introduction to Number Theory