

Grade 9 Mathematics

Full Curriculum Guide

Algebra I Core + Geometry, Statistics, Probability & Financial Modeling

Purpose: Establish a rigorous Grade 9 / Algebra I foundation while connecting algebra to functions, geometry, data, probability, and real-world financial situations.

Course	Grade 9 Mathematics / Algebra I foundation
Primary audience	Grade 9 students / equivalent high-school level
ROED model	Live online instruction small groups concept-focused learning
Structure	Core Algebra I progression + integrated geometry/data/financial applications
Major strands	Number • Algebra • Functions • Geometry • Statistics • Probability • Financial Mathematics

Prepared as the master Grade 9 curriculum framework for ROED. This guide defines core Algebra I competencies, conceptual progressions, multi-step problem solving, modeling applications, and comprehensive end-of-year standards.

1. Course Overview

Grade 9 Mathematics at ROED is the transition from the broad middle-school foundation of Grade 8 into a more formal Algebra I program. Students move from solving and representing individual relationships toward analyzing families of functions, polynomial structure, systems, quadratics, exponential models, radicals, and rational expressions.

The course deliberately builds on Grade 8 rather than repeating it. Grade 8 introduced many foundational ideas; Grade 9 develops greater algebraic fluency, formal notation, modeling, multi-step reasoning, and mathematical independence.

Central philosophy: students should understand the structure behind algebraic procedures. Equations, graphs, tables, functions, and real-world contexts should be treated as different representations of connected mathematical ideas.

2. Course Mission & Learning Philosophy

- Build formal Algebra I understanding without sacrificing conceptual reasoning.
- Connect equations, functions, tables, graphs, words, and real-world situations.
- Move students from procedural competence toward explanation, justification, and modeling.
- Use multiple representations to expose structure and check solutions.
- Integrate geometry, statistics, probability, and financial mathematics with algebra wherever useful.
- Use digital tools strategically for exploration, graphing, regression, simulation, and verification.
- Provide repeated opportunities for problem solving, error analysis, estimation, and mathematical communication.

3. Grade 8 • Grade 9 Progression

Area	Grade 8 role	Grade 9 role
Linear equations	Core mastery	More complex modeling and applications
Functions	Core foundation	Formal function notation and deeper analysis
Systems	Core introduction	Deeper methods, modeling, and applications
Polynomials	Extension	Core Algebra I content
Factoring	Extension	Core and connected to quadratics
Quadratics	Extension/preview	Core major unit
Exponential relationships	Extension	Core functions, growth and decay
Radicals	Core/basic	Algebraic operations and equations
Rational expressions	Extension	Core introductory Algebra I work
Geometry	Core	Coordinate/algebraic modeling
Statistics	Core	Modeling, regression, sampling, association
Probability	Core	Conditional probability and expected value

4. Suggested Course Sequence

The sequence below organizes the master Grade 9 / Algebra I progression across 12 comprehensive units, integrating core algebraic mastery with coordinate geometry, bivariate data modeling, probability, and financial mathematics.

Order	Unit	Primary focus
1	Real Numbers, Exponents & Algebraic Foundations	Algebraic structure and prerequisite fluency
2	Linear Equations, Inequalities & Algebraic Problem Solving	Equations, inequalities, absolute value, formulas
3	Functions & Linear Relationships	Function notation, slope, forms, modeling
4	Systems of Linear Equations	Graphing, substitution, elimination, applications
5	Coordinate Geometry & Geometric Modeling	Distance, midpoint, slope, transformations, coordinate reasoning
6	Polynomials & Factoring	Operations, special products, factoring
7	Quadratic Functions & Equations	Parabolas, forms, solving, applications
8	Exponential Functions, Growth & Decay	Exponential models and comparisons
9	Radicals & Rational Expressions	Radicals, rational exponents, rational algebra
10	Statistics & Bivariate Data	Regression, association, sampling, two-way tables
11	Probability & Statistical Reasoning	Compound/conditional probability, simulation, expected value
12	Financial Mathematics & Mathematical Modeling	Interest, loans, depreciation, budgeting, integrated modeling

Curriculum Progression Note: Units 1 through 12 present an integrated Algebra I progression that links procedural fluency directly to function analysis, geometry, statistical regression, and real-world quantitative decision-making.

Unit 1 Real Numbers, Exponents & Algebraic Foundations

Learning Goal: Students strengthen number-system fluency and develop the algebraic language and structural reasoning needed for formal Algebra I.

CORE TOPICS:

- Rational, irrational, and real numbers; classification and comparison.
- Approximating irrational numbers and understanding exact versus approximate values.
- Commutative, associative, and distributive properties.
- Variables, constants, coefficients, terms, factors, and algebraic expressions.
- Evaluating numerical and algebraic expressions.
- Combining like terms and simplifying expressions.
- Equivalent expressions and using properties to justify equivalence.
- Factoring out a greatest common factor.
- Integer exponents, including zero and negative exponents.
- Exponent rules: product, quotient, and power of a power.
- Scientific notation as review/application, including multiplication and division.
- Estimation, order of magnitude, and reasonableness.

EXTENSION:

Advanced exponent reasoning; deeper radical/number-system connections.

REAL-WORLD APPLICATIONS:

Science and technology measurements, scale, magnitude, and algebraic simplification.

END-OF-UNIT OUTCOMES:

- Classify and compare real numbers.
- Simplify and evaluate algebraic expressions.
- Use properties to justify equivalent forms.
- Apply exponent rules accurately.
- Use scientific notation and estimation appropriately.

Unit 2 Linear Equations, Inequalities & Algebraic Problem Solving

Learning Goal: Students solve, represent, and interpret equations and inequalities and learn to preserve equality while manipulating expressions.

CORE TOPICS:

- Multi-step linear equations with fractions, decimals, and parentheses.
- Variables on both sides.
- One solution, no solution, and infinitely many solutions.
- Linear inequalities and reversal of inequality when multiplying/dividing by a negative.
- Compound inequalities and number-line representations.
- Interval and inequality notation.
- Absolute-value equations and inequalities.
- Literal equations and rearranging formulas.
- Translating verbal situations into equations and inequalities.
- Word problems involving rate, distance, cost, mixtures, and comparison.
- Checking solutions through substitution and contextual reasoning.

EXTENSION:

More complex absolute-value situations and algebraic equations.

REAL-WORLD APPLICATIONS:

Rates, wages, unit costs, distance/time, budgeting, and constraints.

END-OF-UNIT OUTCOMES:

- Solve and interpret multi-step equations and inequalities.
- Handle one/no/infinite-solution cases.
- Solve basic absolute-value equations/inequalities.
- Rearrange formulas.
- Translate and solve contextual problems.

Unit 3 Functions & Linear Relationships

Learning Goal: Students develop formal function language and analyze linear relationships through multiple representations.

CORE TOPICS:

- Function as a relationship assigning exactly one output to each input.
- Input-output tables, mappings, ordered pairs, and graphs.
- Function versus non-function; vertical line test conceptually.
- Domain and range, including contextual restrictions.
- Function notation $f(x)$ and evaluating functions.
- Linear versus nonlinear functions.
- Slope as rate of change and rise over run.
- Positive, negative, zero, and undefined slope.
- Y-intercept and x-intercept.
- Slope-intercept form $y = mx + b$.
- Point-slope form and standard form.
- Graphing a line from an equation, table, context, or points.
- Writing equations from two points, graphs, tables, and situations.
- Comparing functions represented in different forms.
- Average rate of change.
- Parallel and perpendicular lines.
- Interpreting slope and intercepts in context.

EXTENSION:

Piecewise functions and more advanced domain/range work.

REAL-WORLD APPLICATIONS:

Phone plans, subscriptions, wages, constant speed, temperature change, and fixed-plus-variable costs.

END-OF-UNIT OUTCOMES:

- Determine whether a relation is a function.
- Use function notation and interpret domain/range.
- Calculate and interpret slope and intercepts.
- Write, graph, compare, and interpret linear functions.
- Use average rate of change and parallel/perpendicular relationships.

Unit 4 Systems of Linear Equations

Learning Goal: Students treat multiple linear relationships simultaneously and interpret solutions as intersections or shared constraints.

CORE TOPICS:

- Meaning of a system of two linear equations.
- Solution as an ordered pair satisfying both equations.
- Graphing systems.
- Substitution.
- Elimination.
- Choosing an efficient method.
- One solution, no solution, and infinitely many solutions.
- Exact versus approximate solutions.
- Checking solutions in both equations.
- Writing systems from real-world situations.
- Interpreting the intersection in context.
- Comparing algebraic and graphical methods.

EXTENSION:

Systems involving more varied coefficients and introductory linear-inequality systems.

REAL-WORLD APPLICATIONS:

Pricing plans, ticket combinations, mixtures, break-even situations, and financial comparisons.

END-OF-UNIT OUTCOMES:

- Solve systems using graphing, substitution, or elimination.
- Classify solution types.
- Interpret systems in context.
- Choose an efficient solution method.
- Verify solutions.

Unit 5 - Coordinate Geometry & Geometric Modeling

Learning Goal: Students use algebraic tools to describe and analyze geometric relationships rather than repeating the full Grade 8 geometry program.

CORE TOPICS:

- Coordinate plane review and geometric interpretation of coordinates.
- Distance formula and its connection to the Pythagorean theorem.
- Midpoint formula and applications.
- Slope as a geometric relationship.
- Parallel and perpendicular lines using slope.
- Equations of lines connected to geometric figures.
- Coordinate proofs and justifying geometric relationships.
- Translations, reflections, rotations, and dilations as review and algebraic transformations.
- Area and perimeter of polygons in the coordinate plane.
- Composite geometric figures and modeling.

EXTENSION:

Equation of a circle and basic coordinate-circle reasoning.

REAL-WORLD APPLICATIONS:

Maps, design, architecture, engineering diagrams, navigation, and coordinate modeling.

END-OF-UNIT OUTCOMES:

- Use distance, midpoint, and slope formulas.
- Analyze parallel/perpendicular relationships.
- Represent geometric relationships algebraically.
- Use coordinate reasoning to justify conclusions.
- Model geometric situations.

Unit 6 Polynomials & Factoring

Learning Goal: Students develop polynomial fluency and learn factoring as the reverse of multiplication and a tool for solving equations.

CORE TOPICS:

- Polynomial vocabulary: term, coefficient, degree, leading coefficient.
- Monomials, binomials, trinomials, and general polynomials.
- Adding and subtracting polynomials.
- Multiplying monomials.
- Monomial times polynomial.
- Binomial times binomial and polynomial multiplication.
- Special products: $(a+b)^2$, $(a-b)^2$, and $(a+b)(a-b)$.
- Greatest-common-factor factoring.
- Difference of squares.
- Factoring simple trinomials $x^2 + bx + c$.
- Factoring by grouping as an introductory method.
- Factoring as reverse distribution.
- Connecting factors, zeros, and solutions.

EXTENSION:

More complex trinomial factoring and polynomial identities.

REAL-WORLD APPLICATIONS:

Area models, algebraic identities, equation solving, and preparation for quadratics.

END-OF-UNIT OUTCOMES:

- Perform polynomial operations.
- Use special-product identities.
- Factor common Algebra I polynomial forms.
- Connect factors and zeros.
- Use factoring as a solving strategy.

Unit 7 Quadratic Functions & Equations

Learning Goal: Students analyze quadratic functions as a major family of functions and solve quadratic equations using several methods.

CORE TOPICS:

- Recognizing quadratic relationships.
- Standard form $y = ax^2 + bx + c$.
- Parabolas and direction of opening.
- Vertex, axis of symmetry, x-intercepts, and y-intercept.
- Tables and graphs of quadratic functions.
- Factored form and relationship to zeros.
- Vertex form and interpretation of the vertex.
- Converting among common forms in appropriate cases.
- Solving by factoring.
- Solving by the square-root method.
- Completing the square.
- Quadratic formula.
- Discriminant and number of real solutions.
- Checking solutions.
- Comparing graphical and algebraic solutions.
- Quadratic modeling.

EXTENSION:

More complex parameter analysis and deeper quadratic modeling.

REAL-WORLD APPLICATIONS:

Area, projectile motion, revenue, optimization, and geometric applications.

END-OF-UNIT OUTCOMES:

- Identify key features of quadratic functions.
- Move among standard, factored, and vertex forms.
- Solve quadratics using multiple methods.
- Use the discriminant to analyze solutions.
- Build and interpret quadratic models.

Unit 8 - Exponential Functions, Growth & Decay

Learning Goal: Students distinguish additive from multiplicative change and build exponential models for growth and decay.

CORE TOPICS:

- Arithmetic versus multiplicative change.
- Exponential functions of the form $y = ab^x$.
- Initial value and growth/decay factor.
- Percent growth and percent decay.
- Tables, graphs, equations, and verbal descriptions of exponential relationships.
- Compare linear, quadratic, and exponential behavior.
- Growth and decay applications.
- Compound-growth situations.
- Interpret parameters in context.
- Use technology to graph and compare models.
- Recognize limitations of an exponential model.

EXTENSION:

Solving simple exponential equations; introductory logarithmic thinking without making logarithms a core unit.

REAL-WORLD APPLICATIONS:

Population, depreciation, savings, compound growth, and other real-world change.

END-OF-UNIT OUTCOMES:

- Distinguish linear and exponential change.
- Build and interpret exponential models.
- Calculate growth/decay factors.
- Compare function families.
- Apply exponential models to real situations.

Unit 9 Radicals & Rational Expressions

Learning Goal: Students extend square-root reasoning into formal radical and rational algebra while developing domain awareness.

CORE TOPICS:

- Square roots and perfect squares review.
- Simplifying radicals.
- Adding and subtracting like radicals.
- Multiplying radicals.
- Radicals in geometric and quadratic contexts.
- Rational exponents as a connection to radicals.
- Simple radical equations.
- Rational expressions and meaning of a denominator.
- Domain restrictions: denominator cannot equal zero.
- Simplifying rational expressions.
- Multiplying and dividing rational expressions.
- Adding and subtracting simple rational expressions.
- Simple rational equations.
- Checking for extraneous solutions.

EXTENSION:

More advanced rational-expression operations and rational equations.

REAL-WORLD APPLICATIONS:

Distance, geometry, rates, algebraic modeling, and formula manipulation.

END-OF-UNIT OUTCOMES:

- Simplify and operate with radicals.
- Connect radicals and rational exponents.
- Simplify rational expressions with domain restrictions.
- Solve simple radical/rational equations.
- Check for extraneous solutions.

Unit 10 Statistics & Bivariate Data

Learning Goal: Students analyze relationships between variables, build informal and technology-assisted models, and make appropriately cautious predictions.

CORE TOPICS:

- Review of mean, median, range, IQR, and MAD as useful.
- Dot plots, histograms, and box plots.
- Comparing distributions.
- Scatter plots and bivariate data.
- Positive, negative, and no association.
- Strength of association.
- Linear versus nonlinear patterns.
- Outliers and influential observations conceptually.
- Informal line of fit.
- Linear regression using technology.
- Interpret slope and intercept of a fitted line.
- Predictions and extrapolation versus interpolation.
- Residual idea conceptually.
- Correlation versus causation.
- Two-way tables and relative frequencies.
- Population, sample, representative sample, and sampling bias.
- Choosing an appropriate model from a description or graph.

EXTENSION:

More quantitative regression diagnostics and model comparison.

REAL-WORLD APPLICATIONS:

Sports, science, survey data, prices, education, weather, and social data.

END-OF-UNIT OUTCOMES:

- Analyze distributions and scatter plots.
- Describe association and outliers.
- Use a line of fit/regression for prediction.
- Interpret model parameters.
- Recognize sampling bias and correlation-versus-causation limits.

Unit 11 - Probability & Statistical Reasoning

Learning Goal: Students deepen probability reasoning and connect probability models with simulation, conditional information, and expected outcomes.

CORE TOPICS:

- Experimental versus theoretical probability review.
- Sample spaces and event notation.
- Simple and compound events.
- Independent and dependent events.
- Addition and multiplication rules.
- Tree diagrams and organized counting in probability contexts.
- Conditional probability conceptually.
- Two-way tables as probability models.
- Simulations and long-run relative frequency.
- Comparing theoretical and experimental results.
- Expected value as a weighted average in simple contexts.
- Probability as a measure from 0 to 1 and as a percentage.
- Interpreting probability in real-world decision contexts.

EXTENSION:

More formal conditional probability notation and more sophisticated expected-value models.

REAL-WORLD APPLICATIONS:

Games, risk, quality control, surveys, insurance-style examples, and decision-making.

END-OF-UNIT OUTCOMES:

- Build sample spaces and probability models.
- Calculate compound and conditional probabilities.
- Use simulations.
- Compare theoretical and experimental results.
- Calculate and interpret simple expected values.

Unit 12 Financial Mathematics & Mathematical Modeling

Learning Goal: Students integrate algebraic and quantitative skills to model everyday financial decisions and evaluate competing options.

CORE TOPICS:

- Income, expenses, budgeting, and savings goals.
- Fixed and variable expenses.
- Unit price and comparison shopping.
- Discounts, markup, sales tax, and tips.
- Percent increase and decrease.
- Linear cost models.
- Pricing plans and break-even points.
- Simple interest.
- Compound interest and exponential growth.
- Savings models.
- Loans: principal, interest, total repayment, and monthly payment concepts.
- Comparing loan options using tables, equations, and graphs.
- Depreciation: linear and exponential models.
- Financial decision-making and reasonableness.
- Multi-step financial modeling projects.

EXTENSION:

More sophisticated amortization and algebraic financial modeling where appropriate.

REAL-WORLD APPLICATIONS:

Personal budgets, phone/streaming plans, loans, savings, depreciation, and business-style cost models.

END-OF-UNIT OUTCOMES:

- Build and interpret budgets.
- Model costs and break-even points.
- Calculate interest and percent changes.
- Compare savings and loan situations.
- Use algebraic models to communicate financial conclusions.

Mathematical Practices - Embedded All Year

The eight mathematical practices should be visible across lessons, assignments, projects, discussions, and assessments rather than taught as an isolated chapter.

- **1. Make sense of problems and persevere:** identify knowns/unknowns, choose strategies, revise when needed.
- **2. Reason abstractly and quantitatively:** connect symbols, quantities, representations, and context.
- **3. Construct arguments and critique reasoning:** justify solutions and evaluate mathematical claims.
- **4. Model with mathematics:** represent real situations with equations, functions, graphs, tables, and data.
- **5. Use tools strategically:** use calculators, graphers, spreadsheets, geometry tools, and simulations appropriately.
- **6. Attend to precision:** use correct notation, units, definitions, labels, and appropriate accuracy.
- **7. Look for and make use of structure:** recognize algebraic patterns, properties, and relationships.
- **8. Look for and express regularity in repeated reasoning:** identify repeated processes and generalize.

Digital Mathematics & Tool Use

- Use Desmos or equivalent tools to explore functions, transformations, systems, and models.
- Use graphing technology to compare linear, quadratic, and exponential functions.
- Use spreadsheets for financial calculations, repeated computations, and data analysis.
- Use technology-assisted regression for bivariate data.
- Use simulations to investigate probability.
- Use digital geometry tools for coordinate and transformation exploration.
- Verify technology outputs with estimation, algebra, or graphical reasoning.

Assessment Framework

Assessment should measure conceptual understanding, procedural fluency, application, reasoning, and communication.

Assessment	Purpose
Diagnostic/readiness	Identify prerequisite gaps and determine appropriate support.
Formative checks	Catch misconceptions during instruction.
Practice	Develop fluency and reinforce concepts.
Reasoning tasks	Measure explanation, justification, and mathematical thinking.
Unit assessment	Measure mastery of core outcomes.
Modeling/project tasks	Integrate algebra with data, geometry, probability, or finance.
Cumulative review	Maintain retention across the year.

Homework & Practice Philosophy

- Reinforce material that has been taught rather than using homework as the primary introduction to new concepts.
- Mix fluency, reasoning, application, and error analysis.
- Use spaced retrieval so earlier algebra skills remain active.
- Require occasional explanation of why a method works.
- Avoid excessive repetition after mastery is demonstrated.
- Use challenge questions to extend strong students without making advanced content the definition of success.

Differentiation at ROED

Student profile	ROED response
Prerequisite gaps	Targeted review of missing foundations while maintaining Grade 9 goals.
On-level	Core instruction, practice, modeling, and reasoning.
Strong mastery	Challenge tasks and deeper applications.
Advanced	Accelerated depth in polynomials, quadratics, exponentials, and rational algebra as appropriate.
Needs additional practice	Scaffolds, multiple representations, guided practice, and retrieval.
Procedurally fast but conceptually weak	Increase explanation, modeling, error analysis, and representation-switching.

Suggested Integrated Projects

- **Pricing Plan Investigation:** model competing subscription/phone plans with linear functions and break-even analysis.
- **Quadratic Design Challenge:** use a quadratic model for area, projectile motion, or optimization.
- **Growth & Depreciation Study:** compare linear and exponential models using realistic financial or scientific data.
- **Data Investigation:** collect or use a dataset, run a scatter-plot/regression analysis, and discuss limitations.
- **Probability Simulation:** design a chance experiment and compare theoretical, experimental, and simulated results.
- **Personal Finance Project:** build a budget, compare savings/loan options, and justify assumptions mathematically.

End-of-Year Grade 9 Outcomes

By the end of the Grade 9 Core program, a successful student should be able to:

- Work fluently with real numbers, algebraic expressions, and integer exponents.
- Solve and interpret linear equations, inequalities, and basic absolute-value situations.
- Use formal function notation and analyze domain, range, rate of change, and key features.
- Represent and interpret linear functions in equations, tables, graphs, and contexts.
- Solve systems of linear equations and interpret their solutions.
- Use coordinate geometry to connect algebraic relationships with geometric figures.
- Perform polynomial operations and factor common polynomial forms.
- Analyze quadratic functions and solve quadratic equations using appropriate methods.
- Build and interpret exponential growth and decay models.
- Work with radicals, rational exponents, and introductory rational expressions/equations.
- Analyze bivariate data, use regression appropriately, and recognize sampling and causation limitations.
- Use compound and conditional probability, simulations, and simple expected value.
- Apply algebra and quantitative reasoning to budgeting, interest, loans, depreciation, and financial decisions.
- Communicate mathematical reasoning clearly and verify results using appropriate tools and estimates.

Final Curriculum Map - One-Page Reference

Unit	Core focus	Major integrated/application focus
1	Real numbers, exponents, algebraic foundations	Structure, estimation, scientific notation
2	Linear equations and inequalities	Formula manipulation and problem solving
3	Functions and linear relationships	Linear modeling and function analysis
4	Systems of linear equations	Simultaneous relationships and break-even modeling
5	Coordinate geometry	Algebraic geometric reasoning
6	Polynomials and factoring	Structure and preparation for quadratics
7	Quadratic functions and equations	Forms, solving, modeling, optimization
8	Exponential functions	Growth, decay, and comparison of models
9	Radicals and rational expressions	Advanced algebraic manipulation
10	Statistics and bivariate data	Regression, sampling, association
11	Probability and statistical reasoning	Conditional probability, simulation, expected value
12	Financial mathematics	Budgeting, interest, loans, depreciation, modeling

Curriculum design principle: Grade 9 is the formal Algebra I year for ROED. Grade 8 provides the foundation and bridge; Grade 9 consolidates that foundation into a coherent algebraic system while continuing meaningful geometry, statistics, probability, and financial applications.