# Seymour Public Schools Curriculum

The Mathematics Department believes its students must learn the importance of mathematics, the integration of different branches of mathematics, the application of math to real-life problems, and the connections between mathematics and other disciplines. Throughout this course, it is hoped that students recognize and appreciate the power of mathematical thinking and how analyzing mathematical models aids in making important decisions.

This is the introductory unit for the Algebra I course. Students will be given an opportunity to work cooperatively and communicate clearly both orally and in writing. At the same time, students will be invited to engage in learning mathematical skills within the context of interesting problems that connect to real world issues. This unit demonstrates how ubiquitous patterns are in nature and in man-made objects.

| **Grade:** 9 | **Algebra**<br>**Unit 1 - Patterns** |
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| **Common Core Standards** | **Standards with Priority Standards in Bold**<br>F-IF 3. Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.<br>F-BF 1. Write a function that describes a relationship between two quantities.*<br>a. Determine an explicit expression, a recursive process, or steps for calculation from a context.<br>**F-BF 2. Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.*** |
| **Seymour High School Learning Expectations** | • Students will think critically<br>• Students will communicate effectively and creatively<br>• Students will access, evaluate, and use information for a variety of tasks and purposes |
| **Enduring Understanding** | Analyzing patterns and writing recursive and explicit algebraic rules provides a powerful way to extend patterns and make predictions. |
| **Essential Questions** | ▸ What is a sequence?<br>▸ How can patterns be represented?<br>▸ What are the advantages and disadvantages of a recursive rule compared to an explicit rule? |

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| **Content Standards:** | *Mathematical Practices #1 and #3 describe a classroom environment that encourages thinking mathematically and are critical for quality teaching and learning. Practices in bold are to be emphasized in the unit.*<br><br>1. Make sense of problems and persevere in solving them.<br>2. Reason abstractly and quantitatively<br>3. Construct viable arguments and critique the reasoning of others.<br>**4. Model with mathematics.**<br>5. Use appropriate tools strategically.<br>6. Attend to precision.<br>7. Look for and make use of structure.<br>**8. Look for and express regularity in repeated reasoning.** |
| **Performance Expectations (Student outcomes)** | • Determine the recursive and explicit rules for patterns represented in words, images, tables, and graphs<br>• Determine if a numerical pattern is an arithmetic sequence or a geometric sequence<br>• Evaluate expressions<br>• Create fractal designs |

| **Strategies/Modes (examples)** | **Materials/Resources (examples)** | **Assessment Strategies** |
|---|---|---|
| • Guided practice<br>• Worksheets<br>• Homework<br>• Cooperative Group work<br>• Quizzes<br>• Tests<br>• Projects<br>• | Investigations 1-5<br>Videos<br>Graphing Calculators | ▸ Performance Task: Honeycombs<br><br>Formative and Summative Assessments<br><br>▸ Exit Slips<br>▸ Class Work<br>▸ Homework Assignments<br>▸ Math Journals<br>▸ Mid-Unit 1 Test<br>▸ Unit 1 Test |

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The material in this unit is the heart of algebraic thinking. Students write, simplify, evaluate, and model situations with linear expressions. Students then examine the concept of equality and use linear equations and linear inequalities to model and solve real-world problems.

The properties of real numbers play a prominent role in this unit. The commutative, associative, and distributive properties are used when students simplify and evaluate expressions and solve multi-step equations. Opposites, reciprocals, and order of operations are used when students evaluate expressions and solve equations. Students revisit rational numbers when they solve equations and inequalities with rational number coefficients and rational number solutions.

| **Grade:** 9 | **Algebra**<br>**Unit 2 - Linear Equations and Inequalities** |
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| **Common Core Standard** | **Standards with Priority Standards in Bold**<br>8EE 7. Solve linear equations in one variable.<br>A-SSE 1. Interpret expressions that represent a quantity in terms of its context.<br>A-SSE 3. (part) Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.<br>**A-CED 1. (part) Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear ... functions***<br>A-CED 4. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V = IR to highlight resistance R.*<br>**A-REI 1. Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.**<br>A-REI 3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.<br>**N-**Q 1 Use units as a way to understand problems and to guise the solution of multi-step problems; choose and interpret units consistently in formulas….<br>N-Q 2 Define appropriate quantities for the purpose of descriptive modeling. |

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| | N-Q 3 Choose a level of accuracy appropriate to limitations on measurements when reporting quantities. |
| **Seymour High School Learning Expectations** | • Students will think critically<br>• Students will communicate effectively and creatively<br>• Students will access, evaluate, and use information for a variety of tasks and purposes |
| **Enduring Understanding** | • To obtain a solution to an equation, no matter how complex, always involves the process of undoing the operations. |
| **Essential Questions** | ▸ What is an equation?<br>▸ What is an expression?<br>▸ What does equality mean?<br>▸ What is an inequality?<br>▸ How can we use linear equations and linear inequalities to solve real world problems?<br>▸ What is a solution set for a linear equation or linear inequality?<br>▸ How can models and technology aid in the solving of linear equations and linear inequalities? |
| **Content Standards:** | *Mathematical Practices #1 and #3 describe a classroom environment that encourages thinking mathematically and are critical for quality teaching and learning. Practices in bold are to be emphasized in the unit.*<br><br>1. **Make sense of problems and persevere in solving them.**<br>2. Reason abstractly and quantitatively.<br>3. Construct viable arguments and critique the reasoning of others.<br>4. Model with mathematics**.**<br>5. Use appropriate tools strategically.<br>6. **Attend to precision.**<br>7. **Look for and make use of structure**.<br>8. Look for and express regularity in repeated reasoning. |
| **Performance Expectations (Student** | ▸ Simplify an expression by combining like terms<br>▸ Evaluate an expression according to the order of operations |

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| **outcomes)** | ▸ Solve multi-step linear equations<br>▸ Solve equations which require the use of the distributive property<br>▸ Solve equations involving fractions<br>▸ Solve a literal equation for a variable |

| **Strategies/Modes (examples)** | **Materials/Resources (examples)** | **Assessments (examples)** |
|---|---|---|
| • Guided practice<br>• Worksheets<br>• Homework<br>• Cooperative Group work<br>• Quizzes<br>• Tests<br>• Projects | Investigations 1-6<br>Videos<br>Graphing Calculators | **Performance Task: iPods**<br><br>**Other Evidence (Formative and Summative Assessments)**<br>• Exit slips<br>• Class work<br>• Quizzes<br>• Homework assignments<br>• Math journals<br>• Mid-unit assessment<br>• End-of-Unit Tests (Versions 1 & 2) |

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Students are introduced to the concept of a function in this unit. After identifying relationships that are or are not functions, they learn how to define the domain and range of a function. Students will be given the opportunity to practice applying the concept of a function through various contextual problems. Students will organize and analyze data in tables and graphs and use the information to describe relationships that exist.

| **Grade:** 9 | **Algebra**<br>**Unit 3 - Functions** |
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| **Common Core Standard** | **Standards with Priority Standards in Bold**<br>8F 1. Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.1<br>8F 2. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.*<br>8F 5. Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.<br>**A-CED 2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.**<br>A-CED 10. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).<br>F-IF 1. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If $f$ is a function and $x$ is an element of its domain, then $f(x)$ denotes the output of $f$ corresponding to the input $x$. The graph of $f$ is the graph of the equation $y = f(x)$.<br>**F-IF 2. Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.**<br>**F-IF 4. For a function that models a relationship between two quantities, interpret key features of graphs and** |

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| | **tables in terms of the quantities and sketch graphs showing key features given a verbal description of the relationship.** ***Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative....**** <br>F-IF 5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in factory, then the positive integers would be an appropriate domain for the function.** <br>F-IF 7b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions <br>F-IF 9. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). |
| **Seymour High School Learning Expectations** | • Students will think critically <br>• Students will communicate effectively and creatively <br>• Students will access, evaluate, and use information for a variety of tasks and purposes |
| **Enduring Understanding** | • Functions are a mathematical way to describe relationships between two quantities that vary. |
| **Essential Questions** | • What is a function? <br>• What are the different ways in which functions may be represented? <br>• How can functions be used to model real world situations, make predictions, and solve problems? |
| **Content Standards:** | **Common Core Standards** <br>*Mathematical Practices #1 and #3 describe a classroom environment that encourages thinking mathematically and are critical for quality teaching and learning. Practices in bold are to be emphasized in the unit.* <br><br>1. Make sense of problems and persevere in solving them. <br>2. Reason abstractly and quantitatively. <br>3. Construct viable arguments and critique the reasoning of others. <br>**4. Model with mathematics.** <br>**5. Use appropriate tools strategically.** <br>6. Attend to precision. |

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| | 7. Look for and make use of structure.<br>8. Look for and express regularity in repeated reasoning. |
| **Performance Expectations (Student outcomes)** | ▸ Determine whether a relation is a function<br>▸ Identify the domain and range of a function<br>▸ Represent a function using an equation, table, and graph<br>▸ Evaluate linear and non-linear functions<br>▸ Evaluate functions using function notation<br>▸ Recognize functions in contextual situations<br>▸ Use functions to solve problems in real world contexts |

| **Strategies/Modes (examples)** | **Materials/Resources (examples)** | **Assessments (examples)** |
|---|---|---|
| • Guided practice<br>• Worksheets<br>• Homework<br>• Cooperative Group work<br>• Quizzes<br>• Tests<br>• Projects | Investigations 1-4<br>Videos<br>Graphing Calculators | **Performance Task: Pendulums**<br><br>**Other Evidence (Formative and Summative Assessments)**<br><br>• Exit slips<br>• Class work<br>• Homework assignments<br>• Math journals<br>• Unit 3 Test |

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Students start Unit 4 by exploring the distinction between linear and nonlinear behavior, and then focus on learning about linear functions. Throughout Unit 4, students derive linear models of real-world situations in order to analyze situations, make predictions or solve problems. Analyzing situations often takes the form of identifying the real world meaning of the slope and the *x*- and *y*-intercepts of a linear model. Making predictions involves evaluating models for a given independent variable (given *x* find *y*), and solving equations for the independent variable given the dependent variable (given *y* find *x*). Problem solving occurs through the use of various representations: algebraic, tabular, graphic and numeric.

| **Grade:** 9 | **Algebra**<br>**Unit - 4 Linear Functions** |
|---|---|
| **Common Core Standard** | **Standards with Priority Standards in Bold**<br>F-IF 6. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.*<br><br>F-IF 7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*<br>a. Graph linear ...functions and show intercepts..<br><br>F-IF 8. Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.<br><br>**F-LE 1.** Distinguish between situations that can be modeled with linear functions [and with exponential functions].<br>**a. Prove that linear functions grow by equal differences over equal intervals...**<br>b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another....<br><br>**F-LE 2. Construct linear ... functions, including arithmetic ... sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).** |

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| | **F-LE 5. Interpret the parameters in a linear ... function in terms of a context.** |
| **Seymour High School Learning Expectations** | • Students will think critically<br>• Students will communicate effectively and creatively<br>• Students will access, evaluate, and use information for a variety of tasks and purposes |
| **Enduring Understanding** | Linear functions are characterized by a constant average rate of change (or constant additive change). |
| **Essential Questions** | • What is a linear function?<br>• What are the different ways that linear functions may be represented?<br>• What is the significance of a linear function's slope and *y*-intercept?<br>• How may linear functions model real world situations?<br>• How may linear functions help us analyze real world situations and solve practical problems? |
| **Content Standards:** | **Common Core Standards**<br>*Mathematical Practices #1 and #3 describe a classroom environment that encourages thinking mathematically and are critical for quality teaching and learning. Practices in bold are to be emphasized in the unit.*<br><br>1. Make sense of problems and persevere in solving them.<br>2. Reason abstractly and quantitatively.<br>3. Construct viable arguments and critique the reasoning of others.<br>**4. Model with mathematics.**<br>**5. Use appropriate tools strategically.**<br>6. Attend to precision.<br>7. Look for and make use of structure.<br>8. Look for and express regularity in repeated reasoning. |
| **Performance Expectations (Student outcomes)** | • Determine if a function is linear from words, tables, equations and graphs.<br>• Determine the slope of linear functions represented in words, equations, tables and graphs.<br>• Given a linear equation in any of four representations- algebraic, graphical, tabular or verbal - write it in |

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| | any of the other three.<br>• Transform equations of lines to either slope intercept or standard form.<br>• Use linear functions to model and analyze real world situations and solve practical problems. |

| Strategies/Modes (examples) | Materials/Resources (examples) | Assessments (examples) |
|---|---|---|
| • Guided practice<br>• Worksheets<br>• Homework<br>• Cooperative Group work<br>• Quizzes<br>• Tests<br>• Projects | Investigations 1-6<br>Videos<br>Graphing Calculators | **Performance Task: Linear Models**<br><br>**Other Evidence (Formative and Summative Assessments)**<br><br>• Exit slips<br>• Class work<br>• Homework assignments<br>• Math journals<br>• Unit 4 Investigations 1 & 2 Quiz<br>• Mid-Unit Test<br>• Unit 4 Investigation 5 Quiz<br>• Unit 4 Test |

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Students will begin the unit by exploring measures of central tendency and spread and displays of one-variable data including, dot plots, histograms, and box-and-whisker plots. They will use the five number summary to create box-and-whisker plots and identify outliers with the 1.5 X IQR rule. They will be introduced to using the STAT menu on the graphing calculator.

| **Grade:** 9 | **Algebra**<br>**Unit - 5 Scatter Plots & Trend Lines** |
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| **Common Core Standard** | **Standards with Priority Standards in Bold**<br>8-SP 1. Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.<br>8-SP 2. Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.<br>8-SP 3. Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. *For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.*<br>**S-ID 2. Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.**<br>**S-ID 3. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).**<br>**S-ID 6.** Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.<br>**a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data.**<br>c. Fit a linear function for a scatter plot that suggests a linear association.<br>**S-ID 7. Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.**<br>S-ID 8. Compute (using technology) and interpret the correlation coefficient of a linear fit. |

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| | S-ID 9. Distinguish between correlation and causation. |
| **Seymour High School Learning Expectations** | • Students will think critically<br>• Students will communicate effectively and creatively<br>• Students will access, evaluate, and use information for a variety of tasks and purposes |
| **Enduring Understanding** | • Although scatter plots and trend lines may reveal a pattern, the relationship of the variables may indicate a correlation, but not causation**.** |
| **Essential Questions** | • Find measures of central tendency (mean, median, and mode) and of dispersion (range and IQR).<br>• Create a histogram, dot plot or bar graph.<br>• Use a graphing calculator or computer program (such as excel) to find and analyze statistical data (including standard deviation).<br>• Create a scatter plot by hand and draw the trend line.<br>• Use a graphing calculator to graph a scatter plot, using an appropriate window, and to find a linear regression line.<br>• Interpret the correlation coefficient for a linear model.<br>• Distinguish between correlation and causation.<br>• Understand the effects of outliers.<br>• Write the equations for piecewise functions. |
| **Content Standards:** | *Mathematical Practices #1 and #3describe a classroom environment that encourages thinking mathematically and are critical for quality teaching and learning. Practices in bold are to be emphasized in the unit.*<br><br>1. Make sense of problems and persevere in solving them.<br>2. Reason abstractly and quantitatively.<br>3. Construct viable arguments and critique the reasoning of others.<br>**4. Model with mathematics.**<br>**5. Use appropriate tools strategically.** |

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| | 6. Attend to precision.<br>7. Look for and make use of structure.<br>8. Look for and express regularity in repeated reasoning. |
| **Performance Expectations (Student outcomes)** | • Analyze functions using different representations<br>• Summarize, represent, and interpret data on a single count or measurement variable<br>• Summarize, represent, and interpret data on two categorical and quantitative variables<br>Interpret linear models |

| **Strategies/Modes (examples)** | **Materials/Resources (examples)** | **Assessments (examples)** |
|---|---|---|
| • Guided practice<br>• Worksheets<br>• Homework<br>• Cooperative Group work<br>• Quizzes<br>• Tests<br>• Projects | Investigations 1-6<br>Videos<br>Graphing Calculators | **Performance Task: Linearity is in the Air — Can You Find It?**<br><br>**Other Evidence (Formative and Summative Assessments)**<br>• Exit Slips<br>• Class work<br>• Homework assignments<br>• Math journal<br>• Unit 5 Test |

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In previous units, students studied linear functions and used a linear function to investigate the relationship between two variables. In this unit, students will represent, compare and analyze two linear equations, look for common solutions and use this information to make choices between competing situations in real world contexts. Students will solve systems of equations numerically, graphically, and algebraically. They will be able to explain what the solution of a system of linear equations represents in the context of various applications such as those used by business leaders, economists, scientists, engineers, nutritionists, racecar drivers, and athletes.

They also will explore the special cases of parallel lines (no solution) and identical lines (infinite solutions).

| **Grade:** 9 | **Algebra**<br>**Unit - 6 Systems of Linear Equations** |
|---|---|
| **Common Core Standard** | **Standards with Priority Standards in Bold**<br>A-CED 3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.<br><br>A-REI 5. Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.<br><br>**A-REI 6. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.**<br><br>**A-REI 11. Explain why the *x*-coordinates of the points where the graphs of the equations *y* = *f*(*x*) and *y* = *g*(*x*) intersect are the solutions of the equation *f*(*x*) = *g*(*x*); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where *f*(*x*) and/or *g*(*x*) are linear functions.*** |
| **Seymour High School Learning** | • Students will think critically<br>• Students will communicate effectively and creatively |

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| **Expectations** | • Students will access, evaluate, and use information for a variety of tasks and purposes |
| **Enduring Understanding** | • A system of linear equations is an algebraic way to compare two equations that model a situation and find the breakeven point or choose the most efficient or economical plan. |
| **Essential Questions** | • What does the number of solutions (none, one or infinite) of a system of linear equations represent?<br>• What are the advantages and disadvantages of solving a system of linear equations graphically versus algebraically? |
| **Content Standards:** | *Mathematical Practices #1 and #3 describe a classroom environment that encourages thinking mathematically and are critical for quality teaching and learning. Practices in bold are to be emphasized in the unit.*<br><br>1. Make sense of problems and persevere in solving them.<br>2. Reason abstractly and quantitatively.<br>3. Construct viable arguments and critique the reasoning of others.<br>**4. Model with mathematics.**<br>**5. Use appropriate tools strategically.**<br>6. Attend to precision.<br>7. Look for and make use of structure.<br>8. Look for and express regularity in repeated reasoning. |
| **Performance Expectations (Student outcomes)** | ▸ Create equations that describe numbers or relationships<br>▸ Solve systems of equations<br>▸ Represent and solve systems of equations graphically |

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| Strategies/Modes (examples) | Materials/Resources (examples) | Assessments (examples) |
|---|---|---|
| • Guided practice<br>• Worksheets<br>• Homework<br>• Cooperative Group work<br>• Quizzes<br>• Tests<br>• Projects | Investigations 1-3<br>Videos<br>Graphing Calculators | **Performance Task: Community Park**<br><br>**Other Evidence (Formative and Summative Assessments)**<br><br>• Exit slips<br>• Class work<br>• Homework assignments<br>• Journal entries<br>• Unit 6 Test |

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Unit 7 builds on the concepts of a function and patterns of change. Students work with interesting and significant relationships that are exponential in nature. Many of the contexts explored affect their daily lives. The unit begins with the topic of world population growth and food supply to compare the growth rates of exponential and linear models. This context follows the theme of world hunger and nutrition from the previous unit. Students begin to recognize that real world data is a bit messy and data patterns over restricted domains may be modeled with different functions.

| **Grade:** 9 | **Algebra**<br>**Unit - 7 Introduction to Exponential Functions** |
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| **Common Core Standard** | **Standards with Priority Standards in Bold**<br><br>N-RN 1. Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. *For example, we define* $5^{1/3}$ *to be the cube root of 5 because we want* $(5^{1/3})^3 = 5^{(1/3)3}$ *to hold, so* $(5^{1/3})^3$ *must equal 5.*<br><br>**N-RN 2. Rewrite expressions involving radicals and rational exponents using the properties of exponents.**<br><br>A-SSE 1b. Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret* $P(1+r)^n$ *as the product of P and a factor not depending on P.*<br><br>A-SSE 3c. Use the properties of exponents to transform expressions for exponential functions. For example the expression $1.15^t$ can be rewritten as $[1.15^{(1/12)}]^{(12t)} \approx 1.012^{(12t)}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.<br><br>F-IF 7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*<br>e. Graph exponential ... functions, showing intercepts and end behavior... F-IF 8b. Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)^{12t}$, $y = (1.2)^{(t/10)}$, and classify them as representing exponential functions. |

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| | **F-BF 2. Write ... geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.*** <br><br> F-LE 1. Distinguish between situations that can be modeled with linear functions and with exponential functions. <br><br> **a. Prove ... that exponential functions grow by equal factors over equal intervals....** <br> c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another. <br><br> **F-LE 2. Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).** <br><br> F-LE 3. Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly... <br><br> **F-LE 5. Interpret the parameters in a ... exponential function in terms of a context.** |
| **Seymour High School Learning Expectations** | • Students will think critically <br> • Students will communicate effectively and creatively <br> • Students will access, evaluate, and use information for a variety of tasks and purposes |
| **Enduring Understanding** | When comparing an exponential model with a linear model, the question is not *if* the exponential model will generate very large or very small inputs, but rather *when*. <br><br> With real data, sometimes deciding whether data is linear or non-linear is more complex than just looking at a graph, differences ( $y_n - y_{n-1}$), or an r-value; it is important to examine differences that are approximately the same more carefully to see if there is a pattern of increasing or decreasing values that, because the pattern is exponential, soon begins to produce outputs of remarkable values. |
| **Essential Questions** | What characterizes exponential growth and decay? <br> What are real world models of exponential growth and decay? |

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| | What are the limitations of exponential growth models?<br>How can one differentiate an exponential model from a linear model given a real world data set? |
| **Content Standards:** | *Mathematical Practices #1 and #3 describe a classroom environment that encourages thinking mathematically and are critical for quality teaching and learning. Practices in bold are to be emphasized in the unit.*<br><br>**1. Make sense of problems and persevere in solving them.**<br>2. Reason abstractly and quantitatively.<br>3. Construct viable arguments and critique the reasoning of others.<br>**4. Model with mathematics.**<br>5. Use appropriate tools strategically.<br>**6. Attend to precision.**<br>7. Look for and make use of structure.<br>8. Look for and express regularity in repeated reasoning |
| **Performance Expectations (Student outcomes)** | • Determine whether real-world data best models linear or exponential growth (or decay)<br>• Recognize exponential models in various forms and express them in other forms (situation, data table, graph, and equation)<br>• Identify and explain the meaning of the parameters of an exponential function<br>• Identify similarities and differences between linear models and exponential models<br>• Explain the limitations of exponential growth and decay models<br>• Understand and work with exponential algebraic expressions |

| **Strategies/Modes (examples)** | **Materials/Resources (examples)** | **Assessments (examples)** |
|---|---|---|
| • Guided practice<br>• Worksheets<br>• Homework<br>• Cooperative Group work<br>• Quizzes<br>• Tests<br>• Projects | Investigations 1-6<br>Videos<br>Graphing Calculators | **Performance Task: The Consequences of Global Warming.**<br><br>**Other Evidence (Formative and Summative Assessments)**<br><br>• Exit slips<br>• Class work |

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| | | • Homework assignments<br>• Math journals<br>• Unit 7 Test |

# Seymour Public Schools Curriculum

| **Grade:** 9 | **Algebra**<br>**Unit - 8 Quadratic Functions and Equations** |
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| **Common Core Standard** | **Standards with Priority Standards in Bold**<br>8EE 2. Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where $p$ is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.<br>**A-SSE 3. a Factor a quadratic expression to reveal the zeros of the function it defines. b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.**<br>A-REI 4. a. Use the method of completing the square to transform any quadratic equation in $x$ into an equation of the form $(x – p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form. Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation.<br>**A-APR 1. Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.**<br>A-CED 1. Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from ...quadratic functions ...*<br>A-CED 2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.<br>**F-IF 4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries... ***<br>**F-IF 7a. Graph ... quadratic functions and show intercepts, maxima, and minima.**<br>**F-IF 8a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.**<br>**F-BF 3. Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, and $f(x + k)$ for specific values of $k$ (both positive and negative); find the value of $k$ given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology...** |

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| **Seymour High School Learning Expectations** | • Students will think critically<br>• Students will communicate effectively and creatively<br>• Students will access, evaluate, and use information for a variety of tasks and purposes |
| **Enduring Understanding** | • Quadratic functions can be used to model real world relationships and the key points in quadratic functions have meaning in the real world context.<br>• Polynomials are closed under addition, subtraction, and multiplication.<br>• Dynamic software, graphing calculators, and other technology can be used to explore and deepen our understanding of mathematics |
| **Essential Questions** | • What can the zeros, intercepts, vertex, maximum, minimum and other features of a quadratic function tell you about real world relationships?<br>• How is the polynomial system analogous to the system of integers?<br>• How can technology support investigation and experimentation of the way that parameters effect functions? |
| **Content Standards:** | *Mathematical Practices #1 and #3 describe a classroom environment that encourages thinking mathematically and are critical for quality teaching and learning. Practices in bold are to be emphasized in the unit.*<br><br>1. Make sense of problems and persevere in solving them.<br>2. Reason abstractly and quantitatively.<br>3. Construct viable arguments and critique the reasoning of others.<br>**4. Model with mathematics.**<br>**5. Use appropriate tools strategically.**<br>6. Attend to precision.<br>7. Look for and make use of structure.<br>8. Look for and express regularity in repeated reasoning. |
| **Performance Expectations (Student outcomes)** | • Graph (quadratic functions)<br>• Find (line of symmetry, vertex)<br>• Solve (quadratic equation) |

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| | • Model (with quadratic functions)<br>• Solve (problems arising from quadratic models)<br>• Expand (product of two binomials)<br>• Factor (quadratic trinomial)<br>• Use (quadratic formula)<br>. |

| **Strategies/Modes (examples)** | **Materials/Resources (examples)** | **Assessments (examples)** |
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| • Guided practice<br>• Worksheets<br>• Homework<br>• Cooperative Group work<br>• Quizzes<br>• Tests<br>• Projects | Investigations 1-6<br>Videos<br>Graphing Calculators | **Performance Task: Stopping Distance**<br><br>**Other Evidence (Formative and Summative Assessments)**<br><br>• Exit slips<br>• Class work<br>• Homework assignments<br>• Math journals<br>• Mid-unit quiz<br>• Unit #8 Test |