SOUTHERN LEHIGH SCHOOL DISTRICT
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Scope and Sequence for **Algebra II**

Standards for Mathematical Practice:	
MP1 Make sense of problems and persevere in solving them. **MP2** Reason abstractly and quantitatively. **MP3** Construct viable arguments and critique the reasoning of others. **MP4** Model with mathematics.	**MP5** Use appropriate tools strategically. **MP6** Attend to precision. **MP7** Look for and make use of structure. **MP8** Look for and express regularity in repeated reasoning.

N.RN – Number and Quantity – The Real Number System

CCSSM	PA Core Standards for Mathematics
Extend the properties of exponents to rational exponents. **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.* **N.RN.2** Rewrite expressions involving radicals and rational exponents using the properties of exponents.	**CC.2.1.HS.F.1** Apply and extend the properties of exponents to solve problems with rational exponents.
Use properties of rational and irrational numbers. **N.RN.3** Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.	**CC.2.1.HS.F.2** Apply properties of rational and irrational numbers to solve real world or mathematical problems.

N.Q – Number and Quantity – Quantities

CCSSM	PA Core Standards for Mathematics
Reason quantitatively and use units to solve problems. **N.Q.1** Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. **N.Q.2** Define appropriate quantities for the purpose of descriptive modeling. **N.Q.3** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.	**CC.2.1.HS.F.3** Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs and data displays. **CC.2.1.HS.F.4** Use units as a way to understand problems and to guide the solution of multi-step problems. **CC.2.1.HS.F.5** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

N.CN – Number and Quantity – The Complex Number System

CCSSM	PA Core Standards for Mathematics
Perform arithmetic operations with complex numbers. **N.CN.1** Know there is a complex number i such that $i^2 = –1$, and every complex number has the form $a + bi$ with a and b real. **N.CN.2** Use the relation $i^2 = –1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.	**CC.2.1.HS.F.6** Extend the knowledge of arithmetic operations and apply to complex numbers.
N.CN. 7 Solve quadratic equations with real coefficients that have complex solutions. **N.CN. 8 (+)** Extend polynomial identities to the complex numbers. ***For example,*** *rewrite* $x^2 + 4$ *as* $(x + 2i)(x – 2i)$. **N.CN.9** (+) Know the Fundamental Theorem of Algebra	**CC.2.1.HS.F.7** Apply concepts of complex numbers in polynomial identities and quadratic equations to solve problems.

A.SSE – Algebra – Seeing Structure in Expressions

CCSSM	PA Core Standards for Mathematics
Interpret the structure of expressions. **A.SSE.1** Interpret expressions that represent a quantity in terms of its context. **a.** Interpret parts of an expression, such as terms, factors, and coefficients. **b.** 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. **A.SSE.2** Use the structure of an expression to identify ways to rewrite it. ***For example****, see* $x^4 - y^4$ *as* $(x^2)^2 - (y^2)^2$*, thus recognizing it as a difference of squares that can be factored as* $(x^2 - y^2)(x^2 + y^2)$.	**CC.2.2.HS.D.1** Interpret the structure of expressions to represent a quantity in terms of its context.
Write expressions in equivalent forms to solve problems. **A.SSE.4** Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. *For example, calculate mortgage payments.*	**CC.2.2.HS.D.2** Write expressions in equivalent forms to solve problems.

A.APR – Algebra – Arithmetic with Polynomials and Rational Expression

CCSSM	PA Core Standards for Mathematics
Perform arithmetic operations on polynomials. **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.	**CC.2.2.HS.D.3** Extend the knowledge of arithmetic operations and apply to polynomials.
Understand the relationship between zeros and factors of polynomials. **A.APR.2** Know and apply the Remainder Theorem: For a polynomial $p(x)$ and a number a, the remainder on division by $x - a$ is $p(a)$, so $p(a) = 0$ if and only if $(x - a)$ is a factor of $p(x)$. **A.APR.3** Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.	**CC.2.2.HS.D.4** Understand the relationship between zeros and factors of polynomials to make generalizations about functions and their graphs.

A.APR – Algebra – Arithmetic with Polynomials and Rational Expression – *Continued…*

CCSSM	PA Core Standards for Mathematics
Use polynomial identities to solve problems. **A.APR.4** Prove polynomial identities and use them to describe numerical relationships. *For example, the polynomial identity* $(x^2 + y^2)^2 = (x^2 – y^2)^2 + (2xy)^2$ *can be used to generate Pythagorean triples.* **A.APR.5 (+)** Know and apply the Binomial Theorem for the expansion of $(x + y)^n$ in powers of x and y for a positive integer n, where x and y are any numbers, with coefficients determined for example by Pascal's Triangle.	**CC.2.2.HS.D.5** Use polynomial identities to solve problems.
Rewrite rational expressions. **A.APR.6** Rewrite simple rational expressions in different forms; write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$, using inspection, long division, or, for the more complicated examples, a computer algebra system. **A.APR.7 (+)** Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.	**CC.2.2.HS.D.6** Extend the knowledge of rational functions to rewrite in equivalent forms.

A.CED – Algebra – Creating Equations

CCSSM	PA Core Standards for Mathematics
Create equations that describe numbers or relationships. **A.CED.1** Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational* **A.CED.2** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. **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. ***For example****, represent inequalities describing nutritional and cost constraints on combinations of different foods.* **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.*	**CC.2.2.HS.D.7** Create and graph equations or inequalities to describe numbers or relationships.

A.REI – Algebra – Reasoning with Equations & Inequalities

CCSSM	PA Core Standards for Mathematics
Understand solving equations as a process of reasoning and explain the reasoning. **A.REI.2** Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.	**CC.2.2.HS.D.8** Apply inverse operations to solve equations or formulas for a given variable. **CC.2.2.HS.D.9** Use reasoning to solve equations and justify the solution method.
Represent and solve equations and inequalities graphically. **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, polynomial, rational, absolute value, exponential, and logarithmic functions.	**CC.2.2.HS.D.10** Represent, solve and interpret equations /inequalities and systems of equations/inequalities algebraically and graphically.

F.IF – Functions – Interpreting Functions

CCSSM	PA Core Standards for Mathematics
Understand the concept of function and use function notation. **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 $y = f(x)$. **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. **F.IF.3** Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. ***For example**, the Fibonacci sequence is defined recursively by $f(0) = f(1) = 1, f(n+1) = f(n) + f(n-1)$ for $n \geq 1$.*	**CC.2.2.HS.C.1** Use the concept and notation of functions to interpret and apply them in terms of their context.

F.IF – Functions – Interpreting Functions – *Continued…*

CCSSM	PA Core Standards for Mathematics
Interpret functions that arise in applications in terms of the context. **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; end behavior; and periodicity.* **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 a factory, then the positive integers would be an appropriate domain for the function.* **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. **Analyze functions using different representations.** **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. **a** Graph linear and quadratic functions and show intercepts, maxima, and minima. **b** Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. **c** Graph polynomial functions, identify zeros when suitable factorizations are available, and showing end behavior. **d** (+) Graph rational functions, identify zeros and asymptotes when suitable factorizations are available, and showing end behavior. **e** Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude. **F.IF.8** Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. **a** 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. **b** 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 growth or decay.* **F.IF.9** Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.*	**CC.2.2.HS.C.2** Graph and analyze functions and use their properties to make connections between the different representations.

F.BF – Functions – Building Functions

CCSSM	PA Core Standards for Mathematics
Build a function that models a relationship between two quantities. **F.BF.1** Write a function that describes a relationship between two quantities. **a.** Determine an explicit expression, a recursive process, or steps for calculation from a context. **b.** Combine standard function types using arithmetic operations. ***For example****, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.*	**CC.2.2.HS.C.3** Write functions or sequences that model relationships between two quantities.
Build a new functions from existing functions. **F.BF.3** Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k\,f(x)$, $f(kx)$, 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. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.* **F.BF.4** Find inverse functions. **a.** Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse. ***For example****,* $f(x) = 2x^3$ *or* $f(x) = (x+1)/(x–1)$ *for* $x \neq 1$.	**CC.2.2.HS.C.4** Interpret the effects transformations have on functions and find the inverses of functions.
Interpret expressions for functions in terms of the situation they model. **F.LE.5** Interpret the parameters in a linear or exponential function in terms of a context.	**CC.2.2.HS.C.6** Interpret functions in terms of the situation they model.

F.LE – Functions – Linear, Quadratic, and Exponential Models

CCSSM	PA Core Standards for Mathematics
Construct and compare linear, quadratic, and exponential models and solve problems. **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). **F.LE.3** Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function. **F.LE.4** For exponential models, express as a logarithm the solution to $ab^{ct} = d$ where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology	**CC.2.2.HS.C.5** Construct and compare linear, quadratic and/or exponential models to solve problems.

F.TF – Functions – Trigonometric Functions

CCSSM	PA Core Standards for Mathematics
Extend the domain of trigonometric functions using the unit circle. **F.TF.1** Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle. **F.TF.2** Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.	**CC.2.2.HS.C.7** Apply radian measure of an angle and the unit circle to analyze the trigonometric functions.
Model periodic phenomena with trigonometric functions. **F.TF.5** Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.	**CC.2.2.HS.C.8** Choose trigonometric functions to model periodic phenomena and describe the properties of the graphs.
F.TF.8 Prove the Pythagorean identity $\sin2(\theta) + \cos2(\theta) = 1$ and use it to find $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ given $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ and the quadrant of the angle.	**CC.2.2.HS.C.9** Prove the Pythagorean identity and use it to calculate trigonometric ratios.

S.ID – Statistics and Probability – Interpreting Categorical & Quantitative Data

CCSSM	PA Core Standards for Mathematics
Summarize, represent, and interpret data on a single count or measurement variable. **S.ID.4** Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.	**CC.2.4.HS.B.1** Summarize, represent, and interpret data on a single count or measurement variable.
Summarize, represent, and interpret data on two categorical and quantitative variables. **S.ID.5** Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data. **S.ID.6** Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. **a.** Fit a function to the data; use functions fitted to data to solve problems in the context of the data. *Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.* **b.** Informally assess the fit of a function by plotting and analyzing residuals. **c.** Fit a linear function for a scatter plot that suggests a linear association.	**CC.2.4.HS.B.2** Summarize, represent, and interpret data on two categorical and quantitative variables.
Interpret linear models. **S.ID.7** Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. **S.ID.8** Compute (using technology) and interpret the correlation coefficient of a linear fit. **S.ID.9** Distinguish between correlation and causation.	**CC.2.4.HS.B.3** Analyze linear models to make interpretations based on the data.

S.IC – Statistics and Probability – Making Inferences and Justifying Conclusions

CCSSM	PA Core Standards for Mathematics
Summarize, represent, and interpret data on a single count or measurement variable. **S.IC.1** Understand statistics as a process for making inferences about population parameters based on a random sample from that population. **S.IC.2** Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. ***For example****, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?*	**2.4.HS.B.4** Recognize and evaluate random processes underlying statistical experiments.

S.IC – Statistics and Probability – Making Inferences and Justifying Conclusions – *Continued…*

CCSSM	PA Core Standards for Mathematics
Make inferences and justify conclusions from sample surveys, experiments, and observational studies **S.IC.3** Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each. **S.IC.4** Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling. **S.IC.5** Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant. **S.IC.6** Evaluate reports based on data.	**2.4.HS.B.5** Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.

S.MD – Statistics and Probability – Using Probability to Make Decisions

CCSSM	PA Core Standards for Mathematics
Use probability to evaluate outcomes of decisions. **S.MD.6 (+)** Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator). S **S.MD.7 (+)** Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).	**2.4.HS.B.7** Apply the rules of probability to compute probabilities of compound events in a uniform probability model.