Southern Lehigh School District

UbD Curriculum Template

Course: **Algebra 2** Unit: **nit 1 : Expressions, Equations and Inequalities** Grades: **9-12**

Teacher Team: **Haupt, Malik** Date: **June, 2016**

Stage 1 – Desired Results	
Established Goals	**Enduring Understandings/Transfer**
1. What 21st Century Essentials included in the mission statement will this unit address? *Problem-solving* *Career Planning and Life-Long Learning* *Transfer of Learning* 2. What content standards will this unit address? • ELA PA Core State Standards • Math PA Core State Standards 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. CC.2.2.HS.C.1- Use the concept and notation of functions to interpret and apply them in terms of their context. CC.2.2.HS.C.2- Graph and analyze functions, and use their properties to	**Written as a declarative statement, an enduring understanding is a "big idea" that focuses on larger concepts, principles, and processes that go beyond discrete facts or skills. Enduring Understandings are applicable to new situations across content areas and TRANSFERABLE (the ability to learn in one context and apply to a new situation, particularly outside of the classroom) to the real world.** 3. List the Enduring Understanding(s): *a. Some patterns can be represented using diagrams, words, numbers, or algebraic expressions.* *b. Some mathematicial phrases and real-world quantities can be represented using algebraic expressions.* *c. The properties of equality, inequality, and inverse operations can be used to solve equations.* *d. The set of real numbers has several special subsets related in particular ways.* *e. An absolute value quantity is nonnegative. Since opposites have the same absolute value, an absolute value equation can have two solutions.* 4. What do you want students to do with this knowledge or skill beyond this course? What is Transfer? *a. Students will make sense of and persevere in solving complex and novel mathematical problems.* *b. Students will use effective mathematical reasoning to construct viable arguments and critique the reasoning of others.* *c. Students will communicate precisely when making mathematical statements and express answers with a degree of precision appropriate for the context of the problem/situation.* *d. Students will apply mathematical knowledge to analyze and model situations/relationships using multiple representations and appropriate tools in order to make decisions, solve problems, and draw conclusions.* *e. Students will make use of structure and repeated reasoning to gain a mathematical perspective and formulate generalized problem solving strategies* *f. Given a word problem, students will solve the word problem using an appropriate strategy or strategies and will share and compare the use of multiple strategies leading to the same answer.*
	Essential Questions
	What thought-provoking questions will foster inquiry, meaning-making, and transfer?

make connections between the different representations.
CC.2.2.HS.C.3- Write functions or sequences that model relationships between two quantities
CC.2.2.HS.C.6- Interpret functions in terms of the situations they model.
CC.2.2.HS.D.1- Interpret the structure of expressions to represent a quantity in terms of its context.
CC.2.2.HS.D.2- Write expressions in equivalent forms to solve problems
CC.2.2.HS.D.7- Create and graph equations or inequalities to describe numbers or relationships
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.
CC.2.4.HS.B.2- Summarize, represent, and interpret data on two categorical and quantitative variables.

PA Content Standards

5. List the Essential Question(s) that students should ponder, wonder about or explain by the end of this unit:
   a. *How do variables help you model real-world sitations?*
   b. *How can you use the properties of real numbers to simplify?*
   c. *How do you solve an equation or inequality?*

Acquisition

Students will know...

6. What facts should students know and be able to use to gain further knowledge?
   properties of equality, inverse operations, solving inequalities, compound inequalities, absolute values
7. What vocabulary should students know and be able to recall?
   Tier II- predict, compare, evaluate, justify, check, evaluate, summarize, generalization, unique, process, interpret, pattern, prove, solve, describe, apply, explain, determine, describe

   Tier III- absolute value function, axis of symmetry, constant of variation, correlation, dependent variable, direct variation, domain, function, function notation, function rule, independent variable, line of best fit, linear equation, linear function, linear inequality, parallel lines, parent function, perpendicular lines, point-slope form, range, reflection, relation, scatter plot, slope, slope-intercept form, standard form of a linear form, test point, transformation, translation, vertex, vertical compression, vertical stretch, vertical-line test, x-intercept, y-intercept
8. What basic concepts should students know and be able to recall and apply?
   Students will use an expression to model the nth term of a pattern.
   Students will use variables to represent unknown quantities in real-world situations
   Students will apply properties of real numbers to simplify algebraic expressions
   Students will apply the properties of equality to

Students will be skilled at... (be able to do)

9. What discrete skill and processes should students be able to demonstrate?
   A2.1.3.2.1- Determine how a change in one variable relates to a change in a second variable (e.g., y = 4/ x ; if x doubles, what happens to y ?).
   A2.1.3.2.2- Use algebraic processes to solve a formula for a given variable (e.g., solve d = rt for r).
   A2.2.1.1.1- Analyze a set of data for the existence of a pattern, and represent the pattern with a rule algebraically and/or graphically.
   A2.2.1.1.2- Identify and/or extend a pattern as either an arithmetic or geometric sequence (e.g., given a geometric sequence, find the 20th term).
   A2.2.1.1.3- Determine the domain, range, or inverse of a relation.
   A2.2.2.2.1- Identify or describe the effect of changing parameters within a family of functions (e.g., y = x2 and y = x2 + 3, or y = x2and y = 3x2).

	solve an equation *Students will apply the properties of inequality to solve an inequality* *Students will find all the values of a variable that make an equation or inequality true.*	

Stage 2 – Evidence	
NETS for Students	**PERFORMANCE TASK(S)—can include transfer tasks and Project-Based Learning**
NETS—National Educational Technology Standards; i.e., the standards for evaluating the skills and knowledge students need to learn effectively and live productively in an increasingly global and digital world. *Critical Thinking* *Creative and Innovation* *Technology Operations* *Communication and Collaboration*	*Examples include but are not limited to:* *Labs, open-ended essays, voice recordings, videos, presentations, discussion boards, graphic organizers, songs, skits, dioramas, visual projects (posters, dioramas)* List the task(s), then explain how the student will demonstrate the transfer of knowledge or skill involved in the task(s) (reference Stage 1, Item #4): *Participate in Discussion board responding to teacher created prompts* *Generate equations and representations that can be used to solve problems and check for reasonableness of solution*
	OTHER SUMMATIVE ASSESSMENTS—can include factual recall
	Examples include but are not limited to final projects, research papers, quizzes and tests. List the assessments: *Quizzes and Tests*

Stage 3 – Learning Plan		
NETS for Students	**Learning Activities**	**Progress Monitoring/Formative Assessment**
NETS—National Educational Technology Standards; i.e., the standards for evaluating the skills and knowledge students need to learn effectively and live productively in an increasingly global and digital world. *Critical Thinking* *Creative and Innovation* *Technology Operations* *Communication and Collaboration*	Questions to consider while planning: • Are transfer and acquisition addressed in the learning plan? • Does the learning plan reflect principles of learning and best practices? • Is there tight alignment with Stages 1 and 2? • Is the plan likely to be engaging and effective for all students?	• **How will you monitor students' progress toward acquisition, meaning, and transfer during learning activities?** Daily assessments, teacher observation of students in class performance, teacher observation during peer share-out sessions • **What are potential rough spots and student misunderstandings?** Many letters and symbols can represent variables. The number "e" and "pi" may confuse students. Students may forget to perform operations to both sides of an equation. May forget to check solutions in the original equation. Forgetting to reverse inequality signs when multiplying or dividing by a negative number. Students may assume absolute value is

			always positive. Zero is not positive and not negative. Absolute value is sometimes confused with the opposite • **How will students get the feedback they need?** Graded assessment, teacher observation immediate feedback, peer feedback, mid-chapter quiz
	List planned activities *(examples include but are not limited to: experiments, guided reading, worksheets, discussions, note-taking, research, games)*: worksheets, homework from textbook, Study Island, interactive textbook quizzes	**List resources required** *(examples include but are not limited to: laptops, iPads, websites, digital cameras, magazines, Blackboard, textbooks, novels, primary source documents, other non-fiction text, lab equipment, maps, translator, calculators)* Textbook, laptops, whiteboard, graph paper white boards, on-line text book/answer key, document camera, calculators, Grapher software	**FORMATIVE ASSESSMENTS—any non-graded, diagnostic assessment administered prior to or during a unit that reflects prior knowledge, skill levels, and potential misconceptions.** *Examples include but are not limited to: Pre-tests, clickers (CPS), mini whiteboards, entrance and exit tickets, CDTs, DIBELS, Aimsweb* Interactive textbook quizzes, Study Island, mini-whiteboards, Kahoot, Socrative, Google Forms, TI-nspire technology, Zip-grade

Southern Lehigh School District

UbD Curriculum Template

Course: **Algebra 2** Unit: **Unit 2 : Functions, Equations, and Graphs** Grades: **9-12**

Teacher Team: **Haupt, Malik** Date: **June, 2016**

Stage 1 – Desired Results	
Established Goals	**Enduring Understandings/Transfer**
1. What 21st Century Essentials included in the mission statement will this unit address? *Problem-solving* *Career Planning and Life-Long Learning* *Transfer of Learning* 2. What content standards will this unit address? • ELA PA Core State Standards • Math PA Core State Standards CC.2.1.HS.F.1- Apply and extend the properties of exponents to solve problems with rational exponents. 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. CC.2.2.HS.C.1- Use the concept and notation of functions to interpret and	**Written as a declarative statement, an enduring understanding is a "big idea" that focuses on larger concepts, principles, and processes that go beyond discrete facts or skills. Enduring Understandings are applicable to new situations across content areas and TRANSFERABLE (the ability to learn in one context and apply to a new situation, particularly outside of the classroom) to the real world.** 3. List the Enduring Understanding(s): *a. A pairing of items from two sets is special if each item from one set pairs with exactly one item from the second set.* *b. Some quantities are in a relationship where the ratio of corresponding values is constant.* *c. While moving from any point on a line in the coordinate plane to any other point on the same line,the ratio of the vertical change to the horizontal change is constant. This constant ratio describes the slope of the line.* *d. The slopes of two lines in the same plane indicate how the lines are related.* *e. To draw conclusions about a real-world situation, sometimes it is possible to model data a situation with a linear equation.* *f. There are sets of functions called families, in which each function is a transformation of a special function called the parent.* *g. Just as the absolute value of x is its distance from 0, the absolute value of f(x), or |f(x)|, gives the distance from the line y = 0 for each value of f(x).* *h. The graph of a linear inequality in two variables contains all points on one side of the line and may or may not include the points on the line.* 4. What do you want students to do with this knowledge or skill beyond this course? What is Transfer? *a. Students will make sense of and persevere in solving complex and novel mathematical problems.* *b. Students will use effective mathematical reasoning to construct viable arguments and critique the reasoning of others.* *c. Students will communicate precisely when making mathematical statements and express answers with a degree of precision appropriate for the context of the problem/situation.* *d. Students will apply mathematical knowledge to analyze and model situations/relationships using multiple representations and appropriate tools in order to make decisions, solve problems, and draw conclusions.* *e. Students will make use of structure and repeated reasoning to gain a mathematical perspective and*

apply them in terms of their context.
CC.2.2.HS.C.2- Graph and analyze functions, and use their properties to make connections between the different representations.
CC.2.2.HS.C.3- Write functions or sequences that model relationships between two quantities.
CC.2.2.HS.C.4- Interpret the effects transformations have on functions, and find the inverses of functions.
CC.2.2.HS.C.5- Construct and compare linear, quadratic, and exponential models to solve problems.
CC.2.2.HS.C.6- Interpret functions in terms of the situations they model.
CC.2.2.HS.D.2- Write expressions in equivalent forms to solve problems.
CC.2.2.HS.D.3- Extend the knowledge of arithmetic operations and apply to polynomials.
CC.2.2.HS.D.5- Use polynomial identities to solve problems.
CC.2.2.HS.D.6- Extend the knowledge of rational functions to rewrite in equivalent forms.
CC.2.2.HS.D.7- Create and graph equations or inequalities to describe numbers or relationships
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.
CC.2.2.HS.D.10- Represent, solve and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.
CC.2.3.HS.A.10- Translate between the

formulate generalized problem solving strategies
f. Given a word problem, students will solve the word problem using an appropriate strategy or strategies and will share and compare the use of multiple strategies leading to the same answer.

Essential Questions

What thought-provoking questions will foster inquiry, meaning-making, and transfer?

5. List the Essential Question(s) that students should ponder, wonder about or explain by the end of this unit:
   a. Does it matter which form of a linear equation you use?
   b. How do you use transformations to help graph absolute value functions?
   c. How can you model data with a linear function?

Acquisition

Students will know...	**Students will be skilled at... (be able to do)**
6. What facts should students know and be able to use to gain further knowledge? *domain and range, vertical line test, function notation,line of best fit, translation, reflection, vertical stretch or compression* 7. What vocabulary should students know and be able to recall? *Tier 2 Vocabulary: predict, compare, evaluate, justify, check, evaluate, summarize, generalization, unique, process, interpret, pattern, prove, solve, describe, apply, explain, determine, describe.* *Tier 3 Vocabulary: absolute value function, axis of symmetry, boundary, constant of variation, correlation, correlation coefficient, dependent variable, direct variation, domain, function, function notation, independent variable, line of best fit, linear equation, linear function, linear inequality, parallel lines, parent function, perpendicular lines, point-slope form, range, reflection, relation, scatter plot, slope, slope-intercept form, standard form of a linear equation, test point, transformation, translation, vertex, vertical compression, vertical stretch, vertical-line test, x-intercept, y-intercept*	9. What discrete skill and processes should students be able to demonstrate? *A2.1.2.1.1* *Use exponential expressions to represent rational numbers.* *A2.1.2.1.2* *Simplify or evaluate expressions involving positive and negative exponents and/or roots (may contain all types of real numbers - exponents should not exceed power of 10).* *A2.1.2.1.3* *Simplify/evaluate expressions involving multiplying with exponents (e.g., x6 × x7 = x13), powers of powers (e.g., (x6)7 = x42), and powers of products (e.g., (2x2)3 = 8x6). Note: Limit to rational exponents.* *A2.1.3.1.2* *Solve equations involving rational and/or radical expressions (e.g., 10/(x + 3) + 12/(x-2) = 1 or $\sqrt{\ }$ x2 + 21x = 14).* *A2.1.3.1.4* *Write, solve, and/or apply linear or exponential growth or decay (including problem situations).*

geometric description and the equation for a conic section. CC.2.4.HS.B.2- Summarize, represent, and interpret data on two categorical and quantitative variables. PA Content Standards	8. What basic concepts should students know and be able to recall and apply? *Students will identify forms of linear equations.* *Students will determine which form of a linear equation is most easily found with the given information.* *Students will convert between various forms of linear functions.* *Students will identify the different kinds of transformations.* *Students will determine whether a transformation changes the location or shape of a graph or both.* *Students will make a scatter plot of linear data.* *Students will determine the correlation of linear data.* *Students will use linear regression to find the line of best fit of linear data with a graphing calculator.* *Students will use the correlation coefficient to analyze data with a graphing calculator.*	*A2.1.3.2.1* *Determine how a change in one variable relates to a change in a second variable (e.g., y = 4/ x ; if x doubles, what happens to y ?).* *A2.1.3.2.2* *Use algebraic processes to solve a formula for a given variable (e.g., solve d = rt for r).* *A2.2.1.1.1* *Analyze a set of data for the existence of a pattern, and represent the pattern with a rule algebraically and/or graphically.* *A2.2.2.1.2* *Create, interpret, and/or use the equation, graph, or table of an exponential or logarithmic function (including common and natural logarithms).* *A2.2.1.1.3* *Determine the domain, range, or inverse of a relation.* *A2.2.1.1.4* *Identify and/or determine the characteristics of an exponential, quadratic, or polynomial function (e.g., intervals of increase/decrease, intercepts, zeros, and asymptotes).* *A2.2.2.1.1* *Create, interpret, and/or use the equation, graph, or table of a polynomial function (including quadratics).* *A2.2.2.1.2* *Create, interpret, and/or use the equation, graph, or table of an exponential or logarithmic function (including common and natural logarithms).* *A2.2.2.1.4* *Translate a polynomial, exponential, or logarithmic function from one representation of a function to another (graph, table, and equation).* *A2.2.2.2.1* *Identify or describe the effect of changing parameters within a family of functions (e.g., y = x2 and y = x2 + 3, or y = x2 and y = 3x2).* *A2.2.3.1.1*

		Draw, identify, find, interpret, and/or write an equation for a regression model (lines and curves of best fit) for a scatter plot. *A2.2.3.1.2* *Make predictions using the equations or graphs of regression models (lines and curves of best fit) of scatter plots.*

Stage 2 – Evidence	
NETS for Students	**PERFORMANCE TASK(S)—can include transfer tasks and Project-Based Learning**
NETS—National Educational Technology Standards; i.e., the standards for evaluating the skills and knowledge students need to learn effectively and live productively in an increasingly global and digital world. *Critical Thinking* *Creative and Innovation* *Technology Operations* *Communication and Collaboration*	*Examples include but are not limited to:* *Labs, open-ended essays, voice recordings, videos, presentations, discussion boards, graphic organizers, songs, skits, dioramas, visual projects (posters, dioramas)* List the task(s), then explain how the student will demonstrate the transfer of knowledge or skill involved in the task(s) (reference Stage 1, Item #4): *Participate in Discussion board responding to teacher created prompts* *Generate equations and representations that can be used to solve problems and check for reasonableness of solution*
	OTHER SUMMATIVE ASSESSMENTS—can include factual recall
	Examples include but are not limited to final projects, research papers, quizzes and tests. List the assessments: *Quizzes and Tests*

Stage 3 – Learning Plan		
NETS for Students	**Learning Activities**	**Progress Monitoring/Formative Assessment**
NETS—National Educational Technology Standards; i.e., the standards for evaluating the skills and knowledge students need to learn effectively and live productively in an increasingly global and digital world. *Critical Thinking* *Creative and Innovation* *Technology Operations* *Communication and Collaboration*	Questions to consider while planning: • Are transfer and acquisition addressed in the learning plan? • Does the learning plan reflect principles of learning and best practices? • Is there tight alignment with Stages 1 and 2? • Is the plan likely to be engaging and effective for all students?	• **How will you monitor students' progress toward acquisition, meaning, and transfer during learning activities?** Daily assessments, teacher observation of students in class performance, teacher observation during peer share-out sessions • **What are potential rough spots and student misunderstandings?** a. Determining whether a relation is a function can occur when students do not fully understand the definition of a function as well as the meaning of domain and range.

<table>
<tr><td rowspan="2"></td><td colspan="2"></td><td>b. Errors can happen when students do not remember the steps involved when using a graphing calculator.
c. Errors with transformations occur when students do not know in what direction to translate a graph, vertically or horizontally.

• How will students get the feedback they need? Graded assessment, teacher observation immediate feedback, peer feedback, mid-chapter quiz</td></tr>
<tr><td>List planned activities
(examples include but are not limited to: experiments, guided reading, worksheets, discussions, note-taking, research, games):

worksheets, homework from textbook, Study Island, interactive textbook quizzes</td><td>List resources required
(examples include but are not limited to: laptops, iPads, websites, digital cameras, magazines, Blackboard, textbooks, novels, primary source documents, other non-fiction text, lab equipment, maps, translator, calculators)
Textbook, laptops, whiteboard, graph paper white boards, on-line text book/answer key, document camera, calculators, Grapher software</td><td>FORMATIVE ASSESSMENTS—any non-graded, diagnostic assessment administered prior to or during a unit that reflects prior knowledge, skill levels, and potential misconceptions.

Examples include but are not limited to: Pre-tests, clickers (CPS), mini whiteboards, entrance and exit tickets, CDTs, DIBELS, Aimsweb

Interactive textbook quizzes, Study Island, mini-whiteboards, Kahoot, Socrative, Google Forms, TI-nspire technology, Zip-grade</td></tr>
</table>

Southern Lehigh School District

UbD Curriculum Template

Course: **Algebra 2** Unit: **Unit 3: Systems of Equations** Grades: **9-12**

Teacher Team: **Haupt, Malik** Date: **June 2016**

Stage 1 – Desired Results	
Established Goals	**Enduring Understandings/Transfer**
1. What 21st Century Essentials included in the mission statement will this unit address? *Problem-solving* *Career Planning and Life-Long Learning* *Transfer of Learning* 2. What content standards will this unit address? • ELA PA Core State Standards • Math PA Core State Standards 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.5- Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. CC.2.2.HS.C.2- Graph and analyze functions and use their properties to make connections between the different representations. CC.2.2.HS.C.3- Write functions or sequences that model relationships between two quantities CC.2.2.HS.C.4 -Interpret the effects	**Written as a declarative statement, an enduring understanding is a "big idea" that focuses on larger concepts, principles, and processes that go beyond discrete facts or skills. Enduring Understandings are applicable to new situations across content areas and TRANSFERABLE (the ability to learn in one context and apply to a new situation, particularly outside of the classroom) to the real world.** 3. List the Enduring Understanding(s): *a. To solve a system of equations, find a set of values that replace the variables in the equations and make each equation true.* *b. You can solve a system of inequalities in more than one way. Graphing the solution is usually the most appropriate method. The solution is the set of all points that are solution of each inequality in the system.* *c. Some real-world problems involve multiple linear relationships.* *d. You can solve a system of equations by writing equivalent systems until the value on one variable is clear. The subsitute to find the value(s) of the other variable.* *e. To solve systems of equations in three variables you can we some of the same algebraic methods you used to solve systems of two quations in variables.* 4. What do you want students to do with this knowledge or skill beyond this course? What is Transfer? *a. Students will make sense of and persevere in solving complex and novel mathematical problems.* *b. Students will use effective mathematical reasoning to construct viable arguments and critique the reasoning of others.* *c. Students will communicate precisely when making mathematical statements and express answers with a degree of precision appropriate for the context of the problem/situation.* *d. Students will apply mathematical knowledge to analyze and model situations/relationships using multiple representations and appropriate tools in order to make decisions, solve problems, and draw conclusions.* *e. Students will make use of structure and repeated reasoning to gain a mathematical perspective and formulate generalized problem solving strategies* *f. Given a word problem, students will solve the word problem using an appropriate strategy or strategies and will share and compare the use of multiple strategies leading to the same answer.*

transformations have on functions and find the inverses of functions.
CC.2.2.HS.C.5- Construct and compare linear, quadratic, and exponential models to solve problems
CC.2.2.HS.C.6- Interpret functions in terms of the situations they model.
CC.2.2.HS.D.1- Interpret the structure of expressions to represent a quantity in terms of its context.
CC.2.2.HS.D.2- Write expressions in equivalent forms to solve problems
CC.2.2.HS.D.7- Create and graph equations or inequalities to describe numbers or relationships
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
CC.2.2.HS.D.10- Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically
CC.2.4.HS.B.3- Analyze linear models to make interpretations based on the data.

- PA Content Standards

Essential Questions

What thought-provoking questions will foster inquiry, meaning-making, and transfer?

5. List the Essential Question(s) that students should ponder, wonder about or explain by the end of this unit:
   a. How does representing functions graphically help you solve a system of equations?
   b. How does writing equivalent equations help you solve a system of equations?

Acquisition

Students will know...

6. What facts should students know and be able to use to gain further knowledge?
   Solving by graphing, solving using algebra, subsitution method, elimination method, graphing and tables, linear programing.
7. What vocabulary should students know and be able to recall?
   Tier II- predict, compare, evaluate, justify, check, evaluate, summarize, generalization, unique, process, interpret, pattern, prove, solve, describe, apply, explain, determine, describe

   Tier III- consistent system, constraint, dependent system, equivalent system, feasible region, inconsistent system, independent system, linear programming, linear system, matrix, matrix element, objective function, row operation, solution of a system, system of equations
8. What basic concepts should students know and be able to recall and apply?
   Solve a system of linear equations by graphing the equations to find the points of intersection.
   Use substitution and elimination methods to write equivalent equations until they get an equation with only one variable.

Students will be skilled at... (be able to do)

9. What discrete skill and processes should students be able to demonstrate?
   A2.1.3.2.1 Determine how a change in one variable relates to a change in a second variable (e.g., y = 4/ x ; if x doubles, what happens to y ?).
   A2.1.3.2.2 Use algebraic processes to solve a formula for a given variable (e.g., solve d = rt for r).
   A2.2.1.1.1 Analyze a set of data for the existence of a pattern, and represent the pattern with a rule algebraically and/or graphically.
   A2.2.1.1.2 Identify and/or extend a pattern as either an arithmetic or geometric sequence (e.g., given a geometric sequence, find the 20th term).
   A2.2.1.1.3 Determine the domain, range, or inverse of a relation.
   A2.2.3.1.1 Draw, identify, find, interpret, and/or write an equation for a regression model (lines and curves of best fit) for a scatter plot.
   A2.2.3.1.2 Make predictions using the equations or graphs of regression models (lines and curves of best fit) of scatter plots.

Stage 2 – Evidence	
NETS for Students	**PERFORMANCE TASK(S)—can include transfer tasks and Project-Based Learning**
NETS—National Educational Technology Standards; i.e., the standards for evaluating the skills and knowledge students need to learn effectively and live productively in an increasingly global and digital world. *Critical Thinking* *Creative and Innovation* *Technology Operations* *Communication and Collaboration*	*Examples include but are not limited to:* *Labs, open-ended essays, voice recordings, videos, presentations, discussion boards, graphic organizers, songs, skits, dioramas, visual projects (posters, dioramas)* List the task(s), then explain how the student will demonstrate the transfer of knowledge or skill involved in the task(s) (reference Stage 1, Item #4): *Participate in Discussion board responding to teacher created prompts* *Generate equations and representations that can be used to solve problems and check for reasonableness of solution*
	OTHER SUMMATIVE ASSESSMENTS—can include factual recall
	Examples include but are not limited to final projects, research papers, quizzes and tests. List the assessments: *Quizzes and Tests, Systems of Equations Project*

Stage 3 – Learning Plan		
NETS for Students	**Learning Activities**	**Progress Monitoring/Formative Assessment**
NETS—National Educational Technology Standards; i.e., the standards for evaluating the skills and knowledge students need to learn effectively and live productively in an increasingly global and digital world. *Critical Thinking* *Creative and Innovation* *Technology Operations* *Communication and Collaboration*	Questions to consider while planning: • Are transfer and acquisition addressed in the learning plan? • Does the learning plan reflect principles of learning and best practices? • Is there tight alignment with Stages 1 and 2? • Is the plan likely to be engaging and effective for all students?	• **How will you monitor students' progress toward acquisition, meaning, and transfer during learning activities?** Daily assessments, teacher observation of students in class performance, teacher observation during peer share-out sessions • **What are potential rough spots and student misunderstandings?** Graphing errors can occur when students graph the incorrect slope, or do not use a straight edge to graph and identify the incorrect point of intersection. Algebraic errors in substitution or elimination can occurs when students subsitute into the same equation instead of the other equation, or when forgetting to multiply through to every term when using elimination. With systems of three variables, students can forget to eliminate the same variable- organization of your work is essential. • **How will students get the feedback they need?** Graded assessment, teacher observation immediate feedback, peer feedback, mid-chapter quiz

	List planned activities *(examples include but are not limited to: experiments, guided reading, worksheets, discussions, note-taking, research, games)*: worksheets, homework from textbook, Study Island, interactive textbook quizzes, Systems of Equations Project	**List resources required** *(examples include but are not limited to: laptops, iPads, websites, digital cameras, magazines, Blackboard, textbooks, novels, primary source documents, other non-fiction text, lab equipment, maps, translator, calculators)* Textbook, laptops, whiteboard, graph paper white boards, on-line text book/answer key, document camera, calculators, Grapher software	**FORMATIVE ASSESSMENTS—any non-graded, diagnostic assessment administered prior to or during a unit that reflects prior knowledge, skill levels, and potential misconceptions.** *Examples include but are not limited to: Pre-tests, clickers (CPS), mini whiteboards, entrance and exit tickets, CDTs, DIBELS, Aimsweb* Interactive textbook quizzes, Study Island, mini-whiteboards, Kahoot, Socrative, Google Forms, TI-nspire technology, Zip-grade

Southern Lehigh School District

UbD Curriculum Template

Course: **Algebra 2** Unit: **Unit 4 : Matrices** Grades: **9-12**

Teacher Team: **Haupt, Malik** Date: **June, 2016**

Stage 1 – Desired Results

Established Goals

1. What 21st Century Essentials included in the mission statement will this unit address?
   Problem-solving
   Career Planning and Life-Long Learning
   Transfer of Learning

2. What content standards will this unit address?

   - ELA PA Core State Standards

   - Math PA Core State Standards
     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.5- Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
     CC.2.2.HS.C.1- Use the concept and notation of functions to interpret and apply them in terms of their context.
     CC.2.2.HS.C.3- Write functions or sequences that model relationships between two quantities.
     CC.2.2.HS.C.4- Interpret the effects transformations have on functions, and

Enduring Understandings/Transfer

Written as a declarative statement, an enduring understanding is a "big idea" that focuses on larger concepts, principles, and processes that go beyond discrete facts or skills. Enduring Understandings are applicable to new situations across content areas and TRANSFERABLE (the ability to learn in one context and apply to a new situation, particularly outside of the classroom) to the real world.

3. List the Enduring Understanding(s):
   a. Extend the addition and subtraction of numbers to matrices.
   b. The product of two matrices is a matrix. To find an element in the product matrix, multiply the elements of a row from the first matrix to the corresponding elements of a column from the second matrix. Then add the products.
   c. The product of a matrix and its inverse matrix is the multiplicative identity matrix. Not all matrices have inverse matrices.
   d. Solve some matrix equations AX = B by multiplying each side of the equation by the inverse o matrix A.

4. What do you want students to do with this knowledge or skill beyond this course? What is Transfer?
   a. Students will make sense of and persevere in solving complex and novel mathematical problems.
   b. Students will use effective mathematical reasoning to construct viable arguments and critique the reasoning of others.
   c. Students will communicate precisely when making mathematical statements and express answers with a degree of precision appropriate for the context of the problem/situation.
   d. Students will apply mathematical knowledge to analyze and model situations/relationships using multiple representations and appropriate tools in order to make decisions, solve problems, and draw conclusions.
   e. Students will make use of structure and repeated reasoning to gain a mathematical perspective and formulate generalized problem solving strategies
   f. Given a word problem, students will solve the word problem using an appropriate strategy or strategies and will share and compare the use of multiple strategies leading to the same answer.

Essential Questions

What thought-provoking questions will foster inquiry, meaning-making, and transfer?

find the inverses of functions.
CC.2.2.HS.C.5- Construct and compare linear, quadratic, and exponential models to solve problems.
CC.2.2.HS.C.6- Interpret functions in terms of the situations they model.
CC.2.2.HS.D.1- Interpret the structure of expressions to represent a quantity in terms of its context
CC.2.2.HS.D.2- Write expressions in equivalent forms to solve problems.
CC.2.2.HS.D.3- Extend the knowledge of arithmetic operations and apply to polynomials.
CC.2.2.HS.D.5- Use polynomial identities to solve problems.
CC.2.2.HS.D.6- Extend the knowledge of rational functions to rewrite in equivalent forms.
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.
CC.2.2.HS.D.10- Represent, solve and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.
CC.2.3.HS.A.10- Translate between the geometric description and the equation for a conic section.
CC.2.4.HS.B.2- Summarize, represent, and interpret data on two categorical and quantitative variables.
CC.2.4.HS.B.3- Analyze linear models to make interpretations based on the data.

PA Content Standards

5. List the Essential Question(s) that students should ponder, wonder about or explain by the end of this unit:
   a. *How can you use a matrix to organize data?*
   b. *How can you use a matrix equation to model a real-world situation?*

Acquisition

Students will know...

6. What facts should students know and be able to use to gain further knowledge?
   matrix addition, matrix subtraction, matrix scalar multiplication, errors in dimensions, properties of equality, errors in matrix multiplication
7. What vocabulary should students know and be able to recall?
   Tier 2 Vocabulary: predict, compare, evaluate, justify, check, evaluate, summarize, generalization, unique, process, interpret, pattern, prove, solve, describe, apply, explain, determine, describe.
   Tier 3 Vocabulary: coefficient matrix, constant matrix, corresponding elements, determinant, equal matrices, matrix equation, multiplicative identity matrix, multiplicative inverse matrix, scalar, scalar multiplication, singular matrix, square matrix, variable matrix, zero matrix.
8. What basic concepts should students know and be able to recall and apply?
   Students will use matrices to compare data.
   Students will solve systems of equations with matrix equations.

Students will be skilled at... (be able to do)

9. What discrete skill and processes should students be able to demonstrate?
   A2.1.2.2.2
   Simplify rational algebraic expressions.
   A2.1.3.1.1
   Write and/or solve quadratic equations (including factoring and using the Quadratic Formula).
   A2.1.3.1.2
   Solve equations involving rational and/or radical expressions (e.g., 10/(x + 3) + 12/(x-2) = 1 or $\sqrt{}$ x2 + 21x = 14).
   A2.1.3.1.3
   Write and/or solve a simple exponential or logarithmic equation (including common and natural logarithms).
   A2.1.3.2.1
   Determine how a change in one variable relates to a change in a second variable (e.g., y = 4/ x ; if x doubles, what happens to y ?).
   A2.1.3.2.2
   Use algebraic processes to solve a formula for a given variable (e.g., solve d = rt for r).
   A2.2.1.1.3
   Determine the domain, range, or inverse of a relation.

Stage 2 – Evidence	
NETS for Students	**PERFORMANCE TASK(S)—can include transfer tasks and Project-Based Learning**
NETS—National Educational Technology Standards; i.e., the standards for evaluating the skills and knowledge students need to learn effectively and live productively in an increasingly global and digital world. *Critical Thinking* *Creative and Innovation* *Technology Operations* *Communication and Collaboration*	*Examples include but are not limited to:* *Labs, open-ended essays, voice recordings, videos, presentations, discussion boards, graphic organizers, songs, skits, dioramas, visual projects (posters, dioramas)* List the task(s), then explain how the student will demonstrate the transfer of knowledge or skill involved in the task(s) (reference Stage 1, Item #4): *Participate in Discussion board responding to teacher created prompts* *Generate equations and representations that can be used to solve problems and check for reasonableness of solution*
	OTHER SUMMATIVE ASSESSMENTS—can include factual recall
	Examples include but are not limited to final projects, research papers, quizzes and tests. List the assessments: *Quizzes and Tests*

Stage 3 – Learning Plan		
NETS for Students	**Learning Activities**	**Progress Monitoring/Formative Assessment**
NETS—National Educational Technology Standards; i.e., the standards for evaluating the skills and knowledge students need to learn effectively and live productively in an increasingly global and digital world. *Critical Thinking* *Creative and Innovation* *Technology Operations* *Communication and Collaboration*	Questions to consider while planning: • Are transfer and acquisition addressed in the learning plan? • Does the learning plan reflect principles of learning and best practices? • Is there tight alignment with Stages 1 and 2? • Is the plan likely to be engaging and effective for all students?	• **How will you monitor students' progress toward acquisition, meaning, and transfer during learning activities?** Daily assessments, teacher observation of students in class performance, teacher observation during peer share-out sessions • **What are potential rough spots and student misunderstandings?** a. Errors in dimensions occur when students try to add or subtract matrices of different dimensions, or multiply matrices that cannot be multiplied under defined matrix multiplication. b. Properties of equality may be taken for granted even though matrices are not real numbers. Make sure students understand that matrix multiplication is not commutative. c. Errors in matrix multiplication may occur when students multiply columns by rows instead of rows by columns. • **How will students get the feedback they need?**

			Graded assessment, teacher observation immediate feedback, peer feedback, mid-chapter quiz
	List planned activities *(examples include but are not limited to: experiments, guided reading, worksheets, discussions, note-taking, research, games)*: worksheets, homework from textbook, Study Island, interactive textbook quizzes	**List resources required** *(examples include but are not limited to: laptops, iPads, websites, digital cameras, magazines, Blackboard, textbooks, novels, primary source documents, other non-fiction text, lab equipment, maps, translator, calculators)* Textbook, laptops, whiteboard, graph paper white boards, on-line text book/answer key, document camera, calculators, Grapher software	**FORMATIVE ASSESSMENTS—any non-graded, diagnostic assessment administered prior to or during a unit that reflects prior knowledge, skill levels, and potential misconceptions.** *Examples include but are not limited to: Pre-tests, clickers (CPS), mini whiteboards, entrance and exit tickets, CDTs, DIBELS, Aimsweb* Interactive textbook quizzes, Study Island, mini-whiteboards, Kahoot, Socrative, Google Forms, TI-nspire technology, Zip-grade

Southern Lehigh School District

UbD Curriculum Template

Course: **Algebra 2** Unit: **Unit 5: Quadratic Equations** Grades: **9-12**

Teacher Team: **Haupt, Malik** Date: **June 2016**

Stage 1 – Desired Results	
Established Goals	**Enduring Understandings/Transfer**
1. What 21st Century Essentials included in the mission statement will this unit address? *Problem-solving* *Career Planning and Life-Long Learning* *Transfer of Learning* 2. What content standards will this unit address? • ELA PA Core State Standards • Math PA Core State Standards CC.2.1.HS.F.1- Apply and extend the properties of exponents to solve problems with rational exponents. 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.6- Extend the knowledge of arithmetic operations and apply to complex numbers. CC.2.1.HS.F.7- Apply concepts of	**Written as a declarative statement, an enduring understanding is a "big idea" that focuses on larger concepts, principles, and processes that go beyond discrete facts or skills. Enduring Understandings are applicable to new situations across content areas and TRANSFERABLE (the ability to learn in one context and apply to a new situation, particularly outside of the classroom) to the real world.** 3. List the Enduring Understanding(s): *a. The graph of any quadratic function is a transformation of the graph of the parent function y=x^2.* *b. For any quadratic function f(x)=ax^2+bx+c the values a, b, and c provide key information about its graph.* *c. Three noncolinear points, no two of which are in line vertically, are the graph of exactly one quadratic function.* *d. You can solve systems involving quadratic equations using methods similar to the ones used to solve systems of linear equations.* *e. To find the zeros of a quadratic function y=ax^2+bx+c, solve the related quadratic 0=ax^2+bx+c.* *f. You can factor many quadratic trinomails into the product of two binomials.* *g. Completing a perfect square trinomail allows you to factor the completed trinomial as the square of a binomial.* *h. You can solve a quadratic equation in more than one way.* *i. A basis for the complex numbers is a number whose square is -1.* 4. What do you want students to do with this knowledge or skill beyond this course? What is Transfer? *a. Students will make sense of and persevere in solving complex and novel mathematical problems.* *b. Students will use effective mathematical reasoning to construct viable arguments and critique the reasoning of others.* *c. Students will communicate precisely when making mathematical statements and express answers with a degree of precision appropriate for the context of the problem/situation.* *d. Students will apply mathematical knowledge to analyze and model situations/relationships using multiple representations and appropriate tools in order to make decisions, solve problems, and draw conclusions.* *e. Students will make use of structure and repeated reasoning to gain a mathematical perspective and*

complex numbers in polynomial identities and quadratic equations to solve problems
CC.2.2.HS.C.1- Use the concept and notation of functions to interpret and apply them in terms of their context.
CC.2.2.HS.C.2- Graph and analyze functions, and use their properties to make connections between the different representations.
CC.2.2.HS.C.3- Write functions or sequences that model relationships between two quantities
CC.2.2.HS.C.4- Interpret the effects transformations have on functions, and find the inverses of functions.
CC.2.2.HS.C.5- Construct and compare linear, quadratic, and exponential models to solve problems
CC.2.2.HS.C.6- Interpret functions in terms of the situations they model.
CC.2.2.HS.D.1- Interpret the structure of expressions to represent a quantity in terms of its context.
CC.2.2.HS.D.2- Write expressions in equivalent forms to solve problems
CC.2.2.HS.D.3- Extend the knowledge of arithmetic operations and apply to polynomials.
CC.2.2.HS.D.4- Understand the relationship between zeros and factors of polynomials to make generalizations about functions and their graphs.
CC.2.2.HS.D.5- Use polynomial identities to solve problems
CC.2.2.HS.D.6- Extend the knowledge of rational functions to rewrite in equivalent forms

formulate generalized problem solving strategies
f. Given a word problem, students will solve the word problem using an appropriate strategy or strategies and will share and compare the use of multiple strategies leading to the same answer.

Essential Questions

What thought-provoking questions will foster inquiry, meaning-making, and transfer?

5. List the Essential Question(s) that students should ponder, wonder about or explain by the end of this unit:
   a. What are the advantages of a quadratic function in vertex form? In standard form?
   b. How is any quadratic function related to the parent quadratic function y=x^2?
   c. How are the real solutions of a quadratic equations related to the graph of the related quadratic function?

Acquisition

Students will know...

6. What facts should students know and be able to use to gain further knowledge?
   Standard form of a quadratic, Vertex form of a quadratic, using the graphing calculator, finding the zeros of a quadratic by factoring, completing the square and quadratic formula, imaginary numbers, operations with complex numbers, complex conjugates.
7. What vocabulary should students know and be able to recall?
   Tier II- predict, compare, evaluate, justify, check, evaluate, summarize, generalization, unique, process, interpret, pattern, prove, solve, describe, apply, explain, determine, describe

   Tier III-axis of symmetry, completing the square, complex conjugate, complex number, discriminant, factoring, imaginary number, parabola, perfect square trinomial, quadratic formula, quadratic function, standard form, vertex form, vertex of a parabola, zero of a function, zero product property
8. What basic concepts should students know and be

Students will be skilled at... (be able to do)

9. What discrete skill and processes should students be able to demonstrate?
   A2.1.1.1.1 Simplify/write square roots in terms of i (e.g., $\sqrt{-24} = 2i\sqrt{6}$).
   A2.1.1.1.2 Simplify/evaluate expressions involving powers of i (e.g., i6 + i3 = -1 - i).
   A2.1.1.2.1 Add and subtract complex numbers (e.g., (7 - 3i) - (2 + i) = 5 - 4i).
   A2.1.1.2.2 Multiply and divide complex numbers (e.g., (7 - 3i)(2 + i) = 17 + i).
   A2.1.2.1.1 Use exponential expressions to represent rational numbers.
   A2.1.2.1.2 Simplify/evaluate expressions involving positive and negative exponents and/or roots (may contain all types of real numbers - exponents should not exceed power of 10).
   A2.1.2.2.1 Factor algebraic expressions, including difference of squares and trinomials. Note: Trinomials limited to the form ax2 + bx + c where a is not equal to 0
   A2.1.3.1.1 Write and/or solve quadratic equations (including factoring and using the

CC.2.2.HS.D.7- Create and graph equations or inequalities to describe numbers or relationships 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. CC.2.2.HS.D.10- Represent, solve and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically. CC.2.3.HS.A.10- Translate between the geometric description and the equation for a conic section • PA Content Standards	able to recall and apply? *Identify the vertex, line of symmetry, maximum or minimum, domain, range, and translations of a quadratic graph; graph quadratic functions with and without graphing calculators; use quadratic functions as models; graph transformations of the parent function y=x^2; translations to the parent quadratic function; identify the x-intercepts of the graph of related quadratic functions.*	*Quadratic Formula).* *A2.2.1.1.1 Analyze a set of data for the existence of a pattern, and represent the pattern with a rule algebraically and/or graphically.* *A2.2.1.1.2 Identify and/or extend a pattern as either an arithmetic or geometric sequence (e.g., given a geometric sequence, find the 20th term).* *A2.2.1.1.3 Determine the domain, range, or inverse of a relation.* *A2.2.1.1.4 Identify and/or determine the characteristics of an exponential, quadratic, or polynomial function (e.g., intervals of increase/decrease, intercepts, zeros, and asymptotes).* *A2.2.2.1.1 Create, interpret, and/or use the equation, graph, or table of a polynomial function (including quadratics).* *A2.2.2.1.2 Create, interpret, and/or use the equation, graph, or table of an exponential or logarithmic function (including common and natural logarithms).* *A2.2.2.1.3 Determine, use, and/or interpret minimum and maximum values over a specified interval of a graph of a polynomial, exponential, or logarithmic function.* *A2.2.2.1.4 Translate a polynomial, exponential, or logarithmic function from one representation of a function to another (graph, table, and equation).*

Stage 2 – Evidence	
NETS for Students	**PERFORMANCE TASK(S)—can include transfer tasks and Project-Based Learning**
NETS—National Educational Technology Standards; i.e., the standards for evaluating the skills and knowledge students need to learn effectively and live	*Examples include but are not limited to:* *Labs, open-ended essays, voice recordings, videos, presentations, discussion boards, graphic organizers, songs, skits, dioramas, visual projects (posters, dioramas)* List the task(s), then explain how the student will demonstrate the transfer of knowledge or skill involved in the task(s)

productively in an increasingly global and digital world. *Critical Thinking* *Creative and Innovation* *Technology Operations* *Communication and Collaboration*	(reference Stage 1, Item #4): *Participate in Discussion board responding to teacher created prompts* *Generate equations and representations that can be used to solve problems and check for reasonableness of solution*
	OTHER SUMMATIVE ASSESSMENTS—can include factual recall
	Examples include but are not limited to final projects, research papers, quizzes and tests. List the assessments: *Quizzes and Tests, Curve of Best Fit Project*

Stage 3 – Learning Plan		
NETS for Students	**Learning Activities**	**Progress Monitoring/Formative Assessment**
NETS—National Educational Technology Standards; i.e., the standards for evaluating the skills and knowledge students need to learn effectively and live productively in an increasingly global and digital world. *Critical Thinking* *Creative and Innovation* *Technology Operations* *Communication and Collaboration*	Questions to consider while planning: • Are transfer and acquisition addressed in the learning plan? • Does the learning plan reflect principles of learning and best practices? • Is there tight alignment with Stages 1 and 2? • Is the plan likely to be engaging and effective for all students?	• **How will you monitor students' progress toward acquisition, meaning, and transfer during learning activities?** Daily assessments, teacher observation of students in class performance, teacher observation during peer share-out sessions • **What are potential rough spots and student misunderstandings?** Students may be unfamiliar with the general form, size and orientation of the quadratic function. Students rely of graphing utilities and do not use information about the equation to visualize the graph. Errors in calculations due to algebraic mistakes or inputting the equation incorrectly into calculator. Errors in simplifying radicals. Students will treat "i" like a variable and forget that "i^2" equals -1. Multiplying complex conjugates results in the product of a difference of two perfect squares. • **How will students get the feedback they need?** Graded assessment, teacher observation immediate feedback, peer feedback, mid-chapter quiz

	List planned activities *(examples include but are not limited to: experiments, guided reading, worksheets, discussions, note-taking, research, games)*: worksheets, homework from textbook, Study Island, interactive textbook quizzes, Curve of Best Fit Project	**List resources required** *(examples include but are not limited to: laptops, iPads, websites, digital cameras, magazines, Blackboard, textbooks, novels, primary source documents, other non-fiction text, lab equipment, maps, translator, calculators)* Textbook, laptops, whiteboard, graph paper white boards, on-line text book/answer key, document camera, calculators, Grapher software	**FORMATIVE ASSESSMENTS—any non-graded, diagnostic assessment administered prior to or during a unit that reflects prior knowledge, skill levels, and potential misconceptions.** *Examples include but are not limited to: Pre-tests, clickers (CPS), mini whiteboards, entrance and exit tickets, CDTs, DIBELS, Aimsweb* Interactive textbook quizzes, Study Island, mini-whiteboards, Kahoot, Socrative, Google Forms, TI-nspire technology, Zip-grade

Southern Lehigh School District

UbD Curriculum Template

Course: **Algebra 2** Unit: **Unit 6 : Polynomials and Polynomial Functions** Grades: **9-12**

Teacher Team: **Haupt, Malik** Date: **June, 2016**

Stage 1 – Desired Results	
Established Goals	**Enduring Understandings/Transfer**
1. What 21st Century Essentials included in the mission statement will this unit address? *Problem-solving* *Career Planning and Life-Long Learning* *Transfer of Learning* 2. What content standards will this unit address? • ELA PA Core State Standards • Math PA Core State Standards CC.2.1.HS.F.1- Apply and extend the properties of exponents to solve problems with rational exponents. 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. CC.2.2.HS.C.1- Use the concept and notation of functions to interpret and apply them in terms of their context.	**Written as a declarative statement, an enduring understanding is a "big idea" that focuses on larger concepts, principles, and processes that go beyond discrete facts or skills. Enduring Understandings are applicable to new situations across content areas and TRANSFERABLE (the ability to learn in one context and apply to a new situation, particularly outside of the classroom) to the real world.** 3. List the Enduring Understanding(s): *a. Polynomial functions have distinguishing behaviors. You can look at its algebraic form and know something about its graph; or you can look atits graph and know something about its algebraic form.* *b. Knowing the zeros of a polynomial function can help you understand the behavior of its graph.* *c. If (x - a) is a factor of a polynomial, then the polynomial has a value 0 when x = a. If a is a real number, then the graph of the polynomial has (a, 0) as an x-intercept.* *d. You can divide polynomials using steps that are similar to the long-division steps that you use to divide whole numbers.* *e. The degree of a polynomial equation tells you how many roots the equation has.* *f. You can use the pattern of coefficients with Pascal's Triangle to write the expansion of (a + b)^n.* *g. The graph of the function y = af(x - h) + k is a vertical stretch or compression by a factor |a|, a horizontal shift of h units, and a vertical shift of k units of the graph of y = f(x).* 4. What do you want students to do with this knowledge or skill beyond this course? What is Transfer? *a. Students will make sense of and persevere in solving complex and novel mathematical problems.* *b. Students will use effective mathematical reasoning to construct viable arguments and critique the reasoning of others.* *c. Students will communicate precisely when making mathematical statements and express answers with a degree of precision appropriate for the context of the problem/situation.* *d. Students will apply mathematical knowledge to analyze and model situations/relationships using multiple representations and appropriate tools in order to make decisions, solve problems, and draw conclusions.* *e. Students will make use of structure and repeated reasoning to gain a mathematical perspective and formulate generalized problem solving strategies* *f. Given a word problem, students will solve the word problem using an appropriate strategy or strategies and will share and compare the use of multiple strategies leading to the same answer.*

CC.2.2.HS.C.2- Graph and analyze functions, and use their properties to make connections between the different representations.
CC.2.2.HS.C.3- Write functions or sequences that model relationships between two quantities.
CC.2.2.HS.C.4- Interpret the effects transformations have on functions, and find the inverses of functions.
CC.2.2.HS.C.5- Construct and compare linear, quadratic, and exponential models to solve problems.
CC.2.2.HS.C.6- Interpret functions in terms of the situations they model.
CC.2.2.HS.D.2- Write expressions in equivalent forms to solve problems.
CC.2.2.HS.D.3- Extend the knowledge of arithmetic operations and apply to polynomials.
CC.2.2.HS.D.5- Use polynomial identities to solve problems.
CC.2.2.HS.D.6- Extend the knowledge of rational functions to rewrite in equivalent forms.
CC.2.2.HS.D.7- Create and graph equations or inequalities to describe numbers or relationships
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.
CC.2.2.HS.D.10- Represent, solve and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.
CC.2.3.HS.A.10- Translate between the geometric description and the equation for a conic section.

Essential Questions

What thought-provoking questions will foster inquiry, meaning-making, and transfer?

5. List the Essential Question(s) that students should ponder, wonder about or explain by the end of this unit:
   a. *What does the degree of the Polynomial tell you about it related polynomial function?*
   b. *For a polynomial function, how are factors, zeros, and x-intercepts related?*
   c. *For a polynomial equation, how are factors and roots related?*

Acquisition

Students will know...

6. What facts should students know and be able to use to gain further knowledge?
   domain and range, vertical line test, function notation,line of best fit, translation, reflection, vertical stretch or compression
7. What vocabulary should students know and be able to recall?
   Tier 2 Vocabulary: predict, compare, evaluate, justify, check, evaluate, summarize, generalization, unique, process, interpret, pattern, prove, solve, describe, apply, explain, determine, describe

   Tier 3 Vocabulary: binomial theorem, conjugate root theorem, constant of propotionality, degree of a monomial, degree of a polynomial, Descartes' Rule of Signs, end behavior, expand a binomial, Fundemental Theorem of Algebra, monmial, multiple zero, multiplicity, Pascal's Triangle, polynomial, polynomial funciton, power function, Rational Root Theorem, relative maximum/minimum, Remainder Theorem, standard form of a polynomial, sum/differene of cubes, synthetic division, turning point

8. What basic concepts should students know and be able to recall and apply?
   Students will identify forms of linear equations. Students will determine which form of a linear equation is most easily found with the given information.

Students will be skilled at... (be able to do)

9. What discrete skill and processes should students be able to demonstrate?
   A2.1.2.1.1 Use exponential expressions to represent rational numbers.
   A2.1.2.1.2 Simplify/evaluate expressions involving positive and negative exponents and/or roots (may contain all types of real numbers - exponents should not exceed power of 10).
   A2.1.2.1.3 Simplify/evaluate expressions involving multiplying with exponents (e.g., x6 × x7 = x13), powers of powers (e.g., (x6)7= x42), and powers of products (e.g., (2x2)3 = 8x6). Note: Limit to rational exponents.
   A2.1.2.2.1 Factor algebraic expressions, including difference of squares and trinomials. Note: Trinomials limited to the form ax2 + bx + c where a is not equal to 0
   A2.1.3.1.1 Write and/or solve quadratic equations (including factoring and using the Quadratic Formula).
   A2.2.1.1.1 Analyze a set of data for the existence of a pattern, and represent the pattern with a rule algebraically and/or graphically.
   A2.2.1.1.2 Identify and/or extend a pattern as either an arithmetic or geometric sequence (e.g., given a geometric sequence, find the 20th term).
   A2.2.1.1.3 Determine the domain, range, or inverse of a relation.
   A2.2.1.1.4 Identify and/or determine the characteristics of an exponential, quadratic, or

CC.2.4.HS.B.2- Summarize, represent, and interpret data on two categorical and quantitative variables. PA Content Standards	*Students will convert between various forms of linear functions.* *Students will identify the different kinds of transformations.* *Students will determine whether a transformation changes the location or shape of a graph or both.* *Students will make a scatter plot of linear data.* *Students will determine the correlation of linear data.* *Students will use linear regression to find the line of best fit of linear data with a graphing calculator.* *Students will use the correlation coefficient to analyze data with a graphing calculator.*	*polynomial function (e.g., intervals of increase/decrease, intercepts, zeros, and asymptotes).* *A2.2.2.1.1 Create, interpret, and/or use the equation, graph, or table of a polynomial function (including quadratics).* *A2.2.2.1.3 Determine, use, and/or interpret minimum and maximum values over a specified interval of a graph of a polynomial, exponential, or logarithmic function.* *A2.2.2.1.4 Translate a polynomial, exponential, or logarithmic function from one representation of a function to another (graph, table, and equation).* *A2.2.2.2.1 Identify or describe the effect of changing parameters within a family of functions (e.g., y = x2 and y = x2 + 3, or y = x2and y = 3x2).*

Stage 2 – Evidence	
NETS for Students	**PERFORMANCE TASK(S)—can include transfer tasks and Project-Based Learning**
NETS—National Educational Technology Standards; i.e., the standards for evaluating the skills and knowledge students need to learn effectively and live productively in an increasingly global and digital world. *Critical Thinking* *Creative and Innovation* *Technology Operations* *Communication and Collaboration*	*Examples include but are not limited to:* *Labs, open-ended essays, voice recordings, videos, presentations, discussion boards, graphic organizers, songs, skits, dioramas, visual projects (posters, dioramas)* List the task(s), then explain how the student will demonstrate the transfer of knowledge or skill involved in the task(s) (reference Stage 1, Item #4): *Participate in Discussion board responding to teacher created prompts* *Generate equations and representations that can be used to solve problems and check for reasonableness of solution*
	OTHER SUMMATIVE ASSESSMENTS—can include factual recall
	Examples include but are not limited to final projects, research papers, quizzes and tests. List the assessments: *Quizzes and Tests, Exploring Polynomials Activity*

Stage 3 – Learning Plan		
NETS for Students	**Learning Activities**	**Progress Monitoring/Formative Assessment**
NETS—National Educational Technology Standards; i.e., the standards for evaluating the skills and knowledge students need to	Questions to consider while planning: • Are transfer and acquisition addressed in the learning plan? • Does the learning plan reflect principles of learning and	• **How will you monitor students' progress toward acquisition, meaning, and transfer during learning activities?** Daily assessments, teacher observation of students in

<table>
<tr>
<td rowspan="2">learn effectively and live productively in an increasingly global and digital world.

Critical Thinking
Creative and Innovation
Technology Operations
Communication and Collaboration</td>
<td colspan="2">best practices?
• Is there tight alignment with Stages 1 and 2?
• Is the plan likely to be engaging and effective for all students?</td>
<td>class performance, teacher observation during peer share-out sessions
• What are potential rough spots and student misunderstandings?
Students trust the graphing calculuator, rather than thinking about how the graph "should look." Students should have an idea of what the graph of a polynomial looks like based on characteristics of the equation, and use the graphing calculuator to check their sketch. Misunderstaning of the Rational Root Theorem. When using syntheti division, students forget zeros for missing terms. When using zeros, students may forget conjugate pairs. When picking a line of best fit, students may trust the r^2 value too much, and not look at projected values of the data.
• How will students get the feedback they need?
Graded assessment, teacher observation immediate feedback, peer feedback, mid-chapter quiz</td>
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<tr>
<td>List planned activities
(examples include but are not limited to: experiments, guided reading, worksheets, discussions, note-taking, research, games):

worksheets, homework from textbook, Study Island, interactive textbook quizzes</td>
<td>List resources required
(examples include but are not limited to: laptops, iPads, websites, digital cameras, magazines, Blackboard, textbooks, novels, primary source documents, other non-fiction text, lab equipment, maps, translator, calculators)
Textbook, laptops, whiteboard, graph paper white boards, on-line text book/answer key, document camera, calculators, Grapher software</td>
<td>FORMATIVE ASSESSMENTS—any non-graded, diagnostic assessment administered prior to or during a unit that reflects prior knowledge, skill levels, and potential misconceptions.

Examples include but are not limited to: Pre-tests, clickers (CPS), mini whiteboards, entrance and exit tickets, CDTs, DIBELS, Aimsweb

Interactive textbook quizzes, Study Island, mini-whiteboards, Kahoot, Socrative, Google Forms, TI-nspire technology, Zip-grade</td>
</tr>
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Southern Lehigh School District

UbD Curriculum Template

Course: **Algebra 2** Unit: **Unit 7- Probability and Statistics** Grades: **9-12**

Teacher Team: **Haupt, Malik** Date: **June 2016**

Stage 1 – Desired Results	
Established Goals	**Enduring Understandings/Transfer**
1. What 21st Century Essentials included in the mission statement will this unit address? *Problem-solving* *Career Planning and Life-Long Learning* *Transfer of Learning* 2. What content standards will this unit address? • ELA PA Core State Standards • Math PA Core State Standards CC.2.4.HS.B.1- Summarize, represent, and interpret data on a single count or measurement variable CC.2.4.HS.B.2- Summarize, represent, and interpret data on two categorical and quantitative variables. CC.2.4.HS.B.4- Recognize and evaluate random processes underlying statistical experiments. CC.2.4.HS.B.5- Make inferences and justify conclusions based on sample surveys, experiments, and observational studies. CC.2.4.HS.B.6- Use the concepts of independence and conditional probability to interpret data.	**Written as a declarative statement, an enduring understanding is a "big idea" that focuses on larger concepts, principles, and processes that go beyond discrete facts or skills. Enduring Understandings are applicable to new situations across content areas and TRANSFERABLE (the ability to learn in one context and apply to a new situation, particularly outside of the classroom) to the real world.** 3. List the Enduring Understanding(s): *a. You can use multiplication to quickly count the number of ways certain things can happen.* *b. The probability of an impossible event is 0. The probability of a certain event is 1. Otherwise, the probability of an event is a number between 0 and 1.* *c. To find the probability of two events occurring together, you have to decide whether one event occuring affects the other event.* *d. Conditional probability exists when two events are dependent.* *e. You can describe and compare sets of data using various statistical measures, depending on what characteristics you want to study.* *f. Standard deviation is a measure of how far the numbers in a data set deviate from the mean.* *g. You can get good statistical information about a population by studying a sample of the population.* *h. You can use binomial probabilities in situations involving two possible outcomes.* *i. Many common statistics gathered from samples in the natural world tend to have a normal ditribution about their mean.* 4. What do you want students to do with this knowledge or skill beyond this course? What is Transfer? *a. Students will make sense of and persevere in solving complex and novel mathematical problems.* *b. Students will use effective mathematical reasoning to construct viable arguments and critique the reasoning of others.* *c. Students will communicate precisely when making mathematical statements and express answers with a degree of precision appropriate for the context of the problem/situation.* *d. Students will apply mathematical knowledge to analyze and model situations/relationships using multiple representations and appropriate tools in order to make decisions, solve problems, and draw conclusions.* *e. Students will make use of structure and repeated reasoning to gain a mathematical perspective and formulate generalized problem solving strategies*

CC.2.4.HS.B.7- Apply the rules of probability to compute probabilities of compound events in a uniform probability model

- PA Content Standards

f. Given a word problem, students will solve the word problem using an appropriate strategy or strategies and will share and compare the use of multiple strategies leading to the same answer.

Essential Questions

What thought-provoking questions will foster inquiry, meaning-making, and transfer?

5. List the Essential Question(s) that students should ponder, wonder about or explain by the end of this unit:
   a. What is the difference between a permutation and a combination?
   b. What is the difference between experimental and theoretical probability?
   c. How are measures of central tendency different from standard deviation?

Acquisition

Students will know...

6. What facts should students know and be able to use to gain further knowledge?
   Counting methods, fundamental counting principles, permutations, and combinations, probability rules, identify mutually exclusive events, use measures of central tendency, measures of variation, gathering data, binomial experiment, binomial distribution, normal distribution.
7. What vocabulary should students know and be able to recall?
   Tier II- predict, compare, evaluate, justify, check, evaluate, summarize, generalization, unique, process, interpret, pattern, prove, solve, describe, apply, explain, determine, describe

   Tier III- binomial probability, conditional probability, dependent events, independent events, interquartile range, mean, median, mode, mutually exclusive events, normal distribution, outlier, percentile, probability distribution, quartile, random sample, range of a set data, sample, sample space, standard deviation, variance

8. What basic concepts should students know and be able to recall and apply?

Students will be skilled at... (be able to do)

9. What discrete skill and processes should students be able to demonstrate?
   A2.2.3.2.1 Use combinations, permutations, and the fundamental counting principle to solve problems involving probability.
   A2.2.3.2.2 Use odds to find probability and/or use probability to find odds.
   A2.2.3.2.3 Use probability for independent, dependent, or compound events to predict outcomes.

	Find permutations and combinations of data sets using formulas, use simulations to model experimental probability, find the theoretical probability of events using a formula, find and analyze the measures of central tendency of given data sets, find the standard deviation of given data sets.	

Stage 2 – Evidence	
NETS for Students	**PERFORMANCE TASK(S)—can include transfer tasks and Project-Based Learning**
NETS—National Educational Technology Standards; i.e., the standards for evaluating the skills and knowledge students need to learn effectively and live productively in an increasingly global and digital world. *Critical Thinking* *Creative and Innovation* *Technology Operations* *Communication and Collaboration*	*Examples include but are not limited to:* *Labs, open-ended essays, voice recordings, videos, presentations, discussion boards, graphic organizers, songs, skits, dioramas, visual projects (posters, dioramas)* List the task(s), then explain how the student will demonstrate the transfer of knowledge or skill involved in the task(s) (reference Stage 1, Item #4): *Participate in Discussion board responding to teacher created prompts* *Generate equations and representations that can be used to solve problems and check for reasonableness of solution*
	OTHER SUMMATIVE ASSESSMENTS—can include factual recall
	Examples include but are not limited to final projects, research papers, quizzes and tests. List the assessments: *Quizzes and Tests*

Stage 3 – Learning Plan		
NETS for Students	**Learning Activities**	**Progress Monitoring/Formative Assessment**
NETS—National Educational Technology Standards; i.e., the standards for evaluating the skills and knowledge students need to learn effectively and live productively in an increasingly global and digital world. *Critical Thinking* *Creative and Innovation* *Technology Operations* *Communication and Collaboration*	Questions to consider while planning: • Are transfer and acquisition addressed in the learning plan? • Does the learning plan reflect principles of learning and best practices? • Is there tight alignment with Stages 1 and 2? • Is the plan likely to be engaging and effective for all students?	• **How will you monitor students' progress toward acquisition, meaning, and transfer during learning activities?** Daily assessments, teacher observation of students in class performance, teacher observation during peer share-out sessions • **What are potential rough spots and student misunderstandings?** Using the wrong counting formula, probability rules are used incorrectly, interpretation of data descriptors rather than calculations, designing samples and surveys without bias is difficult, using binomial distributions when a situation does not

			satisfy the conditions of a binomial experiment. • **How will students get the feedback they need?** Graded assessment, teacher observation immediate feedback, peer feedback, mid-chapter quiz
	List planned activities *(examples include but are not limited to: experiments, guided reading, worksheets, discussions, note-taking, research, games)*: worksheets, homework from textbook, Study Island, interactive textbook quizzes	**List resources required** *(examples include but are not limited to: laptops, iPads, websites, digital cameras, magazines, Blackboard, textbooks, novels, primary source documents, other non-fiction text, lab equipment, maps, translator, calculators)* Textbook, laptops, whiteboard, graph paper white boards, on-line text book/answer key, document camera, calculators, Grapher software	**FORMATIVE ASSESSMENTS—any non-graded, diagnostic assessment administered prior to or during a unit that reflects prior knowledge, skill levels, and potential misconceptions.** *Examples include but are not limited to: Pre-tests, clickers (CPS), mini whiteboards, entrance and exit tickets, CDTs, DIBELS, Aimsweb* Interactive textbook quizzes, Study Island, mini-whiteboards, Kahoot, Socrative, Google Forms, TI-nspire technology, Zip-grade

Southern Lehigh School District

UbD Curriculum Template

Course: **Algebra 2** Unit: **Unit 8- Radical Equations and Rational Expoents** Grades: **9-12**

Teacher Team: **Haupt, Malik** Date: **June 2016**

Stage 1 – Desired Results	
Established Goals	**Enduring Understandings/Transfer**
1. What 21st Century Essentials included in the mission statement will this unit address? *Problem-solving* *Career Planning and Life-Long Learning* *Transfer of Learning* 2. What content standards will this unit address? • ELA PA Core State Standards • Math PA Core State Standards CC.2.1.HS.F.1- Apply and extend the properties of exponents to solve problems with rational exponents. CC.2.1.HS.F.2- Apply properties of rational and irrational numbers to solve real-world or mathematical problems 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.6- Extend the knowledge of arithmetic operations and apply to complex numbers. CC.2.1.HS.F.7- Apply concepts of complex numbers in polynomial identities and quadratic equations to	**Written as a declarative statement, an enduring understanding is a "big idea" that focuses on larger concepts, principles, and processes that go beyond discrete facts or skills. Enduring Understandings are applicable to new situations across content areas and TRANSFERABLE (the ability to learn in one context and apply to a new situation, particularly outside of the classroom) to the real world.** 3. List the Enduring Understanding(s): *a. Corresponding to every power, there is a root.* *b. The product of the root of two numbers is equal to the root of their product.* *c. You can combine like radials using the properties of real numbers.* *d. You can write a radical expression in an equivalent form using a fractional exponent instead of a radical sign.* *e. Solving a square root equation may require that you square each side of the equation. This can create extraneous solutions.* *f. You can add, subtract, multiply and divide functions based on how you perform these operations for real numbers.* *g. The inverse of a function may or may not be a function.* *h. A square root is the inverse of a quadratic function that has a restricted domain.* 4. What do you want students to do with this knowledge or skill beyond this course? What is Transfer? *a. Students will make sense of and persevere in solving complex and novel mathematical problems.* *b. Students will use effective mathematical reasoning to construct viable arguments and critique the reasoning of others.* *c. Students will communicate precisely when making mathematical statements and express answers with a degree of precision appropriate for the context of the problem/situation.* *d. Students will apply mathematical knowledge to analyze and model situations/relationships using multiple representations and appropriate tools in order to make decisions, solve problems, and draw conclusions.* *e. Students will make use of structure and repeated reasoning to gain a mathematical perspective and formulate generalized problem solving strategies* *f. Given a word problem, students will solve the word problem using an appropriate strategy or strategies and will share and compare the use of multiple strategies leading to the same answer.*

solve problems
CC.2.2.HS.C.2- Graph and analyze functions, and use their properties to make connections between the different representations.
CC.2.2.HS.C.3- Write functions or sequences that model relationships between two quantities
CC.2.2.HS.C.4- Interpret the effects transformations have on functions, and find the inverses of functions.
CC.2.2.HS.C.5- Construct and compare linear, quadratic, and exponential models to solve problems
CC.2.2.HS.C.6- Interpret functions in terms of the situations they model.
CC.2.2.HS.D.1- Interpret the structure of expressions to represent a quantity in terms of its context.
CC.2.2.HS.D.2- Write expressions in equivalent forms to solve problems
CC.2.2.HS.D.4- Understand the relationship between zeros and factors of polynomials to make generalizations about functions and their graphs.
CC.2.2.HS.D.7- Create and graph equations or inequalities to describe numbers or relationships
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.
CC.2.2.HS.D.10- Represent, solve and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.
CC.2.3.HS.A.10- Translate between the geometric description and the equation

Essential Questions

What thought-provoking questions will foster inquiry, meaning making, and transfer?

5. List the Essential Question(s) that students should ponder, wonder about or explain by the end of this unit:
   a. *To simplify the nth root of an expression, what must be true about the expression?*
   b. *When you square each side of an equation, is the resulting equation equivalent to the original?*
   c. *How are a function and its inverse function related?*

Acquisition

Students will know...

6. What facts should students know and be able to use to gain further knowledge?
   simplifying radical expressions, property for products and quotients, using conjugates appropriately, function operations, rational exponents, radical equations, identifying extraneous solutions, inverse functions, composition of functions
7. What vocabulary should students know and be able to recall?
   Tier II- predict, compare, evaluate, justify, check, evaluate, summarize, generalization, unique, process, interpret, pattern, prove, solve, describe, apply, explain, determine, describe

   Tier III- composite functions, index, inverse function/relation, like radicals, nth root, one-to-one function, radical equation/function, radicand, rational exponent, rationalize the denominator, square root equation/function
8. What basic concepts should students know and be able to recall and apply?
   Simplify radical expressions, Solve radical equations, determine domain of radical functions, check for extraneous solutions, find inverse functions, graph functions and their inverses

Students will be skilled at... (be able to do)

9. What discrete skill and processes should students be able to demonstrate?
   A2.1.1.1.1 Simplify/write square roots in terms of i (e.g., $\sqrt{-24} = 2i\sqrt{6}$).
   A2.1.1.2.1 Add and subtract complex numbers (e.g., (7 - 3i) - (2 + i) = 5 - 4i).
   A2.1.1.2.2 Multiply and divide complex numbers (e.g., (7 - 3i)(2 + i) = 17 + i).
   A2.1.2.1.1 Use exponential expressions to represent rational numbers.
   A2.1.2.1.2 Simplify/evaluate expressions involving positive and negative exponents and/or roots (may contain all types of real numbers - exponents should not exceed power of 10).
   A2.1.2.1.3 Simplify/evaluate expressions involving multiplying with exponents (e.g., $x6 \times x7 = x13$), powers of powers (e.g., (x6)7= x42), and powers of products (e.g., (2x2)3 = 8x6). Note: Limit to rational exponents.
   A2.1.3.1.2 Solve equations involving rational and/or radical expressions (e.g., 10/(x + 3) + 12/(x- 2) = 1 or $\sqrt{x2 + 21x} = 14$).
   A2.1.3.2.1 Determine how a change in one variable relates to a change in a second variable (e.g., y = 4/ x ; if x doubles, what happens to y ?).
   A2.1.3.2.2 Use algebraic processes to solve a formula for a given variable (e.g., solve d = rt for r).
   A2.2.1.1.1 Analyze a set of data for the existence

for a conic section. • PA Content Standards		*of a pattern, and represent the pattern with a rule algebraically and/or graphically.* *A2.2.1.1.2 Identify and/or extend a pattern as either an arithmetic or geometric sequence (e.g., given a geometric sequence, find the 20th term).* *A2.2.1.1.3 Determine the domain, range, or inverse of a relation.* *A2.2.1.1.4 Identify and/or determine the characteristics of an exponential, quadratic, or polynomial function (e.g., intervals of increase/decrease, intercepts, zeros, and asymptotes).* *A2.2.2.1.1 Create, interpret, and/or use the equation, graph, or table of a polynomial function (including quadratics).* *A2.2.2.1.2 Create, interpret, and/or use the equation, graph, or table of an exponential or logarithmic function (including common and natural logarithms).* *A2.2.2.1.3 Determine, use, and/or interpret minimum and maximum values over a specified interval of a graph of a polynomial, exponential, or logarithmic function.* *A2.2.2.1.4 Translate a polynomial, exponential, or logarithmic function from one representation of a function to another (graph, table, and equation).* *A2.2.2.2.1 Identify or describe the effect of changing parameters within a family of functions (e.g., y = x2 and y = x2 + 3, or y = x2and y = 3x2).*

Stage 2 – Evidence	
NETS for Students	**PERFORMANCE TASK(S)—can include transfer tasks and Project-Based Learning**
NETS—National Educational Technology Standards; i.e., the standards for evaluating the skills and knowledge students need to learn effectively and live productively in an increasingly global and digital world.	*Examples include but are not limited to:* *Labs, open-ended essays, voice recordings, videos, presentations, discussion boards, graphic organizers, songs, skits, dioramas, visual projects (posters, dioramas)* List the task(s), then explain how the student will demonstrate the transfer of knowledge or skill involved in the task(s) (reference Stage 1, Item #4): *Participate in Discussion board responding to teacher created prompts*

Critical Thinking *Creative and Innovation* *Technology Operations* *Communication and Collaboration*	*Generate equations and representations that can be used to solve problems and check for reasonableness of solution*
	OTHER SUMMATIVE ASSESSMENTS—can include factual recall
	Examples include but are not limited to final projects, research papers, quizzes and tests. List the assessments: *Quizzes and Tests*

Stage 3 – Learning Plan			
NETS for Students	**Learning Activities**		**Progress Monitoring/Formative Assessment**
NETS—National Educational Technology Standards; i.e., the standards for evaluating the skills and knowledge students need to learn effectively and live productively in an increasingly global and digital world. *Critical Thinking* *Creative and Innovation* *Technology Operations* *Communication and Collaboration*	Questions to consider while planning: • Are transfer and acquisition addressed in the learning plan? • Does the learning plan reflect principles of learning and best practices? • Is there tight alignment with Stages 1 and 2? • Is the plan likely to be engaging and effective for all students?		• **How will you monitor students' progress toward acquisition, meaning, and transfer during learning activities?** Daily assessments, teacher observation of students in class performance, teacher observation during peer share-out sessions • **What are potential rough spots and student misunderstandings?** Students can miss the index number (especially when the radicand is a perfect square). Students may take the root of an exponent. The domains of even roots may be different than the domains for odd roots. When squaring both sides, students may raise each term to the power rather than the entire side. Forgetting to check for extraneous solutions. Algebraic mistakes when finding inverses. • **How will students get the feedback they need?** Graded assessment, teacher observation immediate feedback, peer feedback, mid-chapter quiz
	List planned activities *(examples include but are not limited to: experiments, guided reading, worksheets, discussions, note-taking, research, games)*: worksheets, homework from textbook, Study Island,	**List resources required** *(examples include but are not limited to: laptops, iPads, websites, digital cameras, magazines, Blackboard, textbooks, novels, primary source documents, other non-fiction text, lab equipment, maps, translator, calculators)* Textbook, laptops, whiteboard, graph paper	**FORMATIVE ASSESSMENTS—any non-graded, diagnostic assessment administered prior to or during a unit that reflects prior knowledge, skill levels, and potential misconceptions.** *Examples include but are not limited to: Pre-tests, clickers (CPS), mini whiteboards, entrance and exit tickets, CDTs, DIBELS, Aimsweb* Interactive textbook quizzes, Study Island, mini-whiteboards, Kahoot, Socrative, Google Forms, TI-nspire

	interactive textbook quizzes	white boards, on-line text book/answer key, document camera, calculators, Grapher software	technology, Zip-grade

Southern Lehigh School District

UbD Curriculum Template

Course: **Algebra 2** Unit: **Unit 9- Rational Functions** Grades: **9-12**

Teacher Team: **Haupt, Malik** Date: **June 2016**

Stage 1 – Desired Results	
Established Goals	**Enduring Understandings/Transfer**
1. What 21st Century Essentials included in the mission statement will this unit address? *Problem-solving* *Career Planning and Life-Long Learning* *Transfer of Learning* 2. What content standards will this unit address? • ELA PA Core State Standards • Math PA Core State Standards 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.7- Apply concepts of complex numbers in polynomial identities and quadratic equations to solve problems CC.2.2.HS.C.1- Use the concept and notation of functions to interpret and apply them in terms of their context. CC.2.2.HS.C.2- Graph and analyze	**Written as a declarative statement, an enduring understanding is a "big idea" that focuses on larger concepts, principles, and processes that go beyond discrete facts or skills. Enduring Understandings are applicable to new situations across content areas and TRANSFERABLE (the ability to learn in one context and apply to a new situation, particularly outside of the classroom) to the real world.** 3. List the Enduring Understanding(s): *a. In a direct variation, two positive quantities either increase together or decrease together. In an inverse variation, as one quantity increases the other decreases.* *b. Transformations of the parent reciprocal function include stretches, compressions, reflections, and horizontal and vertical transformations.* *c. A rational function is a ratio of polynomial functions. It can have asymptotic behaviors, and looks different from the graph of either polynomial components.* *d. To operate with rational expressions, you use similar processes to when you are operating with fractions.* *e. To solve an equation containing rational expressions, first multiply each side by the least common denominator of all the rational expressions.* 4. What do you want students to do with this knowledge or skill beyond this course? What is Transfer? *a. Students will make sense of and persevere in solving complex and novel mathematical problems.* *b. Students will use effective mathematical reasoning to construct viable arguments and critique the reasoning of others.* *c. Students will communicate precisely when making mathematical statements and express answers with a degree of precision appropriate for the context of the problem/situation.* *d. Students will apply mathematical knowledge to analyze and model situations/relationships using multiple representations and appropriate tools in order to make decisions, solve problems, and draw conclusions.* *e. Students will make use of structure and repeated reasoning to gain a mathematical perspective and formulate generalized problem solving strategies* *f. Given a word problem, students will solve the word problem using an appropriate strategy or strategies and will share and compare the use of multiple strategies leading to the same answer.*

functions, and use their properties to make connections between the different representations.
CC.2.2.HS.C.3- Write functions or sequences that model relationships between two quantities
CC.2.2.HS.C.4- Interpret the effects transformations have on functions, and find the inverses of functions.
CC.2.2.HS.C.6- Interpret functions in terms of the situations they model.
CC.2.2.HS.D.1- Interpret the structure of expressions to represent a quantity in terms of its context.
CC.2.2.HS.D.2- Write expressions in equivalent forms to solve problems
CC.2.2.HS.D.3- Extend the knowledge of arithmetic operations and apply to polynomials.
CC.2.2.HS.D.4- Understand the relationship between zeros and factors of polynomials to make generalizations about functions and their graphs.
CC.2.2.HS.D.5- Use polynomial identities to solve problems
CC.2.2.HS.D.6- Extend the knowledge of rational functions to rewrite in equivalent forms.
CC.2.2.HS.D.7- Create and graph equations or inequalities to describe numbers or relationships
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.
CC.2.2.HS.D.10- Represent, solve and interpret equations/inequalities and

Essential Questions

What thought-provoking questions will foster inquiry, meaning making, and transfer?

Continuous

5. List the Essential Question(s) that students should ponder, wonder about or explain by the end of this unit:
   a. *Are two quantities inversely proportional if an increase in one corresponds to a decrease in the other?*
   b. *What kinds of asymptotes are possible for a rational function?*
   c. *Are a rational expression and its simplified form equivalent?*

Acquisition

Students will know...

6. What facts should students know and be able to use to gain further knowledge?
   Using direct, inverse, combined, and joint variation; graphing reciprocal functions; properties of continuity and discontinuity; asymptotes; graphing functions; operations with rational equations; solving rational equations.
7. What vocabulary should students know and be able to recall?
   Tier II- predict, compare, evaluate, justify, check, evaluate, summarize, generalization, unique, process, interpret, pattern, prove, solve, describe, apply, explain, determine, describe

   Tier III- combined variation, complex function, continuous graph, discontinuous graph, inverse variation, joint variation, non-removable discontinuity, oblique asymptote, point of discontinuity, rational equation, rational expression, rational function, reciprocal function, removable discontinuity

8. What basic concepts should students know and be able to recall and apply?
   Identify and describe inverse and direct variation functions, graph asymptotes of rational functions, identify whether a rational function has an asymptote, differentiate between vertical, horizontal, and oblique asymptotes, define the domains of simplified rational expressions to make

Students will be skilled at... (be able to do)

9. What discrete skill and processes should students be able to demonstrate?
   A2.1.2.1.2 Simplify/evaluate expressions involving positive and negative exponents and/or roots (may contain all types of real numbers - exponents should not exceed power of 10).
   A2.1.2.1.3 Simplify/evaluate expressions involving multiplying with exponents (e.g., x6 × x7 = x13), powers of powers (e.g., (x6)7= x42), and powers of products (e.g., (2x2)3 = 8x6). Note: Limit to rational exponents.
   A2.1.2.2.1 Factor algebraic expressions, including difference of squares and trinomials. Note: Trinomials limited to the form ax2 + bx + c where a is not equal to 0
   A2.1.2.2.2 Simplify rational algebraic expressions.
   A2.1.3.1.1 Write and/or solve quadratic equations (including factoring and using the Quadratic Formula).
   A2.1.3.1.2 Solve equations involving rational and/or radical expressions (e.g., 10/(x + 3) + 12/(x- 2) = 1 or $\sqrt{}$ x2 + 21x = 14).
   A2.1.3.2.1 Determine how a change in one variable relates to a change in a second variable (e.g., y = 4/ x ; if x doubles, what happens to y ?).A2.2.1.1.1 Analyze a set of data for the existence of a pattern, and represent the pattern with a rule algebraically and/or graphically.
   A2.2.1.1.2 Identify and/or extend a pattern as

systems of equations/inequalities algebraically and graphically. CC.2.3.HS.A.10- Translate between the geometric description and the equation for a conic section. • PA Content Standards	*them equivalent to the originals.*	*either an arithmetic or geometric sequence (e.g., given a geometric sequence, find the 20th term).* *A2.2.1.1.3 Determine the domain, range, or inverse of a relation.* *A2.2.1.1.4 Identify and/or determine the characteristics of an exponential, quadratic, or polynomial function (e.g., intervals of increase/decrease, intercepts, zeros, and asymptotes).* *A2.2.2.1.3 Determine, use, and/or interpret minimum and maximum values over a specified interval of a graph of a polynomial, exponential, or logarithmic function.* *A2.2.2.1.4 Translate a polynomial, exponential, or logarithmic function from one representation of a function to another (graph, table, and equation).*

Stage 2 – Evidence	
NETS for Students	**PERFORMANCE TASK(S)—can include transfer tasks and Project-Based Learning**
NETS—National Educational Technology Standards; i.e., the standards for evaluating the skills and knowledge students need to learn effectively and live productively in an increasingly global and digital world. *Critical Thinking* *Creative and Innovation* *Technology Operations* *Communication and Collaboration*	*Examples include but are not limited to:* *Labs, open-ended essays, voice recordings, videos, presentations, discussion boards, graphic organizers, songs, skits, dioramas, visual projects (posters, dioramas)* List the task(s), then explain how the student will demonstrate the transfer of knowledge or skill involved in the task(s) (reference Stage 1, Item #4): *Participate in Discussion board responding to teacher created prompts* *Generate equations and representations that can be used to solve problems and check for reasonableness of solution*
	OTHER SUMMATIVE ASSESSMENTS—can include factual recall
	Examples include but are not limited to final projects, research papers, quizzes and tests. List the assessments: *Quizzes and Tests*

Stage 3 – Learning Plan		
NETS for Students	**Learning Activities**	**Progress Monitoring/Formative Assessment**
NETS—National Educational Technology Standards; i.e., the standards for evaluating the skills	Questions to consider while planning: • Are transfer and acquisition addressed in the learning plan?	• **How will you monitor students' progress toward acquisition, meaning, and transfer during learning activities?**

<table>
<tr>
<td rowspan="2">and knowledge students need to learn effectively and live productively in an increasingly global and digital world.

Critical Thinking
Creative and Innovation
Technology Operations
Communication and Collaboration</td>
<td colspan="2">• Does the learning plan reflect principles of learning and best practices?
• Is there tight alignment with Stages 1 and 2?
• Is the plan likely to be engaging and effective for all students?</td>
<td>Daily assessments, teacher observation of students in class performance, teacher observation during peer share-out sessions
• What are potential rough spots and student misunderstandings?
writing models for combined variations, confused by removable point of discontinuity because graphing utilities often do not show these, confusion about when and how to use a LCD .
• How will students get the feedback they need?
Graded assessment, teacher observation immediate feedback, peer feedback, mid-chapter quiz</td>
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<tr>
<td>List planned activities
(examples include but are not limited to: experiments, guided reading, worksheets, discussions, note-taking, research, games):

worksheets, homework from textbook, Study Island, interactive textbook quizzes</td>
<td>List resources required
(examples include but are not limited to: laptops, iPads, websites, digital cameras, magazines, Blackboard, textbooks, novels, primary source documents, other non-fiction text, lab equipment, maps, translator, calculators)
Textbook, laptops, whiteboard, graph paper white boards, on-line text book/answer key, document camera, calculators, Grapher software</td>
<td>FORMATIVE ASSESSMENTS—any non-graded, diagnostic assessment administered prior to or during a unit that reflects prior knowledge, skill levels, and potential misconceptions.

Examples include but are not limited to: Pre-tests, clickers (CPS), mini whiteboards, entrance and exit tickets, CDTs, DIBELS, Aimsweb

Interactive textbook quizzes, Study Island, mini-whiteboards, Kahoot, Socrative, Google Forms, TI-nspire technology, Zip-grade</td>
</tr>
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Southern Lehigh School District

UbD Curriculum Template

Course: **Algebra 2** Unit: **Unit 10- Exponential and Logarithmic Functions** Grades: **9-12**

Teacher Team: **Haupt, Malik** Date: **June 2016**

Stage 1 – Desired Results	
Established Goals	**Enduring Understandings/Transfer**
1. What 21st Century Essentials included in the mission statement will this unit address? *Problem-solving* *Career Planning and Life-Long Learning* *Transfer of Learning* 2. What content standards will this unit address? • ELA PA Core State Standards • Math PA Core State Standards 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.2.2.HS.C.2- Graph and analyze functions, and use their properties to make connections between the different representations. CC.2.2.HS.C.3- Write functions or sequences that model relationships between two quantities CC.2.2.HS.C.4- Interpret the effects transformations have on functions, and	**Written as a declarative statement, an enduring understanding is a "big idea" that focuses on larger concepts, principles, and processes that go beyond discrete facts or skills. Enduring Understandings are applicable to new situations across content areas and TRANSFERABLE (the ability to learn in one context and apply to a new situation, particularly outside of the classroom) to the real world.** 3. List the Enduring Understanding(s): *a. You can represent repeated multiplication with a function in the form of y=a*b^x.* *b. The factor a in y=a*b^x can stretch or compress, and possibly reflect the graph of the parent function y=b^x.* *c. The exponential function y=b^x is one-to-one, so its inverse x=b^y is a function.* *d. Logarithms and exponents have corresponding properties.* *e. You can use logarithms to solve exponential equations. You can use exponents to solve logarithmic equations.* *f. The functions y=e^x and y=ln(x) are inverse functions.* 4. What do you want students to do with this knowledge or skill beyond this course? What is Transfer? *a. Students will make sense of and persevere in solving complex and novel mathematical problems.* *b. Students will use effective mathematical reasoning to construct viable arguments and critique the reasoning of others.* *c. Students will communicate precisely when making mathematical statements and express answers with a degree of precision appropriate for the context of the problem/situation.* *d. Students will apply mathematical knowledge to analyze and model situations/relationships using multiple representations and appropriate tools in order to make decisions, solve problems, and draw conclusions.* *e. Students will make use of structure and repeated reasoning to gain a mathematical perspective and formulate generalized problem solving strategies* *f. Given a word problem, students will solve the word problem using an appropriate strategy or strategies and will share and compare the use of multiple strategies leading to the same answer.*
	Essential Questions
	What thought-provoking questions will foster inquiry, meaning-making, and transfer?

find the inverses of functions.
CC.2.2.HS.C.5- Construct and compare linear, quadratic, and exponential models to solve problems
CC.2.2.HS.C.6- Interpret functions in terms of the situations they model.
CC.2.2.HS.D.6- Extend the knowledge of rational functions to rewrite in equivalent forms.
CC.2.2.HS.D.7- Create and graph equations or inequalities to describe numbers or relationships
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.
CC.2.2.HS.D.10- Represent, solve and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.

- PA Content Standards

5. List the Essential Question(s) that students should ponder, wonder about or explain by the end of this unit:
   a. *How do you model a quantity that changes regularly over time by the same percentage?*
   b. *How are exponents and logarithms related?*
   c. *How are exponential functions and logarithmic functions related?*

Acquisition

Students will know...

6. What facts should students know and be able to use to gain further knowledge?
   Exponential models, logarithmic models, solving logarithmic equations, using properties of logarithms, natural logs, solving logarithmic equations algebraically and graphically
7. What vocabulary should students know and be able to recall?
   Tier II- predict, compare, evaluate, justify, check, evaluate, summarize, generalization, unique, process, interpret, pattern, prove, solve, describe, apply, explain, determine, describe

   Tier III-asymptote, Change of Base Formula, common log, continuously compounded interest, decay/growth factor, exponential growth/decay, exponential equation/function, logarithm, logarithmic equation/function, natural base exponential function, natural base logarithmic function
8. What basic concepts should students know and be able to recall and apply?
   Students will model situations with exponential functions, use exponents to solve logarithmic equations and logarithms to solve exponential equations, show that exponents and logarithms are inverse functions, graph exponential and logarithmic functions.

Students will be skilled at... (be able to do)

9. What discrete skill and processes should students be able to demonstrate?
   A2.1.3.1.1 Write and/or solve quadratic equations (including factoring and using the Quadratic Formula).
   A2.1.3.1.2 Solve equations involving rational and/or radical expressions (e.g., 10/(x + 3) + 12/(x-2) = 1 or $\sqrt{}$ x2 + 21x = 14).
   A2.1.3.1.3 Write and/or solve a simple exponential or logarithmic equation (including common and natural logarithms).
   A2.1.3.1.4 Write, solve, and/or apply linear or exponential growth or decay (including problem situations).
   A2.2.2.1.2 Create, interpret, and/or use the equation, graph, or table of an exponential or logarithmic function (including common and natural logarithms).
   A2.2.2.1.3 Determine, use, and/or interpret minimum and maximum values over a specified interval of a graph of a polynomial, exponential, or logarithmic function.
   A2.2.2.1.4 Translate a polynomial, exponential, or logarithmic function from one representation of a function to another (graph, table, and equation).
   A2.2.2.2.1 Identify or describe the effect of changing parameters within a family of functions (e.g., y = x2 and y = x2 + 3, or y = x2and y = 3x2).

Stage 2 – Evidence	
NETS for Students	**PERFORMANCE TASK(S)—can include transfer tasks and Project-Based Learning**
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Stage 3 – Learning Plan		
NETS for Students	**Learning Activities**	**Progress Monitoring/Formative Assessment**
NETS—National Educational Technology Standards; i.e., the standards for evaluating the skills and knowledge students need to learn effectively and live productively in an increasingly global and digital world. *Critical Thinking* *Creative and Innovation* *Technology Operations* *Communication and Collaboration*	Questions to consider while planning: • Are transfer and acquisition addressed in the learning plan? • Does the learning plan reflect principles of learning and best practices? • Is there tight alignment with Stages 1 and 2? • Is the plan likely to be engaging and effective for all students?	• **How will you monitor students' progress toward acquisition, meaning, and transfer during learning activities?** Daily assessments, teacher observation of students in class performance, teacher observation during peer share-out sessions • **What are potential rough spots and student misunderstandings?** Forgetting to convert percents to decimals, confusing domain and range of logarithmic models, use the quotient identity in the wrong order, errors when re-writing in exponential form, Not getting the same base when solving, not considering restrictions on variables. • **How will students get the feedback they need?** Graded assessment, teacher observation immediate feedback, peer feedback, mid-chapter quiz

	List planned activities *(examples include but are not limited to: experiments, guided reading, worksheets, discussions, note-taking, research, games)*:	**List resources required** *(examples include but are not limited to: laptops, iPads, websites, digital cameras, magazines, Blackboard, textbooks, novels, primary source documents, other non-fiction text, lab equipment, maps, translator, calculators)*	**FORMATIVE ASSESSMENTS—any non-graded, diagnostic assessment administered prior to or during a unit that reflects prior knowledge, skill levels, and potential misconceptions.** *Examples include but are not limited to: Pre-tests, clickers (CPS), mini whiteboards, entrance and exit tickets, CDTs, DIBELS, Aimsweb*
	worksheets, homework from textbook, Study Island, interactive textbook quizzes, expoential growth/decay project	Textbook, laptops, whiteboard, graph paper white boards, on-line text book/answer key, document camera, calculators, Grapher software	Interactive textbook quizzes, Study Island, mini-whiteboards, Kahoot, Socrative, Google Forms, TI-nspire technology, Zip-grade