The EUHSD Mathematics curriculum document outlines specific course expectations in a comprehensive integrated math curriculum. The curriculum documents are designed to be updated annually based on student academic achievement data, research and best practices, and input from stakeholders. The EUHSD mathematics curriculum document contains the following:

A. Course Description
B. Course Guidelines - graduation credit information, transcript information, adopted materials, adopted technology, assessment outline
C. Instructional Materials References
D. Scope and Sequence Map with Essential Standards, Unit Topics, and Key Unit Objectives delineated
E. References to key essential design and implementation documents (see items 1-8 below)

The EUHSD Mathematics program is designed so that all students have access to the rigorous curriculum necessary to graduate high school college and career ready. Pathway options and courses of study will provide students with a rich array of courses designed to meet the needs of all learners from acceleration to intervention. Regardless of a student's entry point, the pathway provides all students access to the highest level of courses offered. The contextualized learning inherent in an integrated program provides students with deeper understanding and improved retention of math concepts. Student-Centered learning provides opportunity for collaboration, communication, and a robust learning environment and provides opportunities for all students to meet the goals of the district’s Instructional Focus at the time of this writing: “All students communicate their thinking, ideas and understanding by effectively using oral, written and/or non-verbal expression.”

A key design consideration in the transition to the new California State Standards is a focus on changes to pedagogy. The instructional shifts guide classroom teaching and learning and the foundation of curriculum and instructional design.

### Instructional Shifts in Mathematics

<table>
<thead>
<tr>
<th>Focus:</th>
<th>Focus requires that we significantly narrow and deepen the scope of content in each grade so that students experience concepts at a deeper level.</th>
</tr>
</thead>
</table>
| **Focus strongly where the Standards focus** | • Instruction engages students through cross-curricular concepts and application. Each unit focuses on implementation of the Math Practices in conjunction with math content.  
• Effective instruction is framed by performance tasks that engage students and promote questions in order to provide a clear and explicit purpose for instruction. |
| Coherence: | Coherence in our instruction supports students to make connections within and across grade levels. |
| **Think across grades; and link to major topics within grades** | • Problems and activities connect clusters and domains through the art of questioning.  
• A purposeful sequence of lessons build meaning by moving from concrete to abstract, with new learning built upon prior knowledge and connections made to previous learning.  
• Coherence promotes mathematical sense making. It is critical to think across grades and examine the progressions in the standards to ensure the development of major topics over time. The emphasis on problem solving, reasoning and proof, communication, representation, and connections require students to build comprehension of mathematical concepts, procedural fluency, and productive dispositions. |
| Rigor: | Rigor helps students to read various depths of knowledge by balancing conceptual understanding, procedural skills and fluency, and real-world applications with equal intensity. |
| **In major topics, pursue conceptual** | • Conceptual understanding underpins fluency; fluency is practiced in contextual applications; and applications build conceptual understanding. |
### Understanding, Procedural Skills and Fluency, and Application

- These elements may be explicitly addressed separately or at other times combined. Students demonstrate deep conceptual understanding of core math concepts by applying them in new situations, as well as writing and speaking about their understanding. Students will make meaning of content outside of math by applying math concepts to real-world situations.
- Each unit contains a balance of challenging, multiple-step problems to teach new mathematics, and exercises to practice mathematical skills.

The EUHSD mathematics curriculum document and all supporting documentation are aligned to the [California State Standards for Mathematics](https://www.cde.ca.gov/ta/tg/cc/ccmath/documents/ccsmscontent7112013.pdf), the Eight Standards for Mathematical Practice, as well as the new CA ELD Standards. These standards will be integrated and delineated within each Unit Plan. A detailed list of resources around which the EUHSD Mathematics curriculum is designed and implemented are as follows:

1. [California State Standards for Mathematics](https://www.cde.ca.gov/ta/tg/cc/ccmath/documents/ccsmscontent7112013.pdf)
2. [Guide to the CASS-M Conceptual Category Abbreviations](https://euhsd.k12.ca.us/departments/mathematics/Documents/SciMath_UnitPlan202324.pdf)
3. [Eight Standards for Mathematical Practice](https://euhsd.k12.ca.us/departments/mathematics/Documents/SciMath_UnitPlan202324.pdf)
4. [California Frameworks for Mathematics](https://euhsd.k12.ca.us/departments/mathematics/Documents/SciMath_UnitPlan202324.pdf)
5. [Smarter Balanced Assessment System Mathematics Assessment Blueprint](https://euhsd.k12.ca.us/departments/mathematics/Documents/SciMath_UnitPlan202324.pdf)
6. [California English Language Development Standards](https://euhsd.k12.ca.us/departments/mathematics/Documents/SciMath_UnitPlan202324.pdf)
7. [University of California Mathematics Pathway FAQ](https://euhsd.k12.ca.us/departments/mathematics/Documents/SciMath_UnitPlan202324.pdf)
8. [Core Plus Instructional Materials](https://euhsd.k12.ca.us/departments/mathematics/Documents/SciMath_UnitPlan202324.pdf)

### California State Standards for Mathematics - Content

The California Standards for high school mathematics (CASS-M) are divided into six conceptual categories, which portray a coherent view of higher mathematics, which cross a number of traditional course boundaries. Each conceptual category is further broken down into domains or clusters of standards that address big ideas - [Guide to the CASS-M Conceptual Category Abbreviations](https://euhsd.k12.ca.us/departments/mathematics/Documents/SciMath_UnitPlan202324.pdf). The conceptual categories are Number and Quantity, Algebra, Functions, Modeling, Geometry, and Statistics and Probability. Modeling is best interpreted not as a collection of topics but in relation to other standards, thus Modeling is considered both a conceptual category and a Standard for Mathematical Practice and modeling standards are called within the other conceptual categories, indicated by a (*) symbol.

### Common Core Standards for Mathematical Practice

The CASS-M call for mathematical practices and content to be connected as students engage in mathematical tasks. These connections are essential to support the development of students’ broader mathematical understanding - students who lack understanding of a topic may rely too heavily on procedures. The 8 Math Practice standards must be taught as carefully and practiced as intentionally as the Standards for Math Content. Neither should be isolated from the other; effective mathematics instruction occurs when the two halves of the CASS-M come together as a powerful whole (CASS-M, 2013).
Standards for Mathematical Practice

1. **Make sense of problems and persevere in solving them.**

Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, “Does this make sense?” They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

2. **Reason abstractly and quantitatively.**

Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.

3. **Construct viable arguments and critique the reasoning of others.**

Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.

4. **Model with mathematics.**

Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical
situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

5. Use appropriate tools strategically.

Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.

6. Attend to precision.

Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

7. Look for and make use of structure.

Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see $7 \times 8$ equals the well-remembered $7 \times 5 + 7 \times 3$, in preparation for learning about the distributive property. In the expression $x^2 + 9x + 14$, older students can see the 14 as $2 \times 7$ and the 9 as $2 + 7$. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see $5 – 3(x – y)^2$ as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers $x$ and $y$.

8. Look for and express regularity in repeated reasoning.

Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. Upper elementary students might notice when dividing 25 by 11 that they are repeating the same calculations over and over again, and conclude they have a repeating decimal. By paying attention to the calculation of slope as they repeatedly check whether points are on the line through $(1, 2)$ with slope 3, middle school students might abstract the equation $(y – 2)/(x-1) = 3$. Noticing the regularity in the way terms cancel when expanding $(x – 1) (x + 1), (x – 1) (x^2 + x + 1)$, and $(x – 1) (x^3 + x^2 + x + 1)$ might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.
Math 2 - Course Description

Math 2 is the second of an integrated and investigative mathematics program designed to use patterns, modeling, and conjectures to build student understanding and competency in mathematics. The Math 2 course is designed to formalize and extend student understanding of Algebra and Functions, Geometry and Trigonometry, Statistics and Probability, and Discrete Mathematics. The critical areas of focus include: extending understanding of functions and equations; using matrices as models for solving problems; developing understanding of coordinate methods for representing and analyzing geometric shapes; extending understanding of relationships between two quantitative variables; introducing and developing student ability in modeling and optimization problems using vertex-edge graphs; developing understanding of trigonometric functions; and extending understanding of probability topics. The Math 2 curriculum addresses each of the conceptual categories outlined by the California State Standards for Mathematics: number and quantity, algebra, functions, geometry, statistics and probability, and modeling. The curriculum includes attention to each of the Eight Standards for Mathematical Practice. Instructional materials and classroom experiences provide students with a rich array of resources and technology designed to support student mastery of specific concepts and both procedural and conceptual understanding while building essential 21st Century skills designed for college and career readiness. Assessments are outlined in the Scope and Sequence document. Each unit will culminate in a district-wide common assessment (year 1 implementation will use Core-Plus provided assessments).

Honors Option for Math 2

The primary goals of the EUHSD Mathematics program are as follows: first, ensure students develop a deeper understanding of mathematics; second, prepare students to take on more advanced studies in math; third, personalize the pursuit of honors and advanced coursework; fourth, to focus on the level of rigor evidenced by the work produced by students.

Accordingly, students who elect to participate in and produce honors level work will receive honors credit. Students who earn the honors designation in these courses will produce work that addresses questions that are more sophisticated, delve more deeply into the mathematics of the course, and satisfy the California State Standards with added rigor. The honors modification applied to some course assignments will broaden the scope or deepen the examination of the course content.

Within the first 20 days of the semester, students who elect to challenge themselves with honors work will complete an Honors Option Registration Contract, signed by Student, Teacher, and Parent/Guardian (see attached). Students who opt-in and later elect not to pursue the honors option for the course must complete a Petition for Release from Honors Option Contract by the 8th week of the semester, to be signed by Student, Teacher and Parent/Guardian (also attached).

Students electing the Honors Option will have differentiated homework, required projects, portfolios due each semester, required participation in a demonstration of learning once per semester, and will be required to demonstrate understanding on assessment extension problems.
# Math 2 Course Requirements

<table>
<thead>
<tr>
<th>Course Length: Year-Long</th>
<th>Grade Level: Grade 9-12</th>
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<tbody>
<tr>
<td>UC/CSU Requirement: Approved by UC as a “c” mathematics course</td>
<td>Graduation Requirement: Students will receive (5) math credits per successfully completed semester for a total of (10) math credits for the year. Students who successfully complete the yearlong Math 2 will fulfill the University of California Geometry requirement.</td>
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### Course Number Semester A:

<table>
<thead>
<tr>
<th>Course Number Semester A:</th>
<th>Transcript Name Semester A:</th>
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</thead>
<tbody>
<tr>
<td>(P) 2253</td>
<td>(P): MATH 2 A (P)</td>
</tr>
<tr>
<td>(H) 2255</td>
<td>(H): MATH 2 A (H)</td>
</tr>
<tr>
<td>(SE) 2257</td>
<td>(SE): MATH 2 A (P) (SE)</td>
</tr>
<tr>
<td>(B) 2259</td>
<td>(B): MATH 2 A (Basic)</td>
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<td>(H): MATH 2 A (H)</td>
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<tr>
<td>(SE): MATH 2 A (P) (SE)</td>
</tr>
<tr>
<td>(B): MATH 2 A (Basic)</td>
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### Course Number Semester B:

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<th>Course Number Semester B:</th>
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<tr>
<td>(P) 2254</td>
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<tr>
<td>(H) 2256</td>
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<tr>
<td>(SE) 2258</td>
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<tr>
<td>(B) 2260</td>
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</table>

### Transcript Name Semester B:

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<tr>
<th>Transcript Name Semester B:</th>
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<tbody>
<tr>
<td>(P): MATH 2 B (P)</td>
</tr>
<tr>
<td>(H): MATH 2 B (H)</td>
</tr>
<tr>
<td>(SE): MATH 2 B (P) (SE)</td>
</tr>
<tr>
<td>(B): MATH 2 B (Basic)</td>
</tr>
</tbody>
</table>

Honors course will be the “Opt-in” model, taught within the same classroom. We will not be registering any students for these courses until after the beginning of the school year. Students will be required to sign a contract, as will their parents.

### Number of Credits Semester A: five (5) *Honors Not Weighted

### Number of Credits Semester B: five (5) *Honors Not Weighted

### Required Prerequisites: N/A

### Recommended Prerequisites: Completion of Math 1 or Algebra 1

### Board Approval Date/Curriculum: 4/19/16

### Board Approval Date for Honors Extensions: 6/19/18

### Board Approval Date/Textbooks: 4/19/16


### Supplemental Resource/s:

- All adopted ancillary materials within the Core-Plus instructional program

### Supplemental Technology Resource/s:

- Graphing Calculator
- [CPMP Tools (online resource)]

### Assessment/s:

- Year 2 - All EUHSID Math 2 teachers will give common assessments, which accompany the Core-Plus Mathematics Program (lesson quizzes, unit tests, common district final exams).
Math 2 Scope and Sequence
Unit 1- Functions, Equations, and Systems

<table>
<thead>
<tr>
<th>Unit 1 Functions, Equations, and Systems:</th>
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<tbody>
<tr>
<td>• This unit reviews and extends student ability to recognize, describe, and use functional relationships among quantitative variables with special emphasis on relationships that involve two or more independent variables.</td>
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<tr>
<th>Unit 1 Learning Goals:</th>
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<tbody>
<tr>
<td>• Review familiar families of single variable functions (especially linear, exponential, and quadratic functions).</td>
</tr>
<tr>
<td>• Recognize direct and inverse variation functions with one or more independent variables, express those relationships in symbolic form, and manipulate those expressions into equivalent useful forms.</td>
</tr>
</tbody>
</table>
| • Recognize and represent graphically and symbolically relationships in which one variable is a linear function of two independent variables and graph solutions of equations in the form “ax + by = c”.
| • Set up and solve systems involving two linear equations with two variables by use of graphing, substitution, and elimination methods. Recognize whether systems have 0, 1, or 2 solutions by inspecting the equations. |

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<tr>
<th>Unit 1 Assessments:</th>
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<tbody>
<tr>
<td>• Assessment for Learning- Feedback given in many forms such as direct teacher conversations and revision suggestions, mini-quizzes, peer grading rubrics, and self-grading will help students to improve their quality of work and deepen their understanding. Informal daily assessments will be used daily by teachers through warm ups, journaling, questioning, and observations.</td>
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<tr>
<th>Unit 1 Focus Standards: Algebra</th>
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<tbody>
<tr>
<td>A-SSE.1*: Interpret the structure of expressions that represent a quantity in terms of its context, such as factors, terms, and coefficients and interpret complicated expressions by viewing one or more of their parts as a single entity;</td>
</tr>
<tr>
<td>A-CED.2<em>3</em>, 4*: Create equations that describe number or relationships using two or more variables, graph equations on coordinate axes with labels and scales, represent constraints by equations or inequalities or systems of both and interpret solutions as viable or nonviable options in a modeling context; rearrange formulas to highlight a quantity of interest.</td>
</tr>
<tr>
<td>A-REI.11, 6, 10, 11: Understand solving equations as a process of reasoning and explain the reasoning; Solve systems of linear equations in two variables exactly and approximately (with graphs), Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane. Explain why the x-coordinates of the points where the graphs of two equations intersect are the solutions of the equation setting the two equal, find approximate solutions, using technology. Include cases with linear, polynomial, rational, absolute value, exponential and logarithmic functions.</td>
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<tr>
<th>Functions</th>
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<tbody>
<tr>
<td>F-IF.4*,7*: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features including intercepts, intervals, relative max and min, symmetries, end behavior and periodicity. Graph functions expressed symbolically and show key features of the graph, by hand and using technology.</td>
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</table>
| F-BF.1*: Build a function that models the relationship between two quantities. (linear, exponential, quadratic). Determine an explicit expression, a recursive process or symbolic form of a multivariable function that can be modeled by power functions .  

<table>
<thead>
<tr>
<th>Students will...</th>
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<tbody>
<tr>
<td>• Recognize numeric and graphic patterns of change in direct and inverse variation relationships.</td>
</tr>
<tr>
<td>• Express direct and inverse variation relationships in symbolic forms.</td>
</tr>
<tr>
<td>• Recognize and represent relationships between variables that can be modeled by power functions .</td>
</tr>
<tr>
<td>• Solve problems involving direct and inverse variation.</td>
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<tr>
<td>• Write rules to define functions of two variables that combine direct and inverse variation.</td>
</tr>
<tr>
<td>• Solve for one variable in terms of the others in situations where the variables are related by direct and inverse variation.</td>
</tr>
<tr>
<td>• Write equations in the general form for reducing a linear system with two variables to a single equation with one variable.</td>
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<th>On a Roll-</th>
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<tr>
<td>Students roll a ball down a ramp of different lengths and heights and collect data to see how these dimensions of the ramp affect the roll time. Students represent the data in tables and graphs and analyze the relationships. Students then connect these relationships to other situations of direct and indirect variability.</td>
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<tr>
<th>Combining Direct and Inverse Variation-</th>
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<tr>
<td>In this investigation, students are asked to think about the relationship of current to voltage and resistance in simple circuits as an example of a multivariable function that combines direct and inverse variation.</td>
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<tr>
<th>Solving with Graphs and Substitution-</th>
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<tbody>
<tr>
<td>Students develop graphic strategies for finding solutions to linear systems by locating intersection points of graphs and the substitution strategy for reducing a linear system with two variables to a single equation with one variable.</td>
</tr>
</tbody>
</table>
Informal observations are important for teachers to conduct daily to get the pulse of the classroom and see how students are internalizing the content and procedures.

**Assessment of Learning** - Small quizzes, larger unit tests, and benchmark exams will assess what students have learned. Small quizzes and unit tests will be made up of both highly contextualized problems and more procedural problems. The contextualized problems will assess students’ ability to make sense of problems, reason abstractly, and construct viable arguments as well as modeling with mathematics. Procedural problems will focus on assessing students’ use of tools, attending to precision, making use of structure, and expressing regularity in repeated reasoning. The benchmark exams will be common assessments that will provide data to further drive changes in teaching strategies in order to enhance student success.

**Writing to Learn** - Students will keep a mathematics journal to write about their thinking during investigations and projects. Students will be required to justify their reasoning during any investigation and be able to summarize their conclusions. Writing about the mathematics will encourage students to construct viable arguments and critique the reasoning of others.

**Performance Assessments** - There will be smaller projects and key assignments during the year in which students will show their mastery of the content through a project that allows students to display their learning using multiple representations.

**Common Assessments** - Each unit will culminate in a district-wide common unit assessment (year 1 implementation will use Core-Plus provided assessments).

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</table>
| • Description  
• Learning Goals  
• Key Assessments |
| • Focus Standards  
• Related Standards |
| • Learning Objectives |
| • Sample Investigations and Assignments  
• Honors Extensions |

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Unit 2 Matrix Methods:

- This unit develops student understanding of matrices and ability to use matrices to model and solve problems in a variety of real world and mathematical settings.

Unit 2 Learning Goals:

- See the interconnectedness of mathematics through use of matrices to solve problems in algebra, geometry, statistics, and discrete mathematics.
- Use matrices to organize, display, and analyze data from a variety of contexts, such as archeology, sociology, ecology, sports, and business.
- Understand, carry out, and interpret matrix operations - row and column sums, matrix addition and subtraction, scalar multiplication, and matrix multiplication.
- Understand and apply properties of matrices and matrix operations, compare properties of matrices to those of real numbers, and thereby gain a gentle introduction to algebraic structure.
- Use matrices to solve systems of two linear equations.
- Compare and analyze different methods for solving systems of two linear equations by considering limitations, advantages, and disadvantages of methods learned in this and prior units.

Unit 2 Assessments:

Assessment for Learning- Feedback given in many forms such as direct teacher conversations and revision suggestions, mini-quizzes, peer grading rubrics, and self-grading will help students to improve their quality of work and deepen their understanding. Informal daily assessments will be used daily by teachers through warm ups, journaling, questioning, and observations. Informal observations are important for teachers to conduct daily to get the pulse of the classroom and see how students are internalizing the content and procedures.

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<td>Represent and manipulate data using matrices, multiply matrices by scalars to produce new matrices; add, subtract, and multiply matrices of appropriate dimensions; understand that unlike multiplication of numbers, square matrix multiplication is not commutative, but is associative and distributive; understand that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in real numbers. Understand properties of the determinant.</td>
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<tr>
<td>Algebra</td>
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<td>A-CED.3*: Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.</td>
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<td>Solve systems of linear equations exactly and approximately, focusing on pairs of linear equations in two variables. Represent a system of linear equations as a single matrix equation in a vector variable. Find the inverse of a matrix if it exists and use it to solve systems of linear equations.</td>
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Students will...

- Construct matrices to organize, display, and analyze information.
- Interpreting given matrices.
- Understand, carry out, and interpret matrix operations - row and column sums, matrix addition and subtraction, and scalar multiplication.
- Understand, carry out, and interpret matrix multiplication.
- Use matrix multiplication, including powers of matrices, to solve problems in a variety of settings.
- Represent a vertex-edge graph as a matrix and use powers of the matrix to analyze the situation modeled by the vertex-edge graph.
- Examine properties of operations with matrices.
- Compare properties of matrices with those of real numbers.
- Use matrices and their properties to solve systems of linear equations.
- Review, analyze, and compare various methods for solving systems of linear equations.

There’s No Business Like Shoe Business-
Students collect data from classmates about preferences in athletic shoe brands. Students organize data by student gender and preferred brand. Students learn to display data in matrix arrays and use them to describe patterns and recognize trends in the shoe business.

Analysis Matrices- Students will see how matrices can be used in a variety of contexts. They will interpret given matrices, and they will learn to operate on matrices in formal and informal ways, including finding row and column sums.

Brand Switching- In this investigation, students learn the process of standard matrix multiplication by analyzing situations and seeing how matrix multiplication emerges as a useful procedure to help understand situations and solve problems.

The Power of a Matrix-
Students will learn about the powers of a matrix that is, multiplying a matrix by itself and will use powers of matrices to solve problems in a variety of contexts. They will examine powers of an adjacency matrix.
### Unit 2

**Description**

- Focus Standards
- Related Standards
- Learning Objectives

**Key Assessments**

- Assessment of Learning: Small quizzes, larger unit tests, and benchmark exams will assess what students have learned. Small quizzes and unit tests will be made up of both highly contextualized problems and more procedural problems. The contextualized problems will assess students’ ability to make sense of problems, reason abstractly, and construct viable arguments as well as modeling with mathematics. Procedural problems will focus on assessing students’ use of tools, attending to precision, making use of structure, and expressing regularity in repeated reasoning. The benchmark exams will be common assessments that will provide data to further drive changes in teaching strategies in order to enhance student success.

- Writing to Learn: Students will keep a mathematics journal to write about their thinking during investigations and projects. Students will be required to justify their reasoning during any investigation and be able to summarize their conclusions. Writing about the mathematics will encourage students to construct viable arguments and critique the reasoning of others.

- Performance Assessments: There will be smaller projects and key assignments during the year in which students will show their mastery of the content through a project that allows students to display their learning using multiple representations.

- Common Assessments: Each unit will culminate in a district-wide common unit assessment (year 1 implementation will use Core-Plus provided assessments).

**Learning Objectives**

- **Modeling**: *all standards marked with asterisks are modeling standards.
  - **Unit 2 Related Standards**:
    - A-SSE.1*, 3*: Interpret expressions that represent a quantity in terms of its context. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
    - A-CED.4: Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
    - A-REI.1: Understand solving equations as a process of reasoning and explain the reasoning.
    - F-IF.3: Recognize that sequences are functions, sometimes-defined recursively, whose domain is a subset of the integers.
    - F-FB.1: Build a function that models a relationship between two quantities.

- **Smart Promotions, Smart Solutions**: Students learn a matrix method for solving systems of linear equations. In particular, they learn to translate a system of two linear equations into a matrix equation of the form $AX = D$ and solve the matrix equation by multiplying by $A$ inverse on the left.

- **Analyzing and Comparing Methods**: Students take a closer look at the inverse-matrix method and they review and compare all the methods they now know for solving systems of linear equations.

- **Honors Extensions**:
  - **Lesson 1**: OYO Ext. 19 & 21, pages 97-100 (sub 20 if nec)
  - Finding trends in matrices
  - Finding square root of matrix using digraphs
  - **Lesson 2**: OYO #E21, p. 129
  - Finding solution of system of 4 variables
  - **Lesson 3**: OYO #E17, p. 152
  - Project: Spreadsheets and Matrices

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matrix for a vertex-edge graph and interpret such a matrix in terms of the situation being modeled by the vertex-edge graph.
## Math 2 Scope and Sequence
### Unit 3 Coordinate Methods

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### Unit 3 Coordinate Methods:
- This unit develops student understanding of coordinate methods for representing and analyzing properties of geometric shapes, for describing geometric change, and for producing animations.

### Unit 3 Learning Goals:
- Use coordinates to represent points, lines, and geometric figures in a plane and on a computer or calculator screen.
- Use coordinate representations of figures to analyze and reason about their properties.
- Use coordinate methods and programming techniques as a tool to implement computational algorithms, to model rigid transformations and similarity transformations, and to investigate properties of shapes that are preserved under various transformations.
- Build and use matrix representations of polygons and transformations and use these to create computer animations.

### Unit 3 Assessments:
- **Assessment for Learning:** Feedback given in many forms such as direct teacher conversations and revision suggestions, mini-quizzes, peer grading rubrics, and self-grading will help students to improve their quality of work and deepen their understanding. Informal daily assessments will be used daily by teachers through warm ups, journaling, questioning, and observations. Informal observations are important for teachers to conduct daily to get the pulse of the classroom and see how students are internalizing the content and procedures.
- **Assessment of Learning:** Small quizzes, larger unit tests, and benchmark exams will assess what students

### Unit 3 Focus Standards:

#### Number and Quantity:
- **N-VM.6, 7, 8, 12:** Represent and manipulate data using matrices, multiply matrices by scalars to produce new matrices; add, subtract, and multiply matrices of appropriate dimensions; Work with 2 x 2 matrices as transformations of the plane, and interpret the absolute value of the determinant in terms of the area.

#### Geometry:
- **G-CO.1, 2, 5, 6:** Know precise definitions of angle, circle, perpendicular line, parallel line and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc. Represent transformations in the plane, using a variety of tools, describe them as functions, and compare transformations that preserve distance and angle to those that do not. Transform a geometric figure given a rotation, reflection, or translation using various tools. Use geometric descriptions of rigid motion and transformed geometric figures to predict the effects rigid motion has on figures in the coordinate plane.
- **G-GPE.1, 4, 5, 6:** Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation. Use coordinates to prove simple geometric theorems algebraically. Prove the slope criteria for parallel and

### Students will...
- Use coordinates to represent points, lines, and geometric figures in a plane.
- Develop and use coordinate representations of geometric ideas such as distance, slope, and midpoint to analyze properties of lines and shapes.
- Design algorithms for programming calculators or computers to perform routine geometry-related computations.
- Develop and use equations for circles in a coordinate plane.
- Reason with general coordinates to establish properties of triangles, quadrilaterals and circles.
- Use coordinates to develop function rules modeling translations, line reflections, and rotations and size transformations centered at the origin.
- Use coordinates to investigate properties of figures under one or more

### Representing Geometric Ideas with Coordinates:
- Students will create shapes using interactive geometry software. The will develop formulas and write algorithms for finding slopes of lines, distances and midpoints of segments. They will explore how 2-D software uses coordinates in drawing and in calculating measures of geometric figures.

### Reasoning with Slopes and Lengths:
- Students use slopes and distances to create and reason about figures. They investigate how slopes of perpendicular lines are related. In the process, the matrix representation of polygons is introduced.

### Modeling Rigid Transformations:
- Students develop coordinate rules and program planning algorithms for specific rigid transformations - translations, 90, 180, 270 degree rotations about the origin and reflections across the x- and y-axes and across the lines y = x and y = -x.

### Modeling Size Transformations:
- In this investigation, students will use coordinate methods to discover
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| perpendicular lines and use them to solve geometric problems. Find the point on a directed line segment between two given points that partitions the segment in a given ratio.  
G-MG.3*: Apply geometric methods to solve design problems.  
G-SRT.1: Verify experimentally the properties of dilations given by a center and a scale factor.  
Modeling  
*all standards marked with asterisks are modeling standards  
**Building and Using Rotation Matrices** - In this investigation, students begin by using coordinate rules for 180 and 90 degrees counter-clockwise rotations about the origin to find the matrix representation of such rotations. To allow for more interesting animations, students are then introduced to a more systematic method for finding rotation matrices - here in the case of the matrix for a 45 degrees counterclockwise rotation about the origin.

**Honors Extensions** -  
- **Lesson 1**: OYO #E32, p. 192  
- Orthogonal distance along streets  
- **Lesson 2**: OYO #R26, #E 29, pgs 226 and 227  
- Considering slopes of transformed lines  
- **Lesson 3**: OYO #E20, p. 249  
- Transformation from right to oblique  

**Project**: Street Distances
## Math 2 Scope and Sequence
### Unit 4 Regression and Correlation

#### Unit 4 Regression and Correlation:
- This unit develops student ability to describe how two quantitative variables on a scatterplot are related, including fitting a function to the data and the use of correlation to measure the strength of a linear association between the two variables.

#### Unit 4 Learning Goals:
- Describe the shape of a cloud of points on a scatterplot and describe the association between the two variables.
- Interpret the coefficients of the regression equation, learn some properties of the regression line, and understand that a regression line is an appropriate way to summarize the bivariate relationship only if the points form an elliptical cloud.
- Compute and interpret Pearson’s correlation and understand that a strong correlation does not imply that one variable causes the other.
- Determine whether a point is influential on the correlation and on the equation of the least squares regression line.

#### Unit 4 Assessments:
- **Assessment for Learning:** Feedback given in many forms such as direct teacher conversations and revision suggestions, mini-quizzes, peer grading rubrics, and self-grading will help students to improve their quality of work and deepen their understanding. Informal daily assessments will be used daily by teachers through warm ups, journaling, questioning, and observations. Informal observations are important for teachers to conduct daily to get the pulse of the classroom and see how students are internalizing the content and procedures.

#### Unit 4 Focus Standards:
- **Statistics and Probability**
  - S-ID.6*, 7*, 8*, 9*:
    - Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. Fit a function to the data, use functions fitted to data to solve problems in the context of the data, informally assess the fit of a function by plotting and analyzing residuals, fit a linear function for a scatter plot that suggests a linear association. Interpret the slope (rate of change) and the intercept (constant terms) of a linear model in the context of the data. Compute (using technology) and interpret the correlation coefficient of a linear fit. Distinguish between correlation and causation.
  - S-IC.6: Make inferences and justify conclusions from sample surveys, experiments, and observational studies. Evaluate reports based on data.
- **Modeling**
  - *all standards marked with asterisks are modeling standards

#### Unit 4 Related Standards:
- N-VM.6: Vector and Matrix quantities - Perform operations on matrices and use matrices in applications. Use matrices to represent and manipulate data.
- A-SSE.1: Seeing structure in expressions. Interpret the structure of expressions that represent a quantity in terms of its context. Interpret terms, factors, and coefficients.
- A-REI.10: Represent and solve equations and inequalities graphically. Understand that the

#### Students will…
- Construct scatterplots with appropriate labels and scales.
- Describe shapes of clouds of points on scatterplots (linear, curved, vary in strength).
- Identify types of association (positive and negative, strong and weak, perfect and none, linear and nonlinear).
- Identify clusters and different types of outliers.
- Read and interpret a scatterplot matrix.
- Understand that a linear model is appropriate when the points form an elliptical cloud.
- Computer errors in prediction and residuals and locate residuals on the plot.
- Understand that for the regression equation, the sum of the residuals is 0.
- Understand the regression line as the line that minimizes the sum of the squared residuals.
- Verify that the point \((x, y)\) is on the regression line.
- Determine whether an outlier is an influential point.
- Compute and interpret Pearson’s \(r\) as a measure of how closely the points cluster about the regression line.

#### Rank Correlation:
- Students are introduced to association from an intuitive standpoint with a problem that has students rank their music preferences and then compare their own ranking with that of a classmate. They will develop understanding of strong vs weak correlation and positive vs negative correlation for ranked data.

#### Shapes of Clouds of Points:
- This investigation teaches students that a cloud of points is called linear when the points form an elliptical cloud, to identify patterns that are curved, vary in strength, and have clusters or outliers, identify various types of outliers, and read and interpret a scatterplot matrix.

#### How Good is the Fit?:
- Students will learn to determine which line is “best-fitting” through a cloud of elliptical points. They will review using regression lines to make predictions and learn the difference between an error in prediction and a residual, and understand info about regression equations.
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- **Interpret Pearson’s r as the rescaled sum of the products \((x - \overline{x}, y - \overline{y})\).**
- **Learn that the size of the correlation is not an indication of whether a linear model is appropriate.**
- **Know that adding a constant to each value or multiplying by a positive constant does not change the correlation.**
- **Understand that association does not mean that one of the variables causes the other.**
- **Identify possible explanations (cause-and-effect, lurking variable) for an association and illustrate with a directed graph.**
- **Identify the explanatory variable and the response variable.**

**How Strong is the Association**
- This investigation considers the problem faced by the FCC as it considers assigning frequencies to new stations with broadcasting permits. Students solve the radio-station problem by building and analyzing a vertex-edge graph model. They learn how to color the vertices of a graph to solve the problem.

**Honors Extensions**
- **Lesson 1: OYO #E 17, p. 277** - Interesting new way to rank
- **Lesson 2: OYO #E26, p. 319-320** - Connecting correlation and slope

**Project:** Gathering and Analyzing your own Data
## Math 2 Scope and Sequence
### Unit 5 - Nonlinear Functions and Equations

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| This unit introduces function notation, reviews and extends student ability to construct and reason with functions that model parabolic shapes and other quadratic relationships in science and economics with special emphasis on formal symbolic reasoning methods, and introduces common logarithms and algebraic methods for solving exponential equations. | **Algebra**  
A-SSE.1*, 2*, 3*: See structure in expressions and interpret this structure. Write expressions in equivalent forms to solve problems. Interpret terms, factors, and coefficients, factor quadratic expressions to reveal the zeroes of the function it defines complete the square, use properties of exponents to transform exponential functions.  
A-CED.1*, 2*: Create equations (1 or 2 variables) and inequalities (1 variable only) that describe numbers or relationships, including ones with absolute value (CA), and use them to solve problems. Graph equations on coordinate axes with labels and scales.  
A-APR.3: Understand the relationship between zeroes and factors of polynomials. Identify zeroes of polynomials when suitable factorizations are available, and use the zeroes to construct a rough graph of the function defined by the polynomial.  
A-REL.1, 3, 4, 7, 10, 11*: Examine each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. Solve 1-variable equations and inequalities involving absolute value, graphing and interpreting them in context. Solve quadratic equations in one variable. Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane. Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = | Students will… |  
- Distinguish relationships between variables that are functions from those that are not.  
- Use f(x) notation to represent functions and the common questions about functions that arise in applied problems.  
- Identify domain and range of functions.  
- Construct rules for quadratic functions based on given properties such as x-intercepts, y-intercepts, and maximum/minimum point.  
- Write quadratic expressions in equivalent expanded or factored form.  
- Solve quadratic equations by factoring, by applying the quadratic formula, and by a computer algebra system.  
- Write and solve equations that represent questions about functions that model parabolic shapes and other quadratic relationships in science and economics with special emphasis on formal symbolic reasoning methods, and introduces common logarithms and algebraic methods for solving exponential equations. |  
- Supply and Demand – Students will investigate a summer jobs program which must consider relationships between pay offered for each |
| Generalize the definition of function and introduce “f(x)” notation for functions and the concepts of domain and range.  
- Construct rules for quadratic functions based on given properties such as x-intercepts, y-intercepts, and maximum/minimum point.  
- Write quadratic expressions in equivalent expanded or factored form.  
- Solve quadratic equations by factoring, by applying the quadratic formula, and by a computer algebra system.  
- Write and solve equations that represent questions about “real-life” situations involving comparison of a linear function and either an inverse variation or quadratic function.  
- Estimate solutions to equations in the form ax + b = k/x by using tables or graphs and solve those kinds of equations algebraically.  
- Estimate solutions to equations in the form mx + d = ax^2 + bx + c using tables or graphs and solve those equations algebraically.  
- Use common logarithms to “linearize” exponential patterns of growth that occur in measurement of sound intensity, acidity (or alkalinity) of liquids, and earthquake intensity.  
- Use logarithms to solve exponential equations. | | |

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**Key Assessments**

**Unit 5 Focus Standards:**

**A-REI.1, 3, 4, 7, 10, 11*:** A-REI.1, 3, 4, 7, 10, 11*

**Sample Investigations and Assignments:**

**Honors Extensions:**

**Sample Investigations and Assignments:**

**Honors Extensions:**

**Notation-**

Students further investigate the concept of a function in this investigation by attending to three questions. Which relationships between variables do mathematicians call functions? What is the standard notation used to represent information about functions? What do the terms domain and range mean when referring to functions? Students will investigate three real-world contexts to answer to these questions.

**Designing Parabolas-**

Students will explore the relationship of quadratic expressions in factored form to the graph intercepts and max or min points. They will extend their understanding and skill in the use of quadratic functions by considering types of problems often faced by architects.

**Supply and Demand –**

Students will investigate a summer jobs program which must consider relationships between pay offered for each.
**Unit 5 Assessments:**

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- **Performance Assessments** - There will be smaller projects and key assignments during the year in which students will show their mastery of the content through a project that allows students to display their learning using multiple representations.

**Unit 5 Focus Standards**

- F-IF.1, 2, 4*, 5*, 7*, 8: Understand that a function from one set to another set assigns to each element of the domain exactly one element of the range. If \( f \) is a function and \( x \) is an element of its domain, then \( f(x) \) denotes the output of \( f \) corresponding to the input \( x \). The graph of \( f \) is the graph of the equation \( y = f(x) \). Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of quantities, and sketch graphs showing key features given a verbal description of the relationship. Relate the domain of a function to its graph and to the quantitative relationship, it describes. Analyze functions using different representations. Graph functions expressed symbolically and show key features of the graph by hand in simple cases and using technology for more complicated cases. Functions include linear, quadratic, square root, cube root, piecewise, step, absolute value, polynomial, rational, exponential, and logarithmic. Show max and min; identify zeroes and asymptotes, intercepts, end behaviors and extrema.

- F-BF.1*: Build a function that models a relationship between two quantities. Determine an explicit expression, a recursive process, or steps for calculation from a context. Combine standard function types using arithmetic operations. Compose functions.

- F-LE.5*: Interpret parameters in a linear or exponential function in terms of a context.

**Modeling**

*all standards marked with asterisks are modeling standards

<table>
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<th>Unit 5 Key Assessments</th>
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<tr>
<td>between a linear function and either an inverse variation or quadratic function.</td>
<td>g(x) intersect are the solutions of the equation ( f(x) = g(x) ) and find the solutions in a variety of ways.</td>
<td>Assessment for Learning- Feedback given in many forms such as direct teacher conversations and revision suggestions, mini-quizzes, peer grading rubrics, and self-grading will help students to improve their quality of work and deepen their understanding. Informal daily assessments will be used daily by teachers through warm ups, journaling, questioning, and observations. Informal observations are important for teachers to conduct daily to get the pulse of the classroom and see how students are internalizing the content and procedures.</td>
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<td>Estimate solutions to equations in the form ( ax + b = k/x ) using tables or graphs and solve algebraically.</td>
<td>Estimate solutions to equations in the form ( mx + d = ax^2 + bx + c ) using tables or graphs and solve algebraically.</td>
<td>Assessment of Learning- Small quizzes, larger unit tests, and benchmark exams will assess what students have learned. Small quizzes and unit tests will be made up of both highly contextualized problems and more procedural problems. The contextualized problems will assess students’ ability to make sense of problems, reason abstractly, and construct viable arguments as well as modeling with mathematics. Procedural problems will focus on assessing students’ use of tools, attending to precision, making use of structure, and expressing regularity in repeated reasoning. The benchmark exams will be common assessments that will provide data to further drive changes in teaching strategies in order to enhance student success.</td>
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<tr>
<td>Recognize what is meant by “taking the common logarithm” of a real number.</td>
<td>Be able to rewrite any real number as a power of 10 by finding common logarithms.</td>
<td>Writing to Learn- Students will keep a mathematics journal to write about their thinking during investigations and projects. Students will be required to justify their reasoning during any investigation and be able to summarize their conclusions. Writing about the mathematics will encourage students to construct viable arguments and critique the reasoning of others.</td>
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<tr>
<td>Use common logarithms to solve exponential equations, both in and out of context.</td>
<td>( \log_b a = x ) means ( b^x = a ). For ( y = \log_b x ), ( b^y = x ). Use the properties of logarithms to evaluate or approximate expressions.</td>
<td>Performance Assessments- There will be smaller projects and key assignments during the year in which students will show their mastery of the content through a project that allows students to display their learning using multiple representations.</td>
</tr>
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**Honors Extensions**

- **Lesson 1**: OYO #E35, E41, pgs. 354-355
  - Extending functions to 1-1 and deriving quadratic formula
- **Lesson 2**: OYO #E19, p. 373
  - Fun with coloring
- **Lesson 3**: OYO #E22, p. 389
  - Using logs to find the number of primes

**Making More by Charging Less**

Students will extend the Supply and Demand investigation and will solve equations that involve combinations of linear functions and quadratic functions using tables, graphs, and symbolic reasoning.

**How Loud is Too Loud?**

Students will analyze sound intensity data as they express positive numbers as powers of ten and are introduced to the concept of the common logarithm.
**Unit 5**
- **Description**
- **Learning Goals**
- **Key Assessments**

| Common Assessments - Each unit will culminate in a district-wide common unit assessment (year 1 implementation will use Core-Plus provided assessments). |

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<thead>
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<td>N-RN.1, 2: Extend the properties of exponents to rational exponents. Explain how the properties follow from each other and rewrite expressions involving radicals and rational exponents using these properties.</td>
</tr>
<tr>
<td>A-CED. 3, 4: Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.</td>
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<td>A-REL.2: Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.</td>
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<td>A-APR.1: Understand that polynomials form a system analogous to the integers, namely, that they are closed under addition, subtraction, and multiplication. Add, subtract, and multiply polynomials.</td>
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<tr>
<td>F-IF.6*: Calculate and interpret the average rate of change of a function over a specified interval. Estimate the rate of change from a graph.</td>
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<tr>
<td>F-BF.3: Build new functions from existing functions including using technology to experiment with cases.</td>
</tr>
<tr>
<td>F-LE.1*, 2*: Distinguish between situations that can be modeled with linear functions and with exponential functions. Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (including from a table).</td>
</tr>
<tr>
<td>G-CO.2: Experiment with transformations in the plane. Represent them using transparencies and geometry software; describe them as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not.</td>
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<p>| <strong>Project:</strong> Take Home Test |</p>
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**G-GPE.1, 4:** Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation. Use coordinates to prove simple geometric theorems algebraically.

**S-ID.6:** Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
### Math 2 Scope and Sequence
#### Unit 6 - Modeling and Optimization

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| - This unit develops student ability in mathematical modeling, optimization, and problem solving through study of vertex-edge graphs as students model and solve problems about networks, paths and circuits. | - **Number** N-VM.6: Perform operations on matrices and use matrices in applications. Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network. | - Minimum Spanning Trees- Students will investigate a problem about optimizing a computer network in order to learn about minimum spanning trees. The will explore a best-edge algorithm and a nearest-neighbor algorithm for finding a minimum spanning tree (a connected graph with no circuits that reaches all the vertices of a weighted graph and has the least possible total weight).
| - **Learning Goals:** | - **Geometry** G-MG. 3*: Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios). G-SRT.9, 10, 11: Apply trigonometry to general triangles. Derive the formula A = ½ ab sin © for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side. Prove the Laws of Sines and Cosines and use them to solve problems. Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles. | - **The Traveling Salesperson Problem (TSP)-** Students investigate the TSP in which a salesperson wants to visit several different cities exactly once, and then return home. Among the possible routes, which will minimize the total distance traveled? They will use Hamilton circuits to find its solution and consider its applications.
| - Understand and apply minimum spanning trees, Hamilton circuits, the Traveling Salesperson Problem, and critical paths (including ideas from the Critical Path Method (CPMP) or Program Evaluation and Review Technique (PERT)). | - **Modeling** *all standards marked with asterisks are modeling standards* | - **Building a Model-** Students learn how to construct a project digraph that shows tasks and prerequisite tasks in the context of a spring dance planning project.
| - Further develop skills in mathematical modeling by modeling and solving problems with vertex-edge graphs. | - **Unit 6 Focus Standards:** | - **Critical Paths and the Earliest Finish Time-** Students investigate minimum completion time or earliest finish time (EFT) in a large project in
| - Further develop skills in algorithmic problem solving by designing, using, and analyzing systematics procedures for solving problems involving vertex-edge graphs. | - **Students will...** | |
| - Further develop the ability to recognize, formulate, and solve optimization problems, particularly network optimization problems. | - Understand and apply minimum spanning trees, Hamilton circuits, and the Traveling Salesperson Problem (TSP). | | |
| - **Assessment for Learning:** Feedback given in many forms such as direct teacher conversations and revision suggestions, mini-quizzes, peer grading rubrics, and self-grading will help students to improve their quality of work and deepen their understanding. Informal daily assessments will be used daily by teachers through warm ups, journaling, questioning, and observations. Informal observations are important for teachers to conduct daily to get the pulse of the classroom and see how students are internalizing the content and procedures. | - Compare and contrast graph topics: TSP vs. minimum spanning trees, Hamilton vs. Euler circuits, matrices and graphs. | | |
| - **Unit 6 Related Standards:** N-Q.2*: Define appropriate quantities for the purpose of descriptive modeling. A-SSE.1*: Interpret expressions that represent a quantity in terms of its context. A-REI.1: Reason with equations and inequalities and understand solving equations as a process of reasoning, | - Further develop skills in mathematical modeling, particularly modeling with vertex-edge graphs. | | |
| | - Further develop the ability to recognize, formulate and solve optimization problems, particularly designing, using and analyzing algorithms for minimum spanning trees and the TSP. | | |
| | - Further develop the ability to recognize, formulate and solve optimization problems, particularly related to optimum spanning networks. | | |
| | - Construct and interpret a project digraph. | | |
| | - Determine earliest finish time for a project consisting of many tasks. | | |
| | - Understand and apply critical paths and critical tasks in the context of project scheduling. | | |
| | - Further develop skills in algorithmic problem solving and optimization. | | |
Assessment of Learning- Small quizzes, larger unit tests, and benchmark exams will assess what students have learned. Small quizzes and unit tests will be made up of both highly contextualized problems and more procedural problems. The contextualized problems will assess students’ ability to make sense of problems, reason abstractly, and construct viable arguments as well as modeling with mathematics. Procedural problems will focus on assessing students’ use of tools, attending to precision, making use of structure, and expressing regularity in repeated reasoning. The benchmark exams will be common assessments that will provide data to further drive changes in teaching strategies in order to enhance student success.

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Common Assessments - Each unit will culminate in a district-wide common unit assessment (year 1 implementation will use Core-Plus provided assessments).

including providing explanations of the reasoning.

G-MG.1*:

Use geometric shapes, their measures, and their properties to describe objects.

which the goal is to get all tasks done most efficiently. They will use project digraphs to find EFTs and critical paths for a number of different tasks.

Honors Extensions- Lesson 1: OYO #E20, p. 427 or #E25, p. 432
Lesson 2: OYO #E19, p. 449

Project: Clock Solitaire
### Math 2 Scope and Sequence

#### Unit 7 - Trigonometric Methods

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#### Unit 7 Trigonometric Methods:
- This unit develops student understanding of trigonometric functions and the ability to use trigonometric methods to solve triangulation and indirect measurement problems.

#### Unit 7 Learning Goals:
- Explore the sine, cosine, and tangent functions defined in terms of a point on the terminal side of an angle in standard position in a coordinate plane.
- Explore properties of the sine, cosine, and tangent ratios of acute angles in right triangles and use those ratios to solve applied problems.
- Derive the Law of Sines and the Law of Cosines and use those laws to determine measures of sides and angles for non-right triangles.
- Use the Law of Sines and Cosines to solve a variety of applied problems that involve triangulation.
- Describe the conditions under which two, one, or no triangles are determined given the lengths of two sides and the measure of an angle not included between the two sides.

#### Unit 7 Assessments:
- **Assessment for Learning:** Feedback given in many forms such as direct teacher conversations and revision suggestions, mini- quizzes, peer grading rubrics, and self-grading will help students to improve their quality of work and deepen their understanding. Informal daily assessments will be used daily by teachers through warm-ups, journaling, questioning, and observations. Informal observations are important for teachers to conduct daily to get the pulse of the classroom and see how students are internalizing the content and procedures.
- **Assessment of Learning:** Small quizzes, larger unit tests, and benchmark exams will assess what students have learned. Small quizzes and unit tests will be made up of both highly

#### Unit 7 Focus Standards:

**Geometry**

G-SRT.6, 7, 8*, 9, 10, and 11: Define trigonometric ratios, solve problems involving right triangles, and apply trigonometry to general triangles.

- Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles. Explain and use the relationship between the sine and cosine of complementary angles. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. Apply trigonometry to general triangles. Derive the formula \( A = \frac{1}{2} ab \sin \gamma \) for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side. Prove the Laws of Sines and Cosines and use them to solve problems. Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles.

**Modeling:**

*all standards marked with asterisks are modeling standards

#### Unit 7 Related Standards:

N-Q.3*: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

A-SSE.1*: Interpret expressions that represent a quantity in terms of its context.

**Students will…**

- Determine values of the sine, cosine, and tangent functions of an angle in standard position in a coordinate plane.
- Determine the sine, cosine, and tangent of an acute angle in a right triangle, and determine the angle given one of those ratios.
- Solve problems involving indirect measurement that can be modeled using right triangles.
- Explore basic properties of the sine, cosine, and tangent functions with reference to their interrelationships and their patterns of change as the angle measure changes.
- Use these laws to solve problems involving indirect measurement and analysis of mechanisms that use triangles with a side of variable length.
- Determine whether two, one, or no triangles are possible when the lengths of two sides and the measure of an angle.

**Connecting Angle Measures and Linear Measures**

Students consider a radio transmitter tower and use the Pythagorean Theorem to determine the third side of a right triangle, given the other two sides. They will begin to understand trigonometric ratios in this investigation.

**Measuring without Measuring**

Right triangle definitions of sine, cosine, and tangent are introduced in a variety of applications. Students will develop the ability to solve for missing side lengths and angle measurements of right triangles.

**The Law of Sines**

In this investigation, students provide reasons for steps in the derivation of the Law of Sines for right triangles and then use the Law of Sines to solve for parts of a triangle in applications involving distances and lengths.

**The Law of Cosines**

Students are introduced to the Law of Cosines in this investigation where they will use
### Unit 7

- **Description**
- **Learning Goals**
- **Key Assessments**

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<td><strong>Interpret</strong> parts such as terms, factors and coefficients.</td>
<td><strong>Interpreted</strong> complicated expressions by viewing one or more of their parts as a single entity.</td>
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<td><strong>A-REI.1:</strong> Reason with equations and inequalities and understand solving equations as a process of reasoning, including providing explanations of the reasoning.</td>
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<td><strong>F-IF.7, 8:</strong> Graph functions expressed symbolically and show key features of the graph by hand in simple cases and using technology for more complicated cases. Functions include linear, quadratic, square root, cube root, piecewise, step, absolute value, polynomial, rational, exponential, and logarithmic. Show max and min; identify zeroes and asymptotes, intercepts, end behaviors and extrema.</td>
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<td><strong>G-MG.1</strong>, <strong>3</strong>: Use geometric shapes, their measures, and their properties to describe objects. Apply geometric methods to solve design problems.</td>
<td>not included between these sides are known.</td>
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### Sample Investigations and Assignments

**Honors Extensions**

- **Lesson 1:** OYO #E27, #E30, pages 483-484
  - Two ways to find the area of a triangle; measuring actual tall object using trig

- **Lesson 2:** OYO #C9 and #E23, pages 506 and 511
  - Finding the height of a triangle given only the three side lengths

**Project:** Approximating Pi (1 and 2 only)
### Math 2 Scope and Sequence
#### Unit 8 - Probability Distributions

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#### Unit 8 - Probability Distributions:
- This unit develops student understanding of independent events, conditional probability, and expected value and how to use them to interpret data and evaluate outcomes of decisions.

#### Unit 8 Learning Goals:
- Interpret and compute conditional probabilities.
- Use the Multiplication Rule to find \( P(A \text{ and } B) \), when events \( A \) and \( B \) are independent and when they are not independent.
- Compute the expected value (mean) of a probability distribution.
- Identify waiting-time situations and construct waiting-time distributions.

#### Unit 8 Assessments:
- **Assessment for Learning:** Feedback given in many forms such as direct teacher conversations and revision suggestions, mini-quizzes, peer grading rubrics, and self-grading will help students to improve their quality of work and deepen their understanding. Informal daily assessments will be used daily by teachers through warm-ups, journaling, questioning, and observations. Informal observations are important for teachers to conduct daily to get the pulse of the classroom and see how students are internalizing the content and procedures.
- **Assessment of Learning:** Small quizzes, larger unit tests, and benchmark exams will assess what students have learned. Small quizzes and unit tests will be made up of both highly contextualized problems and more procedural problems. The contextualized problems will assess students’ ability to make sense of problems, reason abstractly, and construct viable arguments as well as modeling with mathematics. Procedural problems will focus on assessing students’ use of tools, attending to precision, making use of structure, and expressing regularity in repeated reasoning. The benchmark exams will be common assessments that will provide data to further drive

### Unit 8 Focus Standards:
**Statistics and Probability:**
- S-ID.1* 5*: Summarize, represent, and interpret data on a single count or measurable variable. Represent data with dot plots, histograms and boxplots. Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data. Recognize possible associations and trends in the data. S-CP.1*, 2*, 3*, 4*, 5*, 6*, 8*: Understand independence and conditional probability and use them to interpret data. Describe events as subsets of sample spaces using characteristics of the outcomes or as unions, intersections, or complements of other events. Understand that two events \( A \) and \( B \) are independent if the probability of \( A \) and \( B \) occurring together is the product of their probabilities, and use this characterization to determine if they are independent. Understand the conditional probability of \( A \) given \( B \) as \( P(A \text{ and } B)/P(B) \), and interpret independence of \( A \) and \( B \) as saying that the conditional probability of \( A \) given \( B \) is the same as the probability of \( A \), and the conditional probability of \( B \) given \( A \) is the same as the probability of \( B \). Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to compute conditional probabilities using the idea of restricting the sample space to include only the outcomes specified by the “condition.”

### Students will…
- Use an area model to find the probability that two independent events both occur.
- Compute conditional probabilities.
- Determine if two events are independent.
- Use the Multiplication Rule to find the probability that two events both occur when the events are or are not independent.
- Compute the fair price (expected value) of insurance and games of chance.
- Develop and use a formula for the expected value of a probability distribution.
- Use simulation to construct an approximate waiting-time distribution and understand why the shape is skewed to the right.
- Recognize rare events in a waiting-time situation.
- Develop and use the formula to construct the probability distribution for a waiting-time situation.
- Discover the formula for the expected value of a waiting-time distribution.
- Understand that some infinite series have a finite sum.

### The Multiplication Rule for Independent Events-
Students will consider which methods they can use to find the probability that two events both happen. They will develop an area model based on the idea that the total probability of all possible events is 1 and this is modeled by a whole rectangular area.

### Conditional Probability-
Students will consider the probability of an event occurring when they know another event occurs. They will learn how to compute conditional probabilities using the idea of restricting the sample space to include only the outcomes specified by the “condition.”

### What’s a Fair Price?-
In this investigation, students learn how to find the price that should be charged to play a game (or to buy insurance) so that, in the long run, the amount won by the players is equal to the amount the players were charged to play. Students will use the mathematical meaning of “fair.”
### Unit 8

- **Description**
- **Learning Goals**
- **Key Assessments**

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<td>Changes in teaching strategies in order to enhance student success.</td>
<td>Decide if events are independent and to approximate conditional probabilities. Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. Find the conditional probability of A given B as the fraction of B’s outcomes that also belong to A, and interpret the answer in terms of the model. Apply the general Multiplication Rule in a uniform probability model and interpret the answer in terms of the model. S-MD.1*, 2, 3*, 5*, 6*: Calculate expected values and use them to solve problems. Define random variable for quantities of interest by assigning numerical values to events in sample spaces and graph the corresponding distribution. Calculate the expected value of a random variable; interpret it as the mean of the probability distribution. Develop probability distributions for random variables defined for a sample space in which theoretical probabilities can be calculated and find the expected value. Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator). S-IC.2: Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. <strong>Modeling:</strong> <em>all standards marked with asterisks are modeling standards</em>*</td>
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**Performance Assessments**- There will be smaller projects and key assignments during the year in which students will show their mastery of the content through a project that allows students to display their learning using multiple representations.

**Common Assessments** - Each unit will culminate in a district-wide common unit assessment (year 1 implementation will use Core-Plus provided assessments).

**Waiting for Doubles**- Students will construct frequency distributions and histograms of waiting-time distributions, both by simulation and theoretically, and will discover that all have the same basic shape.

**Expected Waiting Time**- In this investigation, students find a theoretical way to calculate the expected value of a waiting-time distribution. They will look at data from M & M’s candies about their color distribution and investigate the probability of drawing an orange one from a large bag of candies.

**Honors Extensions**-

- **Lesson 1:** OYO #E21, p. 542 - 2-way tables with independence or mutual exclusivity
- **Lesson 2:** OYO #E17, pgs 557-558 - Expected value – one spinner with three games
- **Lesson 3:** OYO #E22, p. 582 - Infinite series with finite sums

**Project:** Rare, Please
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**Unit 8 Related Standards:**

- **A-SSE.4:** Derive the formula for the sum of a finite geometric series (when the common ration is not 1), and use the formula to solve problems.
- **G-MG.3**: Apply geometric methods to solve design problems.
- **S-ID.2**: Use statistics appropriate to the shape of the data distribution to compare center and spread of two or more different data sets.
- **S-MD.4*, 7**: Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated, find the expected value. Analyze decisions and strategies using probability concepts.
- **S-CP.7**: Apply the Addition Rule, \( P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B) \) and interpret the answer in terms of the model.
The primary goals of the EUHSD Mathematics program are as follows: first, ensure students develop a deeper understanding of mathematics; second, prepare students to take on more advanced studies in math; third, personalize the pursuit of honors and advanced coursework; fourth, to focus on the level of rigor evidenced by the work produced by students. Accordingly, students who elect to participate in and produce honors level work will receive honors credit.

Students who earn the honors designation in these courses will produce work that addresses more sophisticated questions, delve more deeply into the mathematics of the course, and satisfy the California State Standards with added rigor. The honors modification applied to some course assignments will broaden the scope or deepen the examination of the course content.

The honors option is available to all students enrolled in Math 2, Math 3S, Math 3C, and Math 4, and will take place within those classrooms. Students are provided the opportunity to opt in to the Honors requirements. Only students in Math 4 will be eligible for the UC Honors designation (pending) and receive a weighted grade. Honors students in the Math 2 and Math 3 courses will not receive a weighted grade.

Student Name___________________________________________  ID Number __________________________

Semester: (circle)       Fall  Spring    School Year _____________

School Site: (circle)      EHS      OGHS       SPHS     DLA        VHS

Course Name ____________________________________  Email _______________________________

Teacher Name____________________________________ Period_________

(See Reverse)
*I am enrolling in the HONORS OPTION for the above course. I understand that I will be expected to complete different and more challenging work than those students who do not register for the Honors Option.

*I also understand that if I change my mind and decide not to complete the HONORS OPTION, I must make that decision and petition to be released from the HONORS OPTION by the (INSERT DATE or 8 weeks in) of the semester in which this contract applies.

*HONORS OPTIONS drop dates are ________ and ____________ for the Fall and Spring semesters of the 2018-2019 school year, which are after the first unit exam of each semester.

*A Petition to be Released from the Honors Option form requires consultation with and signatures of 1) the course teacher, 2) a parent or guardian, and 3) the student. Form must be submitted to student’s counselor.

*I understand that if I decide not to continue with the HONORS OPTION but drop it by the deadline, my grade will be noted on my transcript as a regular letter grade with no penalty. However, if I do not formally drop the HONORS OPTION by the required deadline, I will remain in the Honors section and all HONORS OPTION requirements (complete or incomplete) will be counted in my final grade.

*I realize that the HONORS OPTION requirements will include attendance outside of school hours for a Demonstration of Learning one time per semester.

Student Signature_________________________________________  Date________________

Teacher Signature_________________________________________  Date________________

To be completed by the Parent(s)/Guardian(s) of the student

I understand the terms of the above contract.

Parent(s)/Guardian(s) Signature___________________________________ Date________________

This form must be submitted to the student’s counselor by the 20th day of the semester. For 2018 – 2019, those dates are:

Fall Semester – September XX, 2018   Spring Semester – February XX, 2019
Petition for Release from Honors Option Contract

Student Name___________________________________________   ID Number ___________________________

Course Name___________________________________________     email _______________________________

Teacher Name___________________________________________   period___________

Semester: (circle)                     Fall     Spring                      School Year __________________

I request that I be released from the HONORS OPTION Contract in the above course for the following reason(s):

__________________________________________________________________________________________________
__________________________________________________________________________________________________

Student Signature_________________________________          Date_____________________

**************************************************************************************************

Teacher Name_____________________________________________

The student and I have discussed this matter and I DO / I DO NOT (circle one)   agree with this decision

Teacher Signature_________________________________________  Date________________

*****************************************************************************************

To be completed by the Parent(s)/Guardian(s) of the student

I / We   DO / DO NOT (circle one) agree with _______________________________'s decision to be released
from the HONORS OPTION in this course.

Parent(s)/Guardian(s) Signature___________________________________ Date________________

This form must be submitted to the student’s counselor before the end of the first 6 week grading period (or whatever we propose)

For 2018 – 2019, those dates are:

Fall Semester – September XX, 2018Spring Semester – February XX, 2019