Mission and Vision

We relentlessly pursue, with optimism, equitable support for all students to navigate a changing world by providing rigorous and relevant learning experiences that strengthen their capacity as

- Open-minded and invested collaborators;
- Effective and thoughtful communicators;
- Resourceful and creative problem solvers;
- Curious and analytical critical thinkers;
- Informed and compassionate community members.

EUHSD curriculum identifies what students should know and be able to do by grade level in a comprehensive, standards-based course of study. Curriculum may be updated, as needed, based on student academic achievement data, research and best practices, and input from stakeholders. The EUHSD curriculum contains the following information:

- **Course Description** – provides a description of the overarching content and goals of the course and is used in the Course Catalog.
- **Course Information** – provides information specific to length of course, course number, transcript abbreviation, credits earned.
- **Course Requirements** – provides information specific to credits, prerequisites, UC/CSU requirements, and grade level of the course.
- **Course Material(s)** – Instructional materials used in course.
- **Scope and Sequence** – provides the standards-based units of instruction including the Learning Objective and Sample Performance Tasks and Assessments.

To ensure all courses empower every student, specifically emerging multilingual students, to graduate prepared for college, career, and life, all EUHSD courses will:

- Incorporate the English Language Development state standards adopted by the CA Department of Education in 2012. Visit the following website to learn more about the new descriptors and corresponding standards: [https://www.cde.ca.gov/sp/el/er/documents/eldstandspublication14.pdf](https://www.cde.ca.gov/sp/el/er/documents/eldstandspublication14.pdf)
- Highlight specific strategies designed to meet the needs of emerging multilingual students as outlined in the 2014 CA Department of Education ELA-ELD Framework and the 2017 CA EL Roadmap. Visit the following URL to learn more about the new Frameworks: [https://www.cde.ca.gov/ci/rl/cf/documents/elaelfwchapter11.pdf](https://www.cde.ca.gov/ci/rl/cf/documents/elaelfwchapter11.pdf). To learn more about the CA EL Roadmap, visit the following website: [https://www.cde.ca.gov/sp/el/rm/](https://www.cde.ca.gov/sp/el/rm/)

Escondido Union High School District prohibits discrimination, harassment, intimidation, and bullying based on actual or perceived ancestry, age, color, disability, gender, gender identity, gender expression, nationality, race or ethnicity, religion, sex, sexual orientation, pregnancy, marital or parental status or association with a person or group with one or more of these actual or perceived characteristics.

Dr. Courtney Goode, Assistant Superintendent of Human Resources, Equity and Title IX Compliance Officer
302 N. Midway Drive, Escondido, CA 92027
Office: (760) 291-3281, Email: cgoode@euhsd.org
**Course Description**

Math 1 is the first of an integrated and investigative mathematics program designed to use patterns, modeling, and conjectures to build student understanding and competency in mathematics. The Math 1 course is designed to formalize and extend student understanding of linear functions and their applications. The critical areas of focus include: (1) extending understanding of numerical manipulation to algebraic manipulation; (2) synthesizing understanding of function; (3) deepening and extending understanding of linear relationships; (4) applying linear models to data that exhibit a linear trend; (5) establishing criteria for congruence based on rigid motions; (6) applying the Pythagorean Theorem to the coordinate plane. The Math 1 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).

<table>
<thead>
<tr>
<th>Semester A:</th>
<th>Course Number:</th>
<th>Transcript Abbreviation:</th>
<th>Credits:</th>
<th>Weighted:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semester B:</td>
<td>2245</td>
<td>MATH 1 A (P)</td>
<td>5</td>
<td>No</td>
</tr>
<tr>
<td>Semester A:</td>
<td>2247</td>
<td>MATH 1 A (H)</td>
<td>5</td>
<td>No</td>
</tr>
<tr>
<td>Semester B:</td>
<td>2248</td>
<td>MATH 1 B (H)</td>
<td>5</td>
<td>No</td>
</tr>
<tr>
<td>Semester A:</td>
<td>2251</td>
<td>MATH 1 A (SAI)</td>
<td>5</td>
<td>No</td>
</tr>
<tr>
<td>Semester B:</td>
<td>2252</td>
<td>MATH 1 B (SAI)</td>
<td>5</td>
<td>No</td>
</tr>
</tbody>
</table>

Students who successfully complete the yearlong Math 1 will fulfill the California Department of Education Algebra 1 state graduation requirement.

**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.

**Course Requirements**

<table>
<thead>
<tr>
<th>Length of Course:</th>
<th>Yearlong</th>
<th>Course Learning Environment:</th>
<th>Classroom Based</th>
<th>Type of Grade:</th>
<th>Letter Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade Level:</td>
<td>9-12</td>
<td>Course Repeatable:</td>
<td>No</td>
<td>Maximum Credits, if Repeatable:</td>
<td>N/A</td>
</tr>
<tr>
<td>Course Type:</td>
<td>College Prep</td>
<td>CTE/Designated College Prep:</td>
<td>No</td>
<td>CTE Course Level:</td>
<td>N/A</td>
</tr>
<tr>
<td>Meets EUHSD Graduation Requirement:</td>
<td>Mathematics</td>
<td>Meets UC/CSU Requirement:</td>
<td>C: Mathematics</td>
<td>UC Honors Designation:</td>
<td>No</td>
</tr>
<tr>
<td>Prerequisite(s):</td>
<td>None</td>
<td><strong>Course Material(s)</strong></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td><strong>It’s All Write</strong> - A writing supplement for high school mathematics classes (consumable and reproducible instructional materials to improve the quality of mathematics writing) (Supplemental Teacher Resource)</td>
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</table>

**Standards**

California State Standards for Mathematics and Common Core Standards for Mathematical Practice
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.

<table>
<thead>
<tr>
<th>Instructional Shifts in Mathematics</th>
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</thead>
<tbody>
<tr>
<td><strong>Focus:</strong> Focus requires that we significantly narrow and deepen the scope of content in each grade so that students experience concepts at a deeper level.</td>
</tr>
<tr>
<td><strong>Focus strongly where the Standards focus</strong></td>
</tr>
<tr>
<td>- Instruction engages students through cross-curricular concepts and application. Each unit focuses on implementation of the Math Practices in conjunction with math content.</td>
</tr>
<tr>
<td>- Effective instruction is framed by performance tasks that engage students and promote questions in order to provide a clear and explicit purpose for instruction.</td>
</tr>
<tr>
<td><strong>Coherence:</strong> Coherence in our instruction supports students to make connections within and across grade levels.</td>
</tr>
<tr>
<td><strong>Think across grades; and link to major topics within grades</strong></td>
</tr>
<tr>
<td>- Problems and activities connect clusters and domains through the art of questioning.</td>
</tr>
<tr>
<td>- 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.</td>
</tr>
<tr>
<td>- 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.</td>
</tr>
<tr>
<td><strong>Rigor:</strong> Rigor helps students to read various depths of knowledge by balancing conceptual understanding, procedural skills and fluency, and real-world applications with equal intensity.</td>
</tr>
<tr>
<td><strong>In major topics, pursue conceptual understanding, procedural skills and fluency, and application</strong></td>
</tr>
<tr>
<td>- Conceptual understanding underpins fluency; fluency is practiced in contextual applications; and applications build conceptual understanding.</td>
</tr>
<tr>
<td>- 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.</td>
</tr>
<tr>
<td>- Each unit contains a balance of challenging, multiple-step problems to teach new mathematics, and exercises to practice mathematical skills.</td>
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</table>
The EUHSD mathematics curriculum document and all supporting documentation are aligned to the California State Standards for Mathematics, 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
2. Guide to the CASS-M Conceptual Category Abbreviations
3. Eight Standards for Mathematical Practice
4. California Frameworks for Mathematics
5. Smarter Balanced Assessment System Mathematics Assessment Blueprint
6. California English Language Development Standards
7. University of California Mathematics Pathway FAQ
8. Core Plus Instructional Materials

<table>
<thead>
<tr>
<th>California State Standards for Mathematics - Content</th>
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<tbody>
<tr>
<td>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. 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.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Common Core Standards for Mathematical Practice</th>
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<tbody>
<tr>
<td>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).</td>
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<table>
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<tr>
<th>Honors Option for Math 1</th>
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</table>
| 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. |
## 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 can apply relevant 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 $(x - 1) (x^3 + x2 + x + 1)$ 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.
## Unit 0: Introductory Writing Unit

### Unit Description

The *It’s All Write* supplemental project is a one-week set of writing activities which helps students at the secondary level examine and improve the quality of their writing about mathematics.

### Unit Outline

<table>
<thead>
<tr>
<th>Standards</th>
<th>Learning Objectives</th>
<th>Essential Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Writing Unit - Standards for Math Practice:</strong></td>
<td>Students will…</td>
<td>1. What are the elements of a clear justification of mathematical thinking?</td>
</tr>
</tbody>
</table>
| **SMP 3** Construct Viable Arguments and Critique the Reasoning of Others - mathematically proficient students justify their conclusions, communicate them to others and respond to the arguments of others. Students can listen to or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments. | • clarify thinking about mathematical problems and the process of solving them through writing.  
• use writing as a tool to generate new ideas in the process of problem-solving.  
• recognize writing as a tool to record important information and thinking to be used at a later time in the problem-solving process.  
• use writing as a tool to communicate their mathematical ideas to others.  
• generalize about solutions to mathematical problems.  
• work collaboratively with peers to problem solve.  
• create and use rubrics to score their own and others’ writing about mathematics.  
• reflect on their own mathematical thinking and express these reflections through writing.  
• reflect on their mathematical writing. | 2. How can academic language be used to communicate mathematical concepts precisely? |
| **SMP 6** Attend to Precision - mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussions with others and in their own reasoning. |                                                                                     |                                                                                       |

### Sample Performance Tasks/Assessments

#### Sample Performance Tasks:
- Checkerboard Squares: Students solve the traditional how many squares are on a checkerboard? problem and use this problem as a launching place to learn about the process of solving and explaining problems. They start the process of thinking
and writing about how they find answers and how they know their answers are correct.

- Rubrics: Students use rubrics to score anchor papers (provided) for the Checkerboard Square problem and develop their own for use with future problems.

**Sample Assessments:**
- Most of the assessing in this unit will be done by the students as they reflect on their mathematical writing by answering the following questions in a culminating essay:
  - How has my mathematics writing changed?
  - How might my writing differ in the future, and why?
  - What do I think about holistic scoring and about the use of rubrics?
  - What have I learned from looking at other student papers?
### Unit Description

This unit develops student ability to recognize and describe important patterns that relate quantitative variables, to use data tables, graphs, words, and symbols to represent the relationships, and to use reasoning and calculating tools to answer questions and solve problems.

### Unit Outline

<table>
<thead>
<tr>
<th>Standards</th>
<th>Learning Objectives</th>
<th>Essential Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number &amp; Quantity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N-Q.3*: Reason quantitatively and use units to solve problems.</td>
<td>Students will...&lt;br&gt;• develop the disposition to look for cause-and effect relationships between variables.&lt;br&gt;• review and develop skills in organizing data in tables and graphs and using words to describe patterns of change shown in those representations.&lt;br&gt;• review or begin to develop knowledge about common patterns of change and the ability to use symbolic rules to represent and reason about those patterns.&lt;br&gt;• use tables, graphs and rules to solve problems of cause-and -effect change.&lt;br&gt;• recognize recursive patterns of change.&lt;br&gt;• use calculators to iterate stages in a recursive pattern.&lt;br&gt;• write NOW-NEXT rules to represent recursive patterns.&lt;br&gt;• write and use spreadsheet formulas to explore recursive patterns of change.&lt;br&gt;• use iteration to solve problems about population and money change over time.&lt;br&gt;• write rules that express problem conditions.&lt;br&gt;• review perimeter and area formulas for triangles, parallelograms, and circles and the Pythagorean Theorem.&lt;br&gt;• produce tables and graphs for functions.&lt;br&gt;• use function tables, graphs, and computer algebra manipulatives to solve problems that involve functional relationships, especially solving equations in one variable.</td>
<td>1. How can tables, graphs, and rules relating variables be used to answer questions about relationships between variables? 2. How do patterns of change affect values in tables, shapes of graphs, and algebraic rules? 3. How do dependent variables change as independent variables increase? 4. What are some effective strategies for finding symbolic expressions that represent relationships between variables? 5. How do the forms of algebraic rules give useful information about the patterns in tables and graphs produced by those rules?</td>
</tr>
<tr>
<td><strong>Algebra</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A-SSE.1*: Interpret the structure of expressions; A-CED.2*: Create equations that describe number or relationships; A-REI.10: Represent and solve equations and inequalities graphically.</td>
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<tr>
<td><strong>Functions</strong></td>
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</tr>
<tr>
<td>F-IF.3, 4*,5*,7*,9: Understand the concept of a function and use function notation, interpret functions that arise in applications in terms of the context, analyze functions using different representations. Interpret key features of graphs and tables, sketching graphs to show key features such as intercepts, increasing, decreasing, positive or negative intervals, relative max and mins, symmetry, end behavior and periodicity. F-BF.1*, 2*: Build a function that models the relationship between two quantities. F-LE.2*,5*: Construct and compare linear, quadratic and exponential models and solve problems, interpret expressions for functions in terms of the situation they model.</td>
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</tr>
<tr>
<td><strong>Modeling</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*all standards marked with asterisks are modeling standards</td>
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<td></td>
</tr>
<tr>
<td>N-Q.2*, 3*: Reason quantitatively and use units to solve</td>
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</tbody>
</table>
problems.

A-SSE.3*: Write expressions in equivalent forms.

A-REI.3: Solve equations and inequalities in one variable.

F-IF.1, 8: Understand the concept of a function as a mapping from a domain to a range. Reveal and explain properties of functions by writing them in equivalent forms.

F-BF.3: Build new functions from existing functions including using technology to experiment with cases.

F-LE.1*: Distinguish between situations that can be modeled with linear functions and with exponential functions.

- develop informal knowledge about connections among function rules, tables, and graphs for linear, inverse, exponential and quadratic relations.

**Sample Performance Tasks/Assessments**

**Sample Performance Tasks:**

- Bungee Jump Physics Investigation: Students use rubber bands and weights to simulate the stretch of a bungee jump cord according to weight of the jumper to investigate data that lends itself to discussions of linearity. Students will investigate relationships between independent and dependent variables (cause and effect).
- Trying to Get Rich Quick: Students are exposed to nonlinear patterns of change in this investigation of inverse variation and exponential growth as they consider average speeds and times of NASCAR races.
- Tracking Population Changes: Students will use a spreadsheet or graphing calculator to answer questions about population changes in humans, whales, wolves, and other endangered species.
- Communicating with Symbols: Students will collaboratively work to find symbolic representations that describe relationships between quantities and variables. They use real-life situations to make sense of and create function rules relating two variables.

**Honors Extensions:**

- Lesson 1: OYO Ext. #18, p.22- Using tables and graphs to maximize profit
- Lesson 2: OYO Ext. #25, p.45- Using a spreadsheet to compare Allowance plans
- Lesson 3: OYO Ext #25, p. 65- Describing a geometric pattern algebraically
- Project: Strengths Testing: Collect Data on the strengths of different items and compare

**Sample 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 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 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).
# Unit 2: Patterns in Data

## Unit Description

This unit develops student ability to summarize, represent, and interpret real-world data on a single count or measurement variable through the use of graphical displays of the distribution, measures of center, and measures of spread.

## Unit Outline

### Standards

#### Statistics and Probability

- **S-ID.1*, 2*, 3***: Summarize, represent, and interpret data on a single count or measurement variable - on number lines, histograms and boxplots, and choose appropriate statistics for the shape of the data to compare center and spread. Analyze differences in shape, center and spread in context.

#### Modeling

*all standards marked with asterisks are modeling standards

### Learning Objectives

Students will…

- construct dot plots, histograms, and relative frequency histograms.
- describe the shape of a distribution.
- Compute and interpret the mean and median (from a list of values and from a frequency table).
- estimate the mean and median from a histogram.
- find and interpret percentiles and quartiles as measures of the position of a value in a distribution.
- find the five-number summary and the interquartile range (IQR) and interpret the IQR as a measure of variability.
- determine if a value is an outlier using a common rule.
- construct and interpret a box plot.
- Compute or estimate and interpret the standard deviation as a measure of spread.
- predict the effect on the shape, center, and spread of a distribution when the same number is added to each value or when each value is multiplied by the same number.

### Essential Questions

1. How can you produce and interpret plots of data and use those plots to compare distributions?
2. How do you decide whether to use the mean or median as a measure of center in summarizing a set of data?
3. How do you find and interpret percentiles and quartiles?
4. How can you use the interquartile range to measure variability?
5. How can you use plots of the five-number summary to compare distributions?
6. What should you do when you identify one or more outliers in a set of data?
7. How can you determine and interpret the standard deviation of an approximately normal distribution?
8. What is the effect on a distribution of adding or subtracting a constant to each value and of multiplying or dividing by a positive constant?

### Sample Performance Tasks/Assessments

#### Sample Performance Tasks:

- Penny Stacking Investigation: Students will learn about distribution patterns, measures of central tendency and measures of variance by playing a game where...
students must stack pennies using their dominant and non-dominant hands. Students must make a conjecture and test it by collecting penny-stacking data.

- Measuring Position: Students will explore the concepts of percentiles and quartiles by using data from growth charts and standardized test results. They will investigate the idea of outliers and use technology to compute means and standard deviations and interpret them as a measure of spread.
- Measuring Variability: The Standard Deviation: Students use online technology resources and their graphing calculators to investigate the idea of variability around the mean using deviations from the mean to define another measure of spread. They will use various data sets including those about height and achievement test scores.

**Honors Extensions:**
- Lesson 1: OYO Ext. #23 & #24, p.100- Computing Means using formulas and spreadsheets
- Lesson 2: OYO Ext.#28, p.142- Describing the distribution of pulse rates given a Histogram.
- Project: Data Analysis

**Sample 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 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 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).
Unit 3: Linear Functions

Unit Description
This unit develops student ability to recognize and represent linear relationships between variables and to use tables, graphs, and algebraic expressions for linear functions to solve problems in situations that involve constant rate of change or slope.

Unit Outline

<table>
<thead>
<tr>
<th>Standards</th>
<th>Learning Objectives</th>
<th>Essential Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit 3 Focus Standards:</td>
<td>Students will...</td>
<td>1. How are patterns in tables of values, graphs, symbolic rules, and problem conditions for linear functions related to each other?</td>
</tr>
<tr>
<td><strong>Algebra</strong></td>
<td></td>
<td>2. How do you write symbolic rules for a linear function using information from a table, graph, or context?</td>
</tr>
<tr>
<td>A-SSE.1*,3*: Interpret the structure of expressions, write expressions in equivalent forms to solve problems;</td>
<td>• calculate the rate of change in one variable as another variable increases.</td>
<td>3. How can you use linear function rules to model data patterns that are not perfectly linear?</td>
</tr>
<tr>
<td>A-CED.1*,2*,3*: Create equations that describe numbers or relationships.</td>
<td>• describe the relationships among the graph, symbolic rule, table of values, and related situation for a linear function.</td>
<td>4. How do you represent questions about linear functions symbolically?</td>
</tr>
<tr>
<td>A-REI.1,3,6,10,11*: Understand solving equations as a process of reasoning and explain the reasoning, solve equations and inequalities in one variable, solve systems of equations, represent and solve equations and inequalities graphically.</td>
<td>• interpret the meaning of the slope and y-intercept of the graph of a linear function in a context.</td>
<td>5. How can you use tables and graphs to estimate solutions of equations and inequalities?</td>
</tr>
<tr>
<td><strong>Functions</strong></td>
<td>• write a rule for a linear function given its graph, two points, or a table of values.</td>
<td>6. How can you solve linear equations in multiple ways?</td>
</tr>
<tr>
<td>F-IF.1,.4*,5*,6*,7*: Understand the concept of a function and use function notation, interpret functions that arise in applications in terms of the context, analyze functions using different representations. Interpret key features of graphs and tables, sketching graphs to show key features such as intercepts, increasing, decreasing, positive or negative intervals, relative max and mins, symmetry, end behavior and periodicity.</td>
<td>• use linear functions to answer questions about the situations they describe.</td>
<td>7. How can you represent and solve problems involving comparisons of two linear functions?</td>
</tr>
<tr>
<td>F-BF.1*,2*: Build a function that models the relationship between two quantities.</td>
<td>• use linear functions to answer questions about the situations that they describe.</td>
<td>8. What are equivalent linear expressions and what operations lead to different but equivalent expressions?</td>
</tr>
<tr>
<td>F-LE.1*,2*,5*: Construct and compare linear, quadratic and exponential models and solve problems, interpret expressions for functions in terms of the situation they model.</td>
<td>• use a linear model to predict the value of one variable given the value of the other and describe the rate of change in one variable as the other increases in a meaningful way.</td>
<td>9. How can algebraic properties of numbers and operations be used to write and verify equivalence of expressions?</td>
</tr>
<tr>
<td>Statistics and Probability</td>
<td>• use a calculator or computer software to find the linear regression model for a set of data.</td>
<td>10. How can you use modeling standards to solve problems involving linear functions?</td>
</tr>
<tr>
<td>S-ID.6*,7*: Summarize, represent, and interpret data on two categorical and quantitative variables, interpret linear models.</td>
<td>• write linear equations and inequalities to express questions about linear functions.</td>
<td>11. How can you use tables and graphs to estimate solutions of equations and inequalities?</td>
</tr>
</tbody>
</table>

*all standards marked with asterisks are modeling standards
**Unit 3 Related Standards:**

**N-Q.1**: Reason quantitatively and use units to solve problems.

**F-IF.3, 9**: Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. Compare properties of two functions each in a different representation.

**F-BF.3**: Build new functions from existing functions including using technology to experiment with cases.

- appropriate graphs and tables of values and interpret the meaning of the solution in the real-world context.
- use “undoing” and “balancing” methods to solve simple linear equations and inequalities.
- use tables of values, graphs, and symbolic reasoning to solve systems of linear equations of the form \( y = a + bx \) and \( y = c + dx \).
- write multiple expressions to represent a variable quantity from a real-world situation.
- use tables, graphs, and properties of numbers and operations to reason about the equivalence of expressions.
- rewrite linear expressions in equivalent forms by expanding, combining like terms, and factoring.

**Sample Performance Tasks/Assessments**

**Sample Performance Tasks:**

- **Getting Credit**: This investigation sharpens student skills in seeing connections between symbolic rules for linear functions and the patterns in tables and graphs. This serves as a great jumping off point for intelligent financial behavior discussions as they consider why credit companies might want to sign up college students for accounts.

- **Fitting Lines**: Students are introduced to the notion of linear functions serving as models of approximately linear patterns. Students make “eyeball” fits of lines to data plots and find related rules and then use their graphing calculators to make data plots and experiment with function graphs and the linear regression tool.

- **Who Will be the Doctor?**: Students use data in tables and graphs as well as equations to describe trends in gender populations for doctors. Students use linear models to show the trends in percentages of male and female doctors in the US between 1960 and 2000 and to make predictions on future prospects for aspiring doctors.

- **Using Your Head...More or Less**: Students explore the effect of multiplying or dividing an inequality by a negative number. The techniques for solving equations by undoing are extended to solve simple linear inequalities.
Honors Extensions:
- Lesson 1: OYO Ext. #34 OR #35, p.181-183-Using data to make predictions with a linear model
- Lesson 2: OYO Ext.#26 & #29, p.209-210- Using Graphs and Rules to solve equations and inequalities
- Lesson 3: OYO Ref #18, p. 228- Equivalent Algebraic Expressions
- Project: Exploring Relationships for Linearity

Sample 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 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 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 Assessment: Each unit will culminate in a district-wide common unit assessment (year 1 implementation will use Core-Plus provided assessments).
## Unit 4: Discrete Mathematical Models

### Unit Description
Discrete Mathematical Modeling develops student ability in modeling, reasoning, and problem solving as they use vertex-edge graphs to model and solve problems about networks, paths, and relations.

### Unit Outline

#### Standards

<table>
<thead>
<tr>
<th><strong>Unit 4 Focus Standards:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number and Quantity</strong></td>
</tr>
<tr>
<td>N-VM.6: Vector and Matrix quantities - Perform operations on matrices and use matrices in applications. Use matrices to represent and manipulate data.</td>
</tr>
</tbody>
</table>

**Modeling**

*all standards marked with asterisks are modeling standards

This unit covers all aspects of the Modeling Conceptual Category. Students will choose and use appropriate mathematics and statistics to analyze empirical situations, to understand them better, and to improve decisions. They will model quantities and their relationships in physical, economic, public policy, social or everyday situations using mathematical and statistical methods. They will use technology for varying assumptions, exploring consequences and comparing predictions with data.

**Unit 4 Related Standards:**

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-CED.2*, 4*: Create equations or inequalities that describe numbers or relationships between quantities. Graph equations on coordinate axes with labels and scales. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

### Learning Objectives

Students will…
- use vertex-edge graphs to model problems related to finding efficient routes - in this case, routes that use each edge exactly once.
- use Euler circuits, circuits through a graph that use each edge exactly once, to help solve such problems
- learn and reason about properties of graphs and Euler circuits
- investigate algorithms for constructing Euler circuits.
- use matrices to represent and analyze graphs.
- use vertex-edge graphs to model problems related to avoiding conflict in a variety of settings.
- color the vertices of a graph so that adjacent vertices have different colors.
- investigate algorithms for vertex coloring.
- use vertex coloring to solve a variety of problems, including assigning frequencies to radio stations, scheduling club meetings, and coloring the countries of a map.

### Essential Questions

1. How can you tell if a Vertex edge graph has an Euler Circuit?
2. If a graph has an Euler circuit, how can you systematically find it?
3. How can matrices be used to represent vertex-edge graphs and help reason about information contained in the graph?
4. What are the basic steps of modeling and solving conflict problems using vertex-edge graphs?

### Sample Performance Tasks/Assessments

#### Sample Performance Tasks:

- **Planning Efficient Routes Locker-Painting:** Students develop plans for the most efficient route to paint lockers in corridors of a high school. Students use vertex-edge graphs to model the situation and decide which route is most efficient. Software such as geogebra or geometry’s sketchpad may be used to create vertex-edge models and find Euler circuits for the models.
- **Graphs and Matrices:** Matrices in the context of vertex-edge graphs are
introduced in this investigation where students learn how to construct and interpret an adjacency matrix for a graph. They also learn about and use the row sum operation of matrix addition.

- Building a Model: 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 Ext. #25 & #26, p.260- Dominoes and Euler Circuits
- Lesson 2: OYO Ext.#14 & #17, p.281–283- Map Coloring and Game Strategies
- Project: Efficient Deliveries

**Sample 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 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 mathematics will encourage students to construct viable arguments and critique the reasoning of others.

- Performance Assessments: There will be smaller projects and key assignments
<table>
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<tr>
<th>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.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common Assessments: Each unit will culminate in a district-wide common unit assessment (year 1 implementation will use Core-Plus provided assessments).</td>
</tr>
</tbody>
</table>
### Unit 5: Exponential Functions

#### Unit Description
This unit develops student ability to recognize and represent exponential growth and decay patterns, to express those patterns in symbolic forms, to solve problems that involve exponential change, and to use properties of exponents to write expressions in equivalent forms.

#### Unit Outline

<table>
<thead>
<tr>
<th>Standards</th>
<th>Learning Objectives</th>
<th>Essential Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit 5 Focus Standards:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Number and Quantity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<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 this property.</td>
<td>Students will…</td>
<td>1. How can exponential growth patterns be modeled in tables, graphs, tree graphs, and symbolic rules?</td>
</tr>
<tr>
<td><strong>Algebra</strong></td>
<td></td>
<td>2. What are the NOW-NEXT and “y=...”rules for basic exponential functions and how can those be modified to model other similar patterns of change?</td>
</tr>
<tr>
<td>A-SSE.1*, 3*: See structure in expressions and interpret this structure. Write expressions in equivalent forms to solve problems.</td>
<td></td>
<td>3. How can investments paying compound interest be represented with symbolic rules?</td>
</tr>
<tr>
<td>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.</td>
<td></td>
<td>4. How can you use exponential function rules to model data patterns that are not perfectly linear?</td>
</tr>
<tr>
<td>A-REI.10: Represent and solve equations and inequalities graphically and understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane.</td>
<td></td>
<td>5. How can properties of exponents be used to make useful algebraic manipulations possible?</td>
</tr>
<tr>
<td><strong>Statistics and Probability</strong></td>
<td></td>
<td>6. What patterns in tables, graphs, and symbolic rules are used to represent exponential decay?</td>
</tr>
<tr>
<td>S-ID.6*: Summarize, represent, and interpret data on two categorical and quantitative variables, represent data on a scatter plot and describe how the variables are related.</td>
<td></td>
<td>7. How can you interpret and estimate values of expressions involving fractional or decimal exponents?</td>
</tr>
<tr>
<td><strong>Modeling</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*all standards marked with asterisks are modeling standards</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Unit 5 Related Standards:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N-Q.1*: Reason quantitatively and use units to solve problems.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A-SSE.1: Interpret the structure of expressions.
F-IF.4*,5, 9: Understand the concept of a function and use function notation, interpret functions that arise in applications in terms of the context, analyze functions using different representations.
F-BF.3: Build new functions from existing functions including using technology to experiment with cases.
F-LE.3*: Observe linear, quadratic and exponential graphs and realize that the increase in the exponential quantity eventually exceeds that of a linear or quadratic (or polynomial) quantity.

| 8. How are properties of exponents connected to radicals and rules for operating with them? |

**Sample Performance Tasks/Assessments**

**Sample Performance Tasks:**
- Pay it Forward: Counting in Tree Graphs: Students develop their understanding and skill in recognizing and modeling patterns of exponential growth. Tree graphs are used to model a Pay it Forward process providing a visual image of the multiplicative growth pattern.
- Compound Interest Lottery Payout: Students decide which payoff method is a better deal for a lottery winner. Students use recursive formulas for compound interest to calculate how much money will be in a CD balance after certain numbers of years. Students will investigate change in exponential relationships and make predictions using tables, graphs, and equations.
- More Bounce to the Ounce: Students investigate ball elasticity by collecting data on heights of successive rebounds when a ball is dropped from a fixed height. Students discover exponential decay relationships through testing different types of balls and their successive rebound heights. Students must use tables, graphs, and equations to answer questions about their data and make predictions.
- Medicine and Mathematic: The goal of this investigation is to extend student understanding of, and skill in working with, exponential decay relationships and their tables, graphs, and rules. Since decay or metabolism of medicines in the body is a nearly continuous process, the problems here motivate interpretation of fractional exponents.
- Modeling Decay: In this investigation, students develop the ability to derive exponential models that fit patterns in experimental data and compare the data patterns to what logical analysis of the experiment suggests might happen. They are asked to think first, then experiment, and to compare the function models suggested by logic to the models derived from use of the graphing calculator or computer tools.

**Honors Extensions:**
- Lesson 1: OYO Ext. #33, p.318- Loans with Quarterly Compounding
- Lesson 2: OYO Ext.#32 & #35, p.349 & 351- Exponential Decay and Properties of Exponents
- Project: Comparing Investment Plans
Sample 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 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 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).
### Unit 6: Patterns in Shape

#### Unit Description

This unit develops student ability to visualize and describe two- and three-dimensional shapes, to represent them with drawings, to examine shape properties through both experimentation and careful reasoning, and to use those properties to solve problems.

#### Unit Outline

<table>
<thead>
<tr>
<th>Standards</th>
<th>Learning Objectives</th>
<th>Essential Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit 6 Focus Standards:</strong></td>
<td>Students will…</td>
<td>1. What conditions on side lengths are needed to build triangles and quadrilaterals?</td>
</tr>
<tr>
<td><strong>Geometry</strong></td>
<td></td>
<td>2. What are congruent shapes and how can you test whether two shapes are congruent?</td>
</tr>
<tr>
<td>G-CO.1, 2, 3, 8, 9, 10, 11, 12: Congruence - Experiment with transformations in the plane, know precise definitions of geometric objects, represent transformation in the plane, describe them as functions, compare transformations and horizontal stretches, describe rotations and reflections of trapezoids, rectangles, parallelograms, and regular polygons. Explain criteria for triangle congruence (ASA, SAS, SSS) in terms of rigid transformations. Prove geometric theorems and make geometric constructions.</td>
<td></td>
<td>3. What combinations of side and angle measures are sufficient to determine if two triangles are congruent?</td>
</tr>
<tr>
<td>G-SRT.5: Prove theorems using similarity, use congruence and similarity criteria for triangles to solve problems and prove relationships in geometric figures.</td>
<td></td>
<td>4. Why is the Pythagorean Theorem true for all right triangles? How can the Converse of the Pythagorean Theorem be used to show that a triangle is a right triangle?</td>
</tr>
<tr>
<td>G-GMD.1, 2, 3*: Explain volume formulas and use them to solve problems. Formulas include but are not limited to the circumference of a circle, area of a circle, volumes of cylinders, pyramids and cones.</td>
<td></td>
<td>5. What is a regular polygon and how can you accurately draw one?</td>
</tr>
<tr>
<td>G-MG.1*, 2*, 3*: Model with Geometry, applying geometric concepts to modeling situations, use geometric shapes, their measures, and their properties to describe objects, apply properties of density based on area and volume in modeling situations.</td>
<td></td>
<td>6. How can you describe symmetries of a regular polygon and other shapes?</td>
</tr>
<tr>
<td><strong>Modeling</strong></td>
<td></td>
<td>7. How are the measures of the angles of any polygon related to the number of sides?</td>
</tr>
<tr>
<td>*all standards marked with asterisks are modeling standards</td>
<td></td>
<td>8. Which polygons or combinations of polygons will tile a plane? What is a tessellation?</td>
</tr>
<tr>
<td><strong>Unit 6 Related Standards:</strong></td>
<td></td>
<td>9. What are important characteristics of common three-dimensional shapes and...</td>
</tr>
</tbody>
</table>

### Learning Objectives

- **Key Learning Objectives**
  - discover and apply the Triangle Inequality and its analog for quadrilaterals.
  - investigate rigidity of two-dimensional shapes.
  - discover and apply properties of quadrilateral linkages, including those with rotating bars.
  - discover and verify using rigid transformations (translations, rotation about a point, and line reflection) combinations of side and angle conditions that are sufficient for testing the congruence of two triangles: Side-Side-Side (SSS), Side-Angle-Side (SAS), Angle-Side-Angle (ASA).
  - use congruence conditions to reason about properties of isosceles triangles and select properties of parallelograms.
  - use area and congruence relationships to justify why the Pythagorean Theorem and its converse are true and use these results to solve problems involving right triangles.
  - recall justify derivations of and use formulas to find areas of triangle and special quadrilaterals.
  - discover and apply properties of the interior, exterior, and central angles of polygons.

### Essential Questions

- What are important characteristics of common three-dimensional shapes and...
F-IF.4*: Interpret functions that arise in applications in terms of the context, including interpreting key features of graphs and tables, sketching graphs to show key features such as intercepts, increasing, decreasing, positive or negative intervals, relative max and mins, symmetry, end behavior and periodicity.

G-CO.9: Prove geometric theorems about lines and angles including the vertical angle theorem, when transversals cross parallel lines, alternate interior angles, corresponding angles, perpendicular bisector theorems.

G-GMD.4: Visualize relationships between 2- and 3-dimensional objects. Identify shapes of 2-dimensional cross-sections of 3-d objects and identify 3-d objects generated through rotations of 2-d objects.

G-MG.2*, 3*: Apply geometric concepts in modeling situations. Apply concepts of density based on area and volume in modeling situations, apply geometric methods to solve design problems.

S-ID.6*: Summarize, represent, and interpret data on 2 categorical and quantitative variables. Represent data on a scatter plot and describe how the variables are related. Fit functions to data and use them to solve problems. Assess fit of functions by plotting and analyzing residuals and fit linear functions for a scatter plot suggesting a linear association.

- recognize and describe line and rotational symmetries of polygons and other two-dimensional shapes.
- (re) discover which triangles, quadrilaterals, and regular polygons will tile a plane and explore semi regular tessellations.
- recognize and describe symmetries of tessellations, including translation symmetry.
- Identify and construct three-dimensional shapes.

Sample Performance Tasks/Assessments

Sample Performance Tasks:
- Form and Function Investigating Two-Dimensional Shapes: Students used uncooked spaghetti noodles, plastic strips, and interactive software to investigate relationships in triangles and quadrilaterals with regard to side length and angle measures. Students are led to discover concepts such as the triangle inequality, rigidity, and Grashof’s Principle for quadrilaterals.
- Reasoning with Shapes: Students are provided further opportunities to use congruent triangles as they reason about geometric properties. They will discover and establish an important property about the perpendicular bisector of a segment and provide arguments for select properties of parallelograms, rectangles, and kites.
- The Triangle Connection: Students explore relationships involving the measures of interior angles and exterior angles of convex polygons. Connections between algebra and geometry are achieved through the development and analysis of function rules relating angle measures to the number of sides of an n-gon.
- Recognizing and Constructing 3-D Shapes: Students construct 3-D shapes (polyhedra) by folding up 2-D nets composed of polygons, emphasizing that polyhedra are constructed from polygons. They classify polyhedra as pyramids, prisms or neither and construct models for these polyhedra. They discover Euler’s relationships among the number of vertices, faces, and edges of a polyhedron.
- Regular Polyhedra: Regular polyhedra (the Platonic solids) have fascinated people for centuries. In this investigation, students have the opportunity to develop their understanding of these wonderful shapes with unique properties and make models to confirm conjectures about the polyhedra.
**Honors Extensions:**
- Lesson 1: OYO Conn. #20, p. 392 - Finding Patterns in Diagonal Lengths of Squares
- Lesson 2: OYO Ext. #26, pg. 421 - Tessellations
- Lesson 3: OYO Conn. #12, p. 447 - Volumes of Cylinders
- Project: One Point Perspective Drawing

**Sample 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 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 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).
### Unit 7: Quadratic Functions

#### Unit Description
This unit develops student ability to recognize and represent quadratic relations between variables using data tables, graphs, and symbolic formulas, to solve problems involving quadratic functions, and to express quadratic polynomials in equivalent factored and expanded forms.

#### Unit Outline

**Unit 7 Focus Standards:**

**Algebra**
- **A-SSE.1**, 2*, 3*: See structure in expressions and interpret this structure. Write expressions in equivalent forms to solve problems. Factor complete the square and use properties of exponents to transform expressions.
- **A-CED.2**: Create equations (1 or 2 variables) and inequalities (1 variable only) that describe numbers or relationships and Graph equations on coordinate axes with labels and scales.
- **A-REI.4, 10**: Solve quadratic equations by completing the square, factoring, taking square roots and inspections and derive the quadratic formula. Represent and solve equations and inequalities graphically and understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane.

**Functions**
- **F-IF.4**, 5*, 7*, 8: Interpret functions that arise in terms of their context, interpret and sketch key features of graphs and tables showing relationships between quantities, analyze functions using different representations, graph functions and relate the domain of a function to its graph. Key features include intercepts, increasing, decreasing, positive or negative intervals, relative max and mins, symmetry, end behavior and periodicity.
- **F-BF.1**, 3*: Build a function that models a relationship between two quantities and build a new function from existing ones.
- **F-LE.3**: Observe linear, quadratic and exponential graphs and realize that the increase in the exponential quantity eventually exceeds that of a linear or quadratic (or polynomial) quantity.

<table>
<thead>
<tr>
<th>Standards</th>
<th>Learning Objectives</th>
<th>Essential Questions</th>
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<tbody>
<tr>
<td>Students will…</td>
<td></td>
<td>1. What functions model (time, height) data and patterns of change for projectiles?</td>
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<tr>
<td></td>
<td>● determine patterns of change associated with quadratic functions.</td>
<td>2. How can tables, graphs, and rules for quadratic functions be used to answer questions about the situations they represent?</td>
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<td></td>
<td>● use tables of values and graphs to estimate answers for questions about situations modeled by quadratic functions.</td>
<td>3. How are the values of a, b, and c related to patterns in the graphs and tables of values for quadratic functions $y = ax^2 + bx + c$</td>
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<td>● describe the effects of each parameter in the functions rule $y = a(x^2) + bx + c$.</td>
<td>4. What strategies are useful in finding rules for quadratic functions?</td>
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<td>● find symbolic rules for quadratic functions using data modeling and reasoning.</td>
<td>5. What strategies are useful in deciding whether two quadratic expressions are equivalent and which equivalent expression to use under given circumstances?</td>
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<tr>
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<td>● determine whether two given quadratic expressions are equivalent.</td>
<td>6. What does it mean to solve a quadratic equation and what are some effective methods for solving quadratic equations algebraically?</td>
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<tr>
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<td>● decide on most useful equivalent forms of quadratics for different question types.</td>
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<td></td>
<td>● create equivalent quadratic expressions by expanding products of linear factors.</td>
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<td></td>
<td>● factor quadratic expressions by extracting common linear factors.</td>
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<td></td>
<td>● write quadratic equations and inequalities to express questions about quadratic functions.</td>
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<td></td>
<td>● find exact values of solutions for quadratic equations in the form $a(x^2) + bx + c = d$ and $a(x^2) + bx = 0$ by reasoning and factoring.</td>
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<td></td>
<td>● relate factored forms of quadratic expressions to x-intercepts of graphs for the related functions.</td>
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</table>
Modeling:
*all standards marked with asterisks are modeling standards

Unit 7 Related Standards:

N-RN.2: Extend the properties of exponents to rational exponents. Rewrite expressions involving radicals and rational exponents using the properties of exponents.

A-CED.1: 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.

A-REI.1, 7: Reason with equations and inequalities and understand solving equations as a process of reasoning, including providing explanations of the reasoning. Solve systems with linear and quadratic equations in two variables algebraically and graphically.

A-APR.3: Understand the relationship between zeroes and factors of polynomials. Identify zeroes when suitable factorizations are available and use the zeroes to construct a rough graph of the function defined by the polynomial.

F-IF.1: Understand the concept of a function and use function notation. Understand function as a mapping from each element of the domain to exactly one element of the range. Understand that the graph of f is the graph of the equation y = f(x).

G-GMD.4: Visualize relationships between 2- and 3-dimensional objects. Identify shapes of 2-dimensional cross-sections of 3-d objects and identify 3-d objects generated through rotations of 2-d objects.

S-ID.6*: Summarize, represent, and interpret data on 2 categorical and quantitative variables. Represent data on a scatter plot and describe how the variables are related. Fit functions to data and use them to solve problems. Assess fit of functions by plotting and analyzing residuals and fit linear functions for a scatter plot suggesting a linear association.

- solve quadratic equations by using the quadratic formula.
- describe the possible number of real solutions for quadratic equations and illustrate the possibilities with graphs.

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<th>Sample Performance Tasks/Assessments</th>
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Sample Performance Tasks:
- Punkin’ Chunkin’ Investigation: Students discover quadratic relationships in data collected at flying pumpkin competitions. Students use tables, graphs, and equations to answer questions about time and height data of projectiles.
- Golden Gate Quadratics: Students will investigate the height of a suspension bridge cable above the surface of the bridge which can be modeled by a quadratic equation that opens upward. They return to the Physics and Bungee Jump questions that were raised about business and have the opportunity to build and study a quadratic function with a rule in a non-standard form and a graph with a negative y-intercept.
- Finding Expressions for Quadratic Patterns: In this investigation, students will develop strategies that are useful in finding rules for quadratic functions, in deciding when two quadratic expressions are equivalent, and in deciding when one type of quadratic expression is more useful than another. They use data analysis tools for modeling patterns and use logical analysis to reason from problem conditions to a function rule.
- Solving Quadratic Equations: Students use different situations to solve quadratic equations in context using the quadratic formula. Situations such as party planning, sports, and architecture are used to model quadratic relationships and students use the quadratic formula to write and solve equations for these situations.

Honors Extensions:
- Lesson 1: OYO Ext. #22 & #23, p. 487-488- Similarities and Differences between different functions
- Lesson 2: OYO Ext. #20, p. 506- Quadratic Expressions and Estimation
- Lesson 3: OYO #26, p. 523- Solving a system of Linear and Quadratic Equations
- Project: Algebraic Functions Report OR Take-Home Test

Sample 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 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 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).
### Unit 8: Patterns in Chance

#### Unit Description

This unit develops student ability to solve problems involving chance by constructing sample spaces of equally-likely outcomes or geometric models and to use simulation to decide whether a model is consistent with the data.

#### Unit Outline

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<td><strong>Unit 8 Focus Standards:</strong></td>
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</tr>
<tr>
<td><strong>Geometry</strong></td>
<td></td>
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<tr>
<td>G-MG.2*: Applying geometric concepts to modeling situations, apply properties of density based on area and volume in modeling situations.</td>
<td>Students will…</td>
<td>1. How can you find and organize the probabilities associated with random situations like the outcomes from the roll of two dice?</td>
</tr>
<tr>
<td><strong>Statistics and Probability</strong></td>
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<tr>
<td>S-ID.1*: Summarize, represent, and interpret data on a single count or measurable variable. Represent data with dot plots, histograms and boxplots.</td>
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<td>2. Under what conditions can you add individual probabilities to find the probability that a given event happens?</td>
</tr>
<tr>
<td>S-CP.1*,7*: Understand independence and conditional probability and use them to interpret data. Describe events as subsets of sample spaces using characteristics of the outcomes as or unions, intersections, or complements of other events. Use the rules of probability to compute probabilities of compound events in a uniform probability model. Apply the Addition Rule and interpret the answer in terms of the model.</td>
<td></td>
<td>3. What are Mutually Exclusive events and how are the probabilities of such events calculated?</td>
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<tr>
<td>S-MD.1*, 3*, 4*: Calculate expected values and use them to solve problems. Define random variables for quantities of interest by assigning numerical values to events in sample spaces and graph the corresponding distribution. Develop probability distributions for random variables defined for a sample space in which theoretical probabilities can be calculated and for sample space in which probabilities are assigned empirically.</td>
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<td>4. What are some different ways to simulate random chance situations?</td>
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<tr>
<td><strong>Modeling:</strong></td>
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<tr>
<td>*all standards marked with asterisks are modeling standards</td>
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<tr>
<td><strong>Unit 8 Related Standards:</strong></td>
<td></td>
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<tr>
<td>A-CED.2*: Create equations in two or more variables to represent</td>
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#### Sample Performance Tasks/Assessments

**Sample Performance Tasks:**

- Probability Distributions: Students will learn to construct sample spaces and probability distributions and consider what the differences are between the two.
relationships between quantities: graph equations on coordinate axes with labels and scales.

**S-ID.2**, 5, 6*: Use statistics appropriate to the shape of the data distribution to compare center and spread. Summarize categorical data in two-way frequency tables and interpret relative frequencies in the context of the data. Summarize, represent, and interpret data on 2 categorical and quantitative variables. Represent data on a scatter plot and describe how the variables are related. Fit functions to data and use them to solve problems. Assess fit of functions by plotting and analyzing residuals and fit linear functions for a scatter plot suggesting a linear association.

**S-MD.2**: Use probability to make decisions by calculating expected values of random variables and interpreting it as the mean of the probability distribution.

**S-CP.9**: Use the rules of probability to compute probabilities of compound events in a uniform probability model. Use permutations and combinations to compute probabilities of compound events and solve problems.

They will roll dice and flip coins to develop these spaces and distributions and use their observed data to solve problems.

- 50-50 Chance Simulation: Students simulate gender population control in China by investigating different options for families while still helping China to reduce population growth. Students first make a conjecture deciding if it is better for Chinese parents to have only one child, children until they have a boy, or some other option. Students simulate this situation by flipping a coin and calculating the number of flips it would take to “get a boy”. This simulation challenges assumptions about chance and leads students to discover the Law of Large Numbers for probability.

- Geometric Probability: In this investigation, students will extend their understanding of probability to area models of situations where the numbers are selected at random from a continuous interval. The diagrams will enable students to compute a probability exactly.

**Honors Extensions:**
- Lesson 1: OYO #11 & #20 OR #11 & #21, pgs. 546 & 548- Venn Diagrams and probability
- Lesson 2: OYO #17 & #21, pgs 578-581- Law of Large Numbers and Probability
- Project: Carnival Games OR Take-Home Test

**Sample 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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