Readington Township Public Schools

Grade 4 Math Curriculum

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I. OVERVIEW

Readington Township Public Schools' K-5 mathematics curriculum provides students with a strong foundation in mathematics content while promoting and instilling the skills of problem solving, communication in mathematics, making mathematical connections, and reasoning. Throughout the delivery of the K-5 mathematics program, various tools and technology are employed, including manipulatives, calculators, software, apps, videos, websites, and computing devices (computers, tablets, interactive whiteboards, etc.). A strong focus of the program is on promoting high levels of mathematical thought through experiences which extend beyond traditional computation.

The Mathematics 4 course is designed to teach students grade level mathematics while promoting higher order thinking skills. The course is directly correlated to the New Jersey Student Learning Standards and covers such topics as number sense, geometry, measurement, number operations in base ten and fractions, and algebraic thinking. The course also promotes and instills the skills of problem solving, communication in mathematics, and making mathematical connections. Students will utilize various tools and technology in the process, including manipulatives, calculators, websites, and computers to better enhance a well-rounded understanding of course topics. A strong focus of the program is on promoting high levels of mathematical thought through experiences which extend beyond traditional computation. Students will use websites such as Reflex Math andi-Ready.

II. STUDENT OUTCOMES (Linked to New Jersey Student Learning Standards for Mathematics 2016)

Grade 4 Math

MATHEMATICAL PRACTICES

- Make sense of problems and persevere in solving them.
- Reason abstractly and quantitatively.
- Construct viable arguments and critique the reasoning of others.
- Model with mathematics.
- Use appropriate tools strategically.
- Attend to precision.
- Look for and make use of structure.
- Look for and express regularity in repeated reasoning

OPERATIONS AND ALGEBRAIC THINKING (4.OA)

A. Use the four operations with whole numbers to solve problems.

1. Interpret a multiplication equation as a comparison, e.g., interpret 35 = 5 × 7 as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations.
2. Multiply or divide to solve word problems involving multiplicative comparison, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem, distinguishing multiplicative comparison from additive comparison.[1]
3. Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.

B. Gain familiarity with factors and multiples.

4. Find all factor pairs for a whole number in the range 1–100. Recognize that a whole number is a multiple of each of its factors. Determine whether a given whole number in the range 1–100 is a multiple of a given one-digit number. Determine whether a given whole number in the range 1–100 is prime or composite.

C. Generate and analyze patterns.

5. Generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit in the rule itself. *For example, given the rule "Add 3" and the starting number 1, generate terms in the resulting sequence and observe that the terms appear to alternate between odd and even numbers. Explain informally why the numbers will continue to alternate in this way.*

NUMBER AND OPERATIONS IN BASE TEN (4.NBT)

A. Generalize place value understanding for multi-digit whole numbers.

1. Recognize that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right. *For example, recognize that 700 ÷ 70 = 10 by applying concepts of place value and division.*
2. Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.
3. Use place value understanding to round multi-digit whole numbers to any place.

B. Use place value understanding and properties of operations to perform multi-digit arithmetic.

4. Fluently add and subtract multi-digit whole numbers using the standard algorithm.
5. Multiply a whole number of up to four digits by a one-digit whole number, and multiply two two-digit numbers, using strategies based on place value and the properties of operations. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.
6. Find whole-number quotients and remainders with up to four-digit dividends and one-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.

NUMBER AND OPERATIONS—FRACTIONS (4.NF)

A. Extend understanding of fraction equivalence and ordering.

1. Explain why a fraction a/b is equivalent to a fraction $(n \times a)/(n \times b)$ by using visual fraction models, with attention to how the number and size of the parts differ even though the two fractions themselves are the same size. Use this principle to recognize and generate equivalent fractions.
2. Compare two fractions with different numerators and different denominators, e.g., by creating common denominators or numerators, or by comparing to a benchmark fraction such as 1/2. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with symbols >, =, or <, and justify the conclusions, e.g., by using a visual fraction model.

B. Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers.

3. Understand a fraction a/b with $a > 1$ as a sum of fractions $1/b$.
    a. Understand addition and subtraction of fractions as joining and separating parts referring to the same whole.
    b. Decompose a fraction into a sum of fractions with the same denominator in more than one way, recording each decomposition by an equation. Justify decompositions, e.g., by using a visual fraction model. *Examples: 3/8 = 1/8 + 1/8 + 1/8 ; 3/8 = 1/8 + 2/8 ; 2 1/8 = 1 + 1 + 1/8 = 8/8 + 8/8 + 1/8.*
    c. Add and subtract mixed numbers with like denominators, e.g., by replacing each mixed number with an equivalent fraction, and/or by using properties of operations and the relationship between addition and subtraction.
    d. d. Solve word problems involving addition and subtraction of fractions referring to the same whole and having like denominators, e.g., by using visual fraction models and equations to represent the problem.
4. Apply and extend previous understandings of multiplication to multiply a fraction by a whole number.
    a. Understand a fraction a/b as a multiple of $1/b$. *For example, use a visual fraction model to represent 5/4 as the product 5 × (1/4), recording the conclusion by the equation 5/4 = 5 × (1/4).*

b. Understand a multiple of a/b as a multiple of $1/b$, and use this understanding to multiply a fraction by a whole number. *For example, use a visual fraction model to express 3 × (2/5) as 6 × (1/5), recognizing this product as 6/5. (In general, n × (a/b) = (n × a)/b.)*
c. Solve word problems involving multiplication of a fraction by a whole number, e.g., by using visual fraction models and equations to represent the problem. *For example, if each person at a party will eat 3/8 of a pound of roast beef, and there will be 5 people at the party, how many pounds of roast beef will be needed? Between what two whole numbers does your answer lie?*

C. Understand decimal notation for fractions, and compare decimal fractions.

5. Express a fraction with denominator 10 as an equivalent fraction with denominator 100, and use this technique to add two fractions with respective denominators 10 and 100.[4] *For example, express 3/10 as 30/100, and add 3/10 + 4/100 = 34/100.*
6. Use decimal notation for fractions with denominators 10 or 100. *For example, rewrite 0.62 as 62/100; describe a length as 0.62 meters; locate 0.62 on a number line diagram.*
7. Compare two decimals to hundredths by reasoning about their size. Recognize that comparisons are valid only when the two decimals refer to the same whole. Record the results of comparisons with the symbols >, =, or <, and justify the conclusions, e.g., by using a visual mod**el.**

MEASUREMENT AND DATA (4.MD)

A. Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.

1. Know relative sizes of measurement units within one system of units including km, m, cm. mm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two column table. *For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36), ...*
2. Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.
3. Apply the area and perimeter formulas for rectangles in real world and mathematical problems. *For example, find the width of a rectangular room given the area of the flooring and the length, by viewing the area formula as a multiplication equation with an unknown factor.*

B. Represent and interpret data.

4. Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Solve problems involving addition and subtraction of fractions by using information presented in line plots. *For example, from a line plot find and interpret the difference in length between the longest and shortest specimens in an insect collection.*

C. Geometric measurement: understand concepts of angle and measure angles.

5. Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement:
    a. An angle is measured with reference to a circle with its center at the common endpoint of the rays, by considering the fraction of the circular arc between the points where the two rays intersect the circle. An angle that turns through 1/360 of a circle is called a "one-degree angle," and can be used to measure angles.
    b. An angle that turns through *n* one-degree angles is said to have an angle measure of *n* degrees.
6. Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure.
7. Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real world and mathematical problems, e.g., by using an equation with a symbol for the unknown angle measure.

GEOMETRY (4.G)

A. Draw and identify lines and angles, and classify shapes by properties of their lines and angles.

1. Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.
2. Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence or absence of angles of a specified size. Recognize right triangles as a category, and identify right triangles.
3. Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry.

PERSONAL FINANCIAL LITERACY (9.1)

Civic Responsibility

9.1.5.CR.1: Compare various ways to give back and relate them to your strengths, interests, and other personal factors.

Credit Profile

9.1.5.CP.1: Identify the advantages of maintaining a positive credit history.

Economic and Government Influences

9.1.5.EG.1: Explain and give examples of what is meant by the term "tax."

9.1.5.EG.2: Describe how tax monies are spent

9.1.5.EG.3: Explain the impact of the economic system on one's personal financial goals.

9.1.5. EG.4: Describe how an individual's financial decisions affect society and contribute to the overall economy.

9.1.5. EG.5: Identify sources of consumer protection and assistance.

Financial Institutions

9.1.5.FI.1: Identify various types of financial institutions and the services they offer including banks, credit unions, and credit card companies.

Financial Psychology

9.1.5.FP.1: Illustrate the impact of financial traits on financial decisions.

9.1.5.FP.2: Identify the elements of being a good steward of money.

9.1.5.FP.3: Analyze how spending choices and decision-making can result in positive or negative consequences.

9.1.5.FP.4: Explain the role of spending money and how it affects wellbeing and happiness (e.g., "happy money," experiences over things, donating to causes, anticipation, etc.).

9.1.5.FP.5: Illustrate how inaccurate information is disseminated through various external influencers including the media, advertisers/marketers, friends, educators, and family members.

Planning and Budgeting

9.1.5.PB.1: Develop a personal budget and explain how it reflects spending, saving, and charitable contributions.

9.1.5.PB.2: Describe choices consumers have with money (e.g., save, spend, donate).

Risk Management and Insurance

9.1.5.RMI.1: Identify risks that individuals and households face.

9.1.5.RMI.2: Justify reasons to have insurance.

III. ESSENTIAL QUESTIONS

Operations and Algebraic Thinking

- What is multiplication?
- How do you use multiplication and division to solve comparison problems?
- How can you identify multiples of a number?
- How can numbers be broken down into its smallest factors?
- How do you figure out and describe patterns?
- How can you model and solve multi-step word problems

Number and Operations in Base Ten

- How can you use place value to understand and compare very large numbers?
- What strategies and understandings allow you to successfully add, subtract, multiply and divide multi-digit whole numbers?
- How can multi-digit whole numbers be rounded?

Number and Operations in Fractions

- How does finding equivalent fractions help you to compare them?
- What is the process of adding and subtracting fractions and mixed numbers with like denominators?
- How can understanding repeated addition of fractions help you to multiply fractions by whole numbers?
- How can you express a fraction as a decimal?
- How can you compare decimals through hundredths?

Measurement and Data

- How can you convert measurements of the U.S. customary system and the metric system?
- What strategies can you use to solve measurement word problems?
- How can you use an understanding of money and time to complete real world problems?
- How can you determine what situations you would use area and perimeter in and how do you solve them?
- How are you able to use a line plot to organize data and answer questions about the data?
- What are angles and how do you measure and draw them?
- How can you use addition and subtraction to solve problems involving angles?

Geometry

- How can you identify a point, line, line segment, ray, and angle?
- How can you use parallel and perpendicular lines to classify two dimensional shapes?
- What is a line of symmetry and how do you find it?
- What is the process of multiplying multi-digit whole numbers using the standard algorithm?

IV. STRATEGIES

- Group discussions
- Teacher presentation
- Student projects
- Guided groups
- One to one instruction
- Interactive SMARTBoard lessons
- Tutorials
- Online practice such as Reflex Math and IXL

V. ACCOMMODATIONS

- **Accommodations and Modification Addendum**

VI. ASSESSMENTS

- **Formative**
  - Independent student work
  - Ready Classroom Lesson Quizzes
  - Teacher Observations
  - Class Participation
  - Class Discussions
  - Class Assignments
  - Homework Assignments
  - Notebooks
  - Anecdotal Records
- **Summative**
  - Mid-Unit Test
  - Unit Test
- **Alternative**

- Live Online Assessment Tools (Quizizz, Kahoot, Plickers, Quizlet, Brainpop)
- Student Projects
- Student Presentations
- Self-Assessments

- **Benchmark** (given September, March, and June)
  - I-Ready Diagnostic
  - Performance Assessments
  - Reflex Mathematics

VII. MATERIALS

- **Core**
  - Ready Classroom Mathematics, Curriculum Associates, LLC
  - Teacher Manual Volumes 1 & 2
  - Student Books Volumes 1 & 2
  - Ready Classroom Teacher Toolbox
- **Supplemental Resources**
  - Technology
    - Brain Pop
    - IXL
    - Reflex Math
    - Online Tutorials (Learnzillion, Khan Academy, Math Antics)
    - Online Math Games (Math is Fun, Funbrain, Cool Math Games, Math Playground)

VIII. CAREER READINESS, LIFE LITERACIES, AND KEY SKILLS AND COMPUTER SCIENCE

Number and Operations in Base Ten

- **Career Ready Practices**
  Utilize critical thinking to make sense of problems and persevere in solving them.
  4.NBT.A.2 Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.
  Activity: Students will be able to work on and complete the Mystery Number enrichment problem that is in lesson 1 of the Ready Classroom Math Grade 4 program. Students will have to use clues that are provided to try and figure out the 4 digit mystery number. Students will be allowed to work with partners.

- **9.2 Career Awareness, Exploration, and Preparation**
  9.2.5.CAP.4 Explain the reasons why some jobs and careers require specific training, skills, and certification (e.g., life guards, child care, medicine, education) and examples of these requirements.
  4.NBT.B.6 Find whole-number quotients and remainders with up to four-digit dividends and one-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.
  Activity: While learning about division in whole numbers students will complete a T-chart. The first column of the chart will list a real-life activity that uses division. The second corresponding column will list a profession that uses this activity. For example, you would need to divide if you were taking a large recipe and splitting it in half for less people. A chef would use division in this manor.

- **9.4 Life Literacies and Key Skills**
  9.4.5.CI.3: Participate in a brainstorming session with individuals with diverse perspectives to expand one's thinking about a topic of curiosity
  4.NBT.A.1 Recognize that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right. *For example, recognize that 700 ÷ 70 = 10 by applying concepts of place value and division*.

Activity: Students will be able to explore large numbers and place value in Lesson 1 of Ready Classroom Math. Students will be able to discuss and brainstorm how numbers are related. Students will be able to figure out on their own that places to the left of a place are 10 times greater than the one to the right. They will also learn that places to the l right are one tenth the value than the place to the left.

- **Computer Science**
  8.1.5.DA.1 Collect, organize, and display data in order to highlight relationships or support a claim.
  4.NBT.A.3 Use place value understanding to round multi-digit whole numbers to any place.
  Activity: Students will be able to use a digital number line to visualize how to round numbers. The teacher will be able to model using this digital tool and then the students can use it via the SMART Board. Students will be able to complete lesson 3 in the Ready Math Classroom Grade 4 book.

Operations and Algebraic Thinking

- **Career Ready Practices**
  Utilize critical thinking to make sense of problems and persevere in solving them.
  4.OA.A.3 Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.
  Activity: Students will be able to complete page 209-212 in Ready Math Grade 4 book. In this activity students will be solving multi-step word problems that have them using equations and deciding what to do with remainders. Students will also have to show how their answer is reasonable.

- **9.2 Career Awareness, Exploration, and Preparation**
  9.2.5.CAP.1 Evaluate personal likes and dislikes and identify careers that might be suited to personal likes.
  4.OA.A.3 Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.
  Activity: Students will be able to complete the Unit 2 Math in Action lesson from the Ready Classroom Math program. In this activity students will learn about a job where a worker has to set up a display for a wildlife museum. Students will be able to see how math relates to his job. Students will also be able to discuss other different traditional and nontraditional jobs based on their likes and dislikes.

- **9.4 Life Literacies and Key Skills**
  9.4.5.CI.3: Participate in a brainstorming session with individuals with diverse perspectives to expand one's thinking about a topic of curiosity.
  4.OA.A.2 Multiply or divide to solve word problems involving multiplicative comparison, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem, distinguishing multiplicative comparison from additive comparison.
  Activity: In Lesson 7 of Ready Classroom math students will be able to brainstorm how to use multiplication and division to solve different multiplicative word problems. Students will be able to discuss this with partners and groups.

- **Computer Science**
  8.1.5.DA.3: Organize and present collected data visually to communicate insights gained from different views of the data.
  4.OA.C.5 Generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit in the rule itself.

Activity: Students will be able to find patterns in the school and make some of their own. They will then display the patterns on a shared Google Jamboard. Students will then explain the properties of the patterns and how they are the same and different.

Number and Operations in Fractions

- **Career Ready Practices**

Work productively in teams while using cultural/global competence.

4.NF.A.2 Compare two fractions with different numerators and different denominators, e.g., by creating common denominators or numerators, or by comparing to a benchmark fraction such as 1/2. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with symbols >, =, or <, and justify the conclusions, e.g., by using a visual fraction model.

Activity: All throughout Lesson 18 in the Ready Classroom Math Grade 4 program students will compare fractions. Students will have to use prior knowledge that they have learned to do this. This skill builds upon their whole number number sense, fraction number sense, and understanding of fractions. Students will be able to work in a group part of the time to solve these problems.

- **9.2 Career Awareness, Exploration, and Preparation**

9.2.5.CAP.4: Explain the reasons why some jobs and careers require specific training, skills, and certification (e.g., life guards, child care, medicine, education) and examples of these requirements.

4.NF.5 Express a fraction with denominator 10 as an equivalent fraction with denominator 100, and use this technique to add two fractions with respective denominators 10 and 100.

Activity: Students will learn how to convert fractions with denominators of 10 and 100 into decimals. Students will be able to relate this to money. Students will be able to understand that the way we write money is in decimal form. As students are learning this in lesson 25 session 2 of the Ready Classroom Grade 4 math program the teacher will discuss with them why it is so important to learn the skill of understanding money and what careers deal with money every day. Students will be able to complete P. 523-526 using this knowledge.

- **9.4 Life Literacies and Key Skills**

9.4.5.CI.4: Research the development process of a product and identify the role of failure as a part of the creative process.

4.NF.B.3 Understand a fraction a/b with a > 1 as a sum of fractions 1/b.

Activity: Students will be able to understand how fractions are important in all parts of everyday life. Students will see in Lesson 20 of the Ready Classroom grade 4 math program how fractions are used in recipes everyday. Students will be able to understand what could happen to their food if they use the wrong amounts. The class will discuss how failure is part of the learning process.

- **Computer Science**

8.1.5.DA.3: Organize and present collected data visually to communicate insights gained from different views of the data.

4.NF.A.1 Explain why a fraction a/b is equivalent to a fraction $(n \times a)/(n \times b)$ by using visual fraction models, with attention to how the number and size of the parts differ even though the two fractions themselves are the same size. Use this principle to recognize and generate equivalent fractions.

Activity: Students will learn how to make equivalent fractions. Students will be able to use a digital tool to help them visualize these equivalent fractions. Students will use this tool to complete Lesson 17 in the Ready Classroom Grade 4 book.

Measurement and Data

- **Career Ready Practices**

Act as a responsible and contributing community members and employee.

4.MD.A.3 Apply the area and perimeter formulas for rectangles in real world and mathematical problems.

Activity: Students will be able to use Math Talk to discuss area and perimeter problems with their classmates and their teacher. Students will use prompts such as, "How did you get started?", "Why did you choose that strategy?", and "Do you agree with me? Why?". Students will be able to use this Math Talk all throughout Lesson 16 in the Ready Classroom Grade 4 program.

- **9.2 Career Awareness, Exploration, and Preparation**
  9.2.5.CAP.1: Evaluate personal likes and dislikes and identify careers that might be suited to personal likes.
  4.MD.A.3 Apply the area and perimeter formulas for rectangles in real world and mathematical problems. For example, find the width of a rectangular room given the area of the flooring and the length, by viewing the area formula as a multiplication equation with an unknown factor.
  Activity: Students will complete Fourth Grade Ready Math Math In Action Unit 3 lesson on page 350-353. In this activity students will pretend they work for a zoo and need to develop birdcages according to different criteria based on perimeter.

- **9.4 Life Literacies and Key Skills**
  9.4.5.CI.4: Research the development process of a product and identify the role of failure as a part of the creative process
  4.MD.A.2 Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.
  Activity: During Lesson 29 in the grade 4 Ready Classroom math program students will be learning how to solve word problems involving length, mass, weight and volume. They will also be converting measurements to larger and smaller units. During this time the teacher will lead a discussion on how important it is to pay attention to the unit. The class will discuss how in history using the wrong unit has caused major problems in the area of space exploration. LA Times article

- **Computer Science**
  8.1.5.IC.1: Identify computing technologies that have impacted how individuals live and work and describe the factors that influenced the changes.
  4.MD.A.1 Know relative sizes of measurement units within one system of units including km, m, cm. mm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two column table.
  Activity: Students will be able to make a graphic organizer using a site like Google Slides. On this graphic organizer they will be able to record what they know about converting measurements. They will explain what it is in their own words, they will be able to illustrate what it is, and then they will show examples and non-examples. This activity will be done during session 1 of lesson 13 in the Ready Math Classroom Grade 4 program. While students are doing this the teacher will discuss how computers and software like Google Slides has changed the way people live and work.

Geometry

- **Career Ready Practice**
  Demonstrate creativity and innovation.
  4.G.A.3 Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry.
  Activity: Students will be able to create pictures that have lines of symmetry. For this activity students will be able to use any mathematical tools that they wish. These tools can include pattern blocks, rulers, protractors or compasses.

- **9.2 Career Awareness, Exploration, and Preparation**
  9.2.5.CAP.3: Identify qualifications needed to pursue traditional and non-traditional careers and

occupations.

4.G.A.2 Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence or absence of angles of a specified size. Recognize right triangles as a category, and identify right triangles.

Activity: During the Unit 5 Math In Action activity in the Ready Classroom Math Grade 4 program students will be able to classify shapes that an artist cut to use in one of her mosaic designs. As students complete this activity the teacher will discuss with them where we can find math in different careers. An artist cutting shapes may not immediately seem like math to many students.

- **9.4 Life Literacies and Key Skills**

  9.4.5.CI.3: Participate in a brainstorming session with individuals with diverse perspectives to expand one's thinking about a topic of curiosity (e.g., 8.2.5.ED.2, 1.5.5.CR1a).

  4.G.A.2 Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence or absence of angles of a specified size. Recognize right triangles as a category, and identify right triangles.

  Activity: Students will be able to learn how to classify 2 dimensional shapes. Students will be able to work in groups to brainstorm based on attributes of shapes what a given shape is.

- **Computer Science**

  8.1.5.IC.1: Identify computing technologies that have impacted how individuals live and work and describe the factors that influenced the changes.

  4.G.A.2 Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence or absence of angles of a specified size. Recognize right triangles as a category, and identify right triangles.

  Activity: Students will be able to use i-Ready to practice classifying two-dimensional figures and triangles. The teacher will discuss with the students how using the I-Ready software is like having another teacher and that having this technology gives students 2 ways to learn information.

IX. PACING

Fourth Grade

Number and Operations in Base Ten

Lessons 1-5, 11-15 (34 days)

- Develop Understanding of Place Value
- Compare and Round Whole Numbers
- Add and Subtract Whole Numbers

Interdisciplinary Connections:

Math/ELA

- **SL.4.1.** Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 4 topics and texts*, building on others' ideas and expressing their own clearly.

  4.NBT.A.1 Recognize that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right. *For example, recognize that 700 ÷ 70 = 10 by applying concepts of place value and division.*

  Activity: Students will be able to solve place value problems by comparing whole numbers. Students will be given small scenarios where it is describing a situation. They will then have to decide which whole number in the scenario is larger. Before they decide, students will complete the routine of Try-it, Discuss-it, Connect-it. In this routine students will give the problem a go on their own. Once they think they have solved it they will then discuss with peers and the teacher how they solved the problem. Once that is done, the teacher will then connect their learning to their background knowledge.

Math/Science

- **4-ESS2-1** Analyze and interpret data from maps to describe patterns of Earth's features.

  4.NBT.B.4 Fluently add and subtract multi-digit whole numbers using the standard algorithm.

Activity: Students will be learning about topographical maps. Students will learn how to read and draw one. Students will understand what the interval measurements mean and be able to calculate the distance between two intervals by using subtraction.

Operations and Algebraic Thinking
Lessons 6-10(24 days)

- Multiplication as a Comparison
- Multiplication and Division in Word Problems
- Patterns
- Model and Solve Multi-Step Problems
- Multiply and Divide Multi-Digit Numbers

Interdisciplinary Connections:
Math/Science

- • **4-ESS1-1** Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.
  4.OA.C.5 Generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit in the rule itself.
  Activity: Students will be able to look at patterns in different landforms and layers of rock. Students will be able to decide from these patterns how the land has changed over time and what type of life had lived there previously.

Math/ELA

- **RI.4.1.** Refer to details and examples in a text and make relevant connections when explaining what the text says explicitly and when drawing inferences from the text.
  4.OA.A.3 Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.
  Activity: Students will be able to learn how to interpret remainders in division problems. Students will complete division problems in lesson 15 session 2 of the Ready Classroom Grade 4 math program. As they are doing these problems they will have to interpret what the remainder means and how to use it in the final answer.

Number and Operations in Fractions
Lessons 17-21, 23-27 (50 days)

- Develop Understanding of Equivalent Fractions
- Compare Fractions
- Add and Subtract Fractions
- Add and Subtract Mixed Numbers
- Multiply Fractions and Fractions by Whole Numbers
- Relate Decimals and Fractions
- Compare Decimals

Interdisciplinary Connections

- **Math/Social Studies**
  6.1.5.CivicsPI.8: Describe how the United States Constitution defines and limits the power of government.
  4.NF.A.1 Explain why a fraction a/b is equivalent to a fraction $(n \times a)/(n \times b)$ by using visual fraction models, with attention to how the number and size of the parts differ even though the two fractions themselves are the same size. Use this principle to recognize and generate equivalent fractions.
  Activity: Students will learn how our government has a series of checks and balances so that one of the three branches doesn't have too much power. The teacher will discuss with the students how another branch's decisions can be overturned. We will look specifically how a President's veto of a bill can be overturned if congress gets a two-thirds vote in each chamber. Students will learn how they can figure out how many senators' and representatives' votes specifically will be needed by using

equivalent fractions.

- **Math/ELA**

  W.4.2. Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

  4.NF.A.2 Compare two fractions with different numerators and different denominators, e.g., by creating common denominators or numerators, or by comparing to a benchmark fraction such as 1/2. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with symbols >, =, or <, and justify the conclusions, e.g., by using a visual fraction model.

  Activity: On P. 380 in the Ready Classroom Grade 4 book students will be able to reflect on the question that if 2 fractions of a granola bar are equivalent to each other will they also be equivalent if the 2 pieces come from different size granola bars.

Measurement and Data
Lessons 16, 22, 28-29, 31-32 (22 days)

- Use Multiplication to Convert Measurements
- Solve Problems with Time and Money
- Solve Problems about Length, Liquid Volume, Mass, and Weight
- Identify and Measure Angles
- Add and Subtract with Angles

Interdisciplinary Connections:

- **Math/ELA**

  4.MD.A.2 Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.

  RI.4.4. Determine the meaning of general academic and domain-specific words or phrases in a text relevant to a grade 4 topic or subject area.

  Activity: Students will solve mathematical word problems. During this activity students will have to use the vocabulary in the problems to determine what operation and unit to use.

Geometry
Lessons 30, 33-34 (16 days)

- Identify points, line segments, rays and perpendicular and parallel lines
- Classify two-dimensional figures
- Draw and identify lines of symmetry

Interdisciplinary Connections:

- **Math/ELA**

  RL.4.7. Make connections between specific descriptions and directions in a text and a visual or oral representation of the text.

  4.G.2 Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence or absence of angles of a specified size. Recognize right triangles as a category, and identify right triangles.

  Activity: In lesson 33 of the Ready Classroom Grade 4 math program students will be asked to classify shapes according to specific attributes they have. These attributes include types of lines and types of shapes. Students will have to make the connection between the written description and the visual representation.

- **Math/Science**

  4-LS1-1 Construct an argument that plants and animals have internal and external structures that

function to support survival, growth, behavior, and reproduction.
4.G.A.3 Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded across the line into matching parts. Identify line-symmetric figures and draw lines of symmetry.
Activity: Students will be able to observe mealworms. As students are observing them they will be able to take notes and make detailed drawings. As they are drawing the teacher will remind them to think about lines of symmetry and how they can be used when drawing the organism. Students will then be able to label their drawing pointing out specific body parts and uses.

Personal Financial Literacy 9.1 (10 days)

Civic Responsibility
- You can give back in areas that matter to you.

Credit Profile
- There are benefits to having a positive credit history.

Economic and Government Influences
- Taxes are collected on a variety of goods and services at the local, state, and federal levels.
- There is a broader economic system that influences your financial goals.
- There are agencies, laws, and resources to protect individuals as consumers.

Financial Institutions
- People can choose to save money in many places such as home in a piggy bank, bank, or credit union.

Financial Psychology
- An individual's financial traits and habits affect his/her finances.
- Spending choices and their intended and unintended consequences impact financial outcomes and personal well-being.
- Not all financial information is accurate or truthful.

Planning and Budgeting
- There are specific steps associated with creating a budget.
- Saving money can impact an individual's ability to address emergencies and accomplish their short-and long-term goals.

Risk Management and Insurance
- Individuals can choose to accept inevitable risk or take steps to protect themselves by avoiding or reducing risk.

Additional time will be spent on reviewing concepts that may need to be revisited and looking ahead to next year's curriculum.

Readington Township Public Schools

Algebra 1
(Honors 7th and Advanced 8th)

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Approval Date: September 14, 2021

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I. OVERVIEW

This full-year Algebra 1 course is designed to provide Advanced 8th grade and Honors 7th grade students with the opportunity to be introduced to algebra skills in the areas of linear, exponential, and quadratic functions, while extending their content base and knowledge to include solving, writing and graphing inequalities, solving systems of equations and inequalities, solving exponential equations, simplifying and factoring higher-degree polynomial functions, graphing and solving quadratic equations, simplifying and solving rational exponents and radical functions, calculating probability, and interpreting data analysis and statistics.

In addition to these topics, and in keeping with the New Jersey Student Learning Standards, students will experience the course content as an integrated, useful, and coherent whole, continually refining their abilities to model with mathematics, reason abstractly and quantitatively while attending to precision both in calculations and vocabulary, and to make sense of problem situations as an essential part of the solution process.

II. STUDENT OUTCOMES (Linked to New Jersey Student Learning Standards for Mathematics)

Seeing Structure in Expressions **A-SSE**

A. Interpret the structure of expressions

1. Interpret expressions that represent a quantity in terms of its context.
    a. Interpret parts of an expression, such as terms, factors, and coefficients.
    b. Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret P(1+r) n as the product of P and a factor not depending on P 2.

Use the structure of an expression to identify ways to rewrite it. For example, see x4 – y4 as (x2) 2 – (y2) 2 , thus recognizing it as a difference of squares that can be factored as (x2 – y2)(x2 + y2).

B. Write expressions in equivalent forms to solve problems

3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
    a. Factor a quadratic expression to reveal the zeros of the function it defines.
    b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.
    c. Use the properties of exponents to transform expressions for exponential functions. For example the expression 1.15t can be rewritten as (1.151/12) 12t ≈1.01212t to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.
4. Derive and/or explain the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. For example, calculate mortgage payments.

Arithmetic with Polynomials and Rational Expressions **A -A**

A. Perform arithmetic operations on polynomials

1. Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

B. Understand the relationship between zeros and factors of polynomials

2. Know and apply the Remainder Theorem: For a polynomial p(x) and a number a, the remainder on division by x – a is p(a), so p(a) = 0 if and only if (x – a) is a factor of p(x).
3. Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.

C. Use polynomial identities to solve problems

4. Prove polynomial identities and use them to describe numerical relationships. For example, the difference of two squares; the sum and difference of two cubes; the polynomial identity (x2 + y2)2 = (x2 – y2)2 + (2xy)2 can be used to generate Pythagorean triples.
5. (+) Know and apply the Binomial Theorem for the expansion of (x + y)n in powers of x and y for a positive integer n, where x and y are any numbers, with coefficients determined for example by Pascal's Triangle.

D. Rewrite rational expressions

6. Rewrite simple rational expressions in different forms; write a(x)/b(x) in the form q(x) + r(x)/b(x), where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or, for the more complicated examples, a computer algebra system.
7. (+) Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.

Creating Equations **A -CED**

A. Create equations that describe numbers or relationships

1. Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.
2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.
4. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R.

Reasoning with Equations and Inequalities **A -REI**

A. Understand solving equations as a process of reasoning and explain the reasoning

1. Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.
2. Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

B. Solve equations and inequalities in one variable

3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
4. Solve quadratic equations in one variable.
    a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form (x – p)2 = q that has the same solutions. Derive the quadratic formula from this form.
    b. Solve quadratic equations by inspection (e.g., for x2 = 49), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as a ± bi for real numbers a and b.

C. Solve systems of equations

5. Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.
6. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.
7. Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line y = –3x and the circle x2 + y2 = 3.
8. (+) Represent a system of linear equations as a single matrix equation in a vector variable.
9. (+) Find the inverse of a matrix if it exists and use it to solve systems of linear equations (using technology for matrices of dimension 3 × 3 or greater).

D. Represent and solve equations and inequalities graphically

10. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).
11. Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.
12. Graph the solutions to a linear inequality in two variables as a half plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

Mathematical Practices

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning

III. ESSENTIAL QUESTIONS AND CONTENT

<u>Reasoning With Equations and Inequalities</u>

What can we do with a system of equations/inequalities that we cannot do with a single equation/inequality?

- Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.
- Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
- Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
- Solve quadratic equations in one variable.
- Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.
- Solve systems of linear equations exactly and approximately, focusing on pairs of linear equations in two variables.
- Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically.
- 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.

- Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve.
- Explain why the x-coordinates of the points where the graphs of two equations intersect are the solutions of the equation when both are set equal.
- Graph the solutions to a linear inequality in two variables as a half-plane and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

Creating Equations

How do we create equations to represent what we see in the real world?

- Create equations and inequalities in one variable and use them to solve problems.
- Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in modeling context.
- Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

Seeing Structure in Expressions and Writing Equivalent Forms

Why do we need to use exponential notation to model situations?

Why should we factor?

How does the graph of a quadratic function relate to its algebraic equation?

- Interpret and understand the parts of an expression, such as the terms, factors, and coefficients.
- Interpret complicated expressions by viewing one or more of their parts as a single entity. (i.e. P(1+r) as the product of P and a factor not depending on P).
- Using the structure of an expression and properties of operations to rewrite the expression in a different form.
- Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
- Factor a quadratic expression to reveal the zeros of the function it defines.
- Complete the square in a quadratic expression to reveal the max or min value of the function it defines.
- Use the properties of exponents to transform expressions for exponential functions.
- Derive the formula for the sum of a finite geometric

Arithmetic with Polynomial, Rational, and Radical Expressions

How are rational and irrational numbers the same and different?

Why should we solve rational equations?

- Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication.
- Know and apply the Remainder Theorem: For a polynomial p(x) and a number a, the remainder on division by x - a is p(a), so p(a) = 0 if and only if (x-a) is a factor of p(x).
- Identify zeros of polynomials when suitable factorizations are available, and use the zeroes to construct a rough graph of the function defined by the polynomial.
- Prove polynomial identities and use them to describe numerical relationships.
- Know and apply the Binomial Theorem for the expansion of (x+y) ^n in powers of x and y for a positive integer n, where x and y are any numbers, with coefficients determined for example by Pascal's Triangle.
- Rewrite simple rational expressions in different forms using inspection, long division, or, for the more complicated examples, a computer algebra system.
- Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression.

IV. STRATEGIES

Intellectual engagement and active involvement of students in daily lessons will be achieved by a variety of teaching strategies, including but not limited to:

- Comprehensive direct instruction utilizing Interactive SMARTBoard technology
- Guided practice using worked-out study examples
- Independent Practice using 'Now You Try' examples

- Student presentation of work/solutions, with explanation and justification of solutions
- High-level questioning and encouragement of student participation
- Student group discussion and mutual help as part of point 3 above
- Regular written 'check for understanding' assessments
- End of unit formative assessments to check for PARCC readiness and to guide instructional choices

V. ACCOMMODATIONS

- **Accommodations and Modification Addendum**

VI. ASSESSMENTS

- **Formative**
  - Independent student work
  - Homework assignments
  - Notebooks
  - Teacher observations
- **Summative**
  - End of Year Test
  - Unit Test
  - Unit Quizzes
- **Alternative**
  - Student projects
- **Benchmark**
  - Performance-based assessments

VII. MATERIALS

- **Core**
  - *McDougal Littell Algebra 1.* Larson, R., Boswell, L., Kanold, T.D., & Stiff, L. Copyright 2004 by McDougal Littell, a Houghton Mifflin Company, Evanston, IL.

- **Supplemental Resources**
  - **Technology**
    - Brain Pop
    - IXL
    - McDougal Littell eEdition Plus Online (online textbook: www.classzone.com)
    - Online Courses including Algebra 1: www.shmoop.com/common-core-standards/
    - Math problems explained in detail with corresponding NJSLSM references : www.illustrativemathematics.org
    - Learnzillion video tutorials: https://learnzillion.com/
    - Khan Academy video tutorials: www.khanacademy.org
    - Gizmos
    - Illustrative Mathematics.

  - Chapter Resource Books. Larson, R., Boswell, L., Kanold, T.D., & Stiff, L. Copyright 2001 by McDougal Littell, a Houghton Mifflin Company, Evanston, IL.

  - Standardized Test Practice Workbook. Larson, R., Boswell, L., Kanold, T.D., & Stiff, L. Copyright 2001 by McDougal Littell, a Houghton Mifflin Company, Evanston, IL.

- *Big Ideas MATH Algebra 1*, Larson, R., Boswell, L. Copyright 2015 by Big Ideas Learning, LLC.

VIII. CAREER READINESS, LIFE LITERACIES, AND KEY SKILLS AND COMPUTER SCIENCE

Seeing Structure in Expressions

- **Career Ready Practices**
  - Utilize critical thinking to make sense of problems and persevere in solving them.
    Activity: Problem Solving Workshop, Lesson 1.5. Using Alternative Methods

- **9.2 Career Awareness, Exploration, and Preparation**
  - **9.2.8.CAP.6:** Compare the costs of postsecondary education with the potential increase in income from a career of choice.
    Activity: Graphing Calculator Activity Lesson 1.6 Make a Table.

- **9.4 Life Literacies and Key Skills**
  - **9.4.8.CT.2:** Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option.
    Activity: Problem Solving Workshop, Lesson 1.5. Using Alternative Methods

- **Computer Science**
  - **8.1.8.DA.1:** Organize and transform data collected using computational tools to make it usable for a specific purpose.
    Activity: https://im.kendallhunt.com/HS/teachers/1/1/11/preparation.html Comparing and Contrasting Data Displays. Students can use provided data or research public database for live data.

Arithmetic with Polynomials and Rational Expressions

- **Career Ready Practices**
  - Utilize critical thinking to make sense of problems and persevere in solving them.
    Activity: Students will be asked to determine the height of a dropped object t seconds after release given the gravity constant for earth versus the gravity constant for moon. (section 9.4 p. 577).

- **9.2 Career Awareness, Exploration, and Preparation**
  - **9.2.8.CAP.18:** Explain how personal behavior, appearance, attitudes, and other choices may impact the job application process.
    Activity: Students will be asked to create a banner that represents themselves and hang it during a school spirit week. Students will be asked to find the width of one banner when given the length of the rectangle. (section 9.5 p. 590)

- **9.4 Life Literacies and Key Skills**
  - **9.4.8.CI.3:** Examine challenges that may exist in the adoption of new ideas
    Activity: Students will be given data to show the number of subscribers to the first U.S. digital satellite radio service for various months after its launch and will be asked to use a graphing calculator to model the quadratic regression. (section 10.8 p. 693)

- **Computer Science**
  - **8.1.8.DA.6:** Analyze climate change computational models and propose refinements.
    Activity: Students will be given climate data and will be asked to use a graphing calculator to model the quadratic regression. (section 10.8 p. 693)

Creating Equations

- **Career Ready Practices**
  - Demonstrate creativity and innovation.
    Activity: https://student.desmos.com/activitybuilder/student/5f089f9293b63626765ea3b5

- **9.2 Career Awareness, Exploration, and Preparation**
  - **9.2.8.CAP.11**: Analyze potential career opportunities by considering different types of resources, including occupation databases, and state and national labor market statistics.
  - **Activity:** Students will use occupation data bases and labor market statistics as the data source for creating equations.

- **9.4 Life Literacies and Key Skills**
  - **9.4.8.CI.1**: Assess data gathered on varying perspectives on causes of climate change (e.g., cross cultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions
    Activity: Students will analyze data gathered on climate change and use it to generate potential solutions.

- **Computer Science**
  - **8.1.8.DA.1**: Organize and transform data collected using computational tools to make it usable for a specific purpose.
    Activity: Students will use a spreadsheet, with formulas, to evaluate an equation with a number of input values. They will be able to graph the result to show how various equations are represented on a graph. (e.g., page 1 and page 42, Algebra 1).

Reasoning with Equations and Inequalities

- **Career Ready Practices**
  - Utilize critical thinking to make sense of problems and persevere in solving them.
    Activity: Through the daily course work required, students will be expected to clearly articulate, using proper mathematical vocabulary, the impact of slope and y-intercept on a graph, as well as what those values mean in relation to the original problem setting. Students will learn to relate phrases and keywords with their accurate representation as inequalities, including compound inequalities.

- **9.2 Career Awareness, Exploration, and Preparation**
  - **9.2.8.CAP.10**: Evaluate how careers have evolved regionally, nationally, and globally.
    Activity: They will understand how compound inequalities reflect many real life situations and will utilize graphs and accurate vocabulary to describe these situations and their graphs.

- **9.4 Life Literacies and Key Skills**
  - **9.4.8.CT.3**: Compare past problem-solving solutions to local, national, or global issues and analyze the factors that led to a positive or negative outcome.
    Activity: Algebra 1, page 342, Internet Activity - Model Data from the Internet

- **Computer Science**
  - **8.1.8.DA.6**: Analyze climate change computational models and propose refinements.
    Activity: Algebra 1, page 342, Internet Activity - Model Data from the Internet (climate change).

IX. PACING

A. Expressions, Equations, and Functions (5 days)
1. Apply Order of Operations
2. Write Expressions
3. Represent Functions as Rules and Tables
4. Represent Functions as Graphs
   Interdisciplinary Connections:
   NJSLSA.W4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
   Activity: Students will create a written summary of key topics and details in this unit, which can be used by other students to learn the material at another time. Students will include practice problems

and answer keys. Organization, clear description, proper voice will be important details on which to focus.

B. Properties of Real Numbers (5 days)
1. Use Integers and Rational Numbers
2. Add, Subtract, Multiply, and Divide Real Numbers
3. Apply the Distributive Property
4. Find Square Roots and Compare Real Numbers

Interdisciplinary Connections:

Social Studies

6.3.8.EconET.1: Using quantitative data, evaluate the opportunity cost of a proposed economic action, and take a position and support it (e.g., healthcare, education, transportation).

Activity: Students will consider an improvement they'd like to see at the Middle School and plan a budget. Will consider various stakeholders and develop a proposal which best meets the needs of the parties.

C. Solving Linear Equations (15 days)
1. Solve One-Step Equations
2. Solve Two-Step Equations
3. Solve Multi-Step Equations
4. Solve Equations with Variables on Both Sides
5. Write Ratios and Proportions
6. Solve Proportions Using Cross Products
7. Solve Percent Problems
8. Rewrite Equations and Formulas

Interdisciplinary Connections:

6.3.8.EconET.1: Using quantitative data, evaluate the opportunity cost of a proposed economic action, and take a position and support it (e.g., healthcare, education, transportation).

Activity: Students will use ratios and proportions to analyze the number of people in the district that would meet certain conditions if our school district were representative of the country at large.

D. Graphing Linear Equations and Functions (15 days)
1. Graph Linear Equations
2. Graph Using Intercepts
3. Find Slope and Rate of Change
4. Graph Using Slope-Intercept Form
5. Model Direct Variation
6. Graph Linear Functions

Interdisciplinary Connections:

NJSLS.MATH.CONTENT.HSA.REI.D.10

MSESS2-1 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale.

Activity: During the course of the problems assigned in this unit, students will meet these interdisciplinary standards. Algebra 1 Chapter 4.

E. Writing Linear Equations (15 days)
1. Write Linear Equations in Slope-Intercept Form
2. Use Linear Equations in Slope-Intercept Form
3. Write Linear Equations in Point-Slope Form
4. Write Linear Equations in Standard Form
5. Write Equations of Parallel and Perpendicular Lines
6. Fit a Line to Data
7. Predict with Linear Models

Interdisciplinary Connections:

Science MS-ETS1 Analyze and interpret data to determine similarities and differences in findings.
Activity: During the course of graphing and writing equations, students will compare/contrast slope, y-intercepts, and their relationships with parallel lines and perpendicular lines. Students will use linear models to make predictions, based on publicly available data. Chapter 5, with emphasis on Section 5.7 Investigation Algebra Activity & Internet Activity.

F. Solving and Graphing Linear Inequalities (16 days)
1. Solve Inequalities Using Addition and Subtraction
2. Solve Inequalities Using Multiplication and Division
3. Solve Multi-Step Inequalities
4. Solve Compound Inequalities
5. Solve Absolute Value Equations
6. Solve Absolute Value Inequalities
7. Graph Linear Inequalities in Two Variables

Interdisciplinary Connections:
Science MS-ESS-1. Develop and use a model to describe phenomena. (MS-ESS1-1),(MS-ESS1-2) 6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (MS-ESS1-2),(MS-ESS1-4) 7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. (MS-ESS1-2),(MS-ESS1-4)
Activity: During the course of this unit, students will use variables, equations and inequalities to represent real world situations. They will model using graphs and equations. Algebra 1 Chapter 6, with emphasis on Investigating Algebra Activity, page 404.

G. Systems of Equations and Inequalities (15 days)
1. Solve Linear Systems by Graphing
2. Solve Linear Systems by Substitution
3. Solve Linear Systems by Adding or Subtracting
4. Solve Linear Systems by Multiplying First
5. Solve Special Types of Linear Systems
6. Solve Systems of Linear Inequalities

Interdisciplinary Connections:
Science (MS-PS2-1),(MS-PS2-4). Models can be used to represent systems and their interactions—such as inputs, processes and outputs. MP.2 Reason abstractly and quantitatively. (MS-PS2-1),(MS-PS2-2),(MS-PS2-3)
Activity: Use systems of equations to solve problems about traveling with and against a current in a kayak. Algebra 1, page 425.

H. Exponents and Exponential Functions (17 days)
1. Apply Exponent Properties Involving Products
2. Apply Exponent Properties Involving Quotients
3. Define and Use Zero and Negative Exponents
4. Use Scientific Notation
5. Write and Graph Exponential Growth Functions
6. Write and Graph Exponential Decay Functions

Interdisciplinary Connections:
Science (MS-PS1-1) Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other.
Activity: Algebra 1, Section 8.4 problem solving, and Graphing Calculator Activity, Using Scientific Notation, page 519.

I. Polynomials and Factoring (18 days)
1. Add and Subtract Polynomials
2. Multiply Polynomials

3. Find Special Products of Polynomials
4. Solve Polynomial Equations in Factored Form
5. Factor x^2+bx+c
6. Factor ax^2+bx+c
7. Factor Special Products
8. Factor Polynomials Completely

Interdisciplinary Connections:

Science (MS-PS2-3, MS-PS2- 5). Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Activity: Students will use a polynomial function to model the height of a jumping animal as a function of time. Students can answer the question, "How does changing the initial vertical velocity of an African cat affect its jumping height?" Algebra 1 Page 553.

J. Quadratic Equations and Functions (18 days)

1. Graph $y=ax^2+c$
2. Graph $y=ax^2+bx+c$
3. Solve Quadratic Equations by Graphing
4. Use Square Roots to Solve Quadratic Equations
5. Solve Quadratic Equations by Completing the Square
6. Solve Quadratic Equations by the Quadratic Formula
7. Interpret the Discriminant
8. Compare Linear, Exponential, and Quadratic Models

Interdisciplinary Connections:

Science (MS-PS3-1*)* Construct and interpret graphical displays of data to identify linear and nonlinear relationships. (MS-PS3-1)

Activity: During the course of this unit, students will regularly create and interpret graphs, including features that make them linear or nonlinear relationships. Algebra 1 Section 10.8.

K. Radicals and Geometry Connections (10 days)

1. Graph Square Root Functions
2. Simplify Radical Expressions
3. Solve Radical Equations
4. Apply the Pythagorean Theorem and Its Converse
5. Apply the Distance and Midpoint Formulas

Interdisciplinary Connections:

Social Studies Skill Table - Presentational Skills**:** Present information in a logical manner using evidence and reasoning while demonstrating presentation skills.

Science. (MS-PS2-3, MS-PS2- 5). Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Activity: Students will use radical equations to solve real-world problems and present their solutions to the class, e.g., calculate the length of a sailboat's waterline for a given hull speed. (Page 731).

L. Rational Equations and Functions (14 days)

1. Model Inverse Variation
2. Graph Rational Functions
3. Divide Polynomials
4. Simplify Rational Expressions
5. Multiply and Divide Rational Expressions
6. Add and Subtract Rational Expressions
7. Solve Rational Equations

Interdisciplinary Connections:

Science MS-LS4-2. Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.

Activity: Use graphs of rational functions to describe how a microorganism's efficiency at performing metabolic tasks changes as its dimension change. (Page 763).

M. Probability and Data Analysis (13 days)

1. Find Probabilities and Odds
2. Find Probabilities Using Permutations
3. Find Probabilities Using Combinations
4. Find Probabilities of Compound Events
5. Analyze Surveys and Samples
6. Use Measures of Central Tendency and Dispersion
7. Interpret Stem-and-Leaf Plots and Histograms
8. Interpret Box-and-Whisker Plots

Interdisciplinary Connections:

NJSLSA.W7. Conduct short as well as more sustained research projects, utilizing an inquiry-based research process, based on focused questions, demonstrating understanding of the subject under investigation.

NJSLSA.W8. Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.

NJSLSA.W9. Draw evidence from literary or informational texts to support analysis, reflection, and research.

Activity*:* Students pick a topic of interest and research. Can be a mathematician or a topic of interest which would lend itself to surveys and the creation of charts and tables to display the results.

Readington Township Public Schools

Algebra 2

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Approval Date: September 14, 2021

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OVERVIEW

This full-year Algebra 2 course is designed to provide advanced 8th grade students with the opportunity to strengthen their skills in the areas of linear, quadratic, and exponential functions, while extending their content base and knowledge to include higher-degree polynomial functions (including now solving these over the set of complex numbers), rational exponents and radical functions, solving exponential and logarithmic equations, rational functions, arithmetic and geometric sequences and series, trigonometric ratios and functions, probability, data analysis and statistics.

In addition to these topics, and in keeping with the New Jersey Student Learning Standards, students will experience the course content as an integrated, useful, and coherent whole, continually refining their abilities to model with mathematics, reason abstractly and quantitatively while attending to precision both in calculations and vocabulary, and to make sense of problem situations as an essential part of the solution process.

STUDENT OUTCOMES (Linked to **New Jersey Student Learning Standards for Mathematics 2016**)

N.RN.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. For example, we define $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5.

N.RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.

N.CN.1 Know there is a complex number i such that $i^2 = -1$, and every complex number has the form a + bi with a and b real.

N.CN.2 Use the relation $i^2 = –1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.

N.CN.7 Solve quadratic equations with real coefficients that have complex solutions.

N.CN.8 (+) Extend polynomial identities to the complex numbers. For example, rewrite x2 + 4 as (x + 2i)(x – 2i).

N.CN.9 (+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.

A.SSE.1 Interpret expressions that represent a quantity in terms of its context. (Linear, exponential, quadratic for Alg.1; Polynomial and rational for Alg. 2)

a. Interpret parts of an expression, such as terms, factors, and coefficients. b. Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P.

A.SSE.2 Use the structure of an expression to identify ways to rewrite it. For example, see $x^4 – y^4$ as $(x^2)^2 – (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 –y^2)(x^2 + y^2)$.

A.SSE.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

a. Factor a quadratic expression to reveal the zeros of the function it defines.

b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.

c. Use the properties of exponents to transform expressions for exponential functions. For example the expression 1.15^t can be rewritten as $(1.15^{1/12})^{12t} \approx 1.012^{12t}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15% .

A.SSE.4 Derive and/or explain the derivation the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. For example, calculate mortgage payments.

A.APR.1 Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

A.APR.2 Know and apply the Remainder Theorem: For a polynomial p(x) and a number a, the remainder on division by x – a is p(a), so p(a) = 0 if and only if (x – a) is a factor of p(x).

A.APR.3 Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.

A.APR.4 Prove Polynomial identities and use them to describe numerical relationships and solve problems.

For example, the difference of two squares; the sum and difference of two cubes; the polynomial identity $(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$ can be used to generate Pythagorean triples.

A.APR.5 (+) Know and apply the Binomial Theorem for the expansion of $(x + y)^n$ in powers of x and y for a positive integer n, where x and y are any numbers, with coefficients determined for example by Pascal's Triangle.

A.APR.6 Rewrite simple rational expressions in different forms; write a(x)/b(x) in the form q(x) + r(x)/b(x), where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or, for the more complicated examples, a computer algebra system.

A.APR.7 (+) Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.

A.CED.1, 2, 3, 4 Create equations that describe numbers or relationships. (This is an Alg. 1 cluster that limits discussion to linear, quadratic, and exponential functions with integer inputs only. Algebra 2 extends this to equations using all types of expressions, including simple root functions).

A.CED.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.

A.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

A.CED.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.

A.CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R.

A.REI.2 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

A.REI.4 Solve quadratic equations in one variable.

*a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.

*b. Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as a ± bi for real numbers a and b.

A-REI.6 Solve algebraically a system of *three* linear equations in three unknowns.

A-REI.7 Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line y=-3x and the circle $x^2 + y^2 = 3$.

A.REI.11 Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.

F.IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.

F.IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.

F.IF.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.

F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.

c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.

e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

F.IF.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

F.IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.

F-BF.1 Write a function that describes a relationship between two quantities.

b. Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.

F-BF.2 Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.

F.BF.3 Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

F.BF.4 Find inverse functions.

a. Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse. For example, f(x) = 2 x3 or f(x) = (x+1)/(x-1) for $x \neq 1$.

F.LE.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

F.LE.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.

F.LE.4 Understand the inverse relationship between exponents and logarithms. For exponential models, express as a logarithm the solution to $ab^{ct} = d$ where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.

F.TF.1 Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.

F.TF.2 Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.

F.TF.5 Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.

F.TF.8 Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ and use it to find sin (θ), cos (θ), or tan (θ), given sin (θ), cos (θ), or tan (θ), and the quadrant of the angle.

S.ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).

S.ID.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.

S.ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).

S.ID.4 Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.

S.ID.5 Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.

S.ID.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.

a. Fit a function to the data (including with the use of technology); use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear and exponential models.

S-ID.6a-1 Solve multi-step contextual word problems with degree of difficulty appropriate to the course,

requiring application of course-level knowledge and skills articulated in S-ID.6a, excluding normal distributions and limiting function fitting to exponential functions
S-ID.6a-2 Solve multi-step contextual word problems with degree of difficulty appropriate to the course, requiring application of course level knowledge and skills articulated in S-ID.6a limiting function fitting to trigonometric functions.
S.IC.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
S.IC.2 Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. E.g., a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?
S.IC.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.
S.IC.4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.
S.IC.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.
S.IC.6 Evaluate reports based on data.
S.CP.1 Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not").
S.CP.2 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.
S.CP.3 Understand the conditional probability of A given B as P(A 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.
S.CP.4 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 decide if events are independent and to approximate conditional probabilities. For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.
**S.CP.5 Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.
S.CP.6 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.
S.CP.7 Apply the Addition Rule, P(A or B) = P(A) + P(B) – P(A and B), and interpret the answer in terms of the model.
S.CP.8 (+) Apply the general Multiplication Rule in a uniform probability model, P(A and B) = P(A)P(B|A) = P(B)P(A|B), and interpret the answer in terms of the model.
S.CP.9 (+) Use permutations and combinations to compute probabilities of compound events and solve problems.
S-CP.Int.1 Solve multi-step contextual word problems with degree of difficulty appropriate to the course, requiring application of course-level knowledge and skills articulated in S-CP.
S.MD.6 (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).
S.MD.7 (+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).

Mathematical Practices

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.

6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning

ESSENTIAL SKILLS AND CONTENT

Polynomial, Rational, and Radical Relationships

• Perform arithmetic operations with complex numbers.
• Use complex numbers in polynomial identities and equations.
• Interpret the structure of expressions.
• Write expressions in equivalent forms to solve problems.
• Perform arithmetic operations on polynomials.
• Understand the relationship between zeros and factors of polynomials.
• Use polynomial identities to solve problems.
• Rewrite rational expressions.
• Understand solving equations as a process of reasoning and explain the reasoning.
• Represent and solve equations and inequalities graphically.
• Analyze functions using different representations.

Trigonometric Functions

• Extend the domain of trigonometric functions using the unit circle.
• Model periodic phenomena with trigonometric function.
• Prove and apply trigonometric identities.

Modeling with Functions

• Create equations that describe numbers or relationships.
• Interpret functions that arise in applications in terms of a context.
• Analyze functions using different representations.
• Build a function that models a relationship between two quantities.
• Build new functions from existing functions.
• Construct and compare linear, quadratic, and exponential models and solve problems.

Inferences and Conclusions from Data

• Summarize, represent, and interpret data on single count or measurement variable.
• Understand and evaluate random processes underlying statistical experiments.
• Make inferences and justify conclusions from sample surveys, experiments and observational studies.
• Use probability to evaluate outcomes of decisions.

STRATEGIES

Intellectual engagement and active involvement of students in daily lessons will be achieved by a variety of teaching strategies, including:
Comprehensive direct instruction utilizing Interactive SmartBoard technology 2. Guided practice using worked-out study examples, followed immediately by 3. Independent Practice using 'Now You Try' examples 4. Student presentation of work and solutions, with explanation and justification of solutions 5. High-level questioning and encouragement of student participation 6. Student group discussion and mutual help as part of point 3 above 7. Regular written 'check for understanding' assessments. 8. End of

unit formative assessments.

ACCOMMODATIONS

- **Accommodations and Modification Addendum**

ASSESSMENTS

- **Formative**
  - Independent student work
  - Homework assignments
  - Notebooks
  - Teacher observations
  -
- **Summative**
  - End of Year Test
  - Unit Test
  - Unit Quizes
- **Alternative**
  - Student projects
  - **o**
- **Benchmark**
  - Performance-based assessments

REQUIRED RESOURCES

- **Core**
  - **Textbook for course:** *Big Ideas MATH Algebra 2*, Larson, R., Boswell, L. Copyright 2015 by Big Ideas Learning, LLC.
- **Supplemental resources for course:**
  - Chapter Resource Books. Larson, R., Boswell, L., Kanold, T.D., & Stiff, L. Copyright 2001 by McDougal Littell, a Houghton Mifflin Company, Evanston, IL.
  - Standardized Test Practice Workbook. Larson, R., Boswell, L., Kanold, T.D., & Stiff, L. Copyright 2001 by McDougal Littell, a Houghton Mifflin Company, Evanston, IL.
  - *McDougal Littell Algebra 2.* Larson, R., Boswell, L., Kanold, T.D., & Stiff, L. Copyright 2004 by McDougal Littell, a Houghton Mifflin Company, Evanston, IL.
- **Suggested supplemental Technology**
  - **o** www.classzone.com
  - **o** www.shmoop.com/common-core-standards/
  - o www.illustrativemathematics.org
  - o Gizmos

CAREER READINESS, LIFE LITERACIES, AND KEY SKILLS AND COMPUTER SCIENCE

Number and Quantity

- **Career Ready Practices**
  - Utilize critical thinking to make sense of problems and persevere in solving them.
    Activity: Collect data on handedness and Male / Female population and enter into two-way tables to compute joint relative, marginal relative, and conditional relative frequencies

- **9.2 Career Awareness, Exploration, and Preparation**
    - **9.2.8.CAP.18**: Explain how personal behavior, appearance, attitudes, and other choices may impact the job application process.
      Activity: Students will perform peer- and self-evaluations on their work effort and behavior during the above activity. Students will self-assess their work and the overall functioning of their work group during this project.

- **9.4 Life Literacies and Key Skills**
    - **9.4.8.TL.1**: Construct a spreadsheet in order to analyze multiple data sets, identify relationships,and facilitate data-based decision-making.
      Activity: Collect data on handedness and Male / Female population and enter into two-way tables to compute joint relative, marginal relative, and conditional relative frequencies using Excel.
- **Computer Science**
    - **8.1.8.DA.1**: Organize and transform data collected using computational tools to make it usable for a specific purpose.
      Activity: Collect data on handedness and Male / Female population and enter into two-way tables to compute joint relative, marginal relative, and conditional relative frequencies using Excel.

Algebra

- **Career Ready Practices**
    - Utilize critical thinking to make sense of problems and persevere in solving them.
      Activity: Students will be asked to calculate height of a dropped object t seconds after release given gravity constant for earth vs. gravity constant for moon. (Ch. 3 of BI Algebra 2).

- **9.2 Career Awareness, Exploration, and Preparation**
    - **9.2.8.CAP.14**: Evaluate sources of income and alternative resources to accurately compare employment options.
      Activity: Students will calculate how to maximize possible income.

- **9.4 Life Literacies and Key Skills**
    - **9.4.8.TL.2**: Gather data and digitally represent information to communicate a real-world problem
      Activity: Students will persevere in solving real world problems involving functions - solving, graphing and interpreting. (Big Ideas Section 2.1, pgs 53-54).

- **Computer Science**
    - **8.1.8.DA.1**: Organize and transform data collected using computational tools to make it usable for a specific purpose.
      Activity: Enter data pairs into TI graphing calculator using time, height data and use quadratic regression.

Functions

- **Career Ready Practices**
    - Use technology to enhance productivity, increase collaboration and communicate effectively.
      Activity: Students will persevere in solving real world problems involving functions - solving, graphing and interpreting. (Big Ideas Section 2.1, pgs 53-54).

- **9.2 Career Awareness, Exploration, and Preparation**
    - **9.2.8.CAP.8**: Compare education and training requirements, income potential, and primary duties of at least two jobs of interest.
      Activity: Students will persevere in solving real world problems involving functions - solving, graphing and interpreting. (Big Ideas Section 2.1, pgs 53-54).

- **9.4 Life Literacies and Key Skills**
    - **9.4.8.TL.3**: Select appropriate tools to organize and present information digitally.
      Activity: Students will use a graphing calculator to model transformations of quadratic functions. They will solve real world problems, e.g., modeling the path of water coming from a fire truck (Big Ideas. Section 2.1).
- **Computer Science**
    - **8.1.8.DA.1**: Organize and transform data collected using computational tools to make it usable for a specific purpose.
      Activity: Students will use a graphing calculator to model transformations of quadratic functions. They will solve real world problems, e.g., modeling the path of water coming from a fire truck (Big Ideas. Section 2.1).

Statistics and Probability

- **Career Ready Practices**
    - Use technology to enhance productivity, increase collaboration and communicate effectively.
      Activity: Students will design and execute a valid research survey, analyze its results on an issue pertaining to education and income . (Big Ideas Sections 11.1 - 11.3)

- **9.2 Career Awareness, Exploration, and Preparation**
    - **9.2.8.CAP.6**: Compare the costs of postsecondary education with the potential increase in income from a career of choice.
      Activity: Through the group survey project above, students will participate fairly and effectively with their group members, to produce a coherent survey, analysis and presentation of its findings. (Big Ideas, Chapter 11).

- **9.4 Life Literacies and Key Skills**
    - **9.4.8.TL.2**: Gather data and digitally represent information to communicate a real-world problem

Activity: Through the group survey project above, students will participate fairly and effectively with their group members, to produce a coherent survey, analysis and presentation of its findings. (Big Ideas, Chapter 11).

- **Computer Science**
  - **8.1.8.DA.5:** Test, analyze, and refine computational models.
    Activity: Students will analyze school-wide data on left-handedness, enter into a spreadsheet and program to calculate one-variable statistics on measures of central tendency and variability. Alternatively, they may use the research topic of their choice (see above).

IX. PACING

A. Polynomials (Quadratics) (34 days)

a. Review rewriting equations and formulas
b. Functions and their graphs
c. Review quick-sketch graphing techniques of linear equations
d. Piecewise functions
e. Absolute value functions
f. Review solving systems of two equations graphically, and algebraically using elimination and substitution methods
g. Solving systems of linear equations in three variables
h. Graphing quadratic functions
i. Solving quadratic functions by factoring
j. Solving quadratic functions by finding square roots
k. Complex numbers
l. Completing the square
m. The quadratic formula and the discriminant
n. Modeling with quadratic functions
o. Solving quadratic systems (i.e. a linear – quadratic system)
p. Parabolas as conic sections (derive equation of a parabola given a focus and directrix)

Interdisciplinary Connections:

- NJSLSA.R7 Integrate and evaluate content presented in Diverse media and formats, including visually and quantitatively, as well as in word.
  Activity: Students will watch Dirt Bike Trajectory video and read its associated written performance task and complete problems relating to calculating the trajectory of a dirt bike launching from a ramp. (Big Ideas. Section 1.1).

B. Polynomials (Higher Order Polynomials) (20 days)

1. Evaluating and graphing polynomial functions
2. Using properties of exponents

3. Adding, subtracting, and multiplying polynomials
4. Factoring and solving polynomial equations
5. The Remainder and Factor Theorems and dividing polynomials
6. The Rational Zero Theorem
7. The Fundamental Theorem of Algebra
8. Analyzing graphs of polynomial functions

Interdisciplinary Connections:

- NJSLSA.R7 Integrate and evaluate content presented in Diverse media nad formats, including visually and quantitatively, as well as in word.
  Activity: Students will watch the Parabolic Mirror video and read associated written performance task and complete problems relating to building their own parabolic mirror that uses sunlight to generate electricity.. (Big Ideas. Section 2.3).

C. Radical and Rational Functions (19 days)

1. Nth roots and rational exponents
2. Properties of rational exponents
3. Power functions and function operations (limited to arithmetic operations)
4. Inverse functions
5. Graphing square root and cube root functions
6. Solving radical equations
7. Inverse and joint variation
8. Graphing simple rational functions
9. Graphing general rational functions
10. Multiplying and dividing rational expressions 1
11. Adding and subtracting rational expressions and simplifying complex fractions
12. Solving rational equations

Interdisciplinary Connections:

- ETS1.B: Developing Possible Solutions A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3) Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3) Models of all kinds are important for testing solutions. (MS-ETS1-4)
  Activity: Through this unit, students will find equivalent expressions, solutions to functions and model their solutions.

D. Exponential and Logarithmic Functions (20 days)

1. Exponential growth
2. Exponential decay
3. The number ***e***
4. Logarithmic functions
5. Properties of Logarithms (cover only those needed to solve exp. and log. Equations, i.e. Power

Property and Change-of-Base Formula. Cover others if time.)
6. Solving exponential and logarithmic equations (Suppl. same as C.8 above for solving *systems* of exponential and logarithmic equations)
7. Modeling with exponential functions (and power functions – time allowing)

Interdisciplinary Connections:

- ETS1.A: Defining and Delimiting Engineering Problems The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1)

  Activity: Throughout the unit, students will analyze limits and constraints in functions.

E. Arithmetic and Geometric Sequences and Series (12 days)

1. Introduction to sequences and series
2. Arithmetic sequences and series
3. Geometric sequences and series
4. Infinite geometric series (Time-allowing. Not in PARCC PBA or EOY) 5. Recursive rules for sequences (11.5)
5. Mathematical induction (Chpt. 11 Extension)

Interdisciplinary Connections:

- Patterns Macroscopic patterns are related to the nature of microscopic and atomic-level structure. (MS-PS1-2) Cause and Effect Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS1-4)

  Activity: Throughout this unit, students will analyze sequences and series to determine the relationship between its terms. They will use these relationships to make predictions.

F. Probability (13 days)

1. Introduction to probability (Suppl. vocab.: outcomes, event, sample space, with Big Ideas Algebra 2, BI- 10.1)
2. Probability of compound events
3. Probability of independent and dependent events (Suppl. with Big Ideas Algebra 2 for 'Two-Way Tables and Probability')
4. The Fundamental Counting Principle and permutations (Time-allowing) 5. Combinations and the Binomial Theorem (Time-allowing)
5. Binomial distributions (Time-allowing)

Interdisciplinary Connections:

- Science: Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy. (MS-ETS1-4)
  Activity: Students will meet this standard through their creation, execution and evaluation of their surveys.

G. Data Analysis and Statistics (24 days)

1. Statistics and statistical graphs
2. Using Normal Distributions (Optional - Suppl. with shmoop.com/precalculus-statistics-probability/z- scores.html)
3. Populations, Samples, and Hypotheses
4. Collecting data
5. Experimental design
6. Making inferences from sample surveys
7. Making inferences from experiments

Interdisciplinary Connections:

- Science: Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy. (MS-ETS1-4)
  Activity: Throughout this unit and through the survey project, students will calculate and compare probabilities, noting similarities and differences.

H. Trigonometry (18 days)

1. Right triangle trigonometry
2. The unit circle (BI-Chpt.9 Mathematical Practices, p.460)
3. General angles and radian measure
4. Trigonometric functions of any angle
5. Graphing sine, cosine, and tangent functions
6. Translations and reflections of trigonometric graphs (Suppl. with BI-9.4 for 'midline' as vocab., and other points as needed)
7. Verifying trigonometric identities (Suppl. with BI-9.7 unit circle discussion of why $\sin^2 + \cos^2 = 1$, p.514)
8. Solving trigonometric equations
9. Modeling with trigonometric functions
10. Using Sum and Difference formulas (time-allowing)

Interdisciplinary Connections:

- NJSLSA.R7 Integrate and evaluate content presented in Diverse media nad formats, including visually and quantitatively, as well as in word.
  NJSLSA.W1 Write arguments to support claims ina n analysis of substantive topics or text, using valid reasoning and relevant and sufficient evidence.

Activity: Students will watch the Parasailing to Great Heights video and read associated written performance task and complete problems relating to calculating just how high a parasailer can fly. (Big Ideas. Section 9.1).

I. Introduction to Geometry, Logical Reasoning and Proofs (20 days)

1. Patterns and inductive reasoning (MLG-1.1) 1 (McDougal Littell Geometry 2004)
2. Points, lines, and planes (MLG-1.2) 1
3. Segments and their measure (MLG-1.3) 1
4. Angles and their measure (MLG-1.4) 1
5. Segment and angle bisectors (MLG-1.5) 1
6. Angle pair relationships (MLG-1.6) 1
7. Introduction to perimeter, circumference, and area (MLG-1.7) 1
8. Conditional statements (MLG-2.1) 2
9. Definitions and biconditional statements (MLG-2.2) 2
10. Deductive reasoning (MLG-2.3) 2
11. Reasoning with properties from algebra (MLG-2.4) 2
12. Proving statements about segments (MLG-2.5) 1
13. Proving statements about angles (MLG-2.6) 1
14. Indirect proofs (MLG-5.6) 2
15. Logical reasoning (McDougal Littell Alg. 2 'Skills Review Handbook' pp. 924-929)

Interdisciplinary Connections:

- RI8.8. Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient; recognize when irrelevant evidence is introduced.
  RI.8.1 Cite the textual evidence and make relevant connections that most strongly supports an analysis of what the text says explicitly as well as inferences drawn from the text.
  Activity: Throughout this unit, students will analyze and create arguments and proofs based on provided evidence.

Readington Township Public Schools

Innovation & Design Grades 4 & 5

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OVERVIEW

The Innovation and Design Curriculum is based on the belief that much of the ingenuity of children is untapped, unrealized potential that, when properly motivated, will lead to the next generation of technologists, innovators, designers and engineers critical to our society. Our goal is to promote Science, Technology, Engineering and Mathematics (STEM) learning, innovative thinking and creative problem-solving.

Our curriculum framework is aligned with the New Jersey Student Learning Standards for Technological Literacy as well as Engineering Design. We believe that by providing an environment that stimulates enthusiasm for learning, students will develop a conceptual understanding of scientific and mathematical principles, establish proficiency with technological systems and become creative and innovative problem solvers. We are committed to integrating technology into all content areas in a manner that is meaningful, natural, appropriate and which extends a student's learning and makes it more efficient. Our curriculum is designed to promote a problem-based course of study where students will be presented with a problem and will work to design a solution for the problem. This type of learning would be "constructivist" in nature with students actively "building" knowledge rather than passively receiving it and is based on four basic principles:

1) Learning by designing meaningful projects to share in the community.
2) Using concrete objects to build and explore the world.
3) Identifying powerful ideas that are both personally and epistemologically significant
4) Engaging in self-reflection as part of the learning process

STUDENT OUTCOME (Linked to New Jersey Student Learning Standards)

NJSLS- Science-Engineering Design

MS.ETS1.A: Defining and Delimiting Engineering Problems
MS.ETS1.B: Developing Possible Solutions
MS.ETS1.C: Optimizing the Design Solution

Computer Science and Design Thinking Practices

1. Fostering an Inclusive Computing and Design Culture
2. Collaborating Around Computing and Design
3. Recognizing and Defining Computational Problems
4. Developing and Using Abstractions
5. Creating Computational Artifacts
6. Testing and Refining Computational Artifacts
7. Communicating About Computing and Design

8.1 Computer Science

Computing Systems

8.1.5.CS.1: Model how computing devices connect to other components to form a system.
8.1.5.CS.2: Model how computer software and hardware work together as a system to accomplish tasks.
8.1.5.CS.3: Identify potential solutions for simple hardware and software problems using common troubleshooting strategies.

Networks and the Internet

8.1.5.NI.1: Develop models that successfully transmit and receive information using both wired and wireless methods.
8.1.5.NI.2: Describe physical and digital security measures for protecting sensitive personal information.

Impacts of Computing

8.1.5.IC.1: Identify computing technologies that have impacted how individuals live and work and describe the factors that influenced the changes.
8.1.5.IC.2: Identify possible ways to improve the accessibility and usability of computing technologies to address the diverse needs and wants of users.

Data & Analysis

8.1.5.DA.1: Collect, organize, and display data in order to highlight relationships or support a claim.
8.1.5.DA.2: Compare the amount of storage space required for different types of data.

8.1.5.DA.3: Organize and present collected data visually to communicate insights gained from different views of the data.
8.1.5.DA.4: Organize and present climate change data visually to highlight relationships or support a claim.
8.1.5.DA.5: Propose cause and effect relationships, predict outcomes, or communicate ideas using data.

Algorithms & Programming

8.1.5.AP.1: Compare and refine multiple algorithms for the same task and determine which is the most appropriate.
8.1.5.AP.2: Create programs that use clearly named variables to store and modify data.
8.1.5.AP.3: Create programs that include sequences, events, loops, and conditionals.
8.1.5.AP.4: Break down problems into smaller, manageable sub-problems to facilitate program development.
8.1.5.AP.5: Modify, remix, or incorporate pieces of existing programs into one's own work to add additional features or create a new program.
8.1.5.AP.6: Develop programs using an iterative process, implement the program design, and test the program to ensure it works as intended.

8.2 Design Thinking

Engineering Design

8.2.5.ED.1: Explain the functions of a system and its subsystems.
8.2.5.ED.2: Collaborate with peers to collect information, brainstorm to solve a problem, and evaluate all possible solutions to provide the best results with supporting sketches or models. 8.2.5.ED.3: Follow step by step directions to assemble a product or solve a problem, using appropriate tools to accomplish the task
8.2.5.ED.4: Explain factors that influence the development and function of products and systems (e.g., resources, criteria, desired features, constraints).
8.2.5.ED.5: Describe how specifications and limitations impact the engineering design process. 8.2.5.ED.6: Evaluate and test alternative solutions to a problem using the constraints and tradeoffs identified in the design process.

Interaction of Technology and Humans

8.2.5.ITH.1: Explain how societal needs and wants influence the development and function of a product and a system.
8.2.5.ITH.2: Evaluate how well a new tool has met its intended purpose and identify any shortcomings it might have.
8.2.5.ITH.3: Analyze the effectiveness of a new product or system and identify the positive and/or negative consequences resulting from its use.
8.2.5.ITH.4: Describe a technology/tool that has made the way people live easier or has led to a new business or career.

Nature of Technology

8.2.5.NT.1: Troubleshoot a product that has stopped working and brainstorm ideas to correct the problem.
8.2.5.NT.2: Identify new technologies resulting from the demands, values, and interests of individuals, businesses, industries, and societies.
8.2.5.NT.3: Redesign an existing product for a different purpose in a collaborative team. 8.2.5.NT.4: Identify how improvement in the understanding of materials science impacts technologies.

Effects of Technology on the Natural World

8.2.5.ETW.1: Describe how resources such as material, energy, information, time, tools, people, and capital are used in products or systems.
8.2.5.ETW.2: Describe ways that various technologies are used to reduce improper use of resources.
8.2.5.ETW.3: Explain why human-designed systems, products, and environments need to be constantly monitored, maintained, and improved.
8.2.5.ETW.4: Explain the impact that resources, such as energy and materials used to develop technology, have on the environment.
8.2.5.ETW.5: Identify the impact of a specific technology on the environment and determine what can be done to increase positive effects and to reduce any negative effects, such as climate change

Ethics & Culture

8.2.5.EC.1: Analyze how technology has contributed to or reduced inequities in local and global communities and determine its short- and long-term effects.

9.4 Life Literacies and Key Skils

Creativity and Innovation

9.4.5.CI.1: Use appropriate communication technologies to collaborate with individuals with diverse perspectives about a local and/or global climate change issue and deliberate about possible solutions (e.g., W.4.6, 3.MD.B.3,7.1.NM.IPERS.6).
9.4.5.CI.2: Investigate a persistent local or global issue, such as climate change, and collaborate with individuals with diverse perspectives to improve upon current actions designed to address the issue (e.g., 6.3.5.CivicsPD.3, W.5.7).
9.4.5.CI.3: Participate in a brainstorming session with individuals with diverse perspectives to expand one's thinking about a topic of curiosity (e.g., 8.2.5.ED.2, 1.5.5.CR1a).
9.4.5.CI.4: Research the development process of a product and identify the role of failure as a part of the creative process (e.g., W.4.7, 8.2.5.ED.6).

Critical Thinking and Problem-solving

9.4.5.CT.1: Identify and gather relevant data that will aid in the problem-solving process (e.g., 2.1.5.EH.4, 4-ESS3-1, 6.3.5.CivicsPD.2).
9.4.5.CT.2: Identify a problem and list the types of individuals and resources (e.g., school, community agencies, governmental, online) that can aid in solving the problem (e.g., 2.1.5.CHSS.1, 4-ESS3-1).
9.4.5.CT.3: Describe how digital tools and technology may be used to solve problems.
9.4.5.CT.4: Apply critical thinking and problem-solving strategies to different types of problems such as personal, academic, community and global (e.g., 6.1.5.CivicsCM.3)

ESSENTIAL QUESTIONS AND CONTENT

GRADE 4:

Unit 1 Engineering Design Process

What is the Engineering Design Process?
What are the steps in the Engineering Design Process?

Unit 2 Innovations

What is an Innovation?
What makes my product an Innovation?

Unit 3 Communication

How is collaboration an important skill when working in a group?
Why is it important to have a trademark or copyright?

Unit 4 Coding

What are the basic fundamentals of programming?

Unit 5 Simple Machines

What is a simple machine?
Can you identify 6 simple machines?

GRADE 5:

Unit 1 Engineered Material

What is the difference between engineered and natural materials?
What is buoyancy and why must my boat be durable?

Unit 2 Chain Reactions

What is a chain reaction?
Who is Rube Goldberg?
How would you describe a Rube Goldberg Machine?

Unit 3 Coding

What are the basic fundamentals of programming?

Unit 4 Reusable Materials

What is recycling?
How can I recycle?
What is necessary to create a vehicle that will travel a specific distance?

STRATEGIES

- Groups Discussions
- Teacher Presentation
- Student Projects
- Interactive SMARTBoard & Google Classroom Lessons
- Tutorials
- Online Practice using lesson specific websites

EVALUATION

Assessments may include but are not limited to:

- Teacher Observation
- Class Participation
- Class Discussions
- Class Assignments
- Student Journals
- Student Projects

REQUIRED RESOURCES

- Computer with Internet Connection
- Makey Makey Boards
- Probots

SCOPE AND SEQUENCE

GRADE 4

Unit 1 Engineering Design Process

- Learn the steps in the Engineering Design Process
- Follow the steps in the Engineering Design Process

Unit 2 Innovations

- Follow the steps in the Engineering Design Process
- Innovations & Inventions
- Patents

Unit 3 Communication

- Intellectual Property Law (trademark / copyright)
- Logos & Slogans

Unit 4 Coding

- Procedures
- Program Coding
- Program debugging

Unit 5 Simple Machines

- Simple machine names
- Simple machine identification

GRADE 5

Unit 1 Engineered Materials

- Buoyancy and Durability
- Engineered Materials
- Manufactured Materials

Unit 2 Chain Reactions

- Chain Reaction Properties
- Rube Goldberg
- Rube Goldberg Machine

Unit 3 Coding

- Procedures
- Program Coding
- Program Debugging

Unit 4 Reusable Materials

- Recycled Materials
- Force & Friction