Grade 8: Unit 2
Functions, Equations and Solutions
Course Philosophy/Description

In mathematics, students will learn to address a range of tasks focusing on the application of concepts, skills and understandings. Students will be asked to solve problems involving the key knowledge and skills for their grade level as identified by the NJSLS; express mathematical reasoning and construct a mathematical argument and apply concepts to solve model real world problems. The balanced math instructional model will be used as the basis for all mathematics instruction.

Eighth grade Mathematics consists of the following domains: The Number System (NS), Expressions and Equations (EE), Functions (F), Geometry (G), and Statistics and Probability (SP). In eighth grade, instructional time should focus on three critical areas: (1) formulating and reasoning about expressions and equations, including modeling an association in bivariate data with a linear equation, and solving linear equations and systems of linear equations; (2) grasping the concept of a function and using functions to describe quantitative relationships; (3) analyzing two- and three-dimensional space and figures using distance, angle, similarity, and congruence, and understanding and applying the Pythagorean Theorem.

1) Students use linear equations and systems of linear equations to represent, analyze, and solve a variety of problems. Students recognize equations for proportions (y/x = m or y = mx) as special linear equations (y = mx + b), understanding that the constant of proportionality (m) is the slope, and the graphs are lines through the origin. They understand that the slope (m) of a line is a constant rate of change, so that if the input or x-coordinate changes by an amount A, the output or y-coordinate changes by the amount m·A. Students also use a linear equation to describe the association between two quantities in bivariate data (such as arm span vs. height for students in a classroom). At this grade, fitting the model, and assessing its fit to the data are done informally. Interpreting the model in the context of the data requires students to express a relationship between the two quantities in question and to interpret components of the relationship (such as slope and y-intercept) in terms of the situation. Students strategically choose and efficiently implement procedures to solve linear equations in one variable, understanding that when they use the properties of equality and the concept of logical equivalence, they maintain the solutions of the original equation. Students solve systems of two linear equations in two variables and relate the systems to pairs of lines in the plane; these intersect, are parallel, or are the same line. Students use linear equations, 3 systems of linear equations, linear functions, and their understanding of slope of a line to analyze situations and solve problems.

2) Students grasp the concept of a function as a rule that assigns to each input exactly one output. They understand that functions describe situations where one quantity determines another. They can translate among representations and partial representations of functions (noting that tabular and graphical representations may be partial representations), and they describe how aspects of the function are reflected in the different representations.

3) Students use ideas about distance and angles, how they behave under translations, rotations, reflections, and dilations, and ideas about congruence and similarity to describe and analyze two-dimensional figures and to solve problems. Students show that the sum of the angles in a triangle is the angle formed by a straight line, and that various configurations of lines give rise to similar triangles because of the angles created when a transversal cuts parallel lines. Students understand the statement of the Pythagorean Theorem and its converse, and can explain why the Pythagorean Theorem holds, for example, by decomposing a square in two different ways. They apply the Pythagorean Theorem to find distances between points on the coordinate plane, to find lengths, and to analyze polygons. Students complete their work on volume by solving problems involving cones, cylinders, and spheres.
ESL Framework

This ESL framework was designed to be used by bilingual, dual language, ESL and general education teachers. Bilingual and dual language programs use the home language and a second language for instruction. ESL teachers and general education or bilingual teachers may use this document to collaborate on unit and lesson planning to decide who will address certain components of the SLO and language objective. ESL teachers may use the appropriate leveled language objective to build lessons for ELLs which reflects what is covered in the general education program. In this way, whether it is a pull-out or push-in model, all teachers are working on the same Student Learning Objective connected to the New Jersey Student Learning Standards. The design of language objectives are based on the alignment of the World-Class Instructional Design Assessment (WIDA) Consortium’s English Language Development (ELD) standards with the New Jersey Student Learning Standards (NJSLS). WIDA’s ELD standards advance academic language development across content areas ultimately leading to academic achievement for English learners. As English learners are progressing through the six developmental linguistic stages, this framework will assist all teachers who work with English learners to appropriately identify the language needed to meet the requirements of the content standard. At the same time, the language objectives recognize the cognitive demand required to complete educational tasks. Even though listening and reading (receptive) skills differ from speaking and writing (expressive) skills across proficiency levels the cognitive function should not be diminished. For example, an Entering Level One student only has the linguistic ability to respond in single words in English with significant support from their home language. However, they could complete a Venn diagram with single words which demonstrates that they understand how the elements compare and contrast with each other or they could respond with the support of their home language (L1) with assistance from a teacher, para-professional, peer or a technology program.

http://www.state.nj.us/education/modelcurriculum/ela/ELLOverview.pdf
<table>
<thead>
<tr>
<th>#</th>
<th>Student Learning Objective</th>
<th>NJSLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Define a function as a rule that assigns one output to each input and determine if data represented as a graph or in a table is a function.</td>
<td>8.F.A.1</td>
</tr>
<tr>
<td>2</td>
<td>Compare two functions each represented in a different way (numerically, verbally, graphically, and algebraically) and draw conclusions about their properties (rate of change and intercepts).</td>
<td>8.F.A.2</td>
</tr>
<tr>
<td>3</td>
<td>Classify functions as linear or non-linear by analyzing equations, graphs, and tables of values; interpret the equation $y = mx + b$ as defining a linear function.</td>
<td>8.F.A.3</td>
</tr>
<tr>
<td>4</td>
<td>Model a linear relationship by constructing a function from two (x,y) values. Interpret the rate of change and initial value of the linear function in terms of the situation it models, and in terms of its graph or a table of values.</td>
<td>8.F.B.4*</td>
</tr>
<tr>
<td>5</td>
<td>Sketch a graph of a function from a qualitative description and give a qualitative description of a graph of a function.</td>
<td>8.F.B.5</td>
</tr>
<tr>
<td>6</td>
<td>Apply the distributive property and collect like terms to solve linear equations in one variable that contain rational numbers as coefficients. Use an equivalent equation of the form $x = a$, $a = a$, or $a = b$ (where $a$ and $b$ are different numbers) to describe the number of solutions.</td>
<td>8.EE.C.7a,b</td>
</tr>
<tr>
<td>7</td>
<td>Solve systems of linear equations in two variables algebraically and by inspection. Estimate solutions by graphing, explain that points of intersection satisfy both equations simultaneously, and interpret solutions in context.</td>
<td>8.EE.C.8*</td>
</tr>
</tbody>
</table>
Research about Teaching and Learning Mathematics

Structure teaching of mathematical concepts and skills around problems to be solved (Checkly, 1997; Wood & Sellars, 1996; Wood & Sellars, 1997)
Encourage students to work cooperatively with others (Johnson & Johnson, 1975; Davidson, 1990)
Use group problem-solving to stimulate students to apply their mathematical thinking skills (Artzt & Armour-Thomas, 1992)
Students interact in ways that support and challenge one another’s strategic thinking (Artzt, Armour-Thomas, & Curcio, 2008)
Activities structured in ways allowing students to explore, explain, extend, and evaluate their progress (National Research Council, 1999)
There are three critical components to effective mathematics instruction (Shellard & Moyer, 2002):
- Teaching for conceptual understanding
- Developing children’s procedural literacy
- Promoting strategic competence through meaningful problem-solving investigations

Teachers should be:
- Demonstrating acceptance and recognition of students’ divergent ideas
- Challenging students to think deeply about the problems they are solving, extending thinking beyond the solutions and algorithms required to solve the problem
- Influencing learning by asking challenging and interesting questions to accelerate students’ innate inquisitiveness and foster them to examine concepts further
- Projecting a positive attitude about mathematics and about students’ ability to “do” mathematics

Students should be:
- Actively engaging in “doing” mathematics
- Solving challenging problems
- Investigating meaningful real-world problems
- Making interdisciplinary connections
- Developing an understanding of mathematical knowledge required to “do” mathematics and connect the language of mathematical ideas with numerical representations
- Sharing mathematical ideas, discussing mathematics with one another, refining and critiquing each other’s ideas and understandings
- Communicating in pairs, small group, or whole group presentations
- Using multiple representations to communicate mathematical ideas
- Using connections between pictures, oral language, written symbols, manipulative models, and real-world situations
- Using technological resources and other 21st century skills to support and enhance mathematical understanding
Mathematics is not a stagnate field of textbook problems; rather, it is a dynamic way of constructing meaning about the world around us, generating knowledge and understanding about the real world every day. Students should be metaphorically rolling up their sleeves and “doing mathematics” themselves, not watching others do mathematics for them or in front of them. (Protheroe, 2007)

**Balanced Mathematics Instructional Model**

Balanced math consists of three different learning opportunities: guided math, shared math, and independent math. Ensuring a balance of all three approaches will build conceptual understanding, problem solving, computational fluency, and procedural fluency. Building conceptual understanding is the focal point of developing mathematical proficiency. Students should frequently work on rigorous tasks, talk about the math, explain their thinking, justify their answer or process, build models with graphs or charts or manipulatives, and use technology.

When balanced math is used in the classroom it provides students opportunities to:

- solve problems
- make connections between math concepts and real-life situations
- communicate mathematical ideas (orally, visually and in writing)
- choose appropriate materials to solve problems
- reflect and monitor their own understanding of the math concepts
- practice strategies to build procedural and conceptual confidence

Teacher builds conceptual understanding by modeling through demonstration, explicit instruction, and think alouds, as well as guiding students as they practice math strategies and apply problem solving strategies. (whole group or small group instruction)

Teacher and students practice mathematics processes together through interactive activities, problem solving, and discussion. (whole group or small group instruction)

Students practice math strategies independently to build procedural and computational fluency. Teacher assesses learning and reteaches as necessary. (whole group instruction, small group instruction, or centers)
## Effective Pedagogical Routines/Instructional Strategies

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<th>Analyze Student Work</th>
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<tr>
<td>Connect Previous Knowledge to New Learning</td>
<td>Identify Student’s Mathematical Understanding</td>
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<td>Making Thinking Visible</td>
<td>Identify Student’s Mathematical Misunderstandings</td>
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<tr>
<td>Develop and Demonstrate Mathematical Practices</td>
<td>Interviews</td>
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<td>Inquiry-Oriented and Exploratory Approach</td>
<td>Role Playing</td>
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<tr>
<td>Multiple Solution Paths and Strategies</td>
<td>Diagrams, Charts, Tables, and Graphs</td>
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<tr>
<td>Use of Multiple Representations</td>
<td>Anticipate Likely and Possible Student Responses</td>
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<tr>
<td>Explain the Rationale of your Math Work</td>
<td>Collect Different Student Approaches</td>
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<td>Quick Writes</td>
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<td>Pair/Trio Sharing</td>
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<td>Turn and Talk</td>
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<td>Charting</td>
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<td>Gallery Walks</td>
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<td>Small Group and Whole Class Discussions</td>
<td>Challenging</td>
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<td>Student Modeling</td>
<td>Pressing for Accuracy and Reasoning</td>
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<td></td>
<td>Maintain the Cognitive Demand</td>
</tr>
</tbody>
</table>
Educational Technology

Standards

8.1.8.A.1, 8.1.8.A.3, 8.2.8.C.8, 8.1.8.E.1

- **Technology Operations and Concepts**
  - Demonstrate knowledge of a real world problem using digital tools.
    
    **Example:** Students can use math websites to determine if given data represented as a graph, table or ordered pairs is a function. 


  - Use and/or develop a simulation that provides an environment to solve a real world problem or theory.
    
    **Example:** Students can use simulation to classify functions as linear by analyzing the graph and interpreting the equation $y = mx + b$.

    [http://www.shodor.org/interactivate/activities/GraphSketcher/](http://www.shodor.org/interactivate/activities/GraphSketcher/)

- **Design**
  - Develop a proposal for a chosen solution that include models (physical, graphical or mathematical) to communicate the solution to peers.
    
    **Example:** Students can model a linear relationship by constructing a function from two $(x, y)$ values and explain the rate of change and initial value of the linear function in terms of the situation it models and in terms of its graph or table of values.

    [https://www.desmos.com/](https://www.desmos.com/)

- **Research and Information Fluency**
  - Effectively use a variety of search tools and filters in professional public database to find information to solve a real world problem.
    
    **Example:** Students can search through Learnzillion, Imagine Math Facts, and other interactive sites for appropriate instructional videos and/or information pertaining to strategies and modeling for defining, evaluating and comparing functions, use functions to model relationships between quantities, and analyze and solve linear equations.
Career Ready Practices

Career Ready Practices describe the career-ready skills that all educators in all content areas should seek to develop in their students. They are practices that have been linked to increase college, career, and life success. Career Ready Practices should be taught and reinforced in all career exploration and preparation programs with increasingly higher levels of complexity and expectation as a student advances through a program of study.

- **CRP2. Apply appropriate academic and technical skills.**
  Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between abstract concepts with real-world applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation.

  **Example:** Students will apply prior knowledge when solving real world problems. Students will make sound judgments about the use of specific tools, such as graphs and tables, to explore and deepen understanding the concepts of linear functions.

- **CRP4. Communicate clearly and effectively and with reason.**
  Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others’ time. They are excellent writers; they master conventions, word choice, and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.

  **Example:** Students will on a daily basis communicate their reasoning behind their solution paths by making connections to the context and the quantities, using proper vocabulary, along with decontextualizing and/or contextualizing the problem. Students will create representations using graphs and tables to compare two functions. They will also explain the meaning behind the quantities and units involved. Students will also ask probing questions to clarify and improve arguments.

- **CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.**
  Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem and devise effective plans to solve the problem. They are aware of problems when they occur and take action quickly to address the problem; they thoughtfully investigate the root cause of the problem prior to introducing solutions. They carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others.
Career Ready Practices

**Example:** Throughout their daily lessons, students will understand the meaning of a problem and look for entry points into solving their problems by analyzing the relationships of the quantities, constraints and goals of the task. Plans for solution paths will be made and have meaning. Students will self-monitor, evaluate and critique their process and progress as they are working and make changes as necessary.

- **CRP12. Work productively in teams while using cultural global competence.**
  Career-ready individuals positively contribute to every team, whether formal or informal. They apply an awareness of cultural difference to avoid barriers to productive and positive interaction. They find ways to increase the engagement and contribution of all team members. They plan and facilitate effective team meetings.

  **Example:** Students will work in collaborative and whole group settings to develop various solutions to math tasks that are presented to them. They will work together to understand the terms of the problem, ask clarifying and challenging questions among each other, and develop agreed upon solutions using a variety of strategies and models. Students will listen to, read and discuss arguments with each other with respect and courtesy at all times and will be willing to assist those that may need assistance. Students will demonstrate and explain to a peer or small group their interpretation of the rate of change and initial value of the linear function in terms of the situation it models.
WIDA Proficiency Levels

At the given level of English language proficiency, English language learners will process, understand, produce or use:

<table>
<thead>
<tr>
<th>Level</th>
<th>Language Proficiency</th>
</tr>
</thead>
</table>
| 6- Reaching | - Specialized or technical language reflective of the content areas at grade level  
- A variety of sentence lengths of varying linguistic complexity in extended oral or written discourse as required by the specified grade level  
- Oral or written communication in English comparable to proficient English peers |
| 5- Bridging | - Specialized or technical language of the content areas  
- A variety of sentence lengths of varying linguistic complexity in extended oral or written discourse, including stories, essays or reports  
- Oral or written language approaching comparability to that of proficient English peers when presented with grade level material. |
| 4- Expanding | - Specific and some technical language of the content areas  
- A variety of sentence lengths of varying linguistic complexity in oral discourse or multiple, related sentences or paragraphs  
- Oral or written language with minimal phonological, syntactic or semantic errors that may impede the communication, but retain much of its meaning, when presented with oral or written connected discourse, with sensory, graphic or interactive support |
| 3- Developing | - General and some specific language of the content areas  
- Expanded sentences in oral interaction or written paragraphs  
- Oral or written language with phonological, syntactic or semantic errors that may impede the communication, but retain much of its meaning, when presented with oral or written, narrative or expository descriptions with sensory, graphic or interactive support |
| 2- Beginning | - General language related to the content area  
- Phrases or short sentences  
- Oral or written language with phonological, syntactic, or semantic errors that often impede the communication when presented with one to multiple-step commands, directions, or a series of statements with sensory, graphic or interactive support |
| 1- Entering | - Pictorial or graphic representation of the language of the content areas  
- Words, phrases or chunks of language when presented with one-step commands directions, WH-, choice or yes/no questions, or statements with sensory, graphic or interactive support |
### Language Development Supports For English Language Learners
To Increase Comprehension and Communication Skills

#### Environment
- Welcoming and stress-free
- Respectful of linguistic and cultural diversity
- Honors students' background knowledge
- Sets clear and high expectations
- Includes routines and norms
- Is thinking-focused vs. answer-seeking
- Offers multiple modalities to engage in content learning and to demonstrate understanding
- Includes explicit instruction of specific language targets
- Provides participation techniques to include all learners
- Integrates learning centers and games in a meaningful way
- Provides opportunities to practice and refine receptive and productive skills in English as a new language
- Integrates meaning and purposeful tasks/activities that:
  - Are accessible by all students through multiple entry points
  - Are relevant to students' lives and cultural experiences
  - Build on prior mathematical learning
  - Demonstrate high cognitive demand
  - Offer multiple strategies for solutions
  - Allow for a language learning experience in addition to content

#### Sensory Supports*
- Real-life objects (realia) or concrete objects
- Physical models
- Manipulatives
- Pictures & photographs
- Visual representations or models such as diagrams or drawings
- Videos & films
- Newspapers or magazines
- Gestures
- Physical movements
- Music & songs

#### Graphic Supports*
- Graphs
- Charts
- Timelines
- Number lines
- Graphic organizers
- Graphing paper

#### Interactive Supports*
- In a whole group
- In a small group
- With a partner such as Turn-and-Talk
- In pairs as a group (first, two pairs work independently, then they form a group of four)
- In triads
- Cooperative learning structures such as Think-Pair-Share
- Interactive websites or software
- With a mentor or coach

#### Verbal and Textual Supports
- Labeling
- Students' native language
- Modeling
- Repetitions
- Paraphrasing
- Summarizing
- Guiding questions
- Clarifying questions
- Probing questions
- Leveled questions such as What? When? Where? Why?
- Questioning prompts & cues
- Word Banks
- Sentence starters
- Sentence frames
- Discussion frames
- Talk moves, including Wait Time

*From Understanding the WIDA English Language Proficiency Standards. A Resource Guide. 2007 Edition... Board of Regents of the University of Wisconsin System, on behalf of the WIDA Consortium—www.wida.us.
BUILDING EQUITY IN YOUR TEACHING PRACTICE

How do the essential questions highlight the connection between the big ideas of the unit and equity in your teaching practice?

CONTENT INTEGRATION
Teachers use examples and content from a variety of cultures & groups.

This unit / lesson is connected to other topics explored with students.

There are multiple viewpoints reflected in the content of this unit / lesson.

The materials and resources are reflective of the diverse identities and experiences of students.

The content affirms students, as well as exposes them to experiences other than their own.

KNOWLEDGE CONSTRUCTION
Teachers help students understand how knowledge is created and influenced by cultural assumptions, perspectives & biases.

This unit / lesson provides context to the history of privilege and oppression.

This unit / lesson addresses power relationships.

This unit / lesson help students to develop research and critical thinking skills.

This curriculum creates windows and mirrors* for students.

PREJUDICE REDUCTION
Teachers implement lessons and activities to assert positive images of ethnic groups & improve intergroup relations.

This unit / lesson help students question and unpack biases & stereotypes.

This unit / lesson help students examine, research and question information and sources.

The curriculum encourages discussion and understanding about the groups of people being represented.

This unit / lesson challenges dominant perspectives.

EQUITABLE PEDAGOGY
Teachers modify techniques and methods to facilitate the academic achievement of students from diverse backgrounds.

The instruction has been modified to meet the needs of each student.

Students feel respected and their cultural identities are valued.

Additional supports have been provided for students to become successful and independent learners.

Opportunities are provided for student to reflect on their learning and provide feedback.

EMPOWERING SCHOOL CULTURE
Using the other four dimensions to create a safe and healthy educational environment for all.

There are opportunities for students to connect with the community.

My classroom is welcoming and supportive for all students?

I am aware of and sensitive to the needs of my students and their families.

There are effective parent communication systems established. Parents can talk to me about issues as they arise in my classroom.

*windows and mirrors - a metaphor for teaching that provides students with different perspectives on the world.
Culturally Relevant Pedagogy Examples

- **Problem-Based Learning Scenarios:** Present relatable real-world problems for your students to solve, explicitly referencing cultures and communities when applicable.
  
  **Example:** Students look up menus from their favorite restaurant and choose a meal for each member of their family. Have them determine total cost, inclusive of tax of 7% and the gratuity of 15%, 18% and 20%.

- **Integrate Relevant Word Problems:** Contextualize equations using word problems that reference student interests and cultures.
  
  **Example:** Create and use word problems that students relate to, have prior knowledge of and includes their interest. These can include current events and/or relevant real-world situations. Using content that students can relate to adds meaning, value and connection. The following link provides you with a variety of word problems that are current, relevant to real-world and student interests: [https://www.yummymath.com/](https://www.yummymath.com/)

- **Use Learning Stations:** Provide a range of material by setting up learning stations.
  
  **Example:** Reinforce understandings of concepts and skills by promoting learning through student interests, modalities, experiences and/or prior knowledge. Encourage the students to make content choices based upon their strengths, needs, values and experiences. Providing students with choice boards will give them a sense of ownership to their learning and understanding.

- **Present New Concepts Using Student Vocabulary:** Use student diction to capture attention and build understanding before using academic terms.
  
  **Example:** Teach math vocabulary in various modalities to increase students’ retention. Use multi-modal activities, analogies, realia, visual cues, graphic representations, gestures, pictures, practice and cognates. Inform students that some vocabulary words have multiple meanings. Have students create the Word Wall with their definitions and examples to foster ownership. Work with students to create a sorting and matching game using vocabulary words from within the unit. Students can work in teams or individually to play these games. This will allow students to familiarize themselves with the vocabulary words within the unit.
## Differentiated Instruction

**Accommodate Based on Students Individual Needs: Strategies**

<table>
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<tr>
<th>Time/General</th>
<th>Processing</th>
<th>Comprehension</th>
<th>Recall</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extra time for assigned tasks</td>
<td>Extra Response time</td>
<td>Precise processes for balanced</td>
<td>Teacher-made checklist</td>
<td>Individual daily planner</td>
</tr>
<tr>
<td>Adjust length of assignment</td>
<td>Have students verbalize steps</td>
<td>math instructional model</td>
<td>Use visual graphic organizers</td>
<td>Display a written agenda</td>
</tr>
<tr>
<td>Timeline with due dates for</td>
<td>Repeat, clarify or reword</td>
<td>Short manageable tasks</td>
<td>Reference resources to promote independence</td>
<td>Note-taking assistance</td>
</tr>
<tr>
<td>reports and projects</td>
<td>directions</td>
<td>Brief and concrete directions</td>
<td>Visual and verbal reminders</td>
<td>Color code materials</td>
</tr>
<tr>
<td>Communication system</td>
<td>Mini-breaks between tasks</td>
<td>Provide immediate feedback</td>
<td>Graphic organizers</td>
<td></td>
</tr>
<tr>
<td>between home and school</td>
<td>Provide a warning for</td>
<td>Small group instruction</td>
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<tr>
<td>Provide lecture notes/outline</td>
<td>transitions</td>
<td>Emphasize multi-sensory learning</td>
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</tr>
</tbody>
</table>

### Assistive Technology
- Computer/whiteboard
- Tape recorder
- Video Tape

### Tests/Quizzes/Grading
- Extended time
- Study guides
- Shortened tests
- Read directions aloud

### Behavior/Attention
- Consistent daily structured routine
- Simple and clear classroom rules
- Frequent feedback

### Organization
- Individual daily planner
- Display a written agenda
- Note-taking assistance
- Color code materials
## Differentiated Instruction

### Accommodate Based on Content Specific Needs: Strategies

- Anchor charts to model strategies and use of formulas
- Reference sheets that list formulas, step-by-step procedures and model strategies
- Conceptual word wall that contains definition, translation, pictures and/or examples
- Graphic organizers, examples include: Venn Diagrams, Four Square, KWL, etc.
- Translation dictionary
- Teacher modeling.
- Graphing calculator to assist with computations
- Students can utilize math journals to write notes, copy solution steps, and translate terms and key vocabulary
- Highlight and label the solution steps for multi-step problems in different colors
- Utilize technological programs which provide verbal and visual instruction in native and/or second language
- Algebra tiles to compare functions algebraically and solve system of linear equations
- Graph paper to graph functions
- Tables to define, evaluate and compare functions
### Interdisciplinary Connections

Model interdisciplinary thinking to expose students to other disciplines.

**ELA Connection:**

*Comparing Value for Money Baseball (RI.3.1)*

Complete “How Did You Work Questionnaire” offering written responses to preferred methods for solving the problem.

**Health Connection:**

*Heart Rate Monitoring (2.1ABCDE-2.2ABCDE)*

Graph and analyze how your heart rate changes through a warm up, workout, and cool down.

**ELA Connection:**

*Various Tasks: (RI.8.1)*

Students will be able to read, analyze, and cite informational text to solve problems and explain their reasoning of how the task was solved. Students will also focus on vocabulary, mechanics and grammar in effective writing.
# Enrichment

## What is the purpose of Enrichment?

- The purpose of enrichment is to provide extended learning opportunities and challenges to students who have already mastered, or can quickly master, the basic curriculum. Enrichment gives the student more time to study concepts with greater depth, breadth, and complexity.
- Enrichment also provides opportunities for students to pursue learning in their own areas of interest and strengths.
- Enrichment keeps advanced students engaged and supports their accelerated academic needs.
- Enrichment provides the most appropriate answer to the question, “What do you do when the student already knows it?”

### Enrichment is…

- Planned and purposeful
- *Different*, or differentiated, work – not just *more* work
- Responsive to students’ needs and situations
- A promotion of high-level thinking skills and making connections within content
- The ability to apply different or multiple strategies to the content
- The ability to synthesize concepts and make real world and cross-curricular connections
- Elevated contextual complexity
- Sometimes independent activities, sometimes direct instruction
- Inquiry based or open ended assignments and projects
- Using supplementary materials in addition to the normal range of resources
- Choices for students
- Tiered/Multi-level activities with flexible groups (may change daily or weekly)

### Enrichment is not…

- Just for gifted students (some gifted students may need intervention in some areas just as some other students may need frequent enrichment)
- Worksheets that are more of the same (busywork)
- Random assignments, games, or puzzles not connected to the content areas or areas of student interest
- Extra homework
- A package that is the same for everyone
- Thinking skills taught in isolation
- Unstructured free time
Assessments

**Required District/State Assessments**
- Unit Assessments
- PARCC
- SGO Assessments

**Suggested Formative/Summative Classroom Assessments**
- Describe Learning Vertically
- Identify Key Building Blocks
- Make Connections (between and among key building blocks)
- Short/Extended Constructed Response Items
- Multiple-Choice Items (where multiple answer choices may be correct)
- Drag and Drop Items
- Use of Equation Editor
- Quizzes
- Journal Entries/Reflections/Quick-Writes
- Accountable talk
- Projects
- Portfolio
- Observation
- Graphic Organizers/ Concept Mapping
- Presentations
- Role Playing
- Teacher-Student and Student-Student Conferencing
- Homework
**New Jersey Student Learning Standards (NJSLS)**

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>8.F.A.1</strong>:</td>
<td>Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.</td>
</tr>
<tr>
<td><strong>8.F.A.2</strong>:</td>
<td>Compare properties (e.g. rate of change, intercepts, domain and range) of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). <em>For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.</em></td>
</tr>
<tr>
<td><strong>8.F.A.3</strong>:</td>
<td>Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. <em>For example, the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.</em></td>
</tr>
<tr>
<td><strong>8.F.B.4</strong>:</td>
<td>Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two $(x, y)$ values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.</td>
</tr>
<tr>
<td><strong>8.F.B.5</strong>:</td>
<td>Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.</td>
</tr>
<tr>
<td><strong>8.EE.C.7</strong>:</td>
<td>Solve linear equations in one variable.</td>
</tr>
<tr>
<td><strong>8.EE.C.7a</strong>:</td>
<td>Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form $x = a$, $a = a$, or $a = b$ results (where $a$ and $b$ are different numbers).</td>
</tr>
<tr>
<td><strong>8.EE.C.7b</strong>:</td>
<td>Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.</td>
</tr>
<tr>
<td><strong>8.EE.C.8</strong>:</td>
<td>Analyze and solve pairs of simultaneous linear equations.</td>
</tr>
<tr>
<td><strong>8.EE.C.8a</strong>:</td>
<td>Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.</td>
</tr>
</tbody>
</table>
**New Jersey Student Learning Standards (NJSLS)**

| **8.EE.C.8b:** | Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. *For example, 3x + 2y = 5 and 3x + 2y = 6 have no solution because 3x + 2y cannot simultaneously be 5 and 6.* |
| **8.EE.C.8c:** | Solve real-world and mathematical problems leading to two linear equations in two variables. *For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.* |
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.
## Grade: Eight | Unit: 2 (Two) | Topic: Functions, Equations and Solutions

**NJSLS:**

**Unit Focus:**
- Define, evaluate, and compare functions
- Use functions to model relationships between quantities
- Analyze and solve linear equations and simultaneous linear equations

---

**New Jersey Student Learning Standard:**

8.F.A.1: Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.

**Student Learning Objective 1:** Define a function as a rule that assigns one output to each input and determine if data represented as a graph or in a table is a function.

**Modified Student Learning Objectives/Standards:**

M.EE.8.F.A.1-3: Given a function table containing at least 2 complete ordered pairs, identify a missing number that completes another ordered pair.

<table>
<thead>
<tr>
<th>MPs</th>
<th>Evidence Statement Key/ Clarifications</th>
<th>Skills, Strategies &amp; Concepts</th>
<th>Essential Understandings/ Questions (Accountable Talk)</th>
<th>Tasks/Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP 2</td>
<td>8.F.A.1</td>
<td>Recognize that a function is a rule. If a function is a rule, then for each input there is exactly one output. Describe ordered pairs as containing an input, and the corresponding output.</td>
<td>How can we determine if a table is a function? How is a function defined?</td>
<td>Foxes and Rabbits</td>
</tr>
<tr>
<td>MP 5</td>
<td>- Tasks do not involve the coordinate plane or the “vertical line test.” - Some of functions in tasks are non-numerical.</td>
<td></td>
<td></td>
<td>Vending Machine</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Order Matters</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>The Concept of a Function from</td>
</tr>
</tbody>
</table>
- Tasks should involve clearly defined inputs and outputs.
- Functions are limited to those with inputs and outputs in the real numbers.
- Most of the tasks require students to graph functions in the coordinate plane or read inputs and outputs from the graph of a function in the coordinate plane.
- Some of the tasks require students to tell whether a set of points in the plane represents a function.
- Tasks should involve clearly defined inputs and outputs.

Distinguish between functions and non-functions using equations, graphs, and tables.

Identify a function as a set of ordered pairs on a graph.

Plot an ordered pair on a coordinate axis.

Analyze input and output tables to determine if the relationship is a function.

Construct and analyze graphs in order to determine if the relationship is a function.

For example, the rule that takes x as input and gives \( x^2 + 5x + 4 \) as output is a function. Using \( y \) to stand for the output we can represent this function with the equation \( y = x^2 + 5x + 4 \), and the graph of the equation is the graph of the function.

Function notation is not required in Grade 8.

**SPED Strategies:**
Create a function rule anchor chart for students to reference.

Provide a function table graphic organizer.

Practice graphing functions that result in a set of ordered pairs consisting of an input (x) and the corresponding output (y).

Make a real-life connection between the function rules and ordered pairs.
Review and practice comparing properties of two functions when they are each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

Review and practice the use of vertical line test to determine if a line is a function.

**Resources UDL - Visual and Auditory Learner(s):**

Roosevelt Middle School Math Team -- Common Core Tutorial Videos -- 8.F.A.1
https://youtu.be/mMIBTvy1L6U

Roosevelt Middle School Math Team -- Common Core Tutorial Videos -- 8.F.A.2
https://youtu.be/6NAu8ag3bts

Math Graphic Organizer(s):
http://www.enchantedlearning.com/graphicorganizers/math/

**ELL Strategies:**

Utilize manipulatives and develop hands-on graph activities.

Have students visualize actual various functions and create their own.
Utilize gestures, or L1 (student’s native language) translations, to demonstrate vocabulary, comprehension and word-meaning.

Provide students with translation dictionary.

Have students work with partners or small groups.
New Jersey Student Learning Standard:

8.F.A.2: Compare properties (e.g. rate of change, intercepts, domain and range) of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.

Student Learning Objective 2: Compare two functions each represented in a different way (numerically, verbally, graphically, and algebraically) and draw conclusions about their properties (rate of change and intercepts).

Modified Student Learning Objectives/Standards:

M.EE.8.F.A.1-3: Given a function table containing at least 2 complete ordered pairs, identify a missing number that completes another ordered pair.

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<tbody>
<tr>
<td>MP 5 MP 8</td>
<td>8.F.A.2 • Tasks have “thin context” or no context. • Equations can be presented in forms other than $y = mx + b$, for example, $2x + 2y = 7$.</td>
<td>Students will apply their understanding of functions and the characteristics of functions in order to compare functions written in different ways. Functions have properties; properties of linear functions. Analyze functions represented algebraically, as a table of values, and as a graph. Interpret functions represented by a verbal description.</td>
<td>How can you determine the slope and intercepts of a graph, algebraic equation and a word problem? What does the slope and y-intercept mean in the context of the graph? Word problem? Algebraic equation?</td>
<td>Battery Charging Secret Codes and Number Rules Which is Which?</td>
</tr>
</tbody>
</table>
Given two functions, each represented in a different way, compare their properties.

Apply knowledge of slope and intercepts in order to compare the characteristics of functions written in different forms.

Compare the two linear functions listed below and determine which equation represents a greater rate of change.

How can you compare the slopes and intercepts of functions represented in various forms?

How do functions model relationships between quantities?

How can functions represented in multiple ways be compared?

Compare the two linear functions listed below and determine which has a negative slope.

<table>
<thead>
<tr>
<th>$x$</th>
<th>$y$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>1</td>
<td>16.50</td>
</tr>
<tr>
<td>2</td>
<td>13.00</td>
</tr>
<tr>
<td>3</td>
<td>9.50</td>
</tr>
<tr>
<td>4</td>
<td>6.00</td>
</tr>
</tbody>
</table>
Function 1: Samantha starts with $20 on a gift card for the book store. She spends $3.50 per week to buy a magazine. Let y be the amount remaining as a function of the number of weeks.

Function 2: The school bookstore rents graphing calculators for $5 per month. It also collects a nonrefundable fee of $10.00 for the school year. Write the rule for the total cost (c) of renting a calculator as a function of the number of months (m).

Solution: Function 1 is an example of a function whose graph has negative slope. Samantha starts with $20 and spends money each week. The amount of money left on the gift card decreases each week. The graph has a negative slope of -3.5, which is the amount the gift card balance decreases with Samantha’s weekly magazine purchase. Function 2 is an example of a function whose graph has positive slope. Students pay a yearly nonrefundable fee for renting the calculator and pay $5 for each month they rent the calculator. This function has a positive slope of 5 which is the amount of the monthly rental fee. An equation for Example 2 could be c = 5m + 10.

SPED Strategies:
Review function rules.

Review and practice relationship represented by a graph in a function.

Review and practice recognizing the constant and variable rates of change.
Review and practice comparing properties of two functions when they are each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

Help students to understand the concept of $x$ and $y$ intercepts by using high student interest topics.

**Resources UDL - Visual and Auditory Learner(s):**
Roosevelt Middle School Math Team -- Common Core Tutorial Videos -- 8.F.A.1
https://youtu.be/mMIBTvylL6U

Roosevelt Middle School Math Team -- Common Core Tutorial Videos -- 8.F.A.2
https://youtu.be/6NAu8ag3bts

Roosevelt Middle School Math Team -- Common Core Tutorial Videos -- 8.F.A.3
https://youtu.be/5O2oQdFq5Lk

**ELL Strategies:**
Utilize manipulatives and develop hands-on graph activities.

Review function rules.

Model structure and clarify unfamiliar syntax.

Have students visualize actual functions and create their own.

Utilizing gestures or L1 (student’s native language) translations to demonstrate vocabulary.
Have students work with partners, small groups.

- Word/picture wall with L1 (student’s native language) translations side by side.
- Provide supplemental resources with L1 (student’s native language) text and/or support.
- Have students create pictures/illustrations and then have them write meaning in their Math Journals.
- Website: Teachers First Adapt a Strategy. Adjusting Lessons for ESL/ELL students [http://www.teachersfirst.com/content/esl/adaptstrat.cfm](http://www.teachersfirst.com/content/esl/adaptstrat.cfm)

<table>
<thead>
<tr>
<th>New Jersey Student Learning Standard:</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.F.A.3: Interpret the equation ( y = mx + b ) as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. <em>For example, the function ( A = s^2 ) giving the area of a square as a function of its side length is not linear because its graph contains the points ((1,1), (2,4)) and ((3,9)), which are not on a straight line.</em></td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>Student Learning Objective 3:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classify functions as linear or non-linear by analyzing equations, graphs, and tables of values; interpret the equation ( y = mx + b ) as defining a linear function.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Modified Student Learning Objectives/Standards:</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.EE.8.F.A.1-3: Given a function table containing at least 2 complete ordered pairs, identify a missing number that completes another ordered pair.</td>
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</table>

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<tr>
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<th>Tasks/Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP 2</td>
<td>8.F.A.3</td>
<td>A linear function is defined by the equation ( y = mx + b ).</td>
<td>How can real world data be transformed into graphs and tables?</td>
<td>By the Book</td>
</tr>
<tr>
<td>MP 3</td>
<td></td>
<td>The graph of a linear function is a straight line.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MP 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
- Tasks have “thin context” or no context.
- Equations can be presented in forms other than \( y = mx + b \), for example, \( 2x + 2y = 7 \).
- Tasks may require students to give examples of equations that are non-linear or pairs of points to show a function is non-linear.
- Students are not required to produce a formal proof. For this aspect of 8.F.3, see 8.C.3.1.

| Analyze tables of values, graphs and equations in order to classify a function as linear or non-linear. | Determine if equations presented in other forms other than \( y = mx + b \) (for example \( 3y - 2x + 7 \)) define a linear function. |
| What are important characteristics needed to construct a linear model? |
| How can you determine the slope and initial value from a table? Graph? |
| How are functions of linear relationships modeled? |
| Once the linear function is modeled, how are the initial value and the rate of change determined? |

| Give examples of equations that are non-linear functions. | Show that a function is not linear using pairs of points. |
| Students will apply knowledge of graphing, slopes and lines in order to determine if a graph is linear or nonlinear. |
| Students will build on previous knowledge of lines recognizing that lines can be written in the form \( y = mx + b \) with \( m \) being a constant slope and \( b \) representing the y intercept. |

| Determine which of the functions listed below are linear and which are not linear and explain your reasoning. |
| What are important characteristics needed to construct a linear model? |
| How can you determine the slope and initial value from a table? Graph? |
| How are functions of linear relationships modeled? |
| Once the linear function is modeled, how are the initial value and the rate of change determined? |
| Heart Rate Monitoring |
| Introduction To Linear Functions |
| Modeling with Linear Functions |
| Nonlinear Functions |
| Party Zone Palace |

\[
\begin{align*}
\text{non linear} & : & -2x + 3 \\
\text{linear} & : & x \\
\text{non linear} & : & \pi r^2 \\
\text{linear} & : & 0.25 + 0.5(x - 2)
\end{align*}
\]
**SPED Strategies:**
Model the thinking process involved in identifying different types of functions.

Provide students with a google doc/graphic organizer/anchor chart where visual and verbal examples of the differences are listed.

Review and practice comparing properties of two functions when they are each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions)

Review and practice identifying functions as linear or nonlinear.

Review and practice interpreting the equation \( y = mx + b \) as defining a linear function.

Review and practice the use of vertical line test to determine if a line is a function.

**Resources UDL - Visual and Auditory Learner(s):**
Roosevelt Middle School Math Team -- Common Core Tutorial Videos -- 8.F.A.1
https://youtu.be/mMIBTvy1L6U

Roosevelt Middle School Math Team -- Common Core Tutorial Videos -- 8.F.A.2
https://youtu.be/6NAu8ag3bts

Roosevelt Middle School Math Team -- Common Core Tutorial Videos -- 8.F.A.3
https://youtu.be/5O2oQdFq5Lk
ELL Strategies:
Utilize Manipulatives and develop hands-on graph activities.

Model structure and clarify unfamiliar syntax.

Have students visualize actual various functions and create their own.

Utilize gestures or L1 (students’ native language) translations to demonstrate vocabulary.

Provide students with translation dictionary.

Have students work with partners, small groups.

Word/picture wall with L1 (Student’s native language) translations side by side.

Provide supplemental resources with L1 (students’ native language) text and/or support.

Website:
Teachers First Adapt a Strategy. Adjusting Lessons for ESL/ELL students

http://www.teachersfirst.com/content/esl/adaptstrat.cfm
New Jersey Student Learning Standard:
8.F.B.4: Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two \((x, y)\) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.

Student Learning Objective 4: Model a linear relationship by constructing a function from two \((x, y)\) values. Interpret the rate of change and initial value of the linear function in terms of the situation it models, and in terms of its graph or a table of values.

Modified Student Learning Objectives/Standards:
M.EE.8.F.B.4 Determine the values or rule of a function using a graph or a table

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<th>Tasks/Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP 2</td>
<td>8.F.B.4</td>
<td>As with equations, two ((x,y)) values can be used to construct a function.</td>
<td>How can real world data be transformed into graphs and tables?</td>
<td>High School Graduation</td>
</tr>
<tr>
<td>MP 6</td>
<td>Tasks may or may not have a context</td>
<td>Determine the rate of change and initial value of a function from a description of a relationship, by reading a table of values or by reading them from a graph.</td>
<td>What are important characteristics needed to construct a linear model?</td>
<td>Video Streaming</td>
</tr>
<tr>
<td>MP 7</td>
<td></td>
<td>Construct a function in order to model a linear relationship.</td>
<td>How can you determine the slope and initial value from a table? Graph?</td>
<td>Filling the Pool</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Identify and calculate slope/rate of change from a table, graph, equation, or two points.</td>
<td>How are functions of linear relationships modeled?</td>
<td>Chicken and Steak</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Determine the slope and (y)-intercept from a graph or table in terms of the situation.</td>
<td>Once the linear function is modeled, how are the initial value and the rate of change determined?</td>
<td>Dan’s Leaking Bottle</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Interpret the rate of change and initial value of a linear function in context.</td>
<td></td>
<td>Distance across the channel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Explain any constraints on the domain of the linear relationship.</td>
<td></td>
<td>Slippery Slopes</td>
</tr>
</tbody>
</table>
Make predictions given a graph. Review that rate of change and slope are the same.

Emphasize the important characteristics of linear functions.

**SPED Strategies:**
Review and practice how a graph, table, set of ordered pairs, or an algebraic rule help describe the relationship between two variables.

Provide graph, table and order pair graphic organizer.

Review and practice recognizing an equation that will produce a linear graph.

Review and practice graphing linear equations as a way to visually represent the relationship between two quantities.

Model real world linear data using tables, graphs, rules, and expressions (See video links and resources).

**Resources UDL - Visual and Auditory Learner(s):**
Roosevelt Middle School Math Team -- Common Core Tutorial Videos -- 8.F.B.4
https://youtu.be/kEBug7HUtcc

**ELL Strategies:**
Incorporate lessons that introduce writing activities using math journals.
<table>
<thead>
<tr>
<th>Model structure and clarify unfamiliar syntax.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Have students visualize, create and model their own linear relationships.</td>
</tr>
<tr>
<td>Utilizing gestures or L1 (student’s native language) translations to demonstrate vocabulary comprehension and word-meaning.</td>
</tr>
<tr>
<td>Have students work with partners, to create sketch graphs, and label parts in English and Spanish.</td>
</tr>
<tr>
<td>Create large charts/ posters with words &amp; pictures on wall; include L1 (student’s native language) translations side by side.</td>
</tr>
<tr>
<td>Provide supplemental resources with L1 (student’s native language) text and/or support.</td>
</tr>
<tr>
<td>Have students create pictures/illustrations and then have them write meaning in their Math Journals.</td>
</tr>
</tbody>
</table>
**New Jersey Student Learning Standard:**
8.F.B.5: Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.

**Student Learning Objective 5:** Sketch a graph of a function from a qualitative description and give a qualitative description of a graph of a function.

**Modified Student Learning Objectives/Standards:**
M.EE.8.F.B.5 Describe how a graph represents a relationship between two quantities.

<table>
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</thead>
<tbody>
<tr>
<td>MP 1 MP 2 MP 4 MP 5</td>
<td>8.F.B.5 • Tasks may or may not have a context.</td>
<td>Emphasize important aspects needed to create graphs of functions such as slope and y-intercepts. Describe how to translate qualitative information into a graph by pulling out the important aspects and how to describe a graph using qualitative descriptions. Provide qualitative descriptions of graphs (e.g. where increasing or decreasing, linear or non-linear). Given a verbal description, sketch a graph of a function based on the qualitative features described. Analyze a graph. Identify the type of function given a graph. The graph below shows a student’s trip to school. This student walks to his friend’s house and, together, they ride a bus to school. The bus stops once before arriving at school. Describe how each part A-E of the graph relates to the story.</td>
<td>How does looking at patterns relate to functions? How can you use functions to model real-world situations? How can graphs and equations of functions help us to interpret real-world problems? How can a functional relationship be modeled in a graph be described qualitatively? How can a verbal description of a function be modeled as a graph?</td>
<td>Vincent’s Graphs Party The Case of the Vase 200 Freestyle Journey Walk the Graph Interpreting Distance Time Graph</td>
</tr>
</tbody>
</table>
**SPED Strategies:**

Model the thinking process involved in graphing functions from a qualitative description using real life examples.

Model the thinking process involved in giving a qualitative description of a graph of a function.

Review and practice how a graph, table, set of ordered pairs, or an algebraic rule help describe the relationship between two variables.

Review and practice recognizing an equation that will produce a linear graph with a constant rate of change.

Review and practice graphing linear equations as a way to visually represent the relationship between two quantities.

Model real world linear data using tables, graphs, rules, and expressions (See video links and resources).
<table>
<thead>
<tr>
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<tbody>
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<td><strong>ELL Strategies:</strong></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Model structure and clarify unfamiliar syntax.</td>
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<td></td>
<td>Have students visualize, create and model their own linear relationships.</td>
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<td>Utilizing gestures or L1 (student’s native language) translations to demonstrate vocabulary.</td>
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<td></td>
<td>Have students work with partners, to create sketch graphs, and label parts in English and Spanish.</td>
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<td>Create Large Charts/ Posters with words &amp; pictures on wall.</td>
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<td>Include L1 (student’s native language) translations side by side.</td>
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<td></td>
<td>Provide supplemental resources with L1 (student’s native language) text and/or support.</td>
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<td></td>
<td>Have students create pictures/illustrations and then have them write meaning in their Math Journals.</td>
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</tbody>
</table>
New Jersey Student Learning Standards:
8.EE.C.7: Solve linear equations in one variable.

8EE.C.7a: Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form \( x = a, a = a, \) or \( a = b \) results (where \( a \) and \( b \) are different numbers).

8.EE.C.7b: Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

Student Learning Objective 6: Apply the distributive property and collect like terms to solve linear equations in one variable that contain rational numbers as coefficients. Use an equivalent equation of the form \( x = a, a = a, \) or \( a = b \) (where \( a \) and \( b \) are different numbers) to describe the number of solutions.

Modified Student Learning Objectives/Standards:
M.EE.8.EE.7: Solve simple algebraic equations with one variable using addition and subtraction

<table>
<thead>
<tr>
<th>MPs</th>
<th>Evidence Statement Key/Clarifications</th>
<th>Skills, Strategies &amp; Concepts</th>
<th>Essential Understandings/Questions (Accountable Talk)</th>
<th>Tasks/Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP 5</td>
<td>8.EE.7</td>
<td>Extend students’ previous knowledge of solving equations, combining like terms, and applying to distributive property in order for students to be able to solve equations.</td>
<td>An equation is a statement that two expressions have the same value. As a result, it can be judged true or false.</td>
<td>IFL Task(s) – Set of Related Lessons named “Equations and Linear Functions: Solving Linear Equations in One Variable”</td>
</tr>
<tr>
<td>MP 6</td>
<td></td>
<td>Emphasize that inverse operations must be used to balance the equation if there are variables on both sides.</td>
<td>The solution (set) to an equation is the value of the variable(s) that make the statement true.</td>
<td>PBA: Dog Park Currency</td>
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<td></td>
<td>Solve linear equations in one variable.</td>
<td>An equation is true when the expressions on either side are equal to each other. A solution is a value that makes the equation true.</td>
<td>Additional Tasks:</td>
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<td></td>
<td>Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent</td>
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</table>

Tasks may or may not contain context.
equation of the form \( x = a, \ a = a, \) or \( a = b \) results (where \( a \) and \( b \) are different numbers).

Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

As students transform linear equations in one variable into simpler forms, they discover the equations can have one solution, infinitely many solutions, or no solutions.

When the equation has one solution, the variable has one value that makes the equation true as in \( 12 - 4y = 16 \). The only value for \( y \) that makes this equation true is \(-1\). When the equation has infinitely many solutions, the equation is true for all real numbers as in \( 7x + 14 = 7(x+2) \). As this equation is simplified, the variable terms cancel leaving \( 14 = 14 \) or \( 0 = 0 \). Since the expressions are equivalent, the value for the two sides of the equation will be the same regardless which real number is used for the substitution.

When an equation has no solutions it is also called an inconsistent equation. This is the case when the two expressions are not equivalent as in \( 5x - 2 = 5(x+1) \). When simplifying this equation, students will find that the solution appears to be two numbers that are not equal or \( -2 = 1 \). In this case, regardless which real number is used for the substitution, the equation is not true and therefore has no solution.

Therefore, substituting a solution in for the variable and simplifying will result in a true equation.

When the addition, subtraction, multiplication and division properties of equality are applied appropriately to a linear equation in one variable, three possibilities exist.

The equation simplifies to \( x = a \), implying that \( a \) is the only solution to the equation, because it is the only number that, when substituted for the variable \( x \), makes the equation a true statement.

The equation simplifies to \( a = a \), implying there are infinitely many solutions to the equation because any number substituted for the variable \( x \) will make the equation a true statement.

The equation simplifies to \( a = b \), where \( a \) and \( b \) are not the same numbers, implying there are no solutions to this equation.

| Writing for a Math Website |
| Solving Linear Equations in one Variable |
| Cell Phone Plans |
| Solving Linear Equations Resources |
| Coupon vs. Discount |
| Sammyls Chipmunk and Squirrel Observation |
| Squares and Circles |
| The Sign of Solution |
SPED Strategies:
Model the thinking strategy involved in utilizing the distributive property.

Provide students with exemplars of linear equations with one solution, infinitely many solutions or no solutions.

Provide students with examples of solving linear equations involving collecting like terms.

Memorialize the learning in the form of anchor charts or notes as a point of reference for students.

ELL Strategies:
Provide students with a word bank, have them translate unfamiliar words and create sentences.

Provide visual cues, graphic representations, gestures, and pictures.

Examples:

- Solve for x:
  - \(-3(x + 7) = 4\)
  - \(3x - 8 = 4x - 8\)
  - \(3(x + 1) - 5 = 3x - 2\)

- Solve:
  - \(7(m - 3) = 7\)
  - \(\frac{1}{2} \cdot \frac{2}{3} = \frac{3}{4} \cdot \frac{1}{3}\)

because there are no numbers that can be substituted for the variable \(x\) to make the equation a true statement. Equivalent equations have the same solution set, because applying the addition, subtraction, multiplication, and division properties of equality maintains the balance and the solution(s) of the equation.

How do we make sure that two equations are equivalent?

How can we check our solution?

How can we determine if there is no solution, one solution, or infinitely many solutions?

Through engagement in the lessons in this set of related tasks, students will:
- Determine whether or not a value is in the solution set of a linear equation in one variable;
<table>
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<tr>
<th>Provide and utilize manipulatives, such as graph paper, charts, and posters.</th>
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<tbody>
<tr>
<td>Create anchor charts illustrating step by step solutions, and graphs with parts labeled and translated.</td>
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<tr>
<td>Build knowledge from real world examples.</td>
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</tbody>
</table>

- Use the distributive property, collecting like terms and properties of equality to simplify and solve linear equations in one variable;

- Classify linear equations as having no solution, a unique solution, or infinitely many solutions.

By the end of these lessons, students will be able to answer the following overarching questions:

- What does it mean for a value to be a solution of an equation?

- How do we systematically solve linear equations in one variable using the properties of equality?

- How do we recognize and interpret when a linear equation in one variable has zero solutions or infinitely many solutions?
Because an equation is a statement that two expressions have the same value, certain properties apply:

- The addition property of equality indicates that adding the same number to both expressions in the equation maintains the balance in the equation.

- The subtraction property of equality indicates that subtracting the same number from both expressions in the equation maintains the balance in the equation.

- The multiplication property of equality indicates that multiplying each expression in the equation by the same nonzero number maintains the balance in the equation.
The division property of equality indicates that dividing the same non-zero number into both expressions in the equation maintains the balance in the equation.

While the distributive property of multiplication over addition and/or combining (collecting) like terms changes the look of an expression, it does not change its value. Therefore, applying the distributive property or collecting like terms to one expression in an equation does not affect the solution set of the equation.

How is a solution to a linear equation derived?
New Jersey Student Learning Standards:

8.EE.C.8: Analyze and solve pairs of simultaneous linear equations.

8.EE.C.8a: Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.

8.EE.C.8b: Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. For example, $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6.

8.EE.C.8c: Solve real-world and mathematical problems leading to two linear equations in two variables. For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.

Student Learning Objective 7: Solve systems of linear equations in two variables algebraically and by inspection. Estimate solutions by graphing, explain that points of intersection satisfy both equations simultaneously, and interpret solutions in context.

Modified Student Learning Objectives/Standards: N/A

<table>
<thead>
<tr>
<th>MP</th>
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</tr>
</thead>
<tbody>
<tr>
<td>MP 1</td>
<td>8.EE.8a</td>
<td>Simultaneous linear equations may have an infinite number of solutions, no solutions or a single solution.</td>
<td>What does it mean to be a solution to a system of equations?</td>
<td>IFL Task(s) – Set of Related Lessons named, “Understanding and Solving Systems of Linear Equations”</td>
</tr>
<tr>
<td>MP 2</td>
<td>8.EE.8b-1,2</td>
<td>Solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs.</td>
<td>How is a solution to a system of equations represented in multiple representations?</td>
<td></td>
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<tr>
<td>MP 6</td>
<td>8.EE.8b-1,2</td>
<td>Solve systems of two linear equations in two variables algebraically.</td>
<td>What strategies are used to solve a system of equations?</td>
<td>PBA: Family Reunion Tanker Truck</td>
</tr>
<tr>
<td>MP 7</td>
<td>8.EE.8b-1,2</td>
<td>Estimate solutions of a linear system of two equations by graphing.</td>
<td>The solutions to a linear equation in two variables can be represented graphically by a line consisting of all of the points represented by the</td>
<td>Additional Tasks: Cell Phone</td>
</tr>
<tr>
<td>o non-zero whole-number coefficients, and at least one fraction among the solutions, or;</td>
<td>o non-zero integer coefficients (with at least one coefficient negative), or;</td>
<td>o non-zero rational coefficients (with at least one coefficient negative and at least one coefficient a non-integer).</td>
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<tr>
<td>Solve real-world and mathematical problems leading to two linear equations in two variables.</td>
<td>Identify the point of intersection to a system of linear equations.</td>
<td>ordered pairs ((x, y)) that make the equation a true statement or satisfy the equation.</td>
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<tr>
<td>Graph a system of linear equations.</td>
<td>Calculate the slope of a line using the slope formula.</td>
<td>The solution(s) to a system of two linear equations in two variables is the ordered pair or pairs ((x, y)) that make both equations true statements or satisfy the equations simultaneously.</td>
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<tr>
<td>Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.</td>
<td>Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations.</td>
<td>The solution to a system of linear equations in two variables can be represented graphically by the point(s) of intersection of the lines representing the solutions to each of the equations in the system because that (those) intersection point(s) make(s) all of the equations true statements or satisfies all of the equations in the system simultaneously.</td>
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<tr>
<td>Solve simple cases by inspection. For example, (3x + 2y = 5) and (3x + 2y = 6) have no solution because (3x + 2y) cannot simultaneously be 5 and 6.</td>
<td>**SPED Strategies:** Review and practice how to determine which method to use when solving a system of equations.</td>
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<tr>
<td>**SPED Strategies:** Review and practice how to determine which method to use when solving a system of equations.</td>
<td>Provide step-by-step guide and/or teacher generated notes on determining which method to use when solving a system of equations.</td>
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<td>Two distinct lines will intersect at one point if and only if they do not have the</td>
<td>Fixing the Furnace Kimi and Jordan Summer Swimming The Intersection of two Lines Classifying Solutions to System of Equations</td>
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</table>
- degenerate systems (infinitely many solutions), where the degeneracy is plausibly visible by inspection, as for example in \(3x + 3y = 1\), \(6x + 6y = 2\), or;
- systems with a unique solution and one coefficient zero, where the solution is plausibly visible by inspection, as for example in \(y = 1\), \(3x + y = 1\).

- Tasks assess solving by inspection.

8.EE.8c
- Tasks may have three equations, but students are only required to analyze two equations at a time.

<table>
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<tr>
<th>Review and practice systems of equations used to solve real-world problems. It is helpful when comparing items that are related to each other (ex. trying to decide between two cell phone plans). There are multiple methods available to use when solving a system of equations. Create and practice writing an equation based on a real-world situation. Provide students with exemplars of linear equations with one solution, infinitely many solutions or no solutions. Select appropriate methods when solving real-world and mathematical problems that lead to a system of equations that students can relate to.</th>
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<tr>
<td>same slope. Therefore, a system of two linear equations representing distinct lines with different slopes has one solution. Parallel lines have no points in common. Therefore, a system of two linear equations representing distinct parallel lines has no solutions. Linear equations representing the same line have infinitely many points in common. Therefore, a system of two linear equations representing the same line has infinitely many solutions. Because both the x-value and the y-value are the same at the point of intersection, use of the properties of equality on the system yields algebraic methods (substitution and the addition/elimination) for finding the solution to the system, or recognition that the system has no or an infinite number of solutions.</td>
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</tbody>
</table>

**Resources UDL-Visual and Auditory Learner(s):**
Algebra - Solving Linear Equations by using the Graphing Method ½ Michel van Biezen [https://youtu.be/CmAMZ_61JSQ?list=PLG_KjgfvPSObJDE_2XDKNqcSznh74meHg](https://youtu.be/CmAMZ_61JSQ?list=PLG_KjgfvPSObJDE_2XDKNqcSznh74meHg)
Roosevelt Middle School Math Team -- Common Core Tutorial Videos -- 8.EE.C.8b [https://youtu.be/czDfCFrLSP8](https://youtu.be/czDfCFrLSP8)

**ELL Strategies:**
Provide students with a word bank. Have students translate unfamiliar words and create sentences.
| Provide visual cues, graphic representations, gestures and pictures. | How is the solution of a system of equations derived? |
| Provide and utilize manipulatives, such as graph paper, charts, and posters. | |
| Create anchor charts illustrating step by step solutions, and graphs with parts labeled and translated. | |
| Build knowledge from real world examples. | |
| Have students work with partners or groups to create graphs, present linear models of equations and orally present their findings on a activity and discuss their problem-solving strategies. | |
Integrated Evidence Statements

8.C.1.2: Base reasoning on the principle that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane. Content Scope: Knowledge and skills articulated in 8.EE.8a.

8.C.2: Given an equation or system of equations, present the solution steps as a logical argument that concludes with the set of solutions (if any). Content Scope: Knowledge and skills articulated in 8.EE.7a, 8.EE.7b, 8.EE.8b.
- Tasks may have three equations, but students are only required to analyze two equations at a time.

8.C.3.1: Construct, autonomously, chains of reasoning that will justify or refute propositions or conjectures. Content Scope: Knowledge and skills articulated in 8.F.3-2.
- Tasks require students to justify whether a given function is linear or nonlinear.

8.C.4.1: Present solutions to multi-step problems in the form of valid chains of reasoning, using symbols such as equals signs appropriately (for example, rubrics award less than full credit for the presence of nonsense statements such as $1 + 4 = 5 + 7 = 12$, even if the final answer is correct), or identify or describe errors in solutions to multi-step problems and present corrected solutions. Content Scope: Knowledge and skills articulated in 8.EE.8c.

8.C.6: Construct, autonomously, chains of reasoning that will justify or refute propositions or conjectures. Content Scope: Knowledge and skills articulated in 7.RP.A, 7.NS.A, 7.EE.A.
- Some of the tasks may use scaffolding.

8.EE.C.Int.1: Solve word problems leading to linear equations in one variable whose solutions require expanding expressions using the distributive property and collecting like terms.
- Most tasks involve contextual real-world problems.

8.D.1: Solve multi-step contextual word problems with degree of difficulty appropriate to Grade 8, requiring application of knowledge and skills articulated in Type I, Sub-Claim A Evidence Statements.
- Some of the tasks may use scaffolding.

8.D.2: Solve multi-step contextual problems with degree of difficulty appropriate to grade 8, requiring application of knowledge and skills articulated in 7.RP.A, 7.NS.3, 7.EE, 7.G, and 7.SP.B.
- Some of the tasks may use scaffolding.
8.D.3: Micro-models: Autonomously apply a technique from pure mathematics to a real-world situation in which the technique yields valuable results even though it is obviously not applicable in a strict mathematical sense (e.g., profitably applying proportional relationships to a phenomenon that is obviously nonlinear or statistical in nature). Content Scope: Knowledge and skills articulated in Type I, Sub-Claim A Evidence Statements.

- Some of the tasks may use scaffolding.


- Some of the tasks may use scaffolding.
## Unit 2 Vocabulary

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<table>
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<tbody>
<tr>
<td>Altitude of a Triangle</td>
<td>Origin</td>
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<tr>
<td>Constant of Variation</td>
<td>Proportional Relationship</td>
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<td>Coordinate Plane Range of a Function</td>
<td>Slope</td>
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<tr>
<td>Domain</td>
<td>Slope Intercept Form</td>
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<tr>
<td>Equivalent Expression</td>
<td>Solution of System of Linear Equations</td>
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<td>Function</td>
<td>System of Equations</td>
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<td>Graph of a Function</td>
<td>X-intercept</td>
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<tr>
<td>Like term</td>
<td>Y-intercept</td>
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<tr>
<td>Linear Equations</td>
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<tr>
<td>References &amp; Suggested Instructional Websites</td>
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<td>---------------------------------------------</td>
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<td><a href="https://illuminations.nctm.org/">https://illuminations.nctm.org/</a></td>
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<td><a href="http://www.internet4classrooms.com">www.internet4classrooms.com</a></td>
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<td><a href="https://www.georgiastandards.org/Georgia-Standards/Pages/Math-6-8.aspx">https://www.georgiastandards.org/Georgia-Standards/Pages/Math-6-8.aspx</a></td>
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<td><a href="http://www.illustrativemathematics.org/">www.illustrativemathematics.org/</a></td>
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<td><a href="http://www.sfps.info/DocumentCenter/View/">http://www.sfps.info/DocumentCenter/View/</a></td>
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<td><a href="http://www.ncpublicschools.org/curriculum/mathematics/">http://www.ncpublicschools.org/curriculum/mathematics/</a></td>
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Field Trip Ideas

THE BOUNCE FACTORY (Warren, NJ) - STEM- Inspired FUN Field Trips. The Bounce Factory, Bricks 4 Kidz of Hunterdon Somerset and Team Makers of North Jersey have combined to create a unique and exciting Field Trip for students in grades 1st – 8th. It integrates STEM learning with fun, hands on activities that will focus on Science, Engineering and Math concepts. The students will build motorized models with LEGO® bricks and discuss engineering and physics principals; enter the Bounce rooms for activities that will set in motion discussions of how physics impacts their play; learn about Math and Science concepts while playing integrative teambuilding activities that build their skills and promote working together; learn strategy and the power of collaboration while playing laser tag in a state of the art facility.
www.bouncefactorynj.com

LIBERTY SCIENCE CENTER (Jersey City, NJ) - An interactive science museum and learning center with math connections. There is a math guidebook for teachers to make connections with math: http://lsc.org/plan-your-visit/

NATIONAL MUSEUM OF MATHEMATICS (New York, NY) - Mathematics illuminates the patterns and structures all around us. Our dynamic exhibits, gallery, and programs will stimulate inquiry, spark curiosity, and reveal the wonders of mathematics. MoMath has innovative exhibits that will engage folks from 105 to 5 years old (and sometimes younger), but with a special emphasis on activities for 4th through 8th graders. **Requires approval from Unit Superintendent**
http://momath.org/

BUEHLER’S CHALLENGER & SCIENCE CENTER (Paramus, NJ) - Fly a space mission beyond your wildest dreams in the challenger simulator! Students will work on teams to complete their mission, while conducting experiments, monitoring life support, and implementing navigation orders. In this dynamic environment, students use principles of science, mathematics, and technology to complete their tasks. There are 3 missions to choose from: “Rendezvous with Comet Halley”, “Return to the Moon”, “Voyage to Mars”. **Requires approval from Unit Superintendent**
http://www.bcsf.org/5-9th-grade/

MUSEUM OF AMERICAN FINANCE (New York, NY) – For more than 20 years, educators from around the country have been bringing students to the Museum to help them understand how finance impacts their daily lives. The Museum offers discounted admission for pre-booked groups of eight or more, as well as a variety of classes for students in middle school through college.
http://www.moaf.org/index
Field Trip Ideas

BRANCH BROOK PARK SKATING RINK (Newark, NJ) - A unique educational experience that gets students excited about learning!

Students will learn how the concepts of Science, Technology, Engineering and Math can be found in everyday experiences, even FUN experiences like roller skating! Our professional STEM Educators teach visiting students about how STEM principles exist in just about every part of life. The lessons focus on hands on activities that are both educational and fun! Lessons are customized based on teachers needs to directly relate back to classroom learning making this program completely unique! Following the completion of the 1hour STEM Lesson, the students roller skate for physical fitness. While Roller Skating the concepts students learned are continually reinforced. Our lessons are designed not only to help students overcome their fear of learning STEM concepts but to show how STEM is both FUN & EXCITING!