Grade 8: Unit 1

Exponents, Expressions, and Equations
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 NJSL; 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 \((y/x = m \text{ or } y = mx)\) 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 \(m \cdot A\). 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.
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>Apply the properties of integer exponents to write equivalent numerical expressions; apply formulas to find the volume of a cone, a cylinder, or a sphere when solving real-world and mathematical problems.</td>
<td>8.EE.A.1, 8.G.C.9</td>
</tr>
<tr>
<td>2</td>
<td>Estimate and express the values of very large or very small numbers with numbers expressed in the form of a single digit times an integer power of 10. Compare numbers expressed in this form, expressing how many times larger or smaller one is than the other.</td>
<td>8.EE.A.3</td>
</tr>
<tr>
<td>3</td>
<td>Perform operations using numbers expressed in scientific notation, including problems where both decimals and scientific notation are used. In real-world problem-solving situations, choose units of appropriate size for measurement of very small and very large quantities and interpret scientific notation generated when technology has been used for calculations.</td>
<td>8.EE.A.4</td>
</tr>
<tr>
<td>4</td>
<td>Represent a rational number with its decimal expansion, showing that it eventually repeats, and convert such decimal expansions into rational numbers.</td>
<td>8.NS.A.1</td>
</tr>
<tr>
<td>5</td>
<td>Use rational numbers to approximate irrational numbers, locate irrational numbers on a number line, and estimate the value of expressions containing irrational numbers.</td>
<td>8.NS.A.2</td>
</tr>
<tr>
<td>6</td>
<td>Graph proportional relationships, interpreting slope as unit rate, and compare two proportional relationships, each represented in different ways.</td>
<td>8.EE.B.5</td>
</tr>
<tr>
<td>7</td>
<td>Derive the equation of a line (y = mx for a line through the origin and the equation y = mx + b for a line intercepting the vertical axis at b) and use similar triangles to explain why the slope (m) is the same between any two points on a non-vertical line in the coordinate plane.</td>
<td>8.EE.B.6</td>
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</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)

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)

Teacher and students practice mathematics processes together through interactive activities, problem solving, and discussion. (whole group or small group instruction)
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<td>Making Thinking Visible</td>
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<td>Develop and Demonstrate Mathematical Practices</td>
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<td>Inquiry-Oriented and Exploratory Approach</td>
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<td>Multiple Solution Paths and Strategies</td>
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<td>Use of Multiple Representations</td>
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<td>Explain the Rationale of your Math Work</td>
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<td>Interviews</td>
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<td>Diagrams, Charts, Tables, and Graphs</td>
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<td>Pressing for Accuracy and Reasoning</td>
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<td>Maintain the Cognitive Demand</td>
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## Educational Technology Standards

### Technology Operations and Concepts

- **Demonstrate knowledge of a real world problem using digital tools.**
  
  **Example:** Students can use math websites to solve operations using numbers expressed in scientific notation.  

- **Use and/or develop a simulation that provides an environment to solve a real world problem or theory.**
  
  **Example:** Students can use simulation to determine the volume of a cylinder.  
  [https://www.learner.org/interactives/geometry/area_volume2.html](https://www.learner.org/interactives/geometry/area_volume2.html)

- **Graph and calculate data within a spreadsheet and present a summary of the results.**
  
  **Example:** Students produce graphs and tables in a spreadsheet application such as Microsoft Excel to compare two proportional relationships to solve Math Task: How much money will I save?

### 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 integer exponents, solving mathematical problems involving volume of cylinder, cones and spheres, understanding rational and irrational numbers and understanding the connection between proportional relationships, lines and 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 judgements about the use of specific tools, such as Graphing Calculators, to explore and deepen understanding the concepts of scientific notation and converting decimal expansions.

- **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 objects, drawings, diagrams, and/or actions, such as number lines to locate rational approximations on a number line. 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 how to graph proportional relationships, interpreting slope as unit rate and compare two proportional relationships, each in different ways.
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>Description</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 of 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? How? Why?
- Questioning prompts & cues
- Word Banks
- Sentence starters
- Sentence frames
- Discussion frames
- Talk moves, including Wait Time

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# 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?

<table>
<thead>
<tr>
<th>Content Integration</th>
<th>Knowledge Construction</th>
<th>Prejudice Reduction</th>
<th>Equitable Pedagogy</th>
<th>Empowering School Culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers use examples and content from a variety of cultures &amp; groups.</td>
<td>Teachers help students understand how knowledge is created and influenced by cultural assumptions, perspectives &amp; biases.</td>
<td>Teachers implement lessons and activities to assert positive images of ethnic groups &amp; improve intergroup relations.</td>
<td>Teachers modify techniques and methods to facilitate the academic achievement of students from diverse backgrounds.</td>
<td>Using the other four dimensions to create a safe and healthy educational environment for all.</td>
</tr>
</tbody>
</table>

- 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.

- 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.

- This unit / lesson help students question and unpack biases & stereotypes.
- This unit / lesson help students examine, research and question information and sources.
- The curriculum encourage discussion and understanding about the groups of people being represented.
- This unit / lesson challenges dominant perspectives.

- 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.

- 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.

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:** Jose works part-time at Guernsey Crest and Gelotti’s ice cream stores in Paterson. He is able to scoop ice cream into perfectly round scoops that have a radius of 6 cm. If a customer buys a triple scoop of ice cream in a cup, how much ice cream will Jose give the customer. Use 3.14 for π and round your answer to the nearest whole cm.

• **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**

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

<table>
<thead>
<tr>
<th>Assistive Technology</th>
<th>Tests/Quizzes/Grading</th>
<th>Behavior/Attention</th>
<th>Organization</th>
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<tr>
<td>Computer/whiteboard</td>
<td>Extended time</td>
<td>Consistent daily structured routine</td>
<td>Individual daily planner</td>
</tr>
<tr>
<td>Tape recorder</td>
<td>Study guides</td>
<td>Simple and clear classroom rules</td>
<td>Display a written agenda</td>
</tr>
<tr>
<td>Video Tape</td>
<td>Shortened tests</td>
<td>Frequent feedback</td>
<td>Note-taking assistance</td>
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<tr>
<td></td>
<td>Read directions aloud</td>
<td></td>
<td>Color code materials</td>
</tr>
</tbody>
</table>

- **Recall**
  - Teacher-made checklist
  - Use visual graphic organizers
  - Reference resources to promote independence
  - Visual and verbal reminders
  - Graphic organizers

- **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
- Three dimensional figures to find the volume of cones, cylinders and spheres
- Two dimensional figures to review area
- Tables to represent exponential patterns and rules
Interdisciplinary Connections

Model interdisciplinary thinking to expose students to other disciplines.

**Science Connection:**
*Integer Exponent and Scientific Notation (MS-ESS-3)*
- Students compare the mass of Earth to the mass of Pluto. Extension: Research the mass of Planets in the Solar System and compare their masses to the mass of Earth.

*Extending the Definitions of Exponents, Variation 1 (MS-LSI.1)*
- Students will analyze that rate at which bacteria is being produced in order to draw a connection to exponents and mathematical concepts.

*Ants versus Humans (MS-LS1.B)*
- Students will use scientific notation in order to perform operations with numbers written in scientific notation in order to answer and analyze a mathematical situation.

**Health Connection:**
*Sore Throats (2.1.D)*
- Show how mathematics is used to cure a sore throat and that the correct proportions need to be in place in order for the cure to work.

*Orders of Magnitude (2.1.B)*
- In the task students will determine the number of times their heart beats, eyes blink, and breaths they take and create an order of magnitude using this information.

**Technology Connection:**
*Mowing Lawns (8.1.8.A.2)*
- Create a spreadsheet that calculates fee based on the price of $10 per half acre.

*Tasks can be found within the additional task folders.*

**ELA Connection:**
*Rational or Irrational Reasoning (W.8.2.ABCDEF)*
- Analyze writing regarding rational and irrational numbers and correct the misconceptions in the paper in order to develop an understanding of rational and irrational numbers.
# Interdisciplinary Connections

## The Difference of Two Squares (W.8.2.ABCDEF)
- Students write about the advantages and disadvantages of each of the three solutions paths. Students will discuss assumptions and paths of importance.

### 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.

*Tasks can be found within the additional task folders.*
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
<table>
<thead>
<tr>
<th>New Jersey Student Learning Standards (NJSLS)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>8.EE.A.1</strong>: Know and apply the properties of integer exponents to generate equivalent numerical expressions. <em>For example,</em> $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$.</td>
</tr>
<tr>
<td><strong>8.G.C.9</strong>: Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.</td>
</tr>
<tr>
<td><strong>8.EE.A.3</strong>: 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. <em>For example, estimate the population of the United States as</em> $3 \times 10^8$ <em>and the population of the world as</em> $7 \times 10^9$, <em>and determine that the world population is more than 20 times larger</em>.</td>
</tr>
<tr>
<td><strong>8.EE.A.4</strong>: Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.</td>
</tr>
<tr>
<td><strong>8.NS.A.1</strong>: Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number.</td>
</tr>
<tr>
<td><strong>8.NS.A.2</strong>: Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., $\pi^2$). <em>For example, by truncating the decimal expansion of ( \sqrt{2} ), show that ( \sqrt{2} ) is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations</em>.</td>
</tr>
<tr>
<td><strong>8.EE.B.5</strong>: Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. <em>For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed</em>.</td>
</tr>
<tr>
<td><strong>8.EE.B.6</strong>: Use similar triangles to explain why the slope <em>m</em> is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at <em>b</em>.</td>
</tr>
</tbody>
</table>
# 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: 1 (One) | Topic: Exponents, Expressions, and Equations

NJSLS: 8.EE.A.1, 8.G.C.9, 8.EE.A.3, 8.EE.A.4, 8.NS.A.1, 8.NS.A.2, 8.EE.B.5, 8.EE.B.6

Unit Focus:
- Work with integer exponents
- Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres
- Know that there are numbers that are not rational, and approximate them by rational numbers
- Understand the connections between proportional relationships, lines, and linear equations

New Jersey Student Learning Standard(s):
8.EE.A.1: Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$.
8.G.C.9: Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.

Student Learning Objective 1: Apply the properties of integer exponents to write equivalent numerical expressions; apply formulas to find the volume of a cone, a cylinder, or a sphere when solving real-world and mathematical problems.

Modified Student Learning Objectives/Standards:
M.EE.8.EE.A.1: Identify the meaning of an exponent (limited to exponents of 2 and 3).
M.EE.8.G.C.9: Use the formulas for perimeter, area, and volume to solve real-world and mathematical problems (limited to perimeter and area of rectangles and triangles and volume of rectangular prisms)

<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 1</td>
<td>8.EE.1</td>
<td>Exponents can be defined as simplified representations of repeated multiplication.</td>
<td>How can you use exponents to write numbers?</td>
<td>Alien Attack</td>
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<tr>
<td>MP 2</td>
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<td>MP 4</td>
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</table>
- Tasks focus on the properties and equivalence, not on simplification.
- Half of the expressions involve one property; half of the expressions involve two or three properties.
- Tasks should involve a single common base or a potential common base, such as, a task that includes 3, 9 and 27.

**MP 5**
**MP 6**
**MP 7**
**MP 8**

| Apply properties of exponents to numerical expressions. |
| Write a numerical expression with a negative exponent as an equivalent numerical expression with a positive exponent. |
| Multiply numerical expressions with integer exponents with like bases by adding the exponents. |
| Evaluate numerical expressions with integer exponents. |
| Generate equivalent numerical expressions using positive and negative integer exponents. |
| Find volume of cones, cylinders and spheres using to solve real world problems. |
| Solve word problems involving the volume of cones, cylinders and spheres. |
| Solve a multi-step equation for a missing variable. |

**SPED Strategies:**
- Review, re-write and/or simplify expressions in exponential form.
- Review properties of integer exponents. Review and rewrite expressions in equivalent form.

**8.G.9**

| When are exponents used and why are they important? |
| Why are exponents added when the bases are the same and they are being multiplied? |
| Why are exponents subtracted when the bases are the same and they being divided? |
| Why does a negative exponent become a fraction? |
| How do I simplify and evaluate numeric expressions involving integer exponents? |
| Where do we see examples of two and three-dimensional objects in the real-world? |
| How does the change in radius affect the volume of a cylinder or sphere? |

**Extending the Definitions of Exponents**

**Exponential Exponents**

**Start With Three See What Happens**

**A Few Folds**

**Nesting Dolls**

**Integer Exponents Resources**

**Applying Properties of Exponents**

**Comparing Snow Cones**

**Comparing Spheres and Cylinders**

**Flower Vases**

N/A
<table>
<thead>
<tr>
<th>Review and provide formulas to find volume (i.e. cone, cylinder and sphere).</th>
<th>How does the change in height affect the volume of a cylinder or sphere?</th>
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</thead>
<tbody>
<tr>
<td>Create and provide real-world and mathematical problem(s) (connection to world).</td>
<td>How does the volume of a cylinder and sphere with the same radius change if it is doubled?</td>
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<tr>
<td>Create and provide step-by-steps strategies on usage of expression and formulas.</td>
<td>How do you use patterns to understand mathematics and model situations?</td>
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<td>Provide a calculator.</td>
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<tr>
<td>Teach and model fundamental skills and procedures explicitly until they become automatic.</td>
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<tr>
<td>Present information through different modalities (i.e. visual, auditory, tactile, &amp; kinesthetic).</td>
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</tbody>
</table>

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


*Rules of Exponents* - 8.EE.1-1 - [https://youtu.be/LtWhMUkj5U0](https://youtu.be/LtWhMUkj5U0)

*Roosevelt Middle School Math Team - Common Core Tutorial Videos* -- 8.G.C.9
[https://youtu.be/BiaBa0IHIg](https://youtu.be/BiaBa0IHIg)

**ELL Strategies:**

Utilize Manipulatives and develop hands-on activities.

Model structure and clarify unfamiliar syntax.

Have students visualize actual models of shapes 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 and/or small groups.

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

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

Pictures/illustrations and have student write meaning in their Math Journals.

**Website:**
**Teachers First Adapt a Strategy.**
**Adapting Lessons for ESL/ELL students**
[http://www.teachersfirst.com/content/esl/adaptstrat.cfm](http://www.teachersfirst.com/content/esl/adaptstrat.cfm)
**New Jersey Student Learning Standard(s):**
8.EE.A.3. 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. *For example, estimate the population of the United States as* $3 \times 10^8$ *and the population of the world as* $7 \times 10^9$, *and determine that the world population is more than 20 times larger.*

**Student Learning Objective 2:** Estimate and express the values of very large or very small numbers with numbers expressed in the form of a single digit times an integer power of 10. Compare numbers expressed in this form, expressing how many times larger or smaller one is than the other.

**Modified Student Learning Objectives/Standard:**

<table>
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<tr>
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<th>Tasks/Activities</th>
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<tbody>
<tr>
<td>MP 2</td>
<td>8.EE.3</td>
<td>Very large and very small quantities can be approximated with numbers expressed in the form of a single digit times an integer power of 10. Estimate very large and very small quantities with numbers expressed in the form of a single digit times an integer power of 10. Compare numbers written in the form of a single digit times an integer power of 10 and express how many times as much one is than the other.</td>
<td>How can I use the powers of 10 to express very small and very large quantities? Students will understand that if the exponent increases by 1, the value increases 10 times. Using this system, how can you determine how much larger or how much smaller one quantity is compared to another? Why is this type of system necessary? How can you define zero and negative exponents?</td>
<td>Orders of Magnitude Exploring Powers of 10 Magnitude &amp; Estimating Quantities How Many Times in a Millennium</td>
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<td>MP 4</td>
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<td>MP 5</td>
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<td>MP 8</td>
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<td>Provide a calculator.</td>
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</table>

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

*Roosevelt Middle School Math Team* -- Common Core Tutorial Videos -- 8.EE.A.3  
[https://youtu.be/nCBK7NTRuQ4](https://youtu.be/nCBK7NTRuQ4)

**ELL Strategies:**

- Incorporate introductory writing activities using students’ math journals.
- Model structure and clarify unfamiliar syntax.
- Utilize gestures, or L1 (native language) translations, to demonstrate vocabulary comprehension and word-meaning.
- Have students work with partners and/or small groups.
- Create word/picture wall with L1 (students’ native language) translations side by side.
- Provide supplemental resources with L1 (students’ native language) text and/or support.
- Utilize pictures/illustrations and have student write meaning in their Math Journals.
- Develop interactive games and activities to promote retention.
New Jersey Student Learning Standard(s):  
8.EE.A.4: Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.

Student Learning Objective 3: Perform operations using numbers expressed in scientific notation, including problems where both decimals and scientific notation are used. In real-world problem-solving situations, choose units of appropriate size for measurement of very small and very large quantities and interpret scientific notation generated when technology has been used for calculations.

Modified Student Learning Objectives/Standards:  

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</thead>
<tbody>
<tr>
<td>MP 2</td>
<td>8.EE.4</td>
<td>Multiply and divide numbers expressed in scientific notation, including problems in which one number is in decimal form and one is in scientific notation.</td>
<td>Why is it important to perform operations in scientific notation?</td>
<td>Ants vs. Humans</td>
</tr>
<tr>
<td>MP 4</td>
<td>Tasks have “thin context” or no context.</td>
<td>Add and subtract numbers expressed in scientific notation, including problems in which one number is in decimal form and one is in scientific notation.</td>
<td>Why is it important that everyone correctly puts their solutions in scientific notation?</td>
<td>E. Coli</td>
</tr>
<tr>
<td>MP 5</td>
<td>Rules or conventions for significant figures are not assessed.</td>
<td>Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities. Interpret scientific notation that has been generated by technology (e.g. recognize 4.1E-2 and 4.1e-2 as 4.1 x 10^{-2}).</td>
<td>How do you change between scientific notation and standard notation?</td>
<td>Giant Burgers</td>
</tr>
<tr>
<td>MP 6</td>
<td>Some of the tasks involve both decimal and scientific notation.</td>
<td></td>
<td>Is it always easier to perform an operation in standard form?</td>
<td>100 People</td>
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<td>MP 7</td>
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<td>Pennies to Heaven</td>
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<td>MP 8</td>
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<td>Estimating Length Using Scientific Notation</td>
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<td>Scientific Notation</td>
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<td>More Scientific Notation</td>
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<tr>
<td><strong>SPED Strategies:</strong></td>
<td>Real world situation involving exponential relationships can be solved using multiple representations.</td>
<td>Expression and Equation-Short Task</td>
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<tr>
<td>Review and practice the use of patterns in order to develop of understanding of powers of 10.</td>
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<tr>
<td>Review and drill writing a number expressed as a single digit times an integer power of 10.</td>
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<tr>
<td>Review and provide strategies on how to read numbers in scientific notation.</td>
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<tr>
<td>Review writing numbers in scientific notation.</td>
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<tr>
<td>Review converting numbers from standard form to scientific notation and vice versa.</td>
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<tr>
<td>Create and provide conversion numbers from standard form to scientific notation chart and/or flip chart.</td>
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<td>Review reading numbers that are powers of ten.</td>
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<tr>
<td>Create and practice write numbers that are powers of ten.</td>
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<tr>
<td>Provide a calculator.</td>
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</tbody>
</table>

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

*Roosevelt Middle School Math Team* -- Common Core Tutorial Videos -- 8.EE.A.4

[https://youtu.be/Pr5CEP56hZQ](https://youtu.be/Pr5CEP56hZQ)
**Comparing Scientific Notated Numbers - How Many Times Bigger - 8.EE.A.4**
[https://youtu.be/MvA7IVSWn4Y](https://youtu.be/MvA7IVSWn4Y)

<table>
<thead>
<tr>
<th><strong>ELL Strategies:</strong></th>
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<td>Incorporate introductory writing activities using students’ math journals.</td>
</tr>
<tr>
<td>Model structure and clarify unfamiliar syntax.</td>
</tr>
<tr>
<td>Have students visualize and create their own conversion charts, and diagrams with labels.</td>
</tr>
<tr>
<td>Utilizing gestures, or L1 (native language) translations, to demonstrate vocabulary comprehension and word-meaning.</td>
</tr>
<tr>
<td>Have students work with partners and/or small groups.</td>
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<td>Provide supplemental resources with L1 (students’ native language) text and/or support.</td>
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<td>Provide pictures/illustrations and have students write meaning in their Math Journals.</td>
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<tr>
<td>Develop interactive games and activities to promote retention.</td>
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</table>
New Jersey Student Learning Standard(s):
8.NS.A.1: Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number.

Student Learning Objective 4: Represent a rational number with its decimal expansion, showing that it eventually repeats, and convert such decimal expansions into rational numbers.

Modified Student Learning Objectives/Standards:
M.EE.8.EE.A.1: Identify the meaning of an exponent (limited to exponents of 2 and 3).

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<tbody>
<tr>
<td>MP 2</td>
<td>8.NS.1</td>
<td>Numbers that are not rational are irrational.</td>
<td>Square roots can be rational or irrational.</td>
<td>Mowing Lawns</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Every number has a decimal expansion.</td>
<td>An irrational number is a real number that cannot be written as a ratio of two integers.</td>
<td>Finite and Infinite Decimals</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Compare decimal expansions of rational and irrational numbers.</td>
<td>Every number has a decimal expansion, for rational numbers it repeats eventually, and can be converted into a rational number.</td>
<td>Translating between Decimals and Fractions</td>
</tr>
<tr>
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<td></td>
<td>Represent a rational number with its decimal expansion, showing that it repeats eventually.</td>
<td>In what ways can rational numbers be represented and how can they be used?</td>
<td>Repeating Decimals</td>
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<td>Convert a decimal expansion (which repeats eventually) into a rational number.</td>
<td>How do you use a number line to compare the size of two irrational numbers?</td>
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<td></td>
<td>SPED Strategies:</td>
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<td>Review locations of rational and irrational numbers on the number line.</td>
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<td>Review and provide strategies to compare and order rational and irrational numbers using number lines.</td>
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<tr>
<td>(i.e. 2.1666..., 0.23232323...)</td>
<td>Review and practice writing very large or very small numbers in an abbreviated way.</td>
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<td>Create visual, verbal or tactile cues or reminders.</td>
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<td>Vary means to assess mastery of materials taught.</td>
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<td>Link new learning to prior learning.</td>
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<td>Provide a calculator.</td>
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<tr>
<td><strong>Resources UDL - Visual and Auditory Learner(s):</strong></td>
<td><strong>Apply properties of integer exponents to generate equivalent numerical expressions 8.EE.A.1</strong></td>
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<td><a href="https://youtu.be/YbUUzGhN44o">https://youtu.be/YbUUzGhN44o</a></td>
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<td><strong>Approximations of Irrational Numbers - Common Core Standard - 8.NS.2-1.5</strong></td>
<td><a href="https://youtu.be/cKF_L0_SFiE">https://youtu.be/cKF_L0_SFiE</a></td>
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<td><strong>ELL Strategies:</strong></td>
<td>Challenge students to create their own math problems explaining rational and irrational numbers in their L1 (students’ native language) and English.</td>
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<td>Have students express their understandings in their math journals.</td>
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<td>Look for interactive games that offer students a chance to practice their mathematical skills.</td>
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<td><strong>Pair students with trained peers who can serve as “buddies” during activities.</strong></td>
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<tr>
<td><strong>Have students write in their journals how to locate irrational and rational numbers on a number line.</strong></td>
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<tr>
<td><strong>Create a word/picture wall with content vocabulary translated side by side.</strong></td>
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<td><strong>Provide students with resources and activities with L1 (students’ native language) text and/or support included.</strong></td>
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<td><strong>Have students work in groups to create actual number-lines on construction or large anchor-chart paper, and place sample rational and irrational number on a number line.</strong></td>
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<tr>
<td><strong>Website:</strong> KHAN ACADEMY in SPANISH</td>
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<td><a href="https://es.khanacademy.org/welcome">https://es.khanacademy.org/welcome</a></td>
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</tbody>
</table>
New Jersey Student Learning Standard(s):
8.NS.A.2: Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., \( \pi^2 \)). *For example, by truncating the decimal expansion of \( \sqrt{2} \), show that \( \sqrt{2} \) is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.*

Student Learning Objective 5: Use rational numbers to approximate irrational numbers, locate irrational numbers on a number line, and estimate the value of expressions containing irrational numbers.

Modified Student Learning Objectives/Standards:
M.EE.8.EE.A.2: Identify a geometric sequence of whole numbers with a whole number common ratio.

<table>
<thead>
<tr>
<th>MPs</th>
<th>Evidence Statement Key/ Clarifications</th>
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<th>Essential Understandings/ Questions (Accountable Talk)</th>
<th>Tasks/Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP 1</td>
<td>8.NS.2</td>
<td>Rational approximation of irrational numbers.</td>
<td>What is the difference between rational and irrational numbers?</td>
<td>Rational or Irrational Reasoning?</td>
</tr>
<tr>
<td>MP 4</td>
<td></td>
<td>Compare irrational numbers by replacing each with its rational approximation.</td>
<td>When are rational approximations appropriate?</td>
<td>Patio Predictions</td>
</tr>
<tr>
<td>MP 5</td>
<td></td>
<td>Locate rational approximations on a number line.</td>
<td>Why do we approximate irrational numbers?</td>
<td>The Code Name Organizer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Estimate the value of expressions containing irrational numbers.</td>
<td>Why is it useful to know the square root of a number?</td>
<td>Irrational Numbers on a Number Line</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Recognize that square roots may be negative and written as ( -\sqrt{32} ), but the radicand cannot be negative in the real number system.</td>
<td>How do you locate the approximate location on a number line and estimate the value of irrational numbers?</td>
<td>Comparison of Irrational Numbers</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>SPED Strategies:</strong> Review locations of rational and irrational numbers on the number line.</td>
<td></td>
<td>Rugs</td>
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<tr>
<td></td>
<td></td>
<td></td>
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<td>The Laundry Problem</td>
</tr>
</tbody>
</table>
| Review and provide strategies on compare and order rational and irrational numbers using number lines.  
Provide a calculator  
**Resources UDL - Visual and Auditory**  
**Learner(s):** Apply properties of integer exponents to generate equivalent numerical expressions - 8.EE.A.1  
[https://youtu.be/YbUUzGhN44o](https://youtu.be/YbUUzGhN44o)  
*Approximations of Irrational Numbers* - Common Core Standard [8.NS.2-1.5]  
[https://youtu.be/cKF_L0_SFiE](https://youtu.be/cKF_L0_SFiE)  
**ELL Strategies:**  
Challenge students to create their own math problems explaining rational and irrational numbers in their L1 (students’ native language) and English.  
Have students express their understandings in their math journals.  
Look for interactive games that offer students a chance to practice their mathematical skills.  
Pair students with trained peers who can serve as "buddies" during activities.  
Have students write in their journals how to locate irrational and rational numbers on a number line.  
How do you convert a rational number into a decimal?  
How do you use a number line to identify rational and irrational numbers?  
In what ways can rational numbers be represented and how can they be used? |
Provide students with resources and activities with L1 (students’ native language) text and/or support included.

Have students work in groups to create actual number-lines on construction or large anchor-chart paper, and place sample rational and irrational number on a number line.

**Website:**
KHAN ACADEMY in SPANISH
https://es.khanacademy.org/welcome

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**New Jersey Student Learning Standard(s):**

**8.EE.B.5:** Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. *For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.*

**Student Learning Objective 6:** Graph proportional relationships, interpreting slope as unit rate, and compare two proportional relationships, each represented in different ways.

**Modified Student Learning Objectives/Standards:**

**M.EE.8.EE. B.5-6:** Graph a simple ratio by connecting the origin to a point representing the ratio in the form of y/x for example, when given a ratio in standard form (2:1), convert to 2/1, and plot (1,2).

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<tr>
<td>MP 2</td>
<td>8.EE.5</td>
<td>Quantitative relationships can be represented in different ways.</td>
<td>How can we find a slope given a graph?</td>
<td>Peaches and Plums</td>
</tr>
<tr>
<td>MP 4</td>
<td></td>
<td>Graph proportional relationships in the coordinate plane.</td>
<td>What does the slope mean in the context of the problem?</td>
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<tr>
<td>MP 5</td>
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<td>MP 6</td>
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<tr>
<td>MP 7</td>
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<td>Sore Throats</td>
</tr>
</tbody>
</table>
| MP 8 | Interpret unit rate of a proportional relationship as the slope of a graph that intersects the origin.  
Compare two different proportional relationships that are represented in different ways (table of values, equation, graph, verbal description).  
**SPED Strategies:**  
Review graphs of a proportional relationships.  
Review graphs to be able to compare the slope of the related line in a proportional relationship.  
Review and practice the meanings of unit rate.  
Review and provide different descriptions of slope.  
Practices and provide strategies on how to simplify rates to unit rates.  
Review and practice how slopes and unit rates are constant rates of change.  
Review and practice unit rate is represented on the graph paper.  
Review and practice drawing the graph of the proportional relationship between the two quantities.  
Review, practice and provide strategy cards and scaffolds on the importance of using the slope and y-intercept. | How are unit rate, slope, and rate of change related?  
What are multiple ways to compare two difference proportional relationships? | Squares and Circles  
How Much Money Will I Save?  
Perplexing Puzzle  
Who has the best job?  
Rolling Tennis Balls  
Drops in a Bucket  
What’s My Line?  
Slopes Between Points on a Line  
*Short Task:* Bike Ride/Scoring Rubric |
<table>
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<tr>
<th>Define slope and y-intercept.</th>
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<tr>
<td>Identify the slope of an equation by counting rise/run on a graph.</td>
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<td>Identify where the graph of the equation crosses the y-axis.</td>
</tr>
<tr>
<td>Review and practice solutions for a linear equation fall on a line on the coordinate plane.</td>
</tr>
<tr>
<td>Review and practice points on the line are solutions for the linear equation.</td>
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<tr>
<td>Review and practice linear equation a constant change in the x-value corresponds to a constant change in the y-value.</td>
</tr>
<tr>
<td>Receive and practice finding a solution to a linear equation by selecting any x-value and finding the corresponding y-value.</td>
</tr>
</tbody>
</table>

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

*Roosevelt Middle School Math Team -- Common Core Tutorial Videos -- 8.EE.B.5*

https://youtu.be/5mJlYlcK6yM

*Graphing Proportional Relationships 8.EE.5*

https://youtu.be/w9REfzJJ24s

*Roosevelt Middle School Math Team -- Common Core Tutorial Videos -- 8.EE.B.6*

https://youtu.be/DRYfHWF67A
**Slope and Similar Triangles - Common Core Standard [8.EE.6-1.0]**

https://youtu.be/S0ENLYcM5AI

**ELL Strategies:**
Have students translate symbols into words, and write out the sentence.

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

Provide and utilize manipulatives, such as graph paper, charts, and posters.

Identify key phrases or new vocabulary to pre-teach.

Build knowledge from real world examples.

Have students work with partners to share problem-solving strategies.

Create a "sentence frame" and post it on the board.

Identify key phrases or new vocabulary to pre-teach.

**Website:**
KHAN ACADEMY
*Expressions and Equations*
https://www.khanacademy.org/commoncore/grade-8-EE
New Jersey Student Learning Standard(s):

8.EE.B.6: Use similar triangles to explain why the slope $m$ is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at $b$.

Student Learning Objective 7: Derive the equation of a line ($y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at $b$) and use similar triangles to explain why the slope ($m$) is the same between any two points on a non-vertical line in the coordinate plane.

Modified Student Learning Objectives/Standards:

M.EE.8.EE. B.5-6: Graph a simple ratio by connecting the origin to a point representing the ratio in the form of $y/x$ for example, when given a ratio in standard form (2:1), convert to 2/1, and plot (1,2).

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| MP 2 MP 4 MP 5 MP 6 MP 7 MP 8 | 8.EE.6 | Show, using similar triangles, and explain why the slope, $m$, is the same between any two distinct points on a non-vertical line. Derive, from two points, the equation $y = mx$ for a line through the origin. Derive, from two points, the equation $y = mx + b$ for a line intercepting the vertical axis at $b$. **SPED Strategies:** Review graphs of a proportional relationship and describe its attributes. Review and practice graphs and compare to the slope of the related line in a proportional relationship. Show, using similar triangles, and explain why the slope, $m$, is the same between any two distinct points on a non-vertical line. Derive, from two points, the equation $y = mx$ for a line through the origin. Derive, from two points, the equation $y = mx + b$ for a line intercepting the vertical axis at $b$.

- Tasks do not have a context.
- Given a non-vertical line in the coordinate plane, tasks might for example require students to choose two pairs of points and record the rise, run, and slope relative to each pair and verify that they are the same.
- Tasks may assess simple graphing of lines from a linear function.

- How can patterns, relations, and functions be used as tools to best describe and help explain real-life relationships?
- How can the same mathematical idea be represented in a different way? Why would that be useful?
- What is the significance of the patterns that exist between the triangles created on the graph of a linear function?
- How is the equation of the line derived?

What’s My Line? Slopes Between Points on a Line Slippery Slopes
| equation in slope-intercept form. | Review and provide different descriptions of slope.  
Review and practice draw the graph of the proportional relationship between the two quantities.  
Review and practice the graph of an equation written as $y = mx + b$ linear.  
Review, practice and provide strategy cards and scaffolds on the importance of using the slope and $y$-intercept.  
Identify the slope of an equation by counting rise/run on a graph.  
Identify where the graph of the equation crosses the $y$-axis.  
Review and practice solutions for a linear equation fall on a line on the coordinate plane.  
Review and practice the concept that points on the line are solutions for the linear equation.  
Review and practice linear equation a constant change in the $x$-value corresponds to a constant change in the $y$-value.  
Receive and practices finding a solution to a linear equation by selecting any $x$-value and finding the corresponding $y$-value. | How can similar triangles be used to model slope? |
Resources UDL - Visual and Auditory Learner(s):

*Roosevelt Middle School Math Team* -- Common Core Tutorial Videos -- 8.EE.B.5
[https://youtu.be/5mJIYIcK6yM](https://youtu.be/5mJIYIcK6yM)

*Graphing Proportional Relationships* -8.EE.5
[https://youtu.be/w9REfzJJ24s](https://youtu.be/w9REfzJJ24s)

*Roosevelt Middle School Math Team* -- Common Core Tutorial Videos -- 8.EE.B.6

*Slope and Similar Triangles* - Common Core Standard - 8.EE.6-1.0
[https://youtu.be/S0ENLYcM5AI](https://youtu.be/S0ENLYcM5AI)

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[https://www.khanacademy.org/commoncore/grade-8-EE](https://www.khanacademy.org/commoncore/grade-8-EE)
Integrated Evidence Statements

8.C.1.1: 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.6
- Tasks require students to derive the equation $y=mx$ for a line through the origin and the equation $y=mx+b$ for a line intersecting the vertical axis at $b$.

8.C.5.1: Apply geometric reasoning in a coordinate setting, and/or use coordinates to draw geometric conclusions. Content Scope: Knowledge and skills articulated in 8.EE.6

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. 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. 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.
## Integrated Evidence Statements

8. D.4: Reasoned estimates: Use reasonable estimates of known quantities in a chain of reasoning that yields an estimate of an unknown quantity. Content Scope: Knowledge and skills articulated in Type I, Sub-Claim A Evidence Statements

Some of the tasks may use scaffolding.
## Unit 1 Vocabulary

- Additive Inverse
- Additive Property of Equality
- Additive Property of Equality
- Algebraic expression
- Cone
- Constant of Variation
- Cube Root
- Cylinders
- Decimal Expansion
- Domain
- Equation
- Equation of linear model
- Equivalent Expression
- Exponent
- Function
- Graph of a Function
- Irrational
- Like term
- Like Terms
- Range of a Function
- Scientific Notation
- Significant Digits
- Slope
- Linear
- Linear association
- Linear Equation in One Variable
- Linear Equations
- Multiplication Property of Equality
- Multiplicative Inverse
- Nonlinear
- Origin
- Perfect Square
- Proportional Relationship
- Radical
- Slope and intercept
- Slope Intercept Form
- Solution
- Solution of System of Linear Equations
- Solve
- Spheres
- Square Root
- System of Equations
- Variables
- Volumes
- X-intercept
- Y-intercept
## References & Suggested Instructional Websites

- [http://illuminations.nctm.org/index](http://illuminations.nctm.org/index)
- [www.internet4classrooms.com](http://www.internet4classrooms.com)
- [www.georgiastandards.org/Common-Core/Pages/Math-6-8.aspx](http://www.georgiastandards.org/Common-Core/Pages/Math-6-8.aspx)
- [www.illustrativemathematics.org/](http://www.illustrativemathematics.org/)
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 http://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/

NEW JERSEY JACKALS (Little Falls, NJ) – Students will be able to watch a live minor league baseball game while figuring out the players batting averages, the earned run average, determine the win to loss ratio for the season, the pitch count, and other player statistics.
http://njjackals.pointstreaksites.com/view/njjackals/home-page-657/

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.bcsc.org/5-9th-grade/
Field Trip Ideas

**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

**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 1 hour 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!