ESL
SCIENCE
BUSINESS
BILINGUAL
PRESCHOOL
MATHEMATICS
LIBRARY MEDIA
SOCIAL STUDIES
WORLD LANGUAGES
GIFTED & TALENTED
TECHNOLOGY EDUCATION
ENGLISH LANGUAGE ARTS
FINE & PERFORMING ARTS
FAMILY & CONSUMER SCIENCE
HEALTH & PHYSICAL EDUCATION

RAHWAY PUBLIC SCHOOLS

CURRICULUM & INSTRUCTION

Content Area: Mathematics

Course: Pre-Algebra

Grade Level: 8

This curriculum is part of the Educational Program of Studies of the Rahway Public Schools.

ACKNOWLEDGMENTS

Jeffery Kurczeski,

Program Supervisor of 7-12 Math & Science and 9-12 Business & Technology Education

The Board acknowledges the following who contributed to the preparation of this curriculum.

Carlos Sabates, Mathematics Teacher

Dr. Tiffany A. Beer, Director of Curriculum and Instruction

Dr. Aleya Shoieb, Superintendent of Schools

Subject/Course Title:
Pre-Algebra
Grade 8

Date of Board Adoption:
August 27, 2024

RAHWAY PUBLIC SCHOOLS CURRICULUM

Pre-Algebra: Grade 8

PACING GUIDE

Unit	Title	Pacing
1	Rigid Transformations and Congruence	5 weeks
2	Dilations, Similarity, and Introducing Slope	5 weeks
3	Linear Relationships	5 weeks
4	Linear Equations and Linear Systems	5 weeks
5	Functions and Volume	6 weeks
6	Associations in Data	4 weeks
7	Exponents and Scientific Notation	5 weeks
8	Pythagorean Theorem and Irrational Numbers	5 weeks

ACCOMMODATIONS

504 Accommodations:

- Provide scaffolded vocabulary and vocabulary lists.
- Provide extra visual and verbal cues and prompts.
- Provide adapted/alternate/excerpted versions of the text and/or modified supplementary materials.
- Provide links to audio files and utilize video clips.
- Provide graphic organizers and/or checklists.
- Provide modified rubrics.
- Provide a copy of teaching notes, especially any key terms, in advance.
- Allow additional time to complete assignments and/or assessments.
- Provide shorter writing assignments.
- Provide sentence starters.
- Utilize small group instruction.
- Utilize Think-Pair-Share structure.
- Check for understanding frequently.
- Have student restate information.
- Support auditory presentations with visuals.
- Weekly home-school communication tools (notebook, daily log, phone calls or email messages).
- Provide study sheets and teacher outlines prior to assessments.
- Quiet corner or room to calm down and relax when anxious.
- Reduction of distractions.
- Permit answers to be dictated.
- Hands-on activities.
- Use of manipulatives.
- Assign preferential seating.
- No penalty for spelling errors or sloppy handwriting.
- Follow a routine/schedule.
- Provide student with rest breaks.
- Use verbal and visual cues regarding directions and staying on task.
- Assist in maintaining agenda book.

IEP Accommodations:

- Provide scaffolded vocabulary and vocabulary lists.
- Differentiate reading levels of texts (e.g., Newsela).
- Provide adapted/alternate/excerpted versions of the text and/or modified supplementary materials.
- Provide extra visual and verbal cues and prompts.
- Provide links to audio files and utilize video clips.
- Provide graphic organizers and/or checklists.
- Provide modified rubrics.
- Provide a copy of teaching notes, especially any key terms, in advance.
- Provide students with additional information to supplement notes.
- Modify questioning techniques and provide a reduced number of questions or items on tests.
- Allow additional time to complete assignments and/or assessments.
- Provide shorter writing assignments.
- Provide sentence starters.
- Utilize small group instruction.
- Utilize Think-Pair-Share structure.
- Check for understanding frequently.
- Have student restate information.
- Support auditory presentations with visuals.
- Provide study sheets and teacher outlines prior to assessments.
- Use of manipulatives.
- Have students work with partners or in groups for reading, presentations, assignments, and analyses.
- Assign appropriate roles in collaborative work.
- Assign preferential seating.
- Follow a routine/schedule.

Gifted and Talented Accommodations:

- Differentiate reading levels of texts (e.g., Newsela).
- Offer students additional texts with higher lexile levels.
- Provide more challenging and/or more supplemental readings and/or activities to deepen understanding.
- Allow for independent reading, research, and projects.
- Accelerate or compact the curriculum.
- Offer higher-level thinking questions for deeper analysis.
- Offer more rigorous materials/tasks/prompts.
- Increase number and complexity of sources.
- Assign group research and presentations to teach the class.
- Assign/allow for leadership roles during collaborative work and in other learning activities.

ML Accommodations:

- Provide extended time.
- Assign preferential seating.
- Assign peer buddy who the student can work with.
- Check for understanding frequently.
- Provide language feedback often (such as grammar errors, tenses, subject-verb agreements, etc…).
- Have student repeat directions.
- Make vocabulary words available during classwork and exams.
- Use study guides/checklists to organize information.
- Repeat directions.
- Increase one-on-one conferencing.
- Allow student to listen to an audio version of the text.
- Give directions in small, distinct steps.
- Allow copying from paper/book.
- Give student a copy of the class notes.

	● Provide written and oral instructions. ● Differentiate reading levels of texts (e.g., Newsela). ● Shorten assignments. ● Read directions aloud to student. ● Give oral clues or prompts. ● Record or type assignments. ● Adapt worksheets/packets. ● Create alternate assignments. ● Have student enter written assignments in criterion, where they can use the planning maps to help get them started and receive feedback after it is submitted. ● Allow student to resubmit assignments. ● Use small group instruction. ● Simplify language. ● Provide scaffolded vocabulary and vocabulary lists. ● Demonstrate concepts possibly through the use of visuals. ● Use manipulatives. ● Emphasize critical information by highlighting it for the student. ● Use graphic organizers. ● Pre-teach or pre-view vocabulary. ● Provide student with a list of prompts or sentence starters that they can use when completing a written assignment. ● Provide audio versions of the textbooks. ● Highlight textbooks/study guides. ● Use supplementary materials. ● Give assistance in note taking ● Use adapted/modified textbooks. ● Allow use of computer/word processor. ● Allow student to answer orally, give extended time (time-and-a-half). ● Allow tests to be given in a separate location (with the ESL teacher). ● Allow additional time to complete assignments and/or assessments. ● Read question to student to clarify. ● Provide a definition or synonym for words on a test that do not impact the validity of the exam. ● Modify the format of assessments. ● Shorten test length or require only selected test items. ● Create alternative assessments. ● On an exam other than a spelling test, don’t take points off for spelling errors.

UNIT 1 OVERVIEW

Content Area: Mathematics

Unit Title: Rigid Transformations and Congruence

Target Course/Grade Level: Pre-Algebra/Grade 8

Unit Summary: In this unit, students learn to understand and use the terms "reflection," "rotation," and "translation," recognizing what determines each type of transformation, e.g., two points determine a translation. They learn to understand and use the terms "transformation" and "rigid transformation." They identify and describe translations, rotations, and reflections, and sequences of these, using the terms "corresponding sides" and "corresponding angles," and recognizing that lengths and angle measures are preserved. They draw images of figures under rigid transformations on and off square grids and the coordinate plane. They use rigid transformations to generate shapes and to reason about measurements of figures. They learn to understand the congruence of plane figures in terms of rigid transformations. They recognize when one plane figure is congruent or not congruent to another. Students use the definition of "congruent" and properties of congruent figures to justify claims of congruence or non-congruence.

Approximate Length of Unit: 5 weeks

LEARNING TARGETS

NJ Student Learning Standards:

8.G.A.1 Verify experimentally the properties of rotations, reflections, and translations:
- a. Lines are transformed to lines, and line segments to line segments of the same length.
- b. Angles are transformed to angles of the same measure.
- c. Parallel lines are transformed to parallel lines.

8.G.A.2 Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them. For example, if a triangle is rotated, reflected, translated or dilated across the x-axis, the sides and angles will remain congruent to the original figure.

8.G.A.3 Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.

8.G.A.5 Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.

Career Readiness, Life Literacies, and Key Skills:

9.2.8.CAP.1 Identify offerings such as high school and county career and technical school courses, apprenticeships, military programs, and dual enrollment courses that support career or occupational areas of interest.

9.2.8.CAP.3 Explain how career choices, educational choices, skills, economic conditions, and personal behavior affect income.

9.4.8.CI.1 Assess data gathered on varying perspectives on causes of climate change (e.g., crosscultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions.
9.4.8.CT.2 Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option.
9.4.8.TL.2 Gather data and digitally represent information to communicate a real-world problem.

Interdisciplinary Connections and Standards:
ELA
L.SS.8.1 Demonstrate command of the system and structure of the English language when writing or speaking.
RI.CR.8.1 Cite a range of textual evidence and make clear and relevant connections (including informational text features such as charts, graphs, and diagrams) that strongly support an analysis of multiple aspects of what an informational text says explicitly, as well as inferences drawn from the text.
RI.CI.8.2 Determine a central idea of an informational text and how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.
W.IW.8.2 Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
SL.PE.8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.
Science
MS-PS1-5 Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.

Unit Understandings:
Students will understand that…

- Utilizing the properties of rotation, reflection, and translation to model and relate pre-images to their resultant image through physical representations.
- Applying an effective sequence of transformations to prove that two figures are congruent.
- Recognizing a dilation as the reduction or an enlargement of a figure and determining the scale factor.
- Applying a sequence of transformations to determine that figures are similar when corresponding parts are proportional.
- Justifying facts about angles created by a set of parallel lines cut by a transversal.
- Justifying facts about the interior and exterior angles of a triangle, and the angle-angle relationship used to identify similar triangles.

Unit Essential Questions:

- If a figure is transformed on the coordinate plane, will the resulting figure always be congruent to the original?
- What relationships are formed when a set of parallel lines is cut by a transversal?
- What properties do the angles of a triangle possess?

Knowledge and Skills:
Students will know...

- How to describe
    - movements of figures.
    - observations about transforming parallel lines.
    - transformations using corresponding points, line segments, and angles.
    - observations about angle measurements.

    - transformations found in tessellations and in designs with rotational symmetry.
- How to generalize
    - about categories for movement.
    - about rotating line segments.
    - about the relationship between vertical angles.
    - about transformations and congruence.
    - about corresponding segments and length.
    - about alternate interior angles.
    - about the sum of angles in a triangle.
- How to justify
    - whether or not rigid transformations could produce an image.
    - whether or not shapes are congruent.
    - whether or not polygons are congruent.
    - whether or not ovals are congruent.
    - whether or not triangles can be created from given angle measurements.
- Vocabulary: vertex, clockwise, counterclockwise, reflection, rotation, translation, image, sequence of transformations, coordinate plane, rigid transformation, corresponding, congruent, right angle, alternate interior angles, transversal, vertical angles, straight angle, and tessellation.

Students will be able to...

- Determine coordinates that represent the image of a polygon or line segment in the coordinate plane after a transformation.
- Draw and label the image of figures that result from translations, rotations, and reflections on a square or isometric grid.
- Explain the sequence of transformations that takes one figure to its image.
- Draw and label rigid transformations of lines and parallel lines and explain the relationship between the original and its image under the transformation.
- Identify a rigid transformation using a drawing of a figure and its image.
- Identify side lengths and angles that have equivalent measurements in composite shapes and explain why they are equivalent.
- Compare and contrast side lengths, angle measures, and other features of shapes using rigid transformations to explain why a shape is or is not congruent to another.
- Justify that two polygons on a grid are congruent using the definition of congruence in terms of rigid transformations.
- Calculate angle measures using alternate interior, vertical, and supplementary angles to solve problems.
- Generalize that the sum of angles in a triangle is 180 degrees using rigid transformations or the congruence of alternate interior angles of parallel lines cut by a transversal.
- Create tessellations and designs with rotational symmetry using rigid transformations.
- Explain (orally and in writing) the rigid transformations needed to move a tessellation or design with rotational symmetry onto itself.

EVIDENCE OF LEARNING

Assessment:

What evidence will be collected and deemed acceptable to show that students truly "understand"?

- End of Unit Common Assessment - See folder for assessment links.
- Warm-Ups
- Cool Downs
- Section Checkpoints
- Practice Sets
- Renaissance Star Math Diagnostic Assessment – Fall, Winter, Spring

Learning Activities:

What differentiated learning experiences and instruction will enable all students to achieve the desired results?

- Lesson 1: Triangle Square Dance - The purpose of this activity is for students to begin to observe and describe translations and rotations. In groups of 2, they describe one of 3 possible dances, presented in cartoon form, and the partner identifies which dance is being described. Identify students who use specific and detailed language to describe the dance and select them to share during class discussion.
- Lesson 7: Which One? - The purpose of this activity is to decide if there is a sequence of translations, rotations, and reflections that take one figure to another and, if so, to produce one such sequence. Deciding whether or not such a sequence is possible uses the knowledge that translations, rotations, and reflections do not change side lengths or angle measures.
- Lesson 10: Triangle Plus One - The purpose of this task is to use rigid transformations to describe an important picture that students have seen previously when they developed the formula for the area of a triangle. They first found the area of a parallelogram to be base times height and then, to find one half base times height for the area of a triangle, they "composed" two copies of a triangle to make a parallelogram. The focus of this activity is on developing this precise language to describe a familiar geometric situation.
- Lesson 11: Area, Perimeter, and Congruence - Sometimes people characterize congruence as "same size, same shape." The problem with this is that it isn't clear what we mean by "same shape." All of the figures in this activity have the same shape because they are all rectangles, but they are not all congruent. Students examine a set of rectangles and classify them according to their area and perimeter. Then they identify which ones are congruent. Because congruent shapes have the same side lengths, congruent rectangles have the same perimeter. But rectangles with the same perimeter are not always congruent. Congruent shapes, including rectangles, also have the same area. But rectangles with the same area are not always congruent. Highlighting important features, like perimeter and area, which can be used to quickly establish that two shapes are not congruent develops MP7, identifying fundamental properties shared by any pair of congruent shapes.
- Lesson 15: Tear It Up - The students found that the sum of the angles of all the triangles on the cards was 180 degrees and questioned if all triangles had the same angle sum. In this activity, students experiment with the converse: If we know the measures of three angles sum to 180 degrees, can these three angles be the interior angles in a triangle?

RESOURCES

Teacher Resources:

- Illustrative Math (IM) Unit 8.1
- IM Student Workbook
- IM Blackline Masters
- Khan Academy IM Unit 8.1 Companion

Equipment Needed:

- Manipulatives
- IM Student Workbooks
- Student Whiteboards
- Chart Paper
- Dry Erase Markers
- Online Approved Digital Resources
- Chromebooks
- Bags, resealable plastic, or envelopes.
- Geometry Toolkit: rulers, graph paper, pattern blocks, straightedges, colored pencils, index cards, patty paper or tracing paper, pencil boxes, and scissors.

UNIT 2 OVERVIEW

Content Area: Mathematics

Unit Title: Dilations, Similarity, and Introducing Slope

Target Course/Grade Level: Pre-Algebra/Grade 8

Unit Summary: In this unit, students learn to understand and use the term "dilation," and to recognize that a dilation is determined by a point called the "center" and a number called the "scale factor." They learn that under a dilation, the image of a circle is a circle and the image of a line is a line parallel to the original. They draw images of figures under dilations on and off the coordinate plane. They use the terms "corresponding sides" and "corresponding angles" to describe correspondences between a figure and its dilated image and recognize that angle measures are preserved, but lengths are multiplied by the scale factor. They learn to understand the similarity of plane figures in terms of rigid transformations and dilations. They learn to recognize when one plane figure is similar or not similar to another. They use the definition of "similar" and properties of similar figures to justify claims of similarity or non-similarity. Students learn the terms "slope" and "slope triangle," and use the similarity of slope triangles on the same line to understand that any two distinct points on a line determine the same slope.

Approximate Length of Unit: 5 weeks

LEARNING TARGETS

NJ Student Learning Standards:

8.G.A.2 Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them.

8.G.A.3 Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.

8.G.A.4 Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them.

8.G.A.5 Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.

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.

Career Readiness, Life Literacies, and Key Skills:

9.2.8.CAP.1 Identify offerings such as high school and county career and technical school courses, apprenticeships, military programs, and dual enrollment courses that support career or occupational areas of interest.

9.2.8.CAP.3 Explain how career choices, educational choices, skills, economic conditions, and personal behavior affect income.
9.4.8.CI.1 Assess data gathered on varying perspectives on causes of climate change (e.g., crosscultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions.
9.4.8.CT.2 Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option.
9.4.8.TL.2 Gather data and digitally represent information to communicate a real-world problem.

Interdisciplinary Connections and Standards:
ELA
L.SS.8.1 Demonstrate command of the system and structure of the English language when writing or speaking.
RI.CR.8.1 Cite a range of textual evidence and make clear and relevant connections (including informational text features such as charts, graphs, and diagrams) that strongly support an analysis of multiple aspects of what an informational text says explicitly, as well as inferences drawn from the text.
RI.CI.8.2 Determine a central idea of an informational text and how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.
W.IW.8.2 Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
SL.PE.8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.
Science
MS-PS1-5 Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.

Unit Understandings:
Students will understand that…

- Dilations are a new type of transformation and way to create a scaled copy.
- Translating, reflecting, rotating and dilating geometric figures can help determine if they are similar and that similar figures have lengths that have the same scale factor.
- Two distinct points on a line determine the same slope as the slope of the overall line.

Unit Essential Questions:

- If a figure is transformed on the coordinate plane, will the resulting figure always be congruent to the original?
- What relationships are formed when a set of parallel lines is cut by a transversal?
- What properties do the angles of a triangle possess?

Knowledge and Skills:
Students will know...

- How to describe
  - observations about scaled rectangles.
  - observations about dilated points, circles, and polygons.
  - sequences of transformations.
  - observations about side lengths in similar triangles.
- How to explain
  - how to apply dilations to find specific images.
  - how to determine whether triangles are congruent, similar, or neither.
  - strategies for finding missing side lengths.

    - how to apply dilations to find specific images of points.
    - reasoning for a conjecture.
- How to represent
    - dilations using given scale factors and coordinates.
    - figures using specific transformations.
    - graphs of lines using equations.
- Vocabulary: scale factor, dilation, center of dilation, similar, and slope.

Students will be able to...

- Create a dilation of a figure given a scale factor and center of dilation.
- Describe a figure on a coordinate grid and its image under a dilation, using coordinates to refer to points.
- Identify the center, scale factor, and image of a dilation.
- Calculate unknown side lengths in similar triangles using the ratios of side lengths within the triangles and the scale factor between similar triangles.
- Justify that two triangles are similar by finding a sequence of transformations that takes one triangle to the other or by checking that two pairs of corresponding angles are congruent.
- Comprehend the term "slope" to mean a number that tells how steep a line is.
- Create an equation relating the quotient of the vertical and horizontal side lengths of a slope triangle to the slope of a line and use it to justify whether a point (x,y) is on the line by verifying that the values of x and y satisfy the equation.
- Calculate the unknown heights of objects by using proportional reasoning and explain (orally) the solution method.
- Justify (orally) why the relationship between the height of objects and the length of their shadows cast by the sun is approximately proportional.

EVIDENCE OF LEARNING

Assessment:

What evidence will be collected and deemed acceptable to show that students truly "understand"?

- End of Unit Common Assessment - See folder for assessment links.
- Warm-Ups
- Cool Downs
- Section Checkpoints
- Practice Sets
- Renaissance Star Math Diagnostic Assessment – Fall, Winter, Spring

Learning Activities:

What differentiated learning experiences and instruction will enable all students to achieve the desired results?

- Lesson 1: Number Talk: Remembering Fraction Division - This Number Talk gives students an opportunity to recall strategies for computation problems that will arise in the lesson. While many strategies may emerge, the focus of these problems is for students to recall and rehearse a reliable way to divide a mixed number by a whole number.
- Lesson 4: Card Sort: Matching Dilations on a Coordinate Grid - This activity adds the structure of coordinates and this extra structure plays a key role, in allowing students to name points. Students match figures with their dilated images, using coordinates to describe the center of dilation and

the vertices. The same strategies that were used previously in dilating images,on a circular grid and with no grid, will be useful here.

- Lesson 7: Find Someone Similar - In the previous activity, students learned that in order to be similar, two figures must have congruent corresponding angles and proportional corresponding side lengths. In this activity, students apply this knowledge. Each student has a card with a figure on it and they identify someone with a similar (but not congruent) figure.
- Lesson 10: Similar Triangles on the Same Line - In this activity, students explain why certain triangles with one side along the same line are similar. This fact about the triangles will be used to define the slope of the line. Students may show that the triangles are similar by describing a sequence of transformations and dilations or by AA (or AAA). Alternatively, they may use the fact that grid lines are parallel and use what they know about the angles where a transverse meets a pair of parallel lines.
- Lesson 11: What We Mean by an Equation of a Line - Prior to this lesson, students have seen that right triangles with a horizontal side, a vertical side, and a long side along the same line are all similar. This activity exploits this structure to examine the coordinates of points lying on a particular line. The discussion then produces an equation for the line. In the case where the line goes through (0,0), the equation will be familiar from prior work with proportional relationships but in the next lesson, similar triangles will be essential.

RESOURCES

Teacher Resources:

- Illustrative Math (IM) Unit 8.2
- IM Student Workbook
- IM Blackline Masters
- Khan Academy IM Unit 8.2 Companion

Equipment Needed:

- Manipulatives
- IM Student Workbooks
- Student Whiteboards
- Chart Paper
- Dry Erase Markers
- Online Approved Digital Resources
- Chromebooks
- Bags, resealable plastic, or envelopes.
- Geometry Toolkit: rulers, graph paper, pattern blocks, straightedges, colored pencils, index cards, patty paper or tracing paper, pencil boxes, and scissors.

UNIT 3 OVERVIEW

Content Area: Mathematics

Unit Title: Linear Relationships

Target Course/Grade Level: Pre-Algebra/Grade 8

Unit Summary: In this unit, students learn to understand and use the terms "rate of change," "linear relationship," and "vertical intercept." They deepen their understanding of slope, and they learn to recognize connections among rate of change, slope, and constant of proportionality, and between linear and proportional relationships. They learn to understand that lines with the same slope are translations of each other. They represent linear relationships with tables, equations, and graphs that include lines with negative slopes or vertical intercepts, and horizontal and vertical lines. They learn to use the term "solution of an equation" when working with one or two linear equations in two variables and learn to understand the graph of a linear equation as the set of its solutions. Students use these terms and representations in reasoning about situations involving one or two constant rates.

Approximate Length of Unit: 5 weeks

LEARNING TARGETS

NJ Student Learning Standards:

8.G.A.1 Verify experimentally the properties of rotations, reflections, and translations

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.

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.

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

a. 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.

Career Readiness, Life Literacies, and Key Skills:

9.2.8.CAP.1 Identify offerings such as high school and county career and technical school courses, apprenticeships, military programs, and dual enrollment courses that support career or occupational areas of interest.

9.2.8.CAP.3 Explain how career choices, educational choices, skills, economic conditions, and personal behavior affect income.

9.4.8.CI.1 Assess data gathered on varying perspectives on causes of climate change (e.g., crosscultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions.

9.4.8.CT.2 Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option.
9.4.8.TL.2 Gather data and digitally represent information to communicate a real-world problem.

Interdisciplinary Connections and Standards:
ELA
L.SS.8.1 Demonstrate command of the system and structure of the English language when writing or speaking.
RI.CR.8.1 Cite a range of textual evidence and make clear and relevant connections (including informational text features such as charts, graphs, and diagrams) that strongly support an analysis of multiple aspects of what an informational text says explicitly, as well as inferences drawn from the text.
RI.CI.8.2 Determine a central idea of an informational text and how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.
W.IW.8.2 Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
SL.PE.8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.
Science
MS-PS1-5 Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.

Unit Understandings:
Students will understand that…

- Utilizing linear relationships and their representations helps them make sense of and solve problems.
- The rate of change is a way to describe the rate per 1 in a linear relationship and is utilized to determine the numerical value of the slope of a line.
- There is a relationship between the coordinates of points on a graph and the solution of an equation.

Unit Essential Questions:

- What do the variables m and b in the linear equation $y = mx + b$ represent?
- How can the unit rate of a proportional relationship be identified from the graph of the equation?
- Why do we graph linear equations, and what does the line represent?
- What is a real-life situation you can apply using the slope-intercept formula?

Knowledge and Skills:
Students will know...

- How to represent
    - situations involving proportional relationships.
    - constants of proportionality in different ways.
    - slope using expressions.
    - linear relationships using graphs, tables, equations, and verbal descriptions.
    - situations using negative slopes and slopes of zero.
    - situations by graphing lines and writing equations.
    - situations involving linear relationships.
- How to generalize
    - categories for graphs.
    - about equations and linear relationships.
    - in order to make predictions about the slope of lines.

- How to explain
    - how to graph proportional relationships.
    - how to use a graph to determine information about a linear situation.
    - how to graph linear relationships.
    - how slope relates to changes in a situation.
- Vocabulary: constant of proportionality, rate of change, linear relationship, slope, vertical intercept, and solution to an equation with two variables.

Students will be able to...

- Create an equation and a graph to represent proportional relationships, including an appropriate scale and axes.
- Interpret multiple representations of a proportional relationship in context.
- Create and compare graphs that represent linear relationships with the same rate of change but different initial values.
- Create an equation that represents a linear relationship.
- Interpret the slope and y-intercept of the graph of a line in context.
- Create multiple representations of a linear relationship, including a graph, equation, and table.
- Interpret the slope of a non-increasing line in context.
- Determine pairs of values that satisfy or do not satisfy a linear relationship using an equation or graph.

EVIDENCE OF LEARNING

Assessment:

What evidence will be collected and deemed acceptable to show that students truly "understand"?

- End of Unit Common Assessment - See folder for assessment links.
- Warm-Ups
- Cool Downs
- Section Checkpoints
- Practice Sets
- Renaissance Star Math Diagnostic Assessment – Fall, Winter, Spring

Learning Activities:

What differentiated learning experiences and instruction will enable all students to achieve the desired results?

- Lesson 2: Card Sort: Proportional Relationships - The purpose of this activity is for students to identify the same proportional relationship graphed using different scales. Students will first sort the cards based on what proportional relationship they represent and then write an equation representing each relationship. Identify and select groups using different strategies to match graphs to share during the Activity Synthesis. For example, some groups may identify the unit rate for each graph in order to match while others may choose to write equations first and use those to match their graphs.
- Lesson 3: Info Gap: Proportional Relationships - This info gap activity allows students to determine and request the information needed when working with proportional relationships. To graph the relationship and the requested information, students need to think carefully about how they can scale the axes.
- Lesson 6: Slopes, Vertical, Intercepts, and Graphs - This task focuses on interpreting the slope of a graph and where it crosses the y-axis in context. Students are given cards describing situations

with a given rate of change and cards with graphs. Students match each graph with a situation it could represent, and then use the context to interpret the meaning of the slope. They find where the line crosses the vertical axis, i.e., the vertical intercept, and interpret its meaning in each situation. They also decide if the two quantities in each situation are in a proportional relationship.

- Lesson 8: Translating a Line - This activity further examines parallel lines, including situations where the y-intercept is negative. In addition, students match lines represented in many different ways including graphically, verbal description, table of values, and equations.
- Lesson 10: Making Designs - The goal of this activity is for students to recognize information that determines the location of a line in the coordinate plane, and to practice distinguishing between positive and negative slopes. In this activity, one partner has a design that they verbally describe to their partner, who then tries to draw it. The purpose of this activity is to provide an environment where students have to describe or interpret the slope and locations of several lines. (Students are not expected to communicate by saying the equations of the lines, though there is nothing stopping them from doing so.) Students take turns describing and interpreting by doing this two times with two different designs.
- Lesson 13: I'll Take and X, Please - Students are given linear equations—some of which represent proportional relationships—in various forms and are also given solutions to their partner's equations in the form of coordinates of a point. The student with the equation decides which quantity they would like to know, x or y, and requests this information from their partner. They then solve for the other quantity. The activity reinforces the concept that solutions to equations with two variables are a pair of numbers, and that knowing one can give you the other by using the value you know and solving the equation. Students also have a chance to think about the most efficient way to find solutions for equations in different forms.

RESOURCES

Teacher Resources:

- Illustrative Math (IM) Unit 8.3
- IM Student Workbook
- IM Blackline Masters
- Khan Academy IM Unit 8.3 Companion

Equipment Needed:

- Manipulatives
- IM Student Workbooks
- Student Whiteboards
- Chart Paper
- Dry Erase Markers
- Online Approved Digital Resources
- Chromebooks
- Bags, resealable plastic, or envelopes.
- Geometry Toolkit: rulers, graph paper, pattern blocks, straightedges, colored pencils, index cards, patty paper or tracing paper, pencil boxes, and scissors.

UNIT 4 OVERVIEW

Content Area: Mathematics

Unit Title: Linear Equations and Linear Systems

Target Course/Grade Level: Pre-Algebra/Grade 8

Unit Summary: In this unit, students write and solve linear equations in one variable. These include equations in which the variable occurs on both sides of the equal sign, and equations with no solutions, exactly one solution, and infinitely many solutions. They learn that any one such equation is false, true for one value of the variable, or true for all values of the variable. They interpret solutions in the contexts from which the equations arose. Students write and solve systems of linear equations in two variables and interpret the solutions in the contexts from which the equations arose. They learn what is meant by a solution for a system of equations, namely that a solution of the system is a solution for each equation in the system. Students use the understanding that each pair of values that make an equation true are coordinates of a point on the graph of the equation and conversely that the coordinates of each point on the graph of an equation make the equation true. Thus, a pair of values that satisfies a system of equations are coordinates of a point that lies on the graphs of all the equations in the system, and, conversely, a point that lies on the graphs of all the equations in the system has coordinates that satisfy all the equations in the system. Students learn to understand and use the terms "system of equations," "solution for the system of equations," "zero solutions," "no solution," "one solution," and "infinitely many solutions."

Approximate Length of Unit: 5 weeks

LEARNING TARGETS

NJ Student Learning Standards:

8.EE.C.7 Solve linear equations in one variable.

a. 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).

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

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

a. 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.

b. Solve systems of two linear equations in two variables using the substitution method and estimate solutions by graphing the equations. Solve simple cases by inspection. For example: by inspection, conclude that $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6. Solve $3x + y = 30$ and $y = 2x$ using the substitution method; Solve $y = 3x + 1$ and $y = -2x + 7$ using the substitution method.

c. 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.

Career Readiness, Life Literacies, and Key Skills:

9.2.8.CAP.1 Identify offerings such as high school and county career and technical school courses, apprenticeships, military programs, and dual enrollment courses that support career or occupational areas of interest.

9.2.8.CAP.3 Explain how career choices, educational choices, skills, economic conditions, and personal behavior affect income.

9.4.8.CI.1 Assess data gathered on varying perspectives on causes of climate change (e.g., crosscultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions.

9.4.8.CT.2 Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option.

9.4.8.TL.2 Gather data and digitally represent information to communicate a real-world problem.

Interdisciplinary Connections and Standards:

ELA

L.SS.8.1 Demonstrate command of the system and structure of the English language when writing or speaking.

RI.CR.8.1 Cite a range of textual evidence and make clear and relevant connections (including informational text features such as charts, graphs, and diagrams) that strongly support an analysis of multiple aspects of what an informational text says explicitly, as well as inferences drawn from the text.

RI.CI.8.2 Determine a central idea of an informational text and how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.

W.IW.8.2 Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

SL.PE.8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.

Science

MS-PS1-5 Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.

Unit Understandings:

Students will understand that…

- Linear equations represent proportional relationships between variables and are connected to ratios and rates with lines and triangles.
- Writing and solving equations can be completed in a variety of ways and there are multiple approaches to reaching the same solution.
- Given descriptions of real-world situations, they can write and solve linear equations in one variable, interpreting solutions in the contexts from which the equations arose.

Unit Essential Questions:

- How do you use patterns to understand mathematics and model situations?
- How do algebraic representations relate and compare to one another?
- How can we communicate and generalize algebraic relationships?
- How are the horizontal and vertical axes related?

Knowledge and Skills:
Students will know...

- How to critique
    - strategies for solving puzzles.
    - reasoning about maintaining balance in equations.
    - solutions of linear equations.
    - reasoning about structures of systems of equations.
    - explanations of solutions.
- How to justify
    - strategies for solving puzzles.
    - predictions about maintaining balance.
    - predictions about solutions of linear equations.
- How to generalize
    - about the structures of equations that have one, infinite, and no solutions.
    - about the structures of systems of equations.
- Vocabulary: term, constant term, coefficient, and system of equations.

Students will be able to...

- Write equivalent equations and describe the moves that are used.
- Write equivalent equations to solve linear equations in one variable.
- Describe features of linear equations that have one solution, no solution, or many solutions.
- Interpret the solution of an equation in one variable in context.
- Categorize systems of equations, including systems with infinitely many or no solutions, and calculate the solution for a system using a variety
- of strategies.
- Comprehend that solving a system of equations means finding values of the variables that make both equations true at the same time.
- Create a system of equations that represents a situation and interpret the solution in context.

EVIDENCE OF LEARNING

Assessment:
What evidence will be collected and deemed acceptable to show that students truly "understand"?

- End of Unit Common Assessment - See folder for assessment links.
- Warm-Ups
- Cool Downs
- Section Checkpoints
- Practice Sets
- Renaissance Star Math Diagnostic Assessment – Fall, Winter, Spring

Learning Activities:
What differentiated learning experiences and instruction will enable all students to achieve the desired results?

- Lesson 1: Making a Puzzle - In this task, students create their own number puzzle to trade with a partner to solve. The purpose of this task is for students to practice writing and solving multi-step number puzzles and compare their representations with the representations of others to decide which is more efficient. While these problems are phrased using the words "number puzzle," it is important to note the mathematical work students are doing here thinking about, creating, and

solving situations that are, essentially, linear equations in one variable, even if not all students are using equations to represent them.

- Lesson 3: Matching Equation Moves - In this activity, students match a card with two equations to another card describing the move that turns the first equation into the second. The goal is to help students think about equations the same way they have been thinking about hangers: objects where equality is maintained so long as the same move is made on each side. Additionally, this is the first activity where students encounter equation moves involving negative numbers, which is not possible when using hangers.
- Lesson 5: Trading Moves - The goal of this activity is for students to build fluency in solving equations with variables on each side. Students describe each step in their solution process to a partner and justify how each of their changes maintains the equality of the two expressions.
- Lesson 7: Thinking About Solutions - Students who pause to think about the structure of a complex equation before taking steps to solve it can find the most efficient solution paths and, sometimes, notice that there is no single solution to be found. The goal of this lesson is to encourage students to make this pause part of their routine and to build their skill at understanding and manipulating the structure of equations through the study of two special types of equations: ones that are always true and ones that are never true.
- Lesson 8: Thinking About Solutions Some More - In this activity, students solve a variety of equation types; both in form and number of solutions. After solving the 10 equations, groups sort them into categories of their choosing. The goal of this activity is to encourage students to look at the structure of equations before solving them and to build fluency in solving complex equations. For example, students who notice that equation D, $3 - 4x + 5 = 2(8 - 2x)$, has the same number of x's on each side but a different constant know that there are no values of x that make the equation true. Similarly, equation J has the same number of x's on each side and the same constants on each side, meaning that all values of x make the equation true. These up-front observations allow students to avoid spending time working out the steps to re-write the equation into a simpler form where the number of solutions to the equations is easier to see.
- Lesson 13: Different Types of Systems - While students have encountered equations with different numbers of solutions in earlier activities, this is the first activity where students connect systems of equations with their previous thinking about equations that have no solution, one solution, or infinitely many solutions. The purpose of this activity is for students to connect the features of the graph of the equations of a system to the number of solutions of a system. While students are not asked to solve the systems of equations, they may choose to rewrite the equations in equivalent forms as they work to graph the lines.
- Lesson 15: Info Gap: Racing and Play Tickets - In this activity, students have an opportunity to apply what they know about systems of linear equations to solve a problem in a real-world situation. One equation for each situation is given. Students may choose to write another equation to create a system that represents the constraints in the problem, and then solve the system algebraically or by graphing. Another possible strategy would be to pull quantities out of the given equation and solve the problem arithmetically. Monitor for students who use each of these strategies to share during the whole-class discussion.

RESOURCES

Teacher Resources:

- Illustrative Math (IM) Unit 8.4
- IM Student Workbook
- IM Blackline Masters
- Khan Academy IM Unit 8.4 Companion

Equipment Needed:

- Manipulatives
- IM Student Workbooks
- Student Whiteboards
- Chart Paper
- Dry Erase Markers
- Online Approved Digital Resources
- Chromebooks
- Bags, resealable plastic, or envelopes.
- Geometry Toolkit: rulers, graph paper, pattern blocks, straightedges, colored pencils, index cards, patty paper or tracing paper, pencil boxes, and scissors.

UNIT 5 OVERVIEW

Content Area: Mathematics

Unit Title: Functions and Volume

Target Course/Grade Level: Pre-Algebra/Grade 8

Unit Summary: In this unit, students are introduced to the concept of a function. They learn to understand and use the terms "input," "output," and "function," e.g., "temperature is a function of time." They describe functions as increasing or decreasing between specific numerical inputs, and they consider the inputs of a function to be values of its independent variable and its outputs to be values of its dependent variable. They use tables, equations, and graphs to represent functions, and describe information presented in tables, equations, or graphs in terms of functions. In working with linear functions, students coordinate and synthesize their understanding of "constant of proportionality", "rate of change" and "slope", and increasing and decreasing. Students perceive similarities in structure between pairs of known and new volume formulas: for a rectangular prism and a cylinder; and for a cylinder and a cone. Students rearrange these formulas to show functional relationships and use them to reason about how the volume of a figure changes as another measurement changes, e.g., the height of a cylinder is proportional to its volume; if the radius of a cylinder triples, its volume becomes nine times larger.

Approximate Length of Unit: 6 weeks

LEARNING TARGETS

NJ Student Learning Standards:

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.

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.

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. 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.

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.

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.

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.

Career Readiness, Life Literacies, and Key Skills:

9.2.8.CAP.1 Identify offerings such as high school and county career and technical school courses, apprenticeships, military programs, and dual enrollment courses that support career or occupational areas of interest.

9.2.8.CAP.3 Explain how career choices, educational choices, skills, economic conditions, and personal behavior affect income.

9.4.8.CI.1 Assess data gathered on varying perspectives on causes of climate change (e.g., crosscultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions.

9.4.8.CT.2 Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option.

9.4.8.TL.2 Gather data and digitally represent information to communicate a real-world problem.

Interdisciplinary Connections and Standards:

ELA

L.SS.8.1 Demonstrate command of the system and structure of the English language when writing or speaking.

RI.CR.8.1 Cite a range of textual evidence and make clear and relevant connections (including informational text features such as charts, graphs, and diagrams) that strongly support an analysis of multiple aspects of what an informational text says explicitly, as well as inferences drawn from the text.

RI.CI.8.2 Determine a central idea of an informational text and how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.

W.IW.8.2 Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

SL.PE.8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.

Science

MS-PS1-5 Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.

Unit Understandings:

Students will understand that…

- A function is a relationship between inputs and outputs, meaning that each input results in exactly one output.
- Functions can be represented in a real-world situation in several ways, including identifying tables, equations, and graphs.
- Linear functions model relationships between quantities and provide information about graphs and other representations.
- Finding the volume of a three-dimensional figure can help them solve real-world problems.

Unit Essential Questions:

- What do the variables m and b in the linear equation $y = mx + b$ represent?
- How can the unit rate of a proportional relationship be identified from the graph of the equation?
- Why do we graph linear equations, and what does the line represent?
- What is a real-life situation you can apply using the slope-intercept formula?
- What is a linear function?

Knowledge and Skills:
Students will know...

- How to generalize
    - about what happens to inputs for each rule.
    - about dimensions of cylinders.
    - about the relationship between the volumes of cylinders and cones.
    - about dimensions of cones.
    - about volumes of spheres, cones, and cylinders as functions of their radii.
- How to justify
    - claims about what can be determined from given information.
    - claims about volumes of cubes and spheres based on graphs.
    - claims about approximately linear relationships.
    - reasoning about the volumes of spheres and cones.
- How to compare
    - different representations of functions.
    - features of graphs, equations, and situations.
    - features of a situation with features of a graph.
    - temperatures are shown on a graph with different temperatures given in a table.
    - the volumes of cones with the volumes of cylinders.
    - methods for finding and approximating the volume of a sphere as a function of its radius.
- Vocabulary: function, independent variable, dependent variable, radius, volume, cylinder, cone, and sphere.

Students will be able to...

- Comprehend the structure of a function as having one and only one output for each allowable input.
- Draw the graph of a function that represents a content, and explain which quantity is a function of which.
- Interpret multiple representations of functions, including graphs, tables, and equations, and explain how to find information in each type of representation.
- Calculate the different rates of change of a piecewise linear function using a graph, and interpret the rates of change in context.
- Comprehend that any linear function can be represented by an equation in the form $y = mx + b$, where ms and b are the rate of change and initial value of the function, respectively,
- Calculate the value of one dimension of a cylinder or cone, and explain the reasoning.
- Calculate the volume of a cylinder or cone.
- Calculate the volume of a sphere.
- Solve problems involving cones, cylinders, and spheres.

EVIDENCE OF LEARNING

Assessment:
What evidence will be collected and deemed acceptable to show that students truly "understand"?

- End of Unit Common Assessment - See folder for assessment links.
- Warm-Ups
- Cool Downs
- Section Checkpoints

- Practice Sets
- Renaissance Star Math Diagnostic Assessment – Fall, Winter, Spring

Learning Activities:
What differentiated learning experiences and instruction will enable all students to achieve the desired results?

- Lesson 1: Guess My Rule - The purpose of this activity is to introduce the idea of input-output rules. One student chooses inputs to tell a partner who uses a rule written on a card only they can see to respond with the corresponding output. The first student then guesses the rule on the card once they think they have enough input-output pairs to know what it is. Partners then reverse roles.
- Lesson 3: Dimes and Quarters - The purpose of this activity is to introduce the idea of input-output rules. One student chooses inputs to tell a partner who uses a rule written on a card only they can see to respond with the corresponding output. The first student then guesses the rule on the card once they think they have enough input-output pairs to know what it is. Partners then reverse roles.
- Lesson 6: Sketching a Story about a Boy and a Bike - The purpose of this task is for students to sketch a graph from a story. In order to make the sketch, students must select two quantities from the story to graph, decide which is the independent variable and which is the dependent variable, and create and label their axes based on their decisions.
- Lesson 8: Is it Filling Up or Draining Out? - The purpose of this activity is to connect features of an equation representing a function to what that means in a context. Students start with two functions that represent a tank being filled up and another being drained out and are asked to determine which equations represent which situation. This gives students the opportunity to connect initial value and slope, which they learned about in a previous unit, to the general form of the linear equation and to the fact that linear relationships are functions.
- Lesson 12: What's Your Estimate? - The purpose of this activity is for students to practice using precise language to describe how they estimated volumes of objects. Starting from an object of known volume, students must consider the difference in dimensions between the two objects. The focus here is on strategies to estimate the volume and units of measure used, not on exact answers or calculating volume using a formula.
- Lesson 16: Number Talk: Thirds - The purpose of this number talk is to elicit understanding and review strategies students have for finding the unknown value in an equation that involves the fraction ⅓. These understandings will be helpful later in this lesson when students are solving for the unknown length of the radius or height of a cone given its volume.
- Lesson 21: Info Gap: Unknown Dimensions - In this info gap activity, students determine and request the information needed to answer questions related to volume equations of cylinders, cones, and spheres.

RESOURCES

Teacher Resources:

- Illustrative Math (IM) Unit 8.5
- IM Student Workbook
- IM Blackline Masters
- Khan Academy IM Unit 8.5 Companion

Equipment Needed:

- Manipulatives
- IM Student Workbooks
- Student Whiteboards
- Chart Paper
- Dry Erase Markers
- Online Approved Digital Resources
- Chromebooks
- Bags, resealable plastic, or envelopes.
- Geometry Toolkit: rulers, graph paper, pattern blocks, straightedges, colored pencils, index cards, patty paper or tracing paper, pencil boxes, and scissors.

UNIT 6 OVERVIEW

Content Area: Mathematics

Unit Title: Association in Data

Target Course/Grade Level: Pre-Algebra/Grade 8

Unit Summary: In this unit, students generate and work with bivariate data sets that has more variability than in previous units. They learn to understand and use the terms "scatter plot" and "association," and describe associations as "positive" or "negative" and "linear" or "non-linear." Students describe scatter plots, using a term previously used to describe univariate data "cluster," and the new term "outlier." They fit lines to scatter plots and informally assess their goodness of fit by judging the closeness of the data points to the lines, and compare predicted and actual values. Students learn to understand and use the terms "two-way table," "bar graph," and "segmented bar graph," using two-way tables to investigate categorical data.

Approximate Length of Unit: 4 weeks

LEARNING TARGETS

NJ Student Learning Standards:

8.SP.A.1 Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.

8.SP.A.2 Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit (e.g. line of best fit) by judging the closeness of the data points to the line.

8.SP.A.3 Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.

8.SP.A.4 Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. For example, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?

Career Readiness, Life Literacies, and Key Skills:

9.2.8.CAP.1 Identify offerings such as high school and county career and technical school courses, apprenticeships, military programs, and dual enrollment courses that support career or occupational areas of interest.

9.2.8.CAP.3 Explain how career choices, educational choices, skills, economic conditions, and personal behavior affect income.

9.4.8.CI.1 Assess data gathered on varying perspectives on causes of climate change (e.g., crosscultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions.
9.4.8.CT.2 Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option.
9.4.8.TL.2 Gather data and digitally represent information to communicate a real-world problem.

Interdisciplinary Connections and Standards:
ELA
L.SS.8.1 Demonstrate command of the system and structure of the English language when writing or speaking.
RI.CR.8.1 Cite a range of textual evidence and make clear and relevant connections (including informational text features such as charts, graphs, and diagrams) that strongly support an analysis of multiple aspects of what an informational text says explicitly, as well as inferences drawn from the text.
RI.CI.8.2 Determine a central idea of an informational text and how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.
W.IW.8.2 Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
SL.PE.8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.
Science
MS-PS1-5 Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.
MS-PS4-1 Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.

Unit Understandings:
Students will understand that…

- Constructing scatter plots for bivariate data and identifying and interpreting data patterns (clustering, outliers, positive or negative association, possible lines of best fit, and nonlinear association).
- Constructing frequency/relative frequency tables to analyze and describe possible associations between two variables.
- Bivariate data has two variables, and graphs such as scatter plots can be useful for displaying and analyzing this type of data. The conclusions made from the data depend on how it is represented and summarized.
- Tables and graphs of functions allow for conclusions to be drawn about their rate of change, intercepts, etc.

Unit Essential Questions:

- What is bivariate data and how can displaying this type of data be useful?
- How can an equation with variables on both sides be used to solve real-world problems?
- How do we use the graph of systems of equations to determine the solution(s)?
- How can real-world problems be solved by using a system of equations?
- How can scatter plots and two-way tables be used to describe the relationship between bivariate data?

Knowledge and Skills:
Students will know...

- How to explain
  - how to estimate using available data.
  - how to use tables and scatter plots to make estimates and predictions.
  - the meaning of slope for a situation.
  - how to use lines to show associations, identify outliers, and answer questions.
- How to represent
  - data in organized ways.
  - data using two-way tables, bar graphs, and segmented bar graphs.
  - data using scatter plots.
- How to interpret
  - situations and graphs involving bivariate data.
  - tables and scatter plots of bivariate data.
  - tables, scatter plots, equations, and situations involving bivariate data.
- Vocabulary: scatter plot, outlier, positive association, negative association, independent variable, dependent variable, segmented bar graph, relative frequency, and two-way (frequency) table.

Students will be able to...

- Create a scatter plot from a table of data, and describe the trend of the data.
- Interpret a point on a scatter plot in context.
- Describe the relationship between two variables using a line fit to data on a scatter plot.
- Draw a linear model to fit data in a scatter plot, and describe features of a line that fits data well.
- Interpret features of data on a scatter plot including linear and non-linear associations, outliers, slope of a linear model, and clustering.
- Calculate relative frequencies, and describe associations between variables using a relative frequency table.
- Create a two-way table and a segmented bar graph that represent relative frequencies, and interpret the frequencies in context.

EVIDENCE OF LEARNING

Assessment:
What evidence will be collected and deemed acceptable to show that students truly "understand"?

- End of Unit Common Assessment - See folder for assessment links.
- Warm-Ups
- Cool Downs
- Section Checkpoints
- Practice Sets
- Renaissance Star Math Diagnostic Assessment – Fall, Winter, Spring

Learning Activities:
What differentiated learning experiences and instruction will enable all students to achieve the desired results?

- Lesson 2: Gathering Data - Data collection is an important part of any statistics unit. Here, students collect data about a partner using the appropriate tools and submit the data for future use.
- Lesson 5: Fitting Lines - In this activity, students draw their own linear model to fit the data in a scatter plot. In one scatter plot, the data points are nearly linear, and in another, there is much

more variation in the data. A discussion follows about what makes some lines a better fit than others.

- Lesson 8: Animal Brains - All of the information from this section about scatter plots comes into play as students analyze data about animal body and brain weights. Students begin with a table of data and create a scatter plot. After seeing the scatter plot, students pick out any outliers and fit a line to the scatter plot. Finally, the slope of the line is estimated and its meaning is interpreted in context.
- Lesson 9: Card Sort; Matching Representations - In this activity, students become familiar with two-way tables, clustered bar graphs, and segmented bar graphs by matching different situations. They label the diagrams to match the data given and create a table to match the data shown in one of the bar graphs.
- Lesson 11: Measuring 30 Seconds - Students practice using the methods they have learned. Students begin by collecting data in small groups and then analyzing the data for the entire class. They create a scatter plot and two-way tables to look for patterns in the data. Although it is expected there is a very weak if any, association in the data, the discussion asks students to think about what it would mean if there were a positive or negative association in context.

RESOURCES

Teacher Resources:

- Illustrative Math (IM) Unit 8.6
- IM Student Workbook
- IM Blackline Masters
- Khan Academy IM Unit 8.6 Companion

Equipment Needed:

- Manipulatives
- IM Student Workbooks
- Student Whiteboards
- Chart Paper
- Dry Erase Markers
- Online Approved Digital Resources
- Chromebooks
- Bags, resealable plastic, or envelopes.
- Geometry Toolkit: rulers, graph paper, pattern blocks, straightedges, colored pencils, index cards, patty paper or tracing paper, pencil boxes, and scissors.

UNIT 7 OVERVIEW

Content Area: Mathematics

Unit Title: Exponents and Scientific Notation

Target Course/Grade Level: Pre-Algebra/Grade 8

Unit Summary: The first section of the unit begins with a lesson that reviews exponential expressions, including work with exponential expressions with bases 2 and ½. Students examine powers of 10. After working with these powers of 10, they consider what the value of 10^0 should be and define 10^0 to be 1. The students expand their work to numerical bases other than 10, using exponent rules with products of exponentials with the same base and contrasting it with products of exponentials with different bases. They note numerical instances of $a^n * b^n = (a \cdot b)^n$. The next section of the unit returns to powers of 10 as a prelude to the introduction of scientific notation. Students consider differences in the magnitude of powers of 10 and use powers of 10 and multiples of powers of 10 to describe magnitudes of quantities, e.g., the distance from Earth to the Sun or the population of Russia. In the remaining section, students write estimates of quantities in terms of integer or non-integer multiples of powers of 10 and use their knowledge of exponential expressions to solve problems, e.g., How many meter sticks does it take to equal the mass of the Moon? They compute sums, differences, products, and quotients of numbers written in scientific notation (some with as many as four significant figures), using such calculations to estimate quantities. They make measurement conversions that involve powers of ten, e.g., converting bytes to kilobytes or gigabytes, choosing appropriate units for measurements, and expressing them in scientific notation.

Approximate Length of Unit: 5 weeks

LEARNING TARGETS

NJ Student Learning Standards:

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.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 3×10^8 and the population of the world as 7×10^9, and determine that the world population is more than 20 times larger.

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.

Career Readiness, Life Literacies, and Key Skills:

9.2.8.CAP.1 Identify offerings such as high school and county career and technical school courses, apprenticeships, military programs, and dual enrollment courses that support career or occupational areas of interest.

9.2.8.CAP.3 Explain how career choices, educational choices, skills, economic conditions, and personal behavior affect income.
9.4.8.CI.1 Assess data gathered on varying perspectives on causes of climate change (e.g., crosscultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions.
9.4.8.CT.2 Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option.
9.4.8.TL.2 Gather data and digitally represent information to communicate a real-world problem.

Interdisciplinary Connections and Standards:
ELA
L.SS.8.1 Demonstrate command of the system and structure of the English language when writing or speaking.
RI.CR.8.1 Cite a range of textual evidence and make clear and relevant connections (including informational text features such as charts, graphs, and diagrams) that strongly support an analysis of multiple aspects of what an informational text says explicitly, as well as inferences drawn from the text.
RI.CI.8.2 Determine a central idea of an informational text and how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.
W.IW.8.2 Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
SL.PE.8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.
Science
MS-PS1-5 Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.
MS-PS4-1 Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.

Unit Understandings:
Students will understand that…
- Integer exponents can be used to represent very small or very large numerical values.
- Extremely small and large numbers can be displayed using integer exponents or conceptually scientific notation.
- Applying properties of integer exponents to simplify and write equivalent numerical expressions.
- Utilizing scientific notation to estimate and express the values of very large or very small numbers and compare their values.
- Performing operations with numbers written in scientific notation.

Unit Essential Questions:
- When can you apply integer exponents to real-world situations?
- Why is it useful to use scientific notation?
- What is the result of a base having a positive, a negative, or a zero exponent?

Knowledge and Skills:
Students will know...
- How to critique
  - reasoning about powers of powers.
  - reasoning about zero exponents.
  - applications of exponent rules.
  - reasoning about scientific notation.

- How to represent
    - situations using exponents.
    - large and small numbers using number lines, exponents, and decimals.
    - situations comparing quantities expressed in scientific notation.
- How to justify
    - reasoning about multiplying powers of 10.
    - reasoning about powers of powers.
    - reasoning about dividing powers of 10.
    - whether or not expressions are equivalent to exponential expressions.
    - reasoning about situations comparing powers of 10.
- Vocabulary: exponent, base (of an exponent), reciprocal, and scientific notation.

Students will be able to...

- Use exponent rules to generate equivalent numerical expressions for powers of 10.
- Use exponent rules to generate equivalent numerical expressions for expressions with different bases and bases other than 10.
- Compare very large or very small quantities expressed as a multiple of a power of 10.
- Use exponent rules and power of 10 to solve problems in context.
- Calculate with numbers in scientific notation and interpret them in context.
- Identify numbers written in scientific notation, including scientific notation that has been generated by technology.

EVIDENCE OF LEARNING

Assessment:

What evidence will be collected and deemed acceptable to show that students truly "understand"?

- End of Unit Common Assessment - See folder for assessment links.
- Warm-Ups
- Cool Downs
- Section Checkpoints
- Practice Sets
- Renaissance Star Math Diagnostic Assessment – Fall, Winter, Spring

Learning Activities:

What differentiated learning experiences and instruction will enable all students to achieve the desired results?

- Lesson 1: Broken Coin - The broken coin prompts students to think about repeated division, laying the foundation for later work on negative exponents. Understanding repeated division by 2 as being equivalent to repeated multiplication by ½ will later allow students to make sense of negative exponents.
- Lesson 3: Big Cube - The purpose of this warm-up is to introduce students to the idea of raising a value with an exponent to another power. Computing the volume of a cube whose side lengths are themselves powers of 10 introduces the basic structure of power to a power, which will lead to a general exponent rule during later activities.
- Lesson 4: Zero Exponent - Students extend exponent rules to discover why it makes sense to define 10^0 as 1. Students create viable arguments and critique the reasoning of others when discussing the argument that 10^0 should be 0.

- Lesson 7: Exponent Rule Practice - This activity develops procedural fluency with exponent rules and encourages students to think about their own learning. Students choose 6 of 12 possible problems to solve, thereby identifying problems that they consider more difficult versus less difficult. Notice which problems students choose more than others, and which problems are skipped more than others. The first set of problems checks whether students can apply the exponent rules procedurally. The next set of problems checks whether students understand what negative exponents mean. The last set of problems asks students to evaluate exponents to check whether they understand the meaning of the zero exponent and the definition of exponents as repeated multiplication (by the base, or by the reciprocal of the base in the case of negative exponents).
- Lesson 10: The Speed of Light - This activity guides students to think in terms of scientific notation while investigating the properties of light. A number line that shows a power of 10 partitioned into 10 equal intervals is again used to illustrate the base-ten structure. Plotting numbers along it gives a clearer meaning to expressions that are a product of a single digit and a power of 10.
- Lesson 12: Meter Sticks to the Moon - The large quantities involved in these questions lend themselves to arithmetic with powers of 10, giving students the opportunity to make use of scientific notation before it is formally introduced. This activity was designed so students could practice modeling skills such as identifying essential features of the problem and gathering the required information. Students use powers of 10 and the number line as tools to make it easier to calculate and interpret results.
- Lesson 14: Info Gap: Distances in the Solar System - In this info gap activity, students continue to use scientific notation as a tool for working with small and large numbers—to describe quantities, make estimates, and make comparisons (e.g., to express how many times as much one is as the other).

RESOURCES

Teacher Resources:

- Illustrative Math (IM) Unit 8.7
- IM Student Workbook
- IM Blackline Masters
- Khan Academy IM Unit 8.7 Companion

Equipment Needed:

- Manipulatives
- IM Student Workbooks
- Student Whiteboards
- Chart Paper
- Dry Erase Markers
- Online Approved Digital Resources
- Chromebooks
- Bags, resealable plastic, or envelopes.
- Geometry Toolkit: rulers, graph paper, pattern blocks, straightedges, colored pencils, index cards, patty paper or tracing paper, pencil boxes, and scissors.

UNIT 8 OVERVIEW

Content Area: Mathematics

Unit Title: Pythagorean Theorem and Irrational Numbers

Target Course/Grade Level: Pre-Algebra/Grade 8

Unit Summary: In this unit, students work with geometric and symbolic representations of square and cube roots. They understand and use notation such as $\sqrt{2}$ and $\sqrt[3]{5}$ for square and cube roots. They understand the terms "rational number" and "irrational number," using long division to express fractions as decimals. They use their understanding of fractions to plot rational numbers on the number line and their understanding of approximation of irrationals by rationals to approximate the number-line location of a given irrational. Students learn (without proof) that $\sqrt{2}$ is irrational. They understand two proofs of the Pythagorean Theorem—an algebraic proof that involves manipulation of two expressions for the same area and a geometric proof that involves decomposing and rearranging two squares. They use the Pythagorean Theorem in two and three dimensions, e.g., to determine lengths of diagonals of rectangles and right rectangular prisms, and to estimate distances between points in the coordinate plane.

Approximate Length of Unit: 5 weeks

LEARNING TARGETS

NJ Student Learning Standards:

8.NS.A.1 Know that there are numbers that are not rational, and approximate them by rational numbers. 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.

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., π^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.

8.EE.A.2 Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number.

a. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.

b. Simplify numerical radicals, limiting to square roots (i.e. non perfect squares). For example, simplify $\sqrt{8}$ to $2\sqrt{2}$.

8.G.B.6 Explain a proof of the Pythagorean Theorem and its converse.

8.G.B.7 Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real world and mathematical problems in two and three dimensions.

8.G.B.8 Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

Career Readiness, Life Literacies, and Key Skills:

9.2.8.CAP.1 Identify offerings such as high school and county career and technical school courses, apprenticeships, military programs, and dual enrollment courses that support career or occupational areas of interest.

9.2.8.CAP.3 Explain how career choices, educational choices, skills, economic conditions, and personal behavior affect income.

9.4.8.CI.1 Assess data gathered on varying perspectives on causes of climate change (e.g., crosscultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions.

9.4.8.CT.2 Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option.

9.4.8.TL.2 Gather data and digitally represent information to communicate a real-world problem.

Interdisciplinary Connections and Standards:

ELA

L.SS.8.1 Demonstrate command of the system and structure of the English language when writing or speaking.

RI.CR.8.1 Cite a range of textual evidence and make clear and relevant connections (including informational text features such as charts, graphs, and diagrams) that strongly support an analysis of multiple aspects of what an informational text says explicitly, as well as inferences drawn from the text.

RI.CI.8.2 Determine a central idea of an informational text and how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.

W.IW.8.2 Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

SL.PE.8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.

Science

MS-PS1-5 Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.

MS-PS4-1 Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.

Unit Understandings:

Students will understand that…

- Rational numbers can be written as a ratio, whereas irrational numbers cannot be written as a ratio.
- Rational numbers can be used to approximate the value of irrational numbers.
- Calculating square roots of perfect squares and identifying them as rational.
- The Pythagorean Theorem is a formula that can determine a missing side of a right triangle if the other two side measurements are known.
- Volume formulas calculate the amount of space enclosed by three-dimensional figures and can be applied to real-life situations.

Unit Essential Questions:

- What is the difference between rational and irrational numbers?
- How do square/cube roots relate to rational and irrational numbers?
- Where and when can the Pythagorean Theorem be applied?
- Why is it important to know and be able to apply formulas for the volume of a cone, cylinder, or sphere?

Knowledge and Skills:
Students will know...

- How to explain
  - strategies for finding area.
  - strategies for approximating and finding square roots.
  - strategies for finding triangle side lengths.
  - predictions about situations involving right triangles and strategies to verify.
  - strategies for finding distances between points on a coordinate plane.
  - strategies for approximating the value of cube roots.
- How to justify
  - which squares have side lengths in a given range.
  - ordering of irrational numbers.
  - ordering of hypotenuse lengths.
- How to compare
  - rational and irrational numbers.
  - lengths of diagonals in rectangular prisms.
  - strategies for approximating irrational numbers.
- Vocabulary: square root, irrational number, rational number, Pythagorean Theorem, hypotenuse, legs, cube root, and repeating decimal.

Students will be able to...

- Comprehend the term "irrational number" to mean a number that is not rational and that is an example of an irrational number.
- Comprehend the term "square root of" and the notation to mean the side length of a square whose area is square units.
- Use the square root symbol to represent solutions to equations of the form and represent the square root as a point on the number line.
- Calculate the distance between two points in the coordinate plane by using the Pythagorean Theorem.
- Explain an area-based algebraic proof of the Pythagorean Theorem.
- Use the Pythagorean Theorem to calculate unknown side lengths of right triangles and to solve problems within a context.
- Coordinate representations of a cube root, including cube root notation, decimal representation, the edge length of a cube or given volume, and a point on the number line.
- Represent rational numbers as equivalent decimals and fractions.

EVIDENCE OF LEARNING

Assessment:
What evidence will be collected and deemed acceptable to show that students truly "understand"?

- End of Unit Common Assessment - See folder for assessment links.
- Warm-Ups
- Cool Downs
- Section Checkpoints
- Practice Sets
- Renaissance Star Math Diagnostic Assessment – Fall, Winter, Spring

Learning Activities:

What differentiated learning experiences and instruction will enable all students to achieve the desired results?

- Lesson 2: One Square - The purpose of this activity is for students to estimate the side length of a square via a geometric construction that relates the side length of the square to a point on the number line, and verify their estimate using techniques from the previous lesson. Once students connect the side length to a point on the number line, they learn that this number has a name and a special notation to denote it: square root and the square root symbol. While this is students' first formal introduction to square roots, they will have many opportunities to deepen their understanding of square roots and practice using square root notation in later activities and lessons.
- Lesson 5: Solutions on a Number Line - The purpose of this activity is for students to use rational approximations of irrational numbers to place both rational and irrational numbers on a number line and to reinforce the definition of a square root as a solution to the equation of the form $x^2 = a$. This is also the first time that students have thought about negative square roots.
- Lesson 7: Adding Up Areas - The purpose of this activity is for students to work through an area-based algebraic proof of the Pythagorean Theorem. One of the figures used in this particular proof was first encountered by students at the start of the year during a unit on transformations and again in a recent lesson where they reasoned about finding the area of the triangles.
- Lesson 10: Cutting Corners - The purpose of this activity is for students to use the Pythagorean Theorem to reason about distances and speeds to figure out who will win a race. Students must translate between the context and the geometric representation of the context and back. Identify students whose work is clearly labeled and organized to share during the whole class discussion.
- Lesson 13: Cube Roots Values - The purpose of this activity is for students to think about cube roots in relation to the two whole number values they are closest to. Students are encouraged to use the fact that $\sqrt[3]{a}$ is a solution to the equation $x^3 = a$. Students can draw a number line if that helps them reason about the magnitude of the given cube roots, but this is not required. However students reason, they need to explain their thinking.
- Lesson 14: Recalculating Rational Numbers - The purpose of this task is for students to rewrite rational numbers with terminating decimal expansions in fraction form and fractions with terminating decimal expansions as decimals. This activity is the first of a series of three in which students rewrite numbers in different ways, supporting their understanding of what rational and irrational numbers are and how they can be represented.

RESOURCES

Teacher Resources:

- Illustrative Math (IM) Unit 8.8
- IM Student Workbook
- IM Blackline Masters
- Khan Academy IM Unit 8.8 Companion

Equipment Needed:

- Manipulatives
- IM Student Workbooks
- Student Whiteboards
- Chart Paper
- Dry Erase Markers
- Online Approved Digital Resources

- Chromebooks
- Bags, resealable plastic, or envelopes.
- Geometry Toolkit: rulers, graph paper, pattern blocks, straightedges, colored pencils, index cards, patty paper or tracing paper, pencil boxes, and scissors.