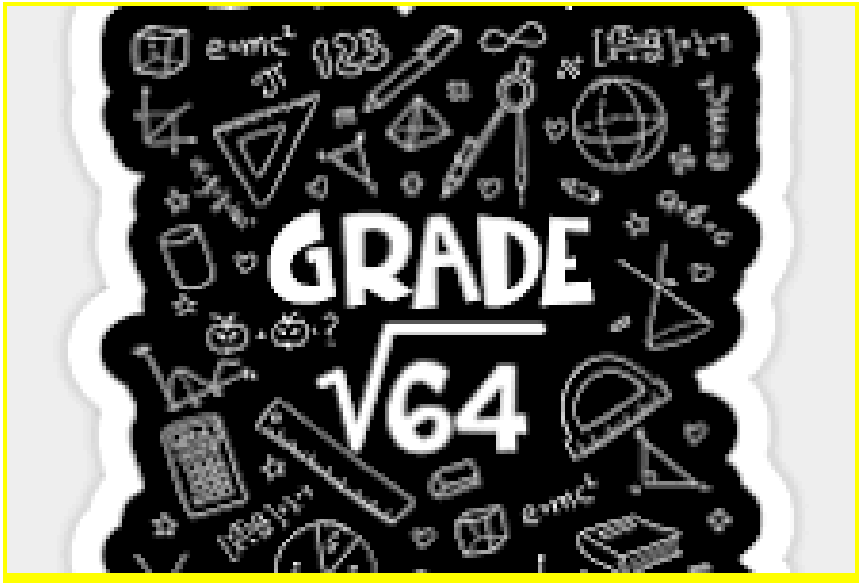
Grade 8 Math CURRICULUM



Grade Level(s): 8th Grade

Curriculum Author(s): Cate Lyman, Connor Mooney

Course Description: Math 8 continues to set a strong foundation in mathematics to prepare students for success in Algebra in high school. Students begin 8th grade with the concept of congruence and transformations such as rotations and translations. Next students build upon their study of scaled copies in 7th grade to include the concept of similarity which leads to understanding the slope of a line. Students expand upon the study of rates and proportional relationships in an introduction to linear functions and an introduction to solving systems of linear equations. Students further develop the concept of a function in mathematics through analyzing tables, graphs, and equations. Students also work with bi-variate data and learn to analyze associations using scatterplots and fitted lines for numerical data and tables, and bar graphs for categorical data. In addition, students learn about the volume of cylinders, cones and spheres, rules of exponents, scientific notation and are introduced to irrational numbers with the application of the Pythagorean Theorem.

Year At A Glance			
Unit Title	**Overarching Essential Question**	**Overarching Enduring Understanding**	**Vision of A Learner "I Can" Statements**
Unit 1: Rigid Transformations and Congruence	How can we use transformations and angle relationships to understand the structure of shapes and the way lines and angles connect and interact?	Understanding geometric transformations and angle relationships helps students recognize when shapes are the same size and shape, and how lines and angles behave in predictable ways. These tools allow students to make sense of shapes, movements, and connections in geometry.	T13(6-8), **P4**(6-8), TCC2(6-8), **CCE1**(6-8), **DE4**(6-8)
Unit 2: Dilations, Similarity, and Introducing Slope	What makes two figures similar, and how can similarity help us understand relationships like slope?	Similarity, defined through dilations and rigid motions, provides a foundation for comparing figures and developing a geometric understanding of slope as a consistent rate of change.	TI3(6-8), P4(6-8), TCC2(6-8);CCE1(6-8), CCE3(6-8), DE4(6-8), **TI2**(6-8)**,** P3(6-8)
Unit 3: Linear Relationships	How do we recognize, describe, and represent relationships that change at a constant rate?	Linear relationships describe situations with a constant rate of change, and understanding slope allows us to connect equations, graphs, and real-world contexts.	CCE3(6-8), DE4(6-8), **P3**(6-8)**, P4**(6-8)**,** TI3(6-8), **TCC2(6-8)**
Unit 4: Linear Equations and Linear Systems	What do the solutions to linear equations and systems tell us about the relationships between quantities?	Linear equations and systems help us represent and solve real-world problems by showing how different quantities are connected. Solving them helps us figure out what values make sense together—and when no solution is possible.	**TCC1**(6-8), TCC4(6-8), CCE3(6-8), **CCE4**(6-8)**,** DE4(6-8), P3(6-8), AA4(6-8), TI3(6-8)

Unit 5: Functions and Volume	How can functions and volume formulas be used to describe and predict relationships between quantities?	Functions describe how one quantity changes in relation to another. Volume formulas are a type of function that show how the size of a shape relates to how much space it holds.	CCE3(6-8), DE4(6-8), P3(6-8), **AA2**(6-8)**, CCE1**(6-8)**,**
Unit 6: Associations in Data	How can we identify, represent, and interpret patterns in data to make sense of relationships?	Patterns in data can be represented and interpreted through scatter plots, trend lines, and two-way tables, allowing us to analyze and predict relationships between variables.	CCE3(6-8), **DE4**(6-8), P3(6-8), **TI3**(6-8)
Unit 7: Exponents and Scientific Notation	How do the properties of exponents and scientific notation help us represent and work with very large or very small numbers?	Exponent rules and scientific notation allow us to represent and manipulate very large or small numbers efficiently, revealing structure and patterns in the number system.	**CCE3**(6-8), DE4(6-8), **P3**(6-8)
Unit 8: Pythagorean Theorem and Irrational Numbers	How do geometric relationships and number properties help us solve problems involving distance and irrational numbers?	The Pythagorean Theorem connects geometry and algebra, and understanding irrational numbers expands our view of the number system beyond rational values.	CCE3(6-8), DE4(6-8), P3(6-8), **TCC4**(6-8)**, TCC2**(6-8)

Unit 1 - Rigid Transformations and Congruence

Desired Results - Goals, Transfer, Meaning, Acquisition

Established Goals:

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

Standards for Mathematical Practice

- MP1: Make sense of problems and persevere in solving them.
- MP2: Reason abstractly and quantitatively.
- MP3: Construct viable arguments and critique the reasoning of others.
- MP4: Model with mathematics.
- MP5: Use appropriate tools strategically.
- MP6: Attend to precision.
- MP7: Look for and make use of structure.
- MP8: Look for and express regularity in repeated reasoning.

Vision of A Learner Attributes: Students will be able to independently use their learning to...

- TCC2: I can evaluate data gathered from multiple perspectives and draw conclusions.
- **CCE1**: I can contribute to discussions with my peers/teachers about a variety of topics, respecting differing viewpoints, actively listening to others, and responding thoughtfully as I apply new knowledge to my thinking.
- **P4**: I can step outside my comfort zone because I recognize that my mistakes are not failures, but rather an opportunity to learn and grow. mistakes as opportunities to learn and grow.
- TI3: I can compose specific questions that are relevant to a task to support my learning.
- **DE4**: I can be respectful and responsible and build positive relationships with all members of the school community.
- P3: I can receive and provide constructive feedback and understand the need to adjust my goals/learning journey.

Understandings: Students will understand that...	**Essential Questions:**
• Rigid transformations (translations, rotations, and reflections)	• How do rigid motions help us understand congruence?

preserve size and shape. • Two figures are congruent if there is a sequence of rigid motions that maps one onto the other. • Coordinates can be used to describe and perform transformations. • Angle relationships in triangles and between parallel lines and transversals follow consistent, predictable patterns. • Informal reasoning and visual models can justify geometric facts like the angle sum of a triangle or relationships formed by transversals.	• What makes two shapes congruent or not congruent? • How can we describe transformations precisely using coordinates? • What angle relationships always exist in triangles and with parallel lines?
Students will know... • Definitions and properties of rigid transformations: translation, rotation, and reflection. • The definition of congruence in terms of rigid motions. • How to identify and describe a sequence of transformations. • Properties of angle relationships: vertical, adjacent, complementary, supplementary, corresponding, alternate interior. • That the sum of the angles in a triangle is always 180°, and how to justify that informally.	**Students will be able to…** • Perform and describe transformations using mathematical vocabulary and coordinates. • Use transformations to justify whether two figures are congruent. • Construct arguments and explanations using geometric transformations. • Use informal arguments to justify angle relationships in geometric figures and with parallel lines.
Key Vocabulary: Rigid transformation, Translation, Rotation, Reflection, Congruent, Coordinates, Sequence of transformations, Image, Pre-image, Angle Sum, Transversal, Alternate Interior Angles, Corresponding Angles, Vertical Angles	
Assessment Evidence	
Performance Tasks: **P4**, **CCE1** & **DE4** End of Unit Assessment: • Finding missing angles and side lengths of congruent polygons	**Other Evidence:** 1.1-1.6 Cluster Quiz CER Responses Mid Unit Assessment Exit Tickets analyzing given transformations or describing sequences

• Finding an unknown angle formed by intersecting lines • Analyzing congruence and translation between two figures • Identifying correct statements about transformations • Describing a sequence of transformations • Explaining how two polygons are congruent using precise language • Determining whether pairs of shapes are congruent and justify answers with descriptive transformations • Working with parallel lines and triangle angle relationships • Finding unknown angle measures • Understanding 180° rotations and their effect on triangle congruence • Identifying and justifying congruent angles • Applying knowledge of angle sums in triangles and quadrilaterals	Exit Tickets with student reflections on P4 and CCE1 Various Thinking Tasks using Building Thinking Classrooms instructional strategies.

Learning Plan

Lesson Focus	**Learning Activities**	**CCSS**	**Vision of a Learner Attribute**
Intro to Rigid Transformations	Paper folding and tracing to show translations, rotations, reflections	8.G.A.1	TI3, P4, CCE1, DE4, P3
Using Transparencies & Tools	Use tracing paper to verify congruence via rigid motions	8.G.A.2	TI3, P4, CCE1, DE4, P3, TCC2
Congruence through Transformations	Collaborative problem-solving to justify congruence	8.G.A.2	TI3, P4, CCE1, DE4, P3
Describing Transformations on a Grid	Grid-based tasks describing transformations algebraically	8.G.A.3	TI3, P4, CCE1, DE4, P3
Practice with Sequences	Students create and apply sequences of transformations	8.G.A.2	TI3, P4, CCE1, DE4, P3, TCC2

Angle Relationships in Triangles	Explore angle sums using triangle diagrams and folding	8.G.A.5	TI3, P4, CCE1, DE4, P3, TCC2
Angles with Parallel lines and Transversals	Use visuals and reasoning to explore angle pliers and informal proof	8.G.A.5	TI3, P4, CCE1, DE4, P3, TCC2

Teacher Resources:

- Illustrative Mathematics Teacher Guide, Unit 1: https://curriculum.illustrativemathematics.org/MS/teachers/3/unit-overview.html
- Family-facing video summaries of each block (Vimeo/YouTube)
- Desmos Geometry Tools (for digital transformations)
- Paper, tracing paper, and patty paper
- Coordinate grid handouts and rulers
- IXL
- 6–8 VoL Attribute List (for guiding student reflection and integration of soft skills)

Unit 2 - Dilations, Similarity, and Introducing Slope

Desired Results - Goals, Transfer, Meaning, Acquisition

Established Goals:

- CCSS 8.G.A.1: Understand that a dilation is defined by a center and a scale factor; analyze images of circles and lines under dilation.
- CCSS 8.G.A.2: Understand similarity by connecting dilations and rigid motions to define when figures are similar.
- CCSS 8.G.A.3 / 8.EE.B.6: Use similarity (including slope triangles) to understand that any two points on a line determine the same slope, and write equations of lines via reasoning from similar triangles
- CCSS 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.
- CCSS 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.

Standards for Mathematical Practice

- MP1: Make sense of problems and persevere in solving them.
- MP2: Reason abstractly and quantitatively.
- MP3: Construct viable arguments and critique the reasoning of others.
- MP4: Model with mathematics.
- MP5: Use appropriate tools strategically.
- MP6: Attend to precision.
- MP7: Look for and make use of structure.
- MP8: Look for and express regularity in repeated reasoning.

Vision of A Learner Attributes: Students will be able to independently use their learning to... (“I can” statements to be demonstrated)

- TCC2: I can evaluate data gathered from multiple perspectives and draw conclusions.
- CCE1:I can contribute to discussions with my peers/teachers about a variety of topics, respecting differing viewpoints, actively listening to others, and responding thoughtfully as I apply new knowledge to my thinking.

- P4: I can step outside my comfort zone because I recognize that my mistakes are not failures, but rather an opportunity to learn and grow. mistakes as opportunities to learn and grow.
- TI3: I can compose specific questions that are relevant to a task to support my learning.
- **DE4**: I can be respectful and responsible and build positive relationships with all members of the school community.
- P3: I can receive and provide constructive feedback and understand the need to adjust my goals/learning journey.

- CCE3: I can participate in collaborative conversations by actively listening, formulating questions ,making connected comments and providing various types of feedback to my peers.
- **T12**: I can identify my objectives and apply the best resources to my learning.

Understandings: Students will understand that…	**Essential Questions:**
• A dilation scales distances from a center by a constant factor while preserving angle measures. • Two figures are similar if one can be obtained from the other via rigid motions and dilation. • All slope triangles on the same line are similar, yielding a consistent slope that defines the relationship between vertical and horizontal change.	• How does changing the scale of a figure affect its size and shape? • What criteria determine whether two figures are similar? • How do similar triangles help us understand slope and describe lines?
Students will know...	**Students will be able to...**
• Definitions: dilation, scale factor, center of dilation, similarity, slope, slope triangle • That dilations preserve angle size but scale length by the factor • That similarity of triangles underpins the concept of slope	• Construct dilations on and off the grid using a given center and factor • Identify when two figures are similar and justify using transformations

Key Vocabulary: Dilation, Center of dilation, Scale factor, Similar, Corresponding points, sides, angles,Slope, slope triangle, Equation of a line

Assessment Evidence	
Performance Tasks: **T12** & **DE4** Summative Assessment • Understanding properties of dilations (lines, circles, angles) • Identifying which statements about dilations are true • Determining which pairs of triangles are similar based on angle information	**Other Evidence:** 2.1-2.5 Quiz 2.6-2.9 Quiz Exit Tickets analyzing student learning and reflections Check Point Assessments Various Thinking Tasks using Building Thinking Classrooms instructional strategies.

• Selecting all lines that have a given slope • Determining if a student correctly drew a similar polygon • Finding missing side lengths using similarity • Calculating the slope of a line • Determining whether a specific point lies on the line • Drawing two dilations of a polygon using given centers and scale factors • Showing and explaining why the dilated figures are similar	

Learning Plan

Lesson Focus	Activities	Standards	Vision Attributes
1- 2. Projecting & Scaling	Hands-on with cut-outs and radial/circular grids exploring scale factor	CCSS 8.G.A.1	TI3, P4, DE4
3-5. Dilation on Grids and Coordinate Plane	Use square grids & coordinates for dilations	CCSS 8.G.A.1, 8.G.A.3	TCC2, DE4
6-9. Exploring Similarity	Compare polygons, define similarity, analyze ratio of sides	CCSS 8.G.A.2, 8.G.A.4, 8.G.A.5	CCE1, TCC2, CCE3, DE4
10-12. Slope via Similar Triangles	Use slope triangles to derive slope	CCSS 8.G.A.3, 8.EE.B.6, 8.G.A.4	TI3, TCC2, DE4, P3

Teacher Resources:

- Illustrative Mathematics Unit 2 Teacher Guide: detailed lesson narratives and alignment
- Family-facing video summaries (Vimeo/YouTube) explaining content and vocabulary
- Geometry toolkits: tracing paper, graph paper, ruler, protractor, patty paper (MP5 support)
- Digital tools: Desmos/GeoGebra for modeling dilations and slope triangles
- IXL
- Formative assessment protocols: exit tickets, partner critique, reflection prompts focused on transformations and slope reasoning

Unit 3 - Linear Relationships

Desired Results - Goals, Transfer, Meaning, Acquisition

Established Goals:

- **CCSS 8.EE.B.5**: Graph proportional relationships and interpret the unit rate as the slope of the graph.
- **CCSS 8.EE.B.6**: Use similar triangles to explain why the slope m is the same between any two points on a non-vertical line in the coordinate plane
- **CCSS 8.F.B.4**: Construct and compare linear models and recognize solutions of a linear equation as points on its graph.

Standards for Mathematical Practice

- MP1: Make sense of problems and persevere in solving them.
- MP2: Reason abstractly and quantitatively.
- MP3: Construct viable arguments and critique the reasoning of others.
- MP4: Model with mathematics.
- MP5: Use appropriate tools strategically.
- MP6: Attend to precision.
- MP7: Look for and make use of structure.
- MP8: Look for and express regularity in repeated reasoning.

Vision of A Learner Attributes: Students will be able to independently use their learning to... ("I can" statements to be demonstrated)

- **TCC2**: I can evaluate data gathered from multiple perspectives and draw conclusions.
- **P4**: I can step outside my comfort zone because I recognize that my mistakes are not failures, but rather an opportunity to learn and grow. mistakes as opportunities to learn and grow.
- TI3: I can compose specific questions that are relevant to a task to support my learning.
- DE4: I can be respectful and responsible and build positive relationships with all members of the school community.
- **P3**: I can receive and provide constructive feedback and understand the need to adjust my goals/learning journey.
- CCE3: I can participate in collaborative conversations by actively listening, formulating questions ,making connected comments and providing various types of feedback to my peers.

Understandings: Students will understand that...	**Essential Questions:**
• A proportional relationship is a linear relationship whose graph	• How are proportional and linear relationships similar? How are

passes through the origin, with slope equal to the constant of proportionality. ● All linear relationships have a constant rate of change (slope); even non-proportional ones can be viewed as translated versions of proportional lines. ● The slope of a line represents how much y changes per unit change in x, and is consistent across any pair of points—established through similar triangles. ● The graph of a linear equation is the set of all its solutions, and each point corresponds to an input-output pair.	they different? ● In what ways does slope describe how a quantity changes? ● What does it mean to be a solution of a linear equation in two variables?
Students will know... ● Definitions: proportional relationship, linear relationship, rate of change, slope, vertical intercept, solution of an equation. ● How slope relates to constant rates and corresponding graph features. ● Translating a proportional line vertically creates a non-proportional linear relationship.	**Students will be able to...** ● Create and interpret graphs, tables, equations (y = mx + b) of proportional and linear relationships. ● Derive slope using similar triangles and calculate from two points. ● Determine whether a point is a solution to a given linear equation. ● Solve contextual problems involving linear growth or decay.
Key Vocabulary: Proportional relationship, Rate of change, Slope, Linear relationship, Vertical intercept (y-intercept), Similar triangles, Solutions / ordered pair	
Assessment Evidence	
Performance Tasks: **P4** & **P3** End of Unit Assessment ● Identifying points that lie on the graph of a linear equation. ● Interpreting graphs of real-world data and comparing rates of change. ● Writing equations for lines from graphs ● Finding the slope between two given points.	**Other Evidence:** Proportional Relationship Lines and Linear Equations FIAB Exit Tickets analyzing student learning and reflections Check Point Assessments Various Thinking Tasks using Building Thinking Classrooms instructional strategies.

• Comparing rates using a graph, an equation, and a table. • Creating a table to represent a linear relationship involving constraints. • Writing an equation to model the relationship between two variables. • Writing and graphing the linear equation. • Identifying whether the relationship is proportional. • Comparing and interpreting two different linear models	

Learning Plan

Lesson Focus	Activities	CCSS	VoL Attributes
Proportional Relationships	Compare graphs with different axis scales (e.g., ladybugs/ants), introduce rate of change.	8.EE.B.5	TI3, CCE3
Graphing Proportional Situations	Graph situations (e.g., Origami Car Wash); Info Gap task for axes decisions.	8.EE.B.5	TI3, CCE3
Non-Proportional / Linear Relationships	Stack cup data, compare to proportional model, observe vertical translation.	8.EE.B.6	TI3, P4, CCE3
Representations of Linear Relationships	Match contexts, tables, graphs with intercepts; craft equations.	8.F.B.4	CCE3
Finding & Calculating Slope	Work with positive & negative slopes; use slope triangles/off-grid coordinates.	8.EE.B.6	P4, CCE3, P3
Linear Equations & Solutions	Graph horizontal/vertical lines; explore solutions of 2 var equations.	8.F.B.4	TI3,CCE3, P3
Culminating-Problem Solving	Solve real-world linear problems with tables, graphs, and equations.	8.EE.B.5, 8.EE.B.6, 8.F.B.4	TI3, P4, CCE3, P3

Teacher Resources:

- Illustrative Mathematics Teacher Guide, Unit 3 (proportional and linear relationships)
- “Story of Unit 3” blog post explaining unit flow & key pedagogical choices
- Family-facing video summaries of each block (Vimeo/YouTube)
- Geometry toolkits: straightedges, protractors, colored pencils, graph paper
- Digital tools: Desmos or GeoGebra for dynamic slope & graphing practice
- IXL
- Formative assessment tools: exit tickets, card sorts, info-gap protocols, gallery walks

Unit 4 - Linear Equations and Linear Systems

Desired Results - Goals, Transfer, Meaning, Acquisition

Established Goals:

- **8.EE.C.7**: Solve linear equations in one variable, including those with variables on both sides, and interpret solutions in context.
- **8.EE.C.8**: Analyze and solve pairs of simultaneous linear equations in two variables; understand solution sets.

Standards for Mathematical Practice

- MP1: Make sense of problems and persevere in solving them.
- MP2: Reason abstractly and quantitatively.
- MP3: Construct viable arguments and critique the reasoning of others.
- MP4: Model with mathematics.
- MP5: Use appropriate tools strategically.
- MP6: Attend to precision.
- MP7: Look for and make use of structure.
- MP8: Look for and express regularity in repeated reasoning.

Vision of A Learner Attributes: Students will be able to independently use their learning to... ("I can" statements to be demonstrated)

- **TCC1**: I can ask relevant questions to evaluate possible solutions.
- TCC4: I can apply my learning to new experiences, determine if it works and adjust in the future.
- **CCE4**:I can express my thoughts and ideas, both verbally and in writing, in order to defend my perspective. I can do this via essays, performance based projects, whole group, and/or small group discussions.
- AA4: I can seek opportunities to learn more and continue to push my thinking.
- TI3: I can compose specific questions that are relevant to a task to support my learning.
- DE4: I can be respectful and responsible and build positive relationships with all members of the school community.
- P3: I can receive and provide constructive feedback and understand the need to adjust my goals/learning journey.
- CCE3: I can participate in collaborative conversations by actively listening, formulating questions ,making connected comments and providing various types of feedback to my peers.

Understandings: Students will understand that…

- Performing the same operation on both sides of an equation preserves equality (like balance scales).
- Linear equations in one variable may have no solution, exactly

Essential Questions:

- How do we maintain balance when solving equations—especially with variables on both sides?
- What strategies help us find all, some, or no solutions of a linear

one, or infinitely many; solution structure depends on equivalence of expressions. ● A point that solves both equations in a system lies at the intersection of their graphs; solving algebraically yields that intersection.	equation? ● How do we interpret and solve systems of linear equations graphically, algebraically, and in context?
Students will know… ● Techniques for solving equations: simplifying, combining like terms, using inverse operations, and balancing. ● Categories of equation outcomes: no solution, one solution, infinitely many. ● Methods for systems: graph intersection, substitution.	**Students will be able to...** ● Solve single-variable linear equations—including those with variables on both sides. ● Analyze an equation to classify its solution set (none, one, infinite). ● Solve systems of two linear equations using multiple strategies (graphically, algebraically). ● Apply solution methods in real-world context problems.
Key Vocabulary: variable, coefficient, constant, like terms, inverse operations, solution, no solution, infinite solutions, system of equations, solution of a system, substitution, intersection	
Assessment Evidence	
Performance Tasks: **TCC1** & **CCE4** Mid Unit Assessment ● Solve multi-step linear equations with variables on one or both sides ● Show all work and check solutions by substitution ● Determine whether a linear equation has: No solution,Exactly one solution, Infinitely many solutions ● Justify the type of solution based on simplification and comparison of both sides ● Solve a word problem involving comparing two linear cost models in a real world context ● Set up and solve a linear equation to determine when the two plans cost the same ● Interpret the solution in context	**Other Evidence:** Exit Tickets analyzing student learning and reflections Check Point Assessments Various Thinking Tasks solving systems using Building Thinking Classrooms instructional strategies.

Learning Plan

Lesson Focus	Activities	Standards	Vision Attributes
Number Puzzles & Balanced Moves	Solve/write puzzles using balance diagrams	8.EE.C.7	TI3, CCE3, DE4, P3
Keeping the Equation Balanced	Simplify and isolate variable steps	8.EE.C.7	CCE3, DE4, P3
Balanced Moves & Strategic Solving	Tackle multi-step equations with variables both sides	8.EE.C.7	TI3, CCE3, DE4, P3
Equations with All/No Solutions	Analyze situations leading to infinite or no solutions	8.EE.C.7	TCC1, TCC4, CCE3, CCE4, DE4, P3
Solving “How Many Solutions?”	Classify and justify solution types	8.EE.C.7	TCC1, TCC4, CCE3, CCE4, DE4, P3, AA4
Systems: On One or Both Lines	Solve via graph intersection and point identification	8.EE.C.8	TI3, TCC1, TCC4, CCE3, CCE4, DE4, P3, AA4
Solve Systems	Practice substitution and elimination methods	8.EE.C.8	TCC1, TCC4, CCE3, CCE4, DE4,P3, AA4

Teacher Resources:

- Illustrative Mathematics Unit 4 Teacher Guide – complete lesson narratives & standards]
- Family Lesson Videos (Solving equations & systems)—Vimeo/YouTube
- Balance diagrams & puzzle worksheets – analog tools for equation understanding
- Graph paper, rulers, calculators for systems instruction
- IXL

Unit 5 - Functions and Volume

Desired Results - Goals, Transfer, Meaning, Acquisition

Established Goals:

- **8.F.A.1**: Understand a function as a rule that assigns to each input exactly one output.
- **8.F.A.2**: Compare properties of two functions represented in different ways.
- **8.F.B.4**: Construct linear functions; relate equation, graph, and table.
- **8.F.B.5**: Interpret the slope and intercept of graphs and tables in context.
- **G.GMD.A.3**: Use volume formulas for cylinders, cones, and spheres and understand relationships between their volumes and dimensions.

Standards for Mathematical Practice

- MP1: Make sense of problems and persevere in solving them.
- MP2: Reason abstractly and quantitatively.
- MP3: Construct viable arguments and critique the reasoning of others.
- MP4: Model with mathematics.
- MP5: Use appropriate tools strategically.
- MP6: Attend to precision.
- MP7: Look for and make use of structure.
- MP8: Look for and express regularity in repeated reasoning.

Vision of A Learner Attributes: Students will be able to independently use their learning to... (“I can” statements to be demonstrated)

- **AA2**: I can identify past successful strategies and apply them independently.
- DE4: I can be respectful and responsible and build positive relationships with all members of the school community.
- P3: I can receive and provide constructive feedback and understand the need to adjust my goals/learning journey.
- **CCE1**: I can contribute to discussions with my peers/teachers about a variety of topics, respecting differing viewpoints, actively listening to others, and responding thoughtfully as I apply new knowledge to my thinking.
- CCE3: I can participate in collaborative conversations by actively listening, formulating questions ,making connected comments and providing various types of feedback to my peers.

Understandings: Students will understand that…	**Essential Questions:**

• A function maps each input to exactly one output across representations . • For linear functions, slope and intercept are consistent and meaningful through graphs, tables, and equations • Volumes of cylinders, cones, and spheres change predictably with dimensions and can be modeled as functions • Volume formulas reveal relationships between dimensions: cylinder and prism; cone and cylinder; sphere as dimension scales	• What makes a rule a “function”? In what ways can we represent it? • How do change patterns in linear functions show themselves in graphs, tables, and equations? • How do measurements of three-dimensional figures change when dimensions change—what is the functional relationship?
Students will know... • Definitions: function, independent/dependent variables, slope, intercept, cylinder/cone/sphere volume formulas. • Ways to represent function: input-output tables, graphs, equations. • How dimensions affect volumes: $V = \pi r^2 h$, $V = (1/3)\pi r^2 h$, $V = (4/3)\pi r^3$	**Students will be able to…** • Determine if a rule defines a function and represent it across multiple formats. Derive linear equations from data; interpret slope and intercept in context. • Use and compare volume formulas; analyze how volume responds to changes in radius or height.
Key Vocabulary: Function, Input, Output, Function Notation, Linear Function, Nonlinear Function, Rate of Change, Constant Rate of Change, Volume, Cylinder, Cone, Sphere, Radius, Height, Volume Formulas, Equation	
Assessment Evidence	
Performance Tasks: **AA2 & CCE1** Summative Assessment • Recall and write the correct volume formulas for: Cylinder, Cone, and Sphere • Use given dimensions and apply appropriate formulas to: Find the volume of a cylinder, Find the volume of a cone, Find the volume of a sphere • Given the volume of a cylinder, work backwards to find the missing height using algebraic reasoning	**Other Evidence:** Exit Tickets analyzing student learning and reflections Check Point Assessments Various Thinking Tasks using Building Thinking Classrooms instructional strategies.

Learning Plan

Lesson Segment	Learning Activities	CCSS	Vision Traits
Inputs & Outputs	Explore input-output tables; define functions and understand functional relationships.	8.F.A.1	CCE1, CCE3, DE4
Function Representations	Match functions to their representations in tables, graphs, and equations; determine if relationships are linear or nonlinear.	8.F.A.2, 8.F.B.4, 8.F.B.5	CCE1, CCE3, DE4
Linear Function Patterns	Analyze slope and y-intercept in real-world contexts; model and explain increasing and decreasing patterns.	8.F.B.4, 8.F.B.5	CCE1, CCE3, DE4, P3
Cylinders & Cones	Investigate how volume changes with height and radius; derive volume formulas; represent relationships with functional graphs.	G.GMD.A.3	CCE1, CCE3, DE4, P3, AA2
Spheres & Scaling	Compare volumes of different solids; examine how volume scales with radius using function concepts.	G.GMD.A.3	CCE1, CCE3, DE4, P3, AA2

Teacher Resources:

- Illustrative Mathematics Unit 5 Teacher Guide (lesson narratives & standards
- Family-facing video summaries for each section (Inputs & Outputs; Functions; Solid Volumes)
- Geometry toolkits: tracing paper, graph paper, rulers, colored pencils, cylinders/prisms for volume exploration
- Volume formula reference & derivation aids (visual and symbolic)
- Digital modeling tools: Desmos/GeoGebra for exploring linear and volume functions
- IXL
- Formative assessments and protocols: exit tickets, peer critique, reflection prompts aligned to representations and function reasoning

Unit 6 - Associations in Data

Desired Results - Goals, Transfer, Meaning, Acquisition

Established Goals:

- **8.SP.A.1–3: Construct and interpret scatter plots for paired numerical data; use association language like cluster, outlier, and trend.**
- **8.SP.A.4–5: Informally fit a line to scatter plots; use the fitted line to interpret and predict values.**
- **8.SP.B.4–5: Use two-way tables and segmented bar graphs to analyze categorical variable associations.**

Standards for Mathematical Practice

- MP1: Make sense of problems and persevere in solving them.
- MP2: Reason abstractly and quantitatively.
- MP3: Construct viable arguments and critique the reasoning of others.
- MP4: Model with mathematics.
- MP5: Use appropriate tools strategically.
- MP6: Attend to precision.
- MP7: Look for and make use of structure.
- MP8: Look for and express regularity in repeated reasoning.

Vision of A Learner Attributes: Students will be able to independently use their learning to... ("I can" statements to be demonstrated)\

- **TI3**: I can compose specific questions that are relevant to a task to support my learning.
- **DE4**: I can be respectful and responsible and build positive relationships with all members of the school community.
- P3: I can receive and provide constructive feedback and understand the need to adjust my goals/learning journey.
- CCE3: I can participate in collaborative conversations by actively listening, formulating questions ,making connected comments and providing various types of feedback to my peers.

Understandings: Students will understand that…

- Scatter plots reveal different association types—positive, negative, linear, or none—through clustering and outliers.
- Fitted lines summarize linear trends and enable informed predictions and over/under prediction evaluation.
- Two-way tables and segmented bar graphs help quantify and visualize categorical relationships using percentages.

Essential Questions:

- What kinds of associations can be shown in scatter plots?
- How can a fitted line reveal trends and support predictions?
- How can we use two-way tables and segmented bar graphs to describe associations in categorical data?

Students will know...	**Students will be able to....**
• Definitions: scatter plot, positive/negative/linear/nonlinear association, cluster, outlier, fitted line, prediction, residual, two-way table, segmented bar graph, relative frequency. • Different association types found in scatter plots • The purpose of two-way tables and segmented bar graphs for sharing data	• Construct and interpret scatter plots, describing association types using precise language. • Create and assess informal trend lines; use them to predict and evaluate predicted values. • Build two-way tables, segment bar graphs, compute relative frequencies, and evaluate categorical associations.

Key Vocabulary: Scatter Plot, Association, Positive Association, Negative Association, No Association, Linear Association, Nonlinear Association, Cluster, Outlier, Trend Line, Fitted Line, Prediction, Two-Way Table, Frequency, Relative Frequency, Segmented Bar Graph,Categorical Data, Numerical Data

Assessment Evidence

Performance Tasks:	**Other Evidence:**
TI3& DE4 Summative Assessment • Understanding and identifying associations in bivariate categorical data (e.g., recognizing associations using two-way tables) • Constructing and interpreting scatter plots for bivariate numerical data • Describing patterns, trends, clusters, and outliers in data • Drawing lines of fit and assessing their appropriateness • Using lines of fit to make predictions and interpret their meaning in context • Distinguishing between correlation and causation • Analyzing and interpreting real-world data situations involving bivariate data	Various Thinking Tasks using Building Thinking Classrooms instructional strategies. Exit Tickets analyzing student learning and reflections Check Point Assessments

Learning Plan

Lesson	Activities	Standards	VoL Attributes
Organizing & Plotting Data	Sort messy data tables, create scatter	8.SP.A.1–2	TI3, DE4, CCE3

	plots.		
Interpreting Single Points & Clusters	Analyze coordinate points for meaning; label cluster, outlier.	8.SP.A.3	DE4, CCE3
Positive/Negative Associations	Compare real-world scatter plots (dogs, cars); describe association type.	8.SP.A.3	DE4, CCE3
Drawing Fitted Lines & Predictions	Draw trend lines, estimate missing y from x, identify over/under predictions.	8.SP.A.4	TI3, DE4, CCE3, P3
Evaluating Fit & Slope Meaning	Analyze how well lines fit; interpret steepness as rate.	8.SP.A.5	DE4, CCE3, P3
Clustering & Non-linear Patterns	Compare linear and non-linear scatter plots; explain differences.	8.SP.A.3, A.5	TI3, DE4, CCE3, P3
Categorical Associations	Collect categorical data, build two-way tables, compute relative frequencies.	8.SP.B.4	TI3, DE4, CCE3
Visualizing with Segmented Bar Graphs	Convert tables to segmented bars; analyze distribution.	8.SP.B.5	DE4, CCE3, P3
Culminating – “Gone in 30 Seconds”	Predict categorical outcomes using data; justify predictions.	All	DE4, CCE3, P3

Teacher Resources:

- Illustrative Mathematics Unit 6 Teacher Guide (narratives & standards)
- Family Lesson Video Summaries covering numerical & categorical associations
- Scatter plot & table construction toolkits: graph/grid paper, colored pencils
- Data collection kits: simple measuring tools or canned datasets
- Digital Tools: Desmos/GeoGebra for scatter plots and categorical charts
- IXL
- Formative Assessment Tools: exit tickets, data talk prompts, peer critique, reflection questions

Unit 7 - Exponents and Scientific Notation

Desired Results - Goals, Transfer, Meaning, Acquisition

Established Goals:

- **8.EE.A.1**: Know and apply the properties of integer exponents to generate equivalent expressions (product, power of a power, quotient, zero, negative exponents)
- **8.EE.A.2**: Use scientific notation to express very large or very small numbers and perform operations with numbers written in scientific notation.
- **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.
- **8.EE.A.4** Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used.

Standards for Mathematical Practice

- MP1: Make sense of problems and persevere in solving them.
- MP2: Reason abstractly and quantitatively.
- MP3: Construct viable arguments and critique the reasoning of others.
- MP4: Model with mathematics.
- MP5: Use appropriate tools strategically.
- MP6: Attend to precision.
- MP7: Look for and make use of structure.
- MP8: Look for and express regularity in repeated reasoning.

Vision of A Learner Attributes: Students will be able to independently use their learning to... (“I can” statements to be demonstrated)

- DE4: I can be respectful and responsible and build positive relationships with all members of the school community.
- **P3**: I can receive and provide constructive feedback and understand the need to adjust my goals/learning journey.
- **CCE3**: I can participate in collaborative conversations by actively listening, formulating questions ,making connected comments and providing various types of feedback to my peers.

Understandings: Students will understand that…	**Essential Questions:**
• Exponent rules (e.g. x^a * x^b = x^(a + b); (x^a)^b = x^(a * b); x^0 = 1; x^(-a) = 1 / x^a) allow systematic manipulation of exponential expressions. • Negative and zero exponents naturally extend exponent concepts to include division and reciprocal relationships. • Scientific notation is a compact form using powers of ten that makes it easier to work with very large/small numbers, both conceptually and computationally.	• How do exponent rules help us simplify expressions and solve problems? • Why do negative and zero exponents make sense in terms of repeated multiplication/division? • When and why is scientific notation useful for representing extremely large or small numbers?
Students will know…	**Students will be able to...**
• Definitions of exponents (integer), exponent rules (product, power of a power, quotient, zero, negative), and scientific notation. • When and how to apply exponent rules to rewrite expressions. • How scientific notation expresses magnitude and supports calculations with large/small numbers.	• Apply exponent properties to simplify and rewrite expressions. • Interpret and simplify expressions with zero and negative exponents. • Convert numbers into and from scientific notation. • Multiply and divide in scientific notation; estimate using order of magnitude.
Key Vocabulary: Exponent, base, product rule, power of a power, quotient rule, zero exponent, negative exponent, scientific notation, order of magnitude, coefficient.	
Assessment Evidence	
Performance Tasks: **P3 & CCE3** Summative Assessment • Evaluate numeric expressions with positive and negative exponents • Demonstrate understanding of exponent meaning (e.g., 3^3, 5^-3) • Simplify expressions using properties of exponents:, Product of powers, Power of a power, Negative exponents • Writing as a single expression with a positive exponent only	**Other Evidence:** Various Thinking Tasks using Building Thinking Classrooms instructional strategies. Exit Tickets analyzing student learning and reflections Check Point Assessments

• Convert standard form numbers (very large and very small) into scientific notation • Apply correct format (significant figure × 10^exponent) • Convert from scientific notation into standard decimal form • Demonstrate understanding of powers of 10 and decimal placement	

Learning Plan

Lesson(s)	Learning Activities	Standards	Vision Traits
Exponent Review	Review whole-number exponents; connect repeated division to negative exponents	8.EE.A.1	DE4, P3, CCE3
Exponent Rules	Explore product, power-of-power, quotient rules through tables & pattern reasoning	8.EE.A.1	DE4, P3, CCE3
Zero & Negative Exponents	Reason through division patterns to understand x^0 and x^–n; apply to rational bases	8.EE.A.1	DE4, P3, CCE3
Powers of Ten	Multiply/divide large powers of ten; understand orders of magnitude	8.EE.A.1	DE4, P3, CCE3
Scientific Notation Intro	Convert numbers to/from scientific notation; place on number lines	8.EE.A.2	DE4, P3, CCE3
Operations in Sci. Notation	Practice multiplying/dividing scientific notation with estimation challenges	8.EE.A.2, 8.EE.A.3 , 8.EE.A.4	DE4, P3, CCE3

Teacher Resources:

- Illustrative Mathematics Unit 7 Teacher Guide (lesson narratives and pedagogy)
- Family-facing video summaries introducing exponent rules and scientific notation Student tools: calculators, exponent rule charts, scientific notation reference sheets

- IXL
  Formative tools: exit tickets on exponent simplification, mini-quizzes on notation conversion
  Visual aids: exponent laws posters and order-of-magnitude number line visuals

Unit 8 - Pythagorean Theorem and Irrational Numbers

Desired Results - Goals, Transfer, Meaning, Acquisition

Established Goals:

- **8.G.B.6: Understand and use the Pythagorean Theorem to determine unknown side lengths in right triangles in contextual and coordinate settings.**
- **8.NS.A.2: Use rational approximations of irrational numbers to locate and compare them on the number line.**
- **8.EE.A.2: Perform arithmetic with numbers expressed in scientific notation, including operations with very large or very small values (supports understanding of irrational decimal representations)**

Standards for Mathematical Practice

- MP1: Make sense of problems and persevere in solving them.
- MP2: Reason abstractly and quantitatively.
- MP3: Construct viable arguments and critique the reasoning of others.
- MP4: Model with mathematics.
- MP5: Use appropriate tools strategically.
- MP6: Attend to precision.
- MP7: Look for and make use of structure.
- MP8: Look for and express regularity in repeated reasoning.

Vision of A Learner Attributes: Students will be able to independently use their learning to... ("I can" statements to be demonstrated)

- **TCC2**: I can evaluate data gathered from multiple perspectives and draw conclusions.
- **TCC4**: I can apply my learning to new experiences, determine if it works and adjust in the future.
- DE4: I can be respectful and responsible and build positive relationships with all members of the school community.
- P3: I can receive and provide constructive feedback and understand the need to adjust my goals/learning journey.
- CCE3: I can participate in collaborative conversations by actively listening, formulating questions ,making connected comments and providing various types of feedback to my peers.

Understandings: Students will understand that…

- Proofs of the Pythagorean Theorem can be constructed both algebraically and geometrically by showing area equivalence.
- The set of real numbers includes irrational numbers (like $\sqrt{2}$)

Essential Questions:

- Why does $a^2 + b^2 = c^2$ for every right triangle?
- What differentiates rational from irrational numbers, and how can we estimate irrational values?

that cannot be expressed exactly as fractions or decimals. • Square roots and cube roots represent side or edge lengths in geometric contexts and often require irrational approximations. • The Pythagorean Theorem extends to coordinate geometry and three-dimensional right rectangular prisms.	• How can we use the Pythagorean Theorem across dimensions and coordinate systems?
Students will know... • Definitions: rational vs. irrational numbers; square root and cube root notation. • Two proofs of the Pythagorean Theorem—using algebraic argument and area decomposition. • How to use the Pythagorean Theorem in problem-solving across two and three dimensions.	**Students will be able to...** • Apply the Pythagorean Theorem to compute distances in right triangles (including 3D prism diagonals). • Justify the theorem using area-based reasoning or algebraic manipulation. • Classify and approximate irrational numbers (e.g., $\sqrt{10}$, $\sqrt{2}$, $\sqrt[3]{30}$) on the number line. • Approximate irrational results in context and compare their magnitudes relative to rational benchmarks.
Key Vocabulary: Pythagorean Theorem, hypotenuse, leg, square root, cube root, irrational number, rational number, approximate, square of a number, proof, coordinate distance, prism diagonal.	
Assessment Evidence	
Performance Tasks: **TCC2**: Evaluate data gathered from multiple perspectives and draw conclusions. **TCC4**: I can apply my learning to new experiences, determine if it works and adjust in the future. Summative Assessment • Calculate area given the side lengths of squares in different units (inches, units, cm). • Determine the side length of a square when given the area in	**Other Evidence:** Various Thinking Tasks using Building Thinking Classrooms instructional strategies. Exit Tickets analyzing student learning and reflections Check Point Assessments

various units. • Classify numbers as rational or irrational. • Identify two whole numbers between which a square root falls • Write the Pythagorean Theorem correctly. • Use the Pythagorean Theorem to find missing side lengths in right triangles • Apply the Pythagorean Theorem in a real-world context	

Learning Plan

Lessons	Activities	Standards	Vision Attributes
Square Area vs. Side Length	Explore area decomposition of tilted squares; introduce √n	8.NS.A.2	TCC2, DE4, CCE3
Number Line Placement of Roots	Sequence √n and ∛n using bounds; plot on number line	8.NS.A.2	TCC2, DE4, CCE3
Pythagorean Proofs	Conduct two Pythagorean Theorem proofs (algebraic and geometric)	8.G.B.6	DE4, CCE3
Applying the Theorem	Solve right triangle and coordinate distance problems	8.G.B.6	DE4, CCE3
Cube Roots & 3D Diagonals	Relate cube roots to volumes; explore 3D prism diagonals	8.NS.A.2, 8.G.B.6	TCC2, DE4, CCE3, P3
Decimal Representations & Irrationality	Explore decimal representations and irrational numbers (e.g., √2)	8.NS.A.2	DE4, CCE3, P3
Culminating – Real-World Problems	Apply Pythagorean and irrational approximations in real-world contexts	All	TCC2, DE4, CCE3, P3

Teacher Resources:

- Illustrative Mathematics Unit 8 Teacher Guide with lesson narratives & standards
- Family-Friendly Unit Videos on square roots, Pythagorean proofs, and approximations
- Geometric tools: square/rectangle manipulatives, draft paper for area proof activities
- Graph paper & calculators for plotting and distance computations
- IXL
- Formative assessments: exit tickets on plotting roots and approximation justification
- Proof scaffolds: graphic organizers for algebraic and geometric theorem proofs