8th Grade Integrated Math

UNIT 1: SOLVING EQUATIONS & INEQUALITIES

ESSENTIAL QUESTION	BIG IDEAS
How can algebraic equations and inequalities be used to model, analyze, and solve real-world situations?	Students will solve equations and inequalities in one variable. Students will investigate and identify equations with a variety of solutions. Students will write equations and inequalities to model real world situations.

GUIDING QUESTIONS

Content and Process

- How are properties used to solve one-step, two-step, and multi-step equations and inequalities, including those with rational coefficients? **8.EE.7, 8.EE.7b**
- What is the difference between the solution(s) of an equation and an inequality? **8.EE.7**
- What method can be used to prove a solution(s) to an equation or inequality is true? **8.EE.7**
- What does it mean if an equation has one, no, or infinite solutions? **8.EE.7a**
- How is the distributive property and collecting like terms used to solve linear equations and inequalities? **8.EE.7b**

Reflective

- What strategies do I use to write an equation or an inequality to model a real life scenario?
- How much do you need to simplify an equation in order to determine the number of solutions it has?
- Using the equation $3(2x + 5) = ax + b$, how can you find a value for *a* and a value for *b* so that there are infinitely many, one, or no solution for the value of *x* that make the equation true?
- How would I tell a friend how to solve $\frac{1}{3}x - 5 + 171 = x$?

FOCUS STANDARDS

Standards of Mathematical Practice

MP.2 Reason abstractly and quantitatively.
MP.7 Look for and make use of structure.

Content Standards

8.EE.7. Fluently (efficiently, accurately, and flexibly) solve one-step, two-step, and multi-step linear equations and inequalities in one variable, including situations with the same variable appearing on both sides of the equal sign.

- **8.EE.7a.** Give examples of linear equations in one variable with one solution ($x = a$), infinitely many solutions ($a = a$), or no solutions ($a = b$). Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form $x = a,\ a = a,\ or\ a = b$results (where *a* and *b* are different numbers).
- **8.EE.7b.** Solve linear equations and inequalities with rational number coefficients, including equations/inequalities whose solutions require expanding and/or factoring expressions using the distributive property and collecting like terms.

UNIT 2: LINEAR FUNCTIONS

ESSENTIAL QUESTION	BIG IDEAS
How can functions be used to describe real-world situations, model predictions, and solve problems?	Students will discover the meaning of a function and investigate how it can be presented in various forms, including graphs, tables, equations and visual patterns. Students will construct and analyze functions that model linear relationships and distinguish how they are different from non-linear functions. Students can distinguish between proportional and non-proportional relationships.

GUIDING QUESTIONS

Content and Process

- When is the relationship between two quantities considered a function? **8.F.1**
- **How can linear functions be represented and compared in various forms. 8.F.2 & 8.F.3**
- What are examples of linear and nonlinear functions? **8.F.3**
- How do you determine and interpret the rate of change and initial value in order to construct various forms of linear functions? **8.F.4**
- What can you infer about a situation given a sketch of a graph? **8.F.5**
- How can similar triangles be used to prove the slope is the same between any two points on a line? **8.EE.5**
- How do I find the slope between any two points? **8.EE.5**
- What are the differences between proportional and nonproportional linear relationships? **8.EE.4, 8.EE.5, 8.EE.6**

Reflective

- How can I translate among representations of functions and describe how aspects of functions are reflected in different representations?
- How would I explain the differences between various forms of proportional and non-proportional

relationships?
- How would I explain to a friend how to derive an equation for a line?

FOCUS STANDARDS

Standards of Mathematical Practice

MP.2 Reason abstractly and quantitatively.
MP.8 Look for and express regularity in repeated reasoning.

Content Standards

8.F.1. Explain 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. *(Function notation is not required in Grade 8.)*

8.F.2. Compare properties of two linear functions represented in a variety of ways (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, the greater y-intercept, or the point of intersection.*

8.F.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.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.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.EE.4. Graph proportional relationships, interpreting its unit rate as the slope (m) 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.5. 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 and extend to include the use of the slope formula ($m = \frac{y_2 - y_1}{x_2 - x_1}$ when given two coordinate points (x_1, y_1) and (x_2, y_2)). Generate the equation $y = mx$ for a line through the origin (proportional) and the equation $y = mx + b$ for a line with slope *m* intercepting the vertical axis at y-intercept *b* (not proportional when $b \neq 0$).

8.EE.6. Describe the relationship between the proportional relationship expressed in $y = mx$ and the non-proportional linear relationship $y = mx + b$ as a result of a vertical translation. *Note: be clear with students that all linear relationships have a constant rate of change (slope), but only the special case of proportional relationships (line that goes through the origin) continue to have a constant of proportionality.*

UNIT 3: ANGLE RELATIONSHIPS

ESSENTIAL QUESTION	BIG IDEAS
How can angle relationships be used to solve mathematical problems?	Students explore and understand concepts of angles and angle measuremen Students investigate and informally prove the relationship between angles tha are created when parallel lines are cut by a transversal. Students examine the relationships between exterior and interior angles of a triangle and construct triangles given a variety of conditions.

GUIDING QUESTIONS

Content and Process

- What is the relationship between the number of degrees in an angle and a circle measuring 360 degrees? **8.G.1a,b**
- How can we classify angles that are created when two rays share a common endpoint based on the degree measurement? **8.G.1**
- How can an angle be measured and constructed using a protractor? **8.G.2**
- How can algebraic reasoning and the angle properties be used to solve for unknown angle measures in a variety of problems? **8.G.3; 8.G.4; 8.G5**
- How can the properties of complementary, supplementary, adjacent and vertical angles be used to solve problems? **8.G.4**
- What is the relationship between angle sums and exterior angle sums of triangles? **8.G.5**
- How can angles be used to prove triangles are similar? **8.G.5**
- How can you use angle measures and side lengths to create multiple and unique triangles, or determine that no triangle is possible? **8.G.6**

Reflective

- How can I use the relationships between parallel lines cut by a transversal to find multiple missing angle measures in a diagram?
- How can I construct triangles using given angle measures and/or side lengths?
- How do I use algebra to create and solve equations to find unknown angle measures in a problem?

FOCUS STANDARDS

Standards of Mathematical Practice

MP.5 Use appropriate tools strategically.
MP.6 Attend to precision.

Content Standards

8.G.1. Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement:

- **8.G.1a.** An angle is measured with reference to a circle with its center at the common endpoint of the rays, by considering the fraction of the circular arc between the points where the two rays intersect th circle. An angle that turns through $\frac{1}{360}$ of a circle is called a "one-degree angle," and can be used to measure angles.
- **8.G.1b.** An angle that turns through *n* one-degree angles is said to have an angle measure of *n* degrees.

8.G.2. Measure angles in whole-number degrees using a protractor. Draw angles of specified measure using protractor and straight edge.

8.G.3. Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real world and mathematical problems, *e.g. by using an equation with a symbol for the unknown angle measure.*

8.G.4. Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem t write and use them to solve simple equations for an unknown angle in a figure.

8.G.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 appear to form a line, and give an argument in terms of transversals why this is so.*

8.G.6. Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given condition Focus on drawing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle.

UNIT 4: DISCOVERING PYTHAGORAS & IRRATIONAL NUMBERS

ESSENTIAL QUESTION	BIG IDEAS
How can the Pythagorean Theorem be used to solve problems?	Students will build a visual understanding of irrational numbers. Students will investigate and apply the Pythagorean Theorem to solve real-world and mathematical problems.

GUIDING QUESTIONS

Content and Process

- What is the difference between rational and irrational numbers? **8.NS.1**
- How does a number line help approximate and compare irrational numbers? **8.NS.2**
- How does understanding inverse operations help solve equations containing square or cube numbers? **8.EE.1**
- How can the square root of a number be classified as rational or irrational? **8.EE.1**
- What is the relationship between the area and the side length of a square? **8.G.7, 8.G.8**
- How is the converse of the Pythagorean Theorem used to show a triangle is right? **8.G.7**
- How does applying the Pythagorean Theorem help find unknown lengths in right triangles and problems in two and three dimensions? **8.G.8**
- How can the Pythagorean Theorem be used to find the distance between two points in a coordinate system? **8.G.9**

Reflective

- How can I find the area of any square by sub-diving it or surrounding it with a larger square?
- What strategies did you use to find the area and side length of a square with an irrational length?
- How would you estimate the value of a square root, such as $\sqrt{60?}$
- How could you find the length of any line segment on a grid?

FOCUS STANDARDS

Standards of Mathematical Practice

MP.5 Use appropriate tools strategically.
MP.7 Look for and make use of structure.

Content Standards

8.NS.1. Know that numbers that are not rational are called irrational. Understand informally that every numbe 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.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, f the approximation of* $\sqrt{68}$ *, show that* $\sqrt{68}$ *is between 8 and 9 and closer to 8.*

8.EE.1. 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. Evaluate square roots of whole number perfect squares with solutions between 0 and 15 and cube roots of whole number perfect cubes with solutions between 0 and 5. Know that $\sqrt{2}$ is irrational.

8.G.7. Explain a proof of the Pythagorean Theorem and its converse.

8.G.8. Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world an mathematical problems in two and three dimensions. *For example: Finding the slant height of pyramids and cones.*

8.G.9. Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

UNIT 5: WHAT'S IN THE DATA? (LINEAR MODELS)

ESSENTIAL QUESTION	BIG IDEAS
How does investigating patterns in data help us solve problems?	Students will investigate patterns of association in bivariate data. Students will use linear models to solve problems.

GUIDING QUESTIONS

Content and Process

- What kind of patterns of associations can be found in bivariate data represented as a scatter plot? **8.SP.1**
- How is a straight line used to model relationships between two quantities? **8.SP.2**
- How is a linear equation used to make predictions about bivariate data and solve problems? **8.SP.3**
- How can the slope and y-intercept be interpreted in the context of a real world problem? **8.SP.3**

Reflective

- Why is a scatter plot a good representation of bivariate data?
- How do outliers and/or clustering influence data analysis?
- How do scatter plots and lines of best fit enable you to make predictions about data?
- What types of patterns did you notice when investigating a variety of scatter plots of data?

FOCUS STANDARDS

Standards of Mathematical Practice

MP.1 Make sense of problems and persevere in solving them.
MP.4 Model with mathematics.

Content Standards

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

8.SP.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 slc of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cn mature plant height.*

UNIT 6: 3D GEOMETRY

ESSENTIAL QUESTION	BIG IDEAS
How can understanding volume and surface area of three dimensional objects help solve real-world and mathematical problems?	Students will investigate and generalize formulas for the volume and surfa area of geometric shapes. Students will apply formulas for the volume and surface area of geometric shapes to solve real-world problems.

GUIDING QUESTIONS

Content and Process

- How is the arc length in a circle measured? **8.G.10**
- How is the area of a sector in a circle calculated? **8.G.10**
- How can arc length and area of sectors be applied to solve real-world and mathematical problems' **8.G.12**
- How can formulas be used to find the surface area and volume of pyramids, cones, and spheres? **8.G.10**
- How is the relationship between 1) the volume of cylinders and cones, 2) the volume of cylinders aı spheres, 3) the volume of prisms and pyramids represented in the corresponding formulas? **8.G.10, 8.G.11**
- How is the formula for finding the surface area of pyramids and cones generalized? **8.G.11**
- How can surface area and volume of three dimensional objects be applied to solve real-world and mathematical problems? **8.G.12**

Reflective

- What relationships between the volumes of cylinders, cones, and spheres do you think will be the most useful to you in the world? Explain.
- What is the relationship between surface area and volume of 3 dimensional geometric shapes?

- What strategy would you tell a friend about to help her find the surface area of any sized pyramid c
cone?

FOCUS STANDARDS

Standards of Mathematical Practice
MP.3 Construct viable arguments and critique the reasoning of others.
MP.6 Attend to precision.

Content Standards

8.G.10 Use the formulas or informal reasoning to find the arc length, areas of sectors, surface areas and volumes of pyramids, cones, and spheres. *For example, given a circle with a 60° central angle, students identify the arc length as* $\frac{1}{6}$ *of the total circumference* $\left(\frac{1}{6} = \frac{60}{360}\right)$.

8.G.11 Investigate the relationship between the formulas of three dimensional geometric shapes;

- **8.G.11a.** Generalize the volume formula for pyramids and cones ($V = \frac{1}{3}Bh$).
- **8.G.11b.** Generalize surface area formula of pyramids and cones ($SA = B + \frac{1}{2}Pl$).

8.G.12. Solve real-world and mathematical problems involving arc length, area of two-dimensional shapes including sectors, volume and surface area of three-dimensional objects including pyramids, cones and spheres.