Theme: Expressions and Equations **Suggested Days of Instruction: 40 days**

Ohio's Learning Standards

EXPRESSIONS AND EQUATIONS (EE)

Work with radicals and integer exponents. Understand the connections between proportional relationships, lines, and linear equations.

8.EE.A.1 Understand, explain, 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.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 positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.

8.EE.A.3 Use numbers expressed in the form of single digit times an integer power of 10 to estimate very large or very small quantities and to express how many times as much one is than the other. *For example, estimate the population of the United States as* $3 \ times \ 10^8$*; and the population of the world as* $7 \ times \ 10^9$*; and determine that the world population is more than 20 times larger.*

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.

8. EE.B. 5 Graph proportional relationships, interpreting the unit rate as rate the slope of 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 the two moving objects has greater*

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 intercepting the vertical *axis* at b.

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 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 corresponds to point of intersection of their graphs, because points of intersection satisfy both equations simultaneously.

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

c. Solve real-world and mathematical problems leading to two linear equations in tow variables. For example, given coordinates for two pair of points, determine whether the line though the first pair of points intersect the line through the second pair of lines.

Commentary

Eighth graders focus on more complex equations by learning about and applying the properties of inter exponents, square and cube roots, and scientific notation, they also connect previous understandings about proportional relationships to linear equations. Systems of two linear equations in two variables are introduced, and three methods for finding solutions are learned.

Students will learn how to compute with integer exponents. Students build in what they have learned about square roots to solve equations in the form of $x^2 = p$ and $\mathrm{x}^3 = \mathrm{p}$, where p is a positive rational number, evaluating perfect square and perfect cube roots. Students learn how to express very large very small numbers in scientific notation and express hoe many times larger or smaller one number written in scientific notation is than another, Students use the properties of integer exponents to perform operations with number written in scientific notation. Students interpret numbers written in scientific notation using technology.

Students connect proportional relationships, lines, and linear equations. First, students compare proportional relationships represented in different ways such as graphs, tables, linear equations. Unit rate is interpreted as the slope of a line, and students learn that the slope is the same between any two points on a line using similar triangles. Then the general equations for a line *(y=mx +b* and *y=mx)* are derived.

Students analyze and solve one variable linear equations for one, zero, or infinitely many solutions, simplifying the equations until they reach x=a, a=a, a=b (*where a and b are different numbers*). Students then apply that knowledge to analyzing and solving pairs of simulations linear equations also known as systems of linear equations in two variables

Students will understand that points of intersections are the solutions to pairs of simultaneous linear equations (also known as systems of linear equations) Students will solve systems graphically, algebraically, and by inspection. Examples in this standard are in real-world context and mathematical problems.

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Resources:

SpringBoard: Unit 2 (Lessons 9-1 to 9 -2) Unit 2 (Lessons 10-1 to 10-2)
Unit 2 (Lessons 11-1 to 11-2) Unit 2 Lessons 12-1 to 12-3)
Unit 2 (Lessons 13-1 to 13-2) Unit 2 (Lessons 14-1 to 14-2)
Unit 2 Lessons (15-1 to 15-2)
Note: Lessons 1-1 to 2-1 provide a review of Grade 7 skills.

Manipulatives: Number lines, square tiles, Unifix or Linking cubes, posters, paper and pencil,

Embedded Assessments

Unit 2

EA1: Expressions and Equations, ***What a Good Idea!***
EA2: Expressions and Equations, ***Who is that?***
EA3: Expressions and Equations, ***Supply and Demand***

Formative Assessments

SpringBoard Digital: Short-Cycle Assessment for each lesson

Summative Assessments

SpringBoard Digital: End of Unit or Customized Assessment

OST Released Items:

Addressing Student Misconceptions and Common Errors

8.EE.1

Students often confuse the rules. This occurs primarily when students are taught to memorize the rules rather than understand what is happening in the properties by working with numerical expressions as in the suggestions above. It is important to present examples and let students discover what the rules are. Then students should be encouraged to write their reasoning so they can clarify the explanations for themselves.

8.EE.2

It is important for students to have multiple opportunities and exposures with perfect cubes. This is a new concept in the curriculum and many students struggle with finding cube roots. A common misconception for cube roots is that any number times 3 is a perfect cube. Building larger cubes from smaller ones gives students a visual that they can rely on.

8.EE.3

Students often confuse a very large number for a small number when written in scientific notation such as 4,000,000 for 4×10^{-6}. This usually is a result of students trying to memorize a rule about moving a decimal point to the left or the right. Instead of teaching a rule, rely on students' background knowledge of negative exponents. Before rewriting a number in standard form, look to the exponent to determine whether it is a small or large number. This can be used as a check.

Students who do not understand the properties of exponents also make errors in computation with scientific notation. Teachers may need to review these properties.

8.EE. 4

When performing operations with numbers in scientific notation, such as $(7 \times 10^5) \times (18 \times 10^9)$, some students will be overwhelmed with keeping track of what they should do. Encourage these students to color code the numbers such as highlighting the numbers in exponential form in the given example so students remember to work them together.

8.EE. 5

Errors occur when students are overwhelmed by being presented with too much information at a time. Encourage students having difficulty making the comparisons to work with one relationship at a time. Graphing may be a difficult skill for some students. Use graph paper larger than 1 cm for these students so they can see the unit rate easier.

Students who are overwhelmed can also be helped by using graphs of experiences that are familiar to them. This makes the information more accessible so student can better understand and interpret proportional relationships.

8. EE. 6

A common error students make is to misuse the formula for finding the slope of a line given two points. They use x-y or use the difference of the x coordinates divided by the difference of the x coordinates divides by the difference of the y coordinates. Look for these common errors. Focus students' attention on the errors by using error analysis task. For example, Jed used the following equation to find the slope of a line $\frac{x_1}{y_1} - \frac{x_2}{y_2}$. Find Jed's mistake and correct it.

8. EE. 7

A common error students make involves applying the distributive property when negative integers are involved, such as -2(-x-4). The error occurs when they try to multiply the -2 and the -4. Students need repeated exposure to equations of this type. Prompting students to consider "minus 4" as plus negative 4" helps correct the misconception. Providing and discussing task that involve students analyzing errors helps students self-correct many misconceptions.

8. EE. 8

Common errors for systems of equations include students who have accurately graphing and, therefore cannot correctly estimate the solution. Technology can be helpful as can graph paper with larger than 1-cm squares.