Click-On TEKS

A simple approach to understanding the Texas Essential Knowledge and Skills

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GRADE 8 MATH

REGION 13
EDUCATION SERVICE CENTER

These explanations of the new state math standards are designed to help you understand what the standards mean and how the models of teaching math help students understand mathematics more deeply. Others may interpret the standards differently and may have different ideas for how to teach them. It is the hope of the authors that this deconstruction of the Texas Essential Knowledge and Skills (TEKS) for mathematics makes teaching math more rigorous, more fun, and a little less confusing.

The goal of this document is to be responsive to the updated information about the new Mathematics TEKS. Specificity and/or activities may be adjusted over time as more information becomes available from the state.

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Strand 1: Mathematical Process Standards	
8.1	Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:

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Structure of the TEKS

The Texas Essential Knowledge and Skills (TEKS) consists of four parts.

Part 1: The Introduction

The state standards, or TEKS, for each grade level begin with an Introduction. The Introduction gives an overview of the focal areas for each grade and provides general information about numerical fluency and the processing skills. While the Introduction has not been reprinted in this product, information from the Introduction has been included in the explanations of the TEKS where appropriate.

Part 2: Strands

The standards are broken into groups or categories called Strands. The TEKS for 8th grade mathematics are divided into seven strands:

1. Mathematical Process Standards: This strand contains the process standards for mathematics, which are the same from Kindergarten through Pre-Cal. The process standards are the ways that students acquire math content through the use of models and tools, communication, problem solving, reasoning and analysis, and making connections. These standards should be woven consistently throughout the content strands (2–6). The dual-coded questions on STAAR will be coded with a content standard and a process standard.
2. Number and Operations
3. Proportionality
4. Expressions, Equations, and Relationships
5. Two-dimensional Shapes
6. Measurement and Data
7. Personal Financial Literacy

Example

8.1 Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:

(A) apply mathematics to problems arising in everyday life, society, and the workplace.

Part 3: Knowledge and Skills Statements

Immediately following the strand is the **Knowledge and Skills** (K&S) statement. It provides the context for the student expectations that follow it.

Numbering: The first number is the grade level. The second number is the Knowledge and Skills number. The K&S statement shown is from eighth grade.

Part 4: Student Expectations

Immediately following each Knowledge and Skills statement is a list of **Student Expectations** (SE).

The letters, such as (A), refer to what students are expected to do with regard to a particular Knowledge and Skills statement. We often refer to this example as 8.1A. [Grade Level eighth grade, Knowledge and Skills statement (1), Student Expectation (A)]

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8.4	Proportionality. The student applies mathematical process standards to explain proportional and non-proportional relationships involving slope. The student is expected to:
8.4A	use similar right triangles to develop an understanding that slope, m, given as the rate comparing the change in y-values to the change in x-values, (y_2-y_1/x_2-x_1) is the same for any two points (x_1, y_1) and (x_2,y_2) on the same line. **RC2, Supporting Standard**
8.4B	graph proportional relationships, interpreting the unit rate as the slope of the line that models the relationship. **RC2, Readiness Standard**
8.4C	use data from a table or graph to determine the rate of change or slope and y-intercept in mathematical and real-world problems. **RC2, Readiness Standard**
8.5	Proportionality. The student applies mathematical process standards to use proportional and non-proportional relationships to develop foundational concepts of functions. The student is expected to:
8.5A	represent proportional situations with tables, graphs and equations in the form of y = kx. **RC2, Supporting Standard**
8.5B	represent linear non-proportional situations with tables, graphs and equations in the form of y = mx + b, where b ≠ 0. **RC2, Supporting Standard**
8.5C	contrast bivariate sets of data that suggest a linear relationship with bivariate sets of data that do not suggest a linear relationship from a graphical representation. **RC4, Supporting Standard**
8.5D	use a trend line that approximates the linear relationships between bivariate sets of data to make predictions. **RC4, Readiness Standard**
8.5E	solve problems involving direct variation. **RC2, Supporting Standard**
8.5F	distinguish between proportional and non-proportional situations using tables, graphs, and equations in the form y = kx or y = mx + b, where b ≠ 0. **RC2, Supporting Standard**
8.5G	identify functions using sets of ordered pairs, tables, mappings, and graphs. **RC2, Readiness Standard**
8.5H	identify examples of proportional and non-proportional functions that arise from mathematical and real-world problems. **RC2, Supporting Standard**
8.5I	write an equation in the form y = mx + b to model a linear relationship between two quantities using verbal, numerical, tabular, and graphical representations. **RC2, Readiness Standard**

Strand 4: Expressions, Equations, and Relationships

8.6	Expressions, equations, and relationships. The student applies mathematical process standards to develop mathematical relationships and make connections to geometric formulas. The student is expected to:
8.6A	describe the volume formulas V = Bh of a cylinder in terms of its base area and its height. **RC3, Supporting Standard**
8.6B	model the relationship between the volume of a cylinder and a cone having both congruent bases and heights and connect that relationship to the formulas.
8.6C	use models and diagrams to explain the Pythagorean Theorem. **RC3, Supporting Standard**
8.7	Expressions, equations, and relationships. The student applies mathematical process standards to use geometry to solve problems. The student is expected to:
8.7A	solve problems involving the volume of cylinders, cones, and spheres. **RC3, Readiness Standard**

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8.7B	use previous knowledge of surface area to make connections to the formulas for lateral and total surface area and determine the solutions for problems involving rectangular prisms, triangular prisms, and cylinders. **RC3, Readiness Standard**
8.7C	use the Pythagorean Theorem and its converse to solve problems. **RC3, Readiness Standard**
8.7D	determine the distance between two points on a coordinate plane using the Pythagorean Theorem. **RC3, Supporting Standard**
8.8	Expressions, equations, and relationships. The student applies mathematical process standards to use one-variable equations or inequalities in problem situations. The student is expected to:
8.8A	write one-variable equations or inequalities with variables on both sides that represent problems using rational number coefficients and constants. **RC2, Supporting Standard**
8.8B	write a corresponding real-world problem when given a one-variable equation or inequality with variables on both sides of the equal sign using rational number coefficients and constants. **RC2, Supporting Standard**
8.8C	model and solve one-variable equations with variables on both sides of the equal sign that represent mathematical and real-world problems using rational number coefficients and constants. **RC2, Readiness Standard**
8.8D	use informal arguments to establish facts about the angle sum and exterior angle of triangles, the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. **RC3, Supporting Standard**
8.9	Expressions, equations, and relationships. The student applies mathematical process standards to use multiple representations to develop foundational concept of simultaneous linear equations. The student is expected to identify and verify the values of x and y that simultaneously satisfy two linear equations in the form y = mx + b from the intersection of the graphed equations. **RC2, Supporting Standard**

Strand 5: Two-Dimensional Shapes	
8.10	Two-dimensional shapes. The student applies mathematical process standards to develop transformational geometry concepts. The student is expected to:
8.10A	generalize the properties of orientation and congruence of rotations, reflections, translations, and dilations of two-dimensional shapes on a coordinate plane. **RC3, Supporting Standard**
8.10B	differentiate between transformations that preserve congruence and those that do not. **RC3, Supporting Standard**
8.10C	explain the effect of translations, reflections over the x- and y-axis and rotations limited to 90°, 180°, 270°, and 360° as applied to two-dimensional shapes on a coordinate place using algebraic representation. **RC3, Readiness Standard**
8.10D	model the effect on linear and area measurements of dilated two-dimensional shapes. **RC3, Supporting Standard**

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Strand 6: Measurement and Data	
8.11	Measurement and data. The student applies mathematical process standards to use statistical procedures to describe data. The student is expected to:
8.11A	construct a scatterplot and describe the observed data to address questions of association such as linear, nonlinear, and no association between bivariate data. **RC4, Supporting Standard**
8.11B	determine the mean absolute deviation and use this quantity as a measure of the average distance data are from the mean using a data set of no more than 10 data points. **RC4, Supporting Standard**
8.11C	simulate generating random samples of the same size from a population with known characteristics to develop the notion of a random sample being representative of the population from which it was selected.

Strand 7: Personal Financial Literacy	
8.12	Personal financial literacy. The student applies mathematical process standards to develop an economic way of thinking and problem solving useful in one's life as a knowledgeable consumer and investor. The student is expected to:
8.12A	solve real-world problems comparing how interest rate and loan length affect the cost of credit. **RC4, Supporting Standard**
8.12B	calculate the total cost of repaying a loan, including credit cards and easy access loans, under various rates of interest and over different periods using an online calculator.
8.12C	explain how small amounts of money invested regularly, including money saved for college and retirement, grow over time. **RC4, Supporting Standard**
8.12D	calculate and compare simple interest and compound interest earnings. **RC4, Readiness Standard**
8.12E	identify and explain the advantages and disadvantages of different payment methods.
8.12F	analyze situations to determine if they represent financially responsible decisions and identify the benefits of financial responsibility and the costs of financial irresponsibility.
8.12G	estimate the cost of a two-year and four-year college education, including family contribution, and devise a periodic savings plan for accumulating the money needed to contribute to the total cost of attendance for at least the first year of college. **RC4, Supporting Standard**

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Strand 2: Numbers and Operations

8.2 Number and operations. The student applies mathematical process standards to represent and use real numbers in a variety of forms. The student is expected to:

8.2A extend previous knowledge of sets and subsets using a visual representation to describe relationships between sets of real numbers. (RC1, Supporting Standard)

Our number system consists of several different sets of numbers—counting numbers, whole numbers, integers, rational numbers, irrational numbers, real numbers, and imaginary numbers. Eighth graders work with all of these sets except imaginary numbers:

Whole numbers are the numbers starting with 0 and counting up.

0, 1, 2, 3, 4 …

Integers include the whole numbers, but they also include negative numbers.

…-3, -2, -1, 0, 1, 2, 3 …

Rational numbers are numbers that can be written in the form of a fraction. Numbers are considered rational even when they are not in fraction form. This includes positive and negative fractions as well as some decimals that repeat a pattern or decimals that terminate. Examples of rational numbers:

$$-16,\ 0,\ 245,\ 3.58,\ \frac{4}{6},\ 5.555\ldots,\ 7.3434343\ldots,\ \sqrt{9}$$

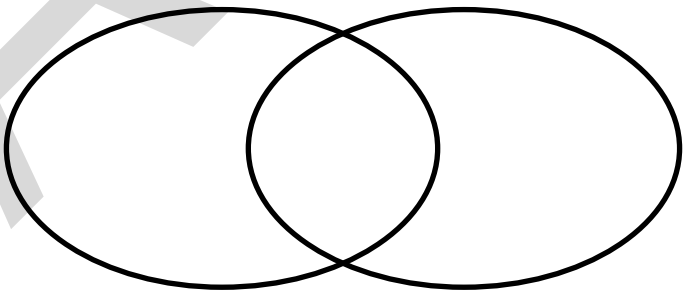
Irrational numbers are numbers that cannot be written in the form of a fraction. They are decimals that neither terminate nor repeat. They also include square roots of numbers that are not perfect squares. Examples of irrational numbers:

$$\pi,\ \sqrt{27},\ 3.3874395\ldots$$

Real numbers are the set of rational numbers and irrational numbers.

Example/Activity

This Student Expectation (SE) suggests that a Venn diagram be used to help students understand the structure of the number system. Typical Venn diagrams look like this:



The overlapping part contains the elements of the set that are common to both sets.

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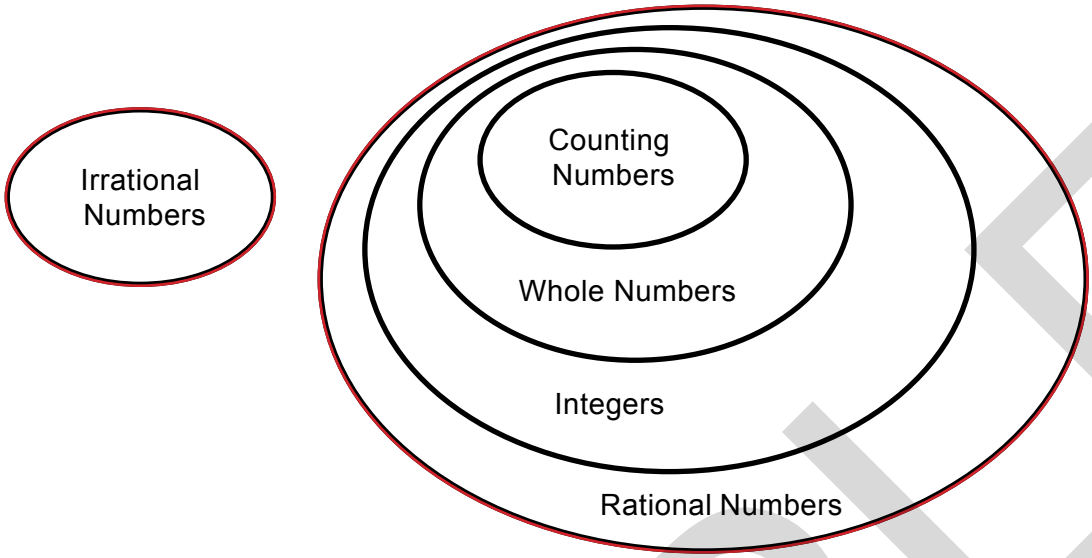
The Venn diagram for the number system looks a bit different. The sets are nested inside each other. This is because each of the smaller sets of numbers is a complete subset of a larger set of numbers. When taken together, all of the rationals and irrationals (all number types within the red rings) make up the set of real numbers.



Students in 8th grade will understand counting and whole numbers as they have been working with them since Kindergarten. Eighth grade students encountered integers and rational numbers in 6th grade. Although rational numbers have been included in middle school, the concept of a rational number will still be new to them. It also includes number types that they have rarely seen—decimals that repeat a pattern. These types of decimals typically appear when students are learning to divide decimals and are not part of the life of a typical 8th grader.

This Student Expectation contains several words that are commonly used in the English language—rational, irrational, and real—but that have a completely different meaning in mathematics. This needs to be explicitly addressed when teaching the names of the sets of numbers.

8.2 Number and operations. The student applies mathematical process standards to represent and use real numbers in a variety of forms. The student is expected to:

8.2B approximate the value of an irrational number, including π and square roots of numbers less than 225, and locate that rational number approximation on a number line. (RC1, Supporting Standard)

8.2B has two parts. First, students have to approximate the value of irrational numbers. Notice that this Student Expectation (SE) does not say that students have to "know" the values. They actually have to approximate the values. This is different from knowing that π is between 3 and 4. Students also have to approximate the value of π.

The second part of the SE is locating the rational number on a number line.

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Example/Activity

To approximate square roots, first identify the perfect square above and below the number. For $\sqrt{11}$, we know that its value must be between 3 and 4. Is the value closer to 3 or closer to 4?
To find the approximation, use the decimal values to the tenths between 3 and 4.

3^2	9
3.1^2	9.61
3.2^2	10.24
3.3^2	10.89
3.4^2	11.56
3.5^2	12.25
3.6^2	12.96
3.7^2	13.69
3.8^2	14.44
3.9^2	15.21
4^2	16

Since 3.3^2 is 10.89 and 3.4^2 is 11.56, $\sqrt{11}$ must be between 3.3 and 3.4.
All of the squares between 3 and 4 are shown here, but students can use their critical thinking to choose which decimals to try. For example, 3^2 is 9 and 4^2 is 16, so $\sqrt{11}$ is probably closer to 3 than it is 4. Through critical thinking, students can reduce the number of perfect squares they have to try, reducing the amount of complicated arithmetic they need to do. This is also an excellent opportunity to use the graphing calculator to help organize the values to be compared.

To approximate π, students will need to compare the circumference of circles with their diameters. When the circumference is divided by the diameter, π appears.

For the second part of the SE, students must graph the decimal approximations on a number line. Since these numbers are decimal approximations, the space between the whole numbers needs to be approximately divided into tenths. Since students have graphed decimals on a number line beginning in 5th grade, they do NOT need to be given number lines with the tenths marked. Students should know that 3.6 is fairly close to halfway between 3 and 4 and that 3.1 is nearly 3.

8.2 Number and operations. The student applies mathematical process standards to represent and use real numbers in a variety of forms. The student is expected to:

8.2C convert between standard decimal notation and scientific notation. (RC1, Supporting Standard)

The verb for 8.2C is *convert*. Students must be able to convert a number that is written in standard notation into scientific notation. They also must be able to convert numbers written in scientific notation back into decimal notation.

Example/Activity

Scientific notation was created as a way to write very large numbers and very small numbers. For example, the speed of light is 299,792,458 meters per second. To write this number in scientific notation, the number is rewritten as a decimal with a digit only in the ones place. The rest of the digits are behind the decimal. Then the decimal is multiplied by a power of ten. So the speed of light in scientific notation is 2.99792458×10^8.

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Here is another example. The speed of a leatherback sea turtle when he/she is swimming is about 10.1 kilometers per hour. Written in scientific notation, this is 1.01×10^1.
Think about those two numbers from an 8th grader's point of view. Which numbers will the 8th grader hone in on? The 2.99792458 and the 1.01. Which numbers really tell the important information? The 10^8 and the 10^1. As the teacher, you are going to have to help students understand the difference in magnitude between those two numbers. Otherwise, the leatherback sea turtle is about a third as fast as the speed of light.

Another possible misconception that students may have deals with very small numbers that are written in scientific notation. For instance, the mass of a proton is 0.00000000000000000000000001673 kilograms, a very small number. In scientific notation this number is 1.673×10^{-27} kg. To many 8th grade students, this looks like a negative number. However, the negative does not indicate a negative number, but rather shows multiplication by a decimal.

Converting from scientific notation to decimal notation can be interesting, too. For example, give students a number like 1.989×10^{30} kg and ask them to guess what that number might describe. Can they hold that much in their hands? Could the strongest man in the world hold that much? You can even tell them that it is the mass of an object. What is the object? It's the sun.

The point of this is that scientific notation taught as a process is easily misunderstood, and it's not fun. Scientific notation taught as a way to think about the size of very large or very small things is fun and interesting, often because of the conversations that surround the sizes.

8.2 Number and operations. The student applies mathematical process standards to represent and use real numbers in a variety of forms. The student is expected to:

8.2D order a set of real numbers arising from mathematical and real-world contexts. (RC1, Readiness Standard)

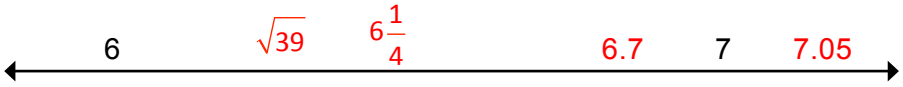
8.2D requires students to order a set of real numbers. The set of numbers needs to come from a mathematical or real-world context. It is important that students see numbers written in a variety of forms in this list, not just a list of decimals or a list of fractions. Students have worked with those kinds of lists for several years, and those lists do not rise to the level of the 8th grade Student Expectation (SE).

Example/Activity

Students should be able to put the list of numbers in order from largest to smallest and smallest to largest. Even when students know the order of the numbers, they sometimes struggle with writing or choosing the correct list of numbers. One way to scaffold students' writing of the list is to have them place the numbers on an open number line first. The spacing does not have to be correct, but the order does. Sometimes this will help them write the list in the order that the problem asks for.

Example: Put the numbers 6.7, $\sqrt{39}$, $6\frac{1}{4}$, and 7.05 in order from greatest to least.

First the student draws an open number line, puts some benchmark numbers on it, and places the "easy" numbers on it (e.g., the numbers in black). Then the student does a quick approximation on scratch paper, finds out that $\sqrt{39}$ is approximately 6.24, and places it on the number line like the numbers in red.



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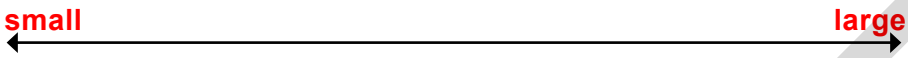
Now they have to write the list. Students know that going from left to right on a number line is smallest to largest. So to write from largest to smallest, they go the opposite direction.

$$7.05 \quad 6\frac{1}{4} \quad \sqrt{39} \quad 6.7$$

Another scaffold you can use is to add the words “small” and “large” to the number line near the arrows.



This might provide a visual cue to writing the list of numbers.

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