HIGLEY UNIFIED SCHOOL DISTRICT
INSTRUCTIONAL ALIGNMENT

8th Grade Math First Quarter

Module 1: Integer Exponents and Scientific Notation (20 days)
Unit 1: Exponential Notation and Properties of Integer Exponents

In Module 1, students' knowledge of operations on numbers will be expanded to include operations on numbers in integer exponents. Module 1 also builds on students' understanding from previous grades with regard to transforming expressions. Students were introduced to exponential notation in Grade 5 as they used whole number exponents to denote powers of ten (**5.NBT.2**). In Grade 6, students expanded the use of exponents to include bases other than ten as they wrote and evaluated exponential expressions limited to whole-number exponents (**6.EE.1**). Students made use of exponents again in Grade 7 as they learned formulas for the area of a circle (**7.G.4**) and volume (**7.G.6**).
In this module, students build upon their foundation with exponents as they make conjectures about how zero and negative exponents of a number should be defined and prove the properties of integer exponents (**8.EE.1**). These properties are codified into three Laws of Exponents. They make sense out of very large and very small numbers, using the number line model to guide their understanding of the relationship of those numbers to each other (**8.EE.3**).

Big Idea:	• The value of any real number can be represented in relation to other real numbers such as with decimals converted to fractions, scientific notation and numbers written with exponents ($8 = 2^3$).
Essential Questions:	• Why are quantities represented in multiple ways? • How is the universal nature of properties applied to real numbers?
Vocabulary	Scientific notation, order of magnitude (exponential notation, base, exponent, power, integer, whole number, expanded form of decimal numbers, square of a number, cube of a number, equivalent fractions)

Grade	Cluster	Standard	Common Core Standards	Explanations & Examples	Comments
8	EE.A	1	**A.Work with radicals and integer exponents.** Know and apply the properties of integer exponents to generate equivalent numerical expressions. *For example,* $3^2 \times 3^{-5} = 3^{-3} = 1/33 = 1/27$. *8.MP.2.* Reason abstractly and quantitatively. *8.MP.5.* Use appropriate tools strategically. *8.MP.6.* Attend to precision. *8.MP.7.* Look for and make use of structure.	In 6th grade, students wrote and evaluated simple numerical expressions with whole number exponents (ie. 53 = 5 • 5 • 5 = 125). Integer (positive and negative) exponents are further developed to generate equivalent numerical expressions when multiplying, dividing or raising a power to a power. Using numerical bases and the laws of exponents, students generate equivalent expressions. Students understand: • Bases must be the same before exponents can be added, subtracted or multiplied. (Example 1) • Exponents are subtracted when like bases are being divided (Example 2)	Modeling mathematics (**MP.4**) with radicals, integer exponents, and scientific notation requires that students attend to precision (**MP.6**) and look for and express regularity in repeated reasoning (**MP.8**). Students will also need to use appropriate tools strategically since

				• A number raised to the zero (0) power is equal to one. (Example 3) • Negative exponents occur when there are more factors in the denominator. These exponents can be expressed as a positive if left in the denominator. (Example 4) • Exponents are added when like bases are being multiplied (Example 5) • Exponents are multiplied when an exponents is raised to an exponent (Example 6) • Several properties may be used to simplify an expression (Example 7) Example 1: $\frac{2^3}{5^2} = \frac{8}{25}$ Example 2: $\frac{2^2}{2^6} = 2^{2-6} = 2^{-4} = \frac{1}{2^4} = \frac{1}{16}$ Example 3: $6^0 = 1$ Students understand this relationship from examples such as $\frac{6^2}{6^2}$. This expression could be simplified as $\frac{36}{36} = 1$. Using the laws of exponents this expression could also be written as $6^{2-2} = 6^0$. Combining these gives $6^0 = 1$.	some calculations can be completed more easily through visual inspection than with a calculator (**MP.5**).

				Example 4: $\frac{3^{-2}}{2^4} = 3^{-2} \text{ x } \frac{1}{2^4} = \frac{1}{3^2} \text{ x } \frac{1}{2^4} = \frac{1}{9} \text{ x } \frac{1}{16} = \frac{1}{144}$ Example 5: $(3^2)(3^4) = (3^{2+4}) = 3^6 = 729$ Example 6: $(4^3)^2 = 4^{3x2} = 4^6 = 4{,}096$ Example 7: $\frac{(3^2)^4}{(3^2)(3^3)} = \frac{3^{2x4}}{3^{2+3}} = \frac{3^8}{3^5} = 3^{8-5} = 3^3 = 27$	
8	EE. A	3	**A.Work with radicals and integer exponents.** Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. *For example, estimate the population of the United States as* 3×10^8 *and the population of the world as* 7×10^9*, and determine that the world population is more than 20 times larger.* *8.MP.2.* Reason abstractly and quantitatively. *8.MP.5.* Use appropriate tools strategically. *8.MP.6.* Attend to precision.	Students use scientific notation to express very large or very small numbers. Students compare and interpret scientific notation quantities in the context of the situation, recognizing that if the exponent increases by one, the value increases 10 times. Likewise, if the exponent decreases by one, the value decreases 10 times. Students solve problems using addition, subtraction or multiplication, expressing the answer in scientific notation. Example 1: Write 75,000,000,000 in scientific notation. *Solution:* $7.5 \text{ x } 10^{10}$ Example 2: Write 0.0000429 in scientific notation. *Solution:* $4.29 \text{ x } 10^{-5}$ Example 3: Express $2.45 \text{ x } 10^5$ in standard form. *Solution:* 245,000 Example 4: How much larger is $6 \text{ x } 10^5$ compared to $2 \text{ x } 10^3$	

				Solution: 300 times larger since 6 is 3 times larger than 2 and 10^5 is 100 times larger than 10^3. <u>Example 5:</u> Which is the larger value: 2×10^6 or 9×10^5? *Solution:* 2×10^6 because the exponent is larger	

8^{th} Grade Math First Quarter

Module 1: Integer Exponents and Scientific Notation (20 days)

Unit 2: Magnitude and Scientific Notation

Having established the properties of integer exponents, students learn to express the magnitude of a positive number through the use of scientific notation and to compare the relative size of two numbers written in scientific notation (**8.EE.3**). Students explore use of scientific notation and choose appropriately sized units as they represent, compare, and make calculations with very large quantities, such as the U.S. national debt, the number of stars in the universe, and the mass of planets; and very small quantities, such as the mass of subatomic particles (**8.EE.4**).

The Mid-Module Assessment follows Topic A. The End-of-Module Assessment follows Topic B.

Big Idea:	• The value of any real number can be represented in relation to other real numbers such as with decimals converted to fractions, scientific notation and numbers written with exponents ($8 = 2^3$).
Essential Questions:	• Why are quantities represented in multiple ways? • How is the universal nature of properties applied to real numbers?
Vocabulary	Scientific notation, order of magnitude (exponential notation, base, exponent, power, integer, whole number, expanded form of decimal numbers, square of a number, cube of a number, equivalent fractions)

Grade	Cluster	Standard	Common Core Standards	Explanations & Examples	Comments
8	EE. A	3	**A.Work with radicals and integer exponents.** Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. *For example, estimate the population of the United States as* 3×10^8 *and the population of the world as* 7×10^9*, and determine that the world population is more than 20 times larger.* *8.MP.2.* Reason abstractly and quantitatively. *8.MP.5.* Use appropriate tools strategically. *8.MP.6.* Attend to precision.	Students use scientific notation to express very large or very small numbers. Students compare and interpret scientific notation quantities in the context of the situation, recognizing that if the exponent increases by one, the value increases 10 times. Likewise, if the exponent decreases by one, the value decreases 10 times. Students solve problems using addition, subtraction or multiplication, expressing the answer in scientific notation. <u>Example 1:</u> Write 75,000,000,000 in scientific notation. *Solution:* 7.5×10^{10} <u>Example 2:</u> Write 0.0000429 in scientific notation. *Solution:* 4.29×10^{-5}	

				<u>Example 3:</u> Express 2.45×10^5 in standard form. *Solution:* 245,000 <u>Example 4:</u> How much larger is 6×10^5 compared to 2×10^3 *Solution:* 300 times larger since 6 is 3 times larger than 2 and 10^5 is 100 times larger than 10^3. <u>Example 5:</u> Which is the larger value: 2×10^6 or 9×10^5? *Solution:* 2×10^6 because the exponent is larger	
8	**EE. A**	**4**	**A.Work with radicals and integer exponents.** 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.MP.2. Reason abstractly and quantitatively. 8.MP.5. Use appropriate tools strategically. 8.MP.6. Attend to precision.	Students understand scientific notation as generated on various calculators or other technology. Students enter scientific notation using E or EE (scientific notation), * (multiplication), and ^ (exponent) symbols. <u>Example 3:</u> $(6.45 \times 10^{11})(3.2 \times 10^4) = (6.45 \times 3.2)(10^{11} \times 10^4)$ *Rearrange factors* $= 20.64 \times 10^{15}$ *Add exponents when multiplying powers of 10* $= 2.064 \times 10^{16}$ *Write in scientific notation* <u>Example 4:</u> $\frac{3.45 \times 10^5}{6.7 \times 10^{-2}}$ $\frac{6.3}{1.6} \times 10^{5-(-2)}$ *Subtract exponents when dividing powers of 10* $= 0.515 \times 10^7$ *Write in scientific notation* $= 5.15 \times 10^6$ <u>Example 5:</u> $(0.0025)(5.2 \times 10^4) = (2.5 \times 10^{-3})(5.2 \times 10^5)$ *Write factors in scientific notation* $= (2.5 \times 5.2)(10^{-3} \times 10^5)$ *Rearrange factors* $= 13 \times 10^2$ *Add exponents when multiplying powers of 10* $= 1.3 \times 10^3$ *Write in scientific notation* Example 6: The speed of light is 3 x 10 8 meters/second. If the sun is 1.5x 1011 meters from earth, how many seconds does it take light to reach the earth? Express your answer in scientific notation.	

				Solution: 5 x 102 (light)(x) = sun, where x is the time in seconds (3 x 10 8)x = 1.5 x 1011 Students understand the magnitude of the number being expressed in scientific notation and choose an appropriate corresponding unit. Example 7: 3 x 108 is equivalent to 300 million, which represents a large quantity. Therefore, this value will affect the unit chosen.	

8th Grade Math First Quarter

Module 2: Congruence (25 days)

Unit 1: Definitions and Properties of the Basic Rigid Motions

In this module, students learn about translations, reflections, and rotations in the plane and, more importantly, how to use them to precisely define the concept of *congruence*. Up to this point, "congruence" has been taken to mean, intuitively, "same size and same shape." Because this module begins a serious study of geometry, this intuitive definition must be replaced by a precise definition. This module is a first step; its goal is to provide the needed intuitive background for the precise definitions that are introduced in this module for the first time.

Translations, reflections, and rotations are examples of *rigid motions*, which are, intuitively, rules of moving points in the plane in such a way that preserves distance. For the sake of brevity, these three rigid motions will be referred to exclusively as the *basic rigid motions*. Initially, the exploration of these basic rigid motions is done via hands-on activities using an overhead projector transparency, but with the availability of geometry software, the use of technology in this learning environment is inevitable, and some general guidelines for this usage will be laid out at the end of Lesson 2. What needs to be emphasized is that the importance of these basic rigid motions lies not in the fun activities they bring but in the *mathematical* purpose they serve in clarifying the meaning of congruence.

Throughout Unit 1, on the definitions and properties of the basic rigid motions, students verify experimentally their basic properties and, when feasible, deepen their understanding of these properties using reasoning. In particular, what students learned in Grade 4 about angles and angle measurement (**4.MD.5**) will be put to good use here: they learn that the basic rigid motions preserve angle measurements, as well as segment lengths.

Big Idea:	• Reflections, translations, and rotations are actions that produce congruent geometric objects. • A two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of transformations.
Essential Questions:	• What are transformations and what effect do they have on an object?
Vocabulary	Transformation, basic rigid motion, translation, reflection, rotation, image of a point, image of a figure, sequence of transformations, vector, congruence, transversal (ray, line, line segment, angle, parallel lines, perpendicular lines, supplementary angles, complementary angles, vertical angles, adjacent angles, triangle, quadrilateral, area and perimeter)

Grade	Cluster	Standard	Common Core Standards	Explanations & Examples	Comments
8	G. A	1	A. **Understand congruence and similarity using physical models, transparencies, or geometry software** Verify experimentally the properties of rotations, reflections, and translations:	Students use compasses, protractors and rulers or technology to explore figures created from translations, reflections and rotations. Characteristics of figures, such as lengths of line segments, angle measures and parallel lines, are explored before the transformation (pre-image) and after the transformation (image). Students understand that these transformations produce images of exactly the	In previous grades, students made scale drawings of geometric figures and solved problems involving angle measure, surface area,

			a. Lines are taken to lines, and line segments to line segments of the same length. b. Angles are taken to angles of the same measure. c. Parallel lines are taken to parallel lines. *8.MP.4.* Model with mathematics. *8.MP.5.* Use appropriate tools strategically. *8.MP.6.* Attend to precision. *8.MP.7.* Look for and make use of structure. *8.MP.8.* Look for and express regularity in repeated reasoning.	same size and shape as the pre-image and are known as rigid transformations. Students need multiple opportunities to explore the transformation of figures so that they can appreciate that points stay the same distance apart and lines stay at the same angle after they have been rotated, reflected, and/or translated. Students are not expected to work formally with properties of dilations until high school.	and volume.

8th Grade Math First Quarter

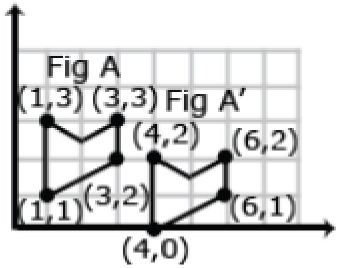
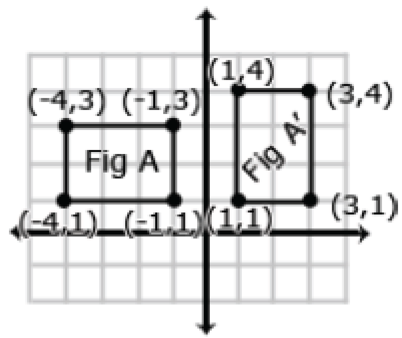
Module 2: Congruence (25 days)

Unit 2: Sequencing the Basic Rigid Motions

Unit 2 is a critical foundation to the understanding of congruence. All the lessons of Unit 2 demonstrate to students the ability to sequence various combinations of rigid motions while maintaining the basic properties of individual rigid motions. Lesson 7 begins this work with a sequence of translations. Students verify experimentally that a sequence of translations have the same properties as a single translation. Lessons 8 and 9 demonstrate sequences of reflections and translations and sequences of rotations. The concept of sequencing a combination of all three rigid motions is introduced in Lesson 10; this paves the way for the study of congruence in the next unit.

Big Idea:	• Reflections, translations, and rotations are actions that produce congruent geometric objects. • A two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of transformations.
Essential Questions:	• What are transformations and what effect do they have on an object?
Vocabulary	Transformation, basic rigid motion, translation, reflection, rotation, image of a point, image of a figure, sequence of transformations, vector, congruence, transversal (ray, line, line segment, angle, parallel lines, perpendicular lines, supplementary angles, complementary angles, vertical angles, adjacent angles, triangle, quadrilateral, area and perimeter)

Grade	Cluster	Standard	Common Core Standards	Explanations & Examples	Comments
8	G. A	2	**A. Understand congruence and similarity using physical models, transparencies, or geometry software** Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them. *8.MP.2.* Reason abstractly and quantitatively. *8.MP.4.* Model with mathematics. *8.MP.6.* Attend to precision. *8.MP.7.* Look for and make use of structure.	This standard is the students' introduction to congruency. Congruent figures have the same shape and size. Translations, reflections and rotations are examples of rigid transformations. A rigid transformation is one in which the pre-image and the image both have exactly the same size and shape since the measures of the corresponding angles and corresponding line segments remain equal (are congruent). Students examine two figures to determine congruency by identifying the rigid transformation(s) that produced the figures. Students recognize the symbol for congruency (≅) and write statements of congruency. <u>Example 1:</u> Is Figure A congruent to Figure A'? Explain how you know.	**8.G.A.2** Student will investigate and describe the effect of dilations on two---dimensional figures in unit 4. Students construct viable arguments and critique the reasoning of others (**MP.3**) as they describe the effect of transformations. As students investigate those effects, they attend to structure (**MP.7**) by recognizing the common

				 *Solution:* These figures are congruent since A' was produced by translating each vertex of Figure A 3 to the right and 1 down. <u>Example 2:</u> Describe the sequence of transformations that results in the transformation of Figure A to Figure A'.  *Solution:* Figure A' was produced by a 90º clockwise rotation around the origin.	attributes and properties generated by the transformations.

8th Grade Math First Quarter

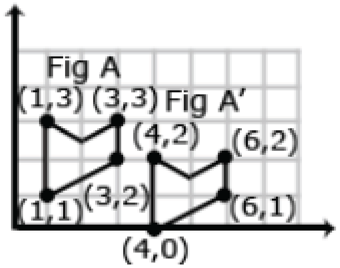
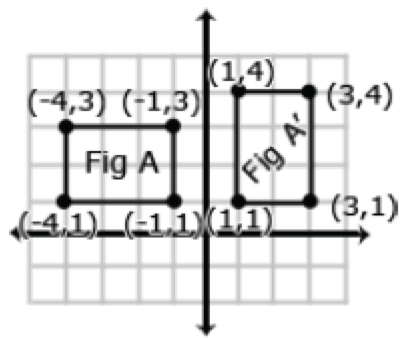
Module 2: Congruence (25 days)

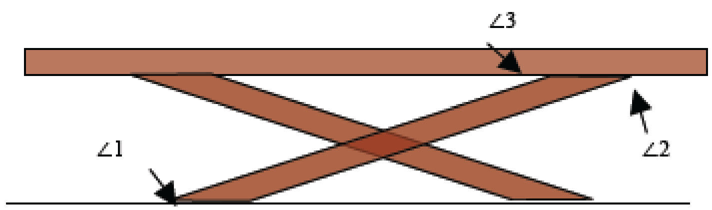
Unit 3: Congruence and Angle Relationships

In Unit 3, on the definition and properties of congruence, students learn that congruence is just a sequence of basic rigid motions. The fundamental properties shared by all the basic rigid motions are then inherited by congruence: congruence moves lines to lines and angles to angles, and it is both distance- and degree-preserving (Lesson 11). In Grade 7, students used facts about supplementary, complementary, vertical, and adjacent angles to find the measures of unknown angles (**7.G.5**). This module extends that knowledge to angle relationships that are formed when two parallel lines are cut by a transversal. In Unit 3, on angle relationships related to parallel lines, students learn that pairs of angles are congruent because they are angles that have been translated along a transversal, rotated around a point, or reflected across a line. Students use this knowledge of angle relationships in Lessons 13 and 14 to show why a triangle has a sum of interior angles equal to 180˚ and why the exterior angles of a triangle is the sum of the two remote interior angles of the triangle.

Big Idea:	• Reflections, translations, and rotations are actions that produce congruent geometric objects. • A two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of transformations.
Essential Questions:	• What are transformations and what effect do they have on an object?
Vocabulary	Transformation, basic rigid motion, translation, reflection, rotation, image of a point, image of a figure, sequence of transformations, vector, congruence, transversal (ray, line, line segment, angle, parallel lines, perpendicular lines, supplementary angles, complementary angles, vertical angles, adjacent angles, triangle, quadrilateral, area and perimeter)

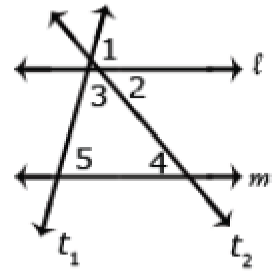
Grade	Cluster	Standard	Common Core Standards	Explanations & Examples	Comments
8	G. A	2	**A. Understand congruence and similarity using physical models, transparencies, or geometry software** Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them. *8.MP.2.* Reason abstractly and quantitatively. *8.MP.4.* Model with mathematics. *8.MP.6.* Attend to precision. *8.MP.7.* Look for and make use of structure.	This standard is the students' introduction to congruency. Congruent figures have the same shape and size. Translations, reflections and rotations are examples of rigid transformations. A rigid transformation is one in which the pre-image and the image both have exactly the same size and shape since the measures of the corresponding angles and corresponding line segments remain equal (are congruent). Students examine two figures to determine congruency by identifying the rigid transformation(s) that produced the figures. Students recognize the symbol for congruency (≅) and write statements of congruency.	**8.G.A.2** Student will investigate and describe the effect of dilations on two---dimensional figures in unit 4. Students construct viable arguments and critique the reasoning of others (**MP.3**) as they describe the effect of transformations. As students investigate those effects, they attend

				Example 1: Is Figure A congruent to Figure A'? Explain how you know.  *Solution:* These figures are congruent since A' was produced by translating each vertex of Figure A 3 to the right and 1 down. Example 2: Describe the sequence of transformations that results in the transformation of Figure A to Figure A'.  *Solution:* Figure A' was produced by a 90º clockwise rotation around the origin.	to structure (**MP.7**) by recognizing the common attributes and properties generated by the transformations.
8	**G. A**	**5**	**A. Understand congruence and similarity using physical models, transparencies, or geometry software** Use informal arguments to establish facts about the	Students use exploration and deductive reasoning to determine relationships that exist between the following: a) angle sums and exterior angle sums of triangles, b) angles created when parallel lines are cut by a transversal, and c) the angle-angle criterion for similarity of triangle.	

			angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. *For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.* *8.MP.3.* Construct viable arguments and critique the reasoning of others. *8.MP.4.* Model with mathematics. *8.MP.5.* Use appropriate tools strategically. *8.MP.6.* Attend to precision. *8.MP.7.* Look for and make use of structure.	Students construct various triangles and find the measures of the interior and exterior angles. Students make conjectures about the relationship between the measure of an exterior angle and the other two angles of a triangle. (the measure of an exterior angle of a triangle is equal to the sum of the measures of the other two interior angles) and the sum of the exterior angles (360º). Using these relationships, students use deductive reasoning to find the measure of missing angles. Students construct parallel lines and a transversal to examine the relationships between the created angles. Students recognize vertical angles, adjacent angles and supplementary angles from 7th grade and build on these relationships to identify other pairs of congruent angles. Using these relationships, students use deductive reasoning to find the measure of missing angles. <ins>Example 1:</ins> You are building a bench for a picnic table. The top of the bench will be parallel to the ground. If $m\angle 1 = 148^\circ$, find $m\angle 2$ and $m\angle 3$. Explain your answer.  *<ins>Solution</ins>*: Angle 1 and angle 2 are alternate interior angles, giving angle 2 a measure of 148º. Angle 2 and angle 3 are supplementary. Angle 3 will have a measure of 32º so the $m\angle 2 + m\angle 3 = 180^\circ$	

Example 2:

Show that $m\angle 3 + m\angle 4 + m\angle 5 = 180^\circ$ if line l and m are parallel lines and t_1 and t_2 are transversals.



Solution: $\angle 1 + \angle 2 + \angle 3 = 180^\circ$

$\angle 5 \cong \angle 1$ corresponding angles are congruent therefore $\angle 1$ can be substituted for $\angle 5$

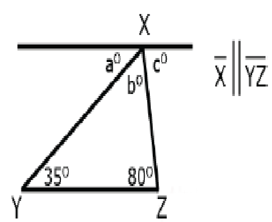
$\angle 4 \cong \angle 2$ alternate interior angles are congruent therefore $\angle 4$ can be substituted for $\angle 2$

Therefore $\angle 3 + \angle 4 + \angle 5 = 180^\circ$

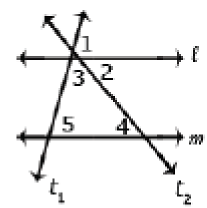
Students can informally conclude that the sum of the angles in a triangle is 180º (the angle-sum theorem) by applying their understanding of lines and alternate interior angles.

Example 3:

In the figure below Line X is parallel to Line $\overline{YZ}$. Prove that the sum of the angles of a triangle is 180º.



Solution: Angle *a* is 35º because it alternates with the angle inside the triangle that measures 35º. Angle *c* is 80º because it alternates with the angle inside the triangle that measures 80º. Because lines have a measure of 180º, and angles *a + b + c* form a straight line, then angle *b*

				must be 65 º (180 – (35 + 80) = 65). Therefore, the sum of the angles of the triangle is 35º + 65 º + 80 º. <u>Example 4:</u> What is the measure of angle 5 if the measure of angle 2 is 45º and the measure of angle 3 is 60º?  *Solution*: Angles 2 and 4 are alternate interior angles, therefore the measure of angle 4 is also 45º. The measure of angles 3, 4 and 5 must add to 180º. If angles 3 and 4 add to 105º the angle 5 must be equal to 75º. Students construct various triangles having line segments of different lengths but with two corresponding congruent angles. Comparing ratios of sides will produce a constant scale factor, meaning the triangles are similar. Students solve problems with similar triangles.	

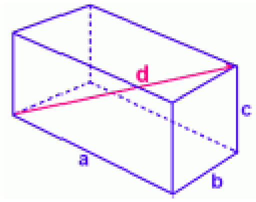
Module 2: Congruence (25 days)

Unit 4: The Pythagorean Theorem

Optional Unit 4 begins the learning of Pythagorean Theorem. Students are shown the “square within a square” proof of the Pythagorean Theorem. The proof uses concepts learned in previous topics of the module, i.e., the concept of congruence and concepts related to degrees of angles. Students begin the work of finding the length of a leg or hypotenuse of a right triangle using $a2 + b2 = c2$. Note that this topic will not be assessed until Module 7.

Big Idea:	• Right triangles have a special relationship among the side lengths which can be represented by a model and a formula. • The Pythagorean Theorem can be used to find the missing side lengths in a coordinate plane and real-world situations. • The Pythagorean Theorem and its converse can be proven.
Essential Questions:	• Why does the Pythagorean Theorem apply only to right triangles?
Vocabulary	right triangle, hypotenuse, legs, Pythagorean Theorem, square root

Grade	Cluster	Standard	Common Core Standards	Explanations & Examples	Comments
8	G.B	6	**B. Understand and apply the Pythagorean Theorem** Explain a proof of the Pythagorean Theorem and its converse. *8.MP.3.* Construct viable arguments and critique the reasoning of others. *8.MP.4.* Model with mathematics. *8.MP.6.* Attend to precision. *8.MP.7.* Look for and make use of structure.	Using models, students explain the Pythagorean Theorem, understanding that the sum of the squares of the legs is equal to the square of the hypotenuse in a right triangle. Students also understand that given three side lengths with this relationship forms a right triangle. Example 1: The distance from Jonestown to Maryville is 180 miles, the distance from Maryville to Elm City is 300 miles, and the distance from Elm City to Jonestown is 240 miles. Do the three towns form a right triangle? Why or why not? *Solution*: If these three towns form a right triangle, then 300 would be the hypotenuse since it is the greatest distance. 1802 + 2402 = 3002 32400 + 57600 = 90000 90000 = 90000 ✓	8.G.6 and 8.G.7 are also taught in Module 3. The balance of 8.G.6 and 8.G.7 are covered in Module 7, along with standard 8.G.8. Pythagorean is proved in this module guided by teacher (square within a square proof). Students are not responsible for explaining a proof until Module 7.

				These three towns form a right triangle.	
8	**G.B**	**7**	**B.Understand and apply the Pythagorean Theorem** Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. *8.MP.1.* Make sense of problems and persevere in solving them. *8.MP.2.* Reason abstractly and quantitatively. *8.MP.4.* Model with mathematics. *8.MP.5.* Use appropriate tools strategically. *8.MP.6.* Attend to precision. *8.MP.7.* Look for and make use of structure.	Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. Example 1: The Irrational Club wants to build a tree house. They have a 9-foot ladder that must be propped diagonally against the tree. If the base of the ladder is 5 feet from the bottom of the tree, how high will the tree house be off the ground? *Solution:* $a^2 + 5^2 = 9^2$ $a^2 + 25 = 81$ $a^2 = 56$ $\sqrt{a^2} = \sqrt{56}$ $a = \sqrt{56}$ or ~7.5 Example 2: Find the length of *d* in the figure to the right if *a* = 8 in., *b* = 3 in. and *c* = 4in. *Solution*: First find the distance of the hypotenuse of the triangle formed with legs *a* and *b*. 	This standard is started in this module and practiced during the year. No solutions that involve irrational numbers are introduced until Module 7.

				$8^2 + 3^2 = c^2$ $64^2 + 9^2 = c^2$ $73 = c^2$ $\sqrt{73} = \sqrt{c^2}$ $\sqrt{73}$ in. $= c$ The $\sqrt{73}$ is the length of the base of a triangle with *c* as the other leg and *d* is the hypotenuse. To find the length of *d*: $\sqrt{73}^2 + 4^2 = d^2$ $73 + 16 = d^2$ $89 = d^2$ $\sqrt{89} = \sqrt{d^2}$ $\sqrt{89}$ in. $= d$ Based on this work, students could then find the volume or surface area.	