**The Learning Targets** (scroll down to find lessons correlated with each learning target)

**UNIT 1: Constructions**

1.1 I know and use precise definitions of geometric terms.
1.2 I can make formal geometric constructions cited in standards both by hand and using geometry software.
1.3 Given a geometric figure and a rotation, reflection and translation, I can draw the transformed figure.
1.4 I Understand and can explain the formal definition of rotation, reflection and translation.
1.5 I can represent transformations in the plane and describe transformations as functions that take points in the plane as inputs and give other points as outputs.

**UNIT 2: Transformations & Congruence**

2.1 I can specify sequences of rigid motions that will carry a figure onto another
2.2 I can use the definition of congruence in terms of rigid motions to decide if two figures are congruent
2.3 I can use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.
2.4 I can explain how the criteria for triangle congruence follow from the definition of congruence in terms of rigid motions
2.5 I can prove theorems about lines and angles
2.6 I can prove theorems about parallelograms
2.7 I can prove base angles of isosceles triangles are congruent

**UNIT 3:Transformations & Similarity**

3.1 I can describe the properties of dilations (non-rigid transformation)
3.2 I can apply similar triangles to calculate measurements.
3.3 I am able to prove that two figures are similar through a series of transformations.
3.4 I understand and can use criterion for proving similar triangles
3.5 I can prove and use some theorems about triangles
3.6 I can prove and use slope criteria for parallel & perpendicular lines
3.7 I can construct points that divide a given segment into specified ratios.

**UNIT 4: Right triangles & Coordinate Proof**

4.1 I can use the Pythagorean theorem to determine the lengths of sides of a right triangle.
4.2 I can find the coordinates of points that divide given segments into specified ratios.
4.3 I can calculate & use the distance between two coordinates.
4.4 I can prove that 2 lines are parallel, perpendicular or neither, given coordinates of points on each line.
4.5 Given four coordinates, I can determine & prove the specific quadrilateral formed by connecting the coordinates.
4.6 I can use sin, cos tan and their inverses to determine lengths of sides and angles in right triangles.

**UNIT 5: Applied Trigonometry & Solids**

5.1 I can use trigonometry to solve a variety of modeling problems.
5.2 I can use dissection arguments to show where the formulas for surface area of cylinders, prisms & pyramids come from.
5.3 I can compute perimeters of polygons and areas of triangles and rectangles on a coordinate grid.
5.4 I can derive & apply volume formulas for cylinders, prisms, cones & pyramids
5.5 I can solve real-world and mathematical situations involving volume and surface area.
5.6 I can identify 2D cross sections & 3D objects generated from rotating 2D shapes

**UNIT 6: Circles**

6.1 I can determine and apply circumference and area of a circle
6.2 I can use the Pythagorean Theorem to derive and apply an equation for a circle of given center & radius
6.3 I can measure angles using both degrees and radians.
6.4 I can determine the length of an arc of a circle.
6.5 I can derive and use a formula to determine the area of a sector of a circle
6.6 I can use properties and relationships of chords, secants and tangents to solve for various lengths and angles

| Unit 1: Constructions & Rigid Transformations | CCSS |
|---|---|
| **1.1** I know and use precise definitions of geometric terms. | G.CO.1 |
| **1.2** I can make formal geometric constructions sited in standards both by hand and using geometry software. | G.CO 12,13 |
| **1.3** Given a geometric figure and a rotation, reflection and translation, I can draw the transformed figure. | G.CO.5 |
| **1.4** I Understand and can explain the formal definition of rotation, reflection and translation. | G.CO.4 |
| **1.5** I can represent transformations in the plane and describe transformations as functions that take points in the plane as inputs and give other points as outputs. | G.CO.2 |

| Enduring Understandings | Essential Questions |
|---|---|
| • You can use special geometric tools to make a figure that is congruent to an original figure without measuring.<br>• Construction is more accurate than sketching and drawing.<br>• Analyzing geometric relationships develops reasoning and justification skills.<br>• Objects in space can be transformed in an infinite number of ways and those transformations can be described and analyzed mathematically.<br>• Congruence of two objects can be established through a series of rigid motions.<br>• Properties of geometric objects can be analyzed and verified through geometric constructions.<br>• Judging, constructing, and communicating mathematically appropriate arguments are central to the study of mathematics. | • What is the relationship between construction and congruency?<br>• How do the properties of lines and angles contribute to geometric understanding?<br>• How is visualization essential to the study of geometry?<br>• How does the rigid motion connect to congruence?<br>• How does geometry explain or describe the structure of our world?<br>• How do constructions enhance understanding of the geometric properties of objects?<br>• How can reasoning be used to establish or refute conjectures?<br>• What are the characteristics of a valid argument?<br>• What facts need to be verified in order to establish that two figures are congruent? |

**Learning Target, Instructional task & Standards for Math Practice**

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| 1.1 | *Geometry Vocabulary*<br>High Tech High | Students engage with the academic language needed in this unit in a way that taps into their prior knowledge and provides a place to discuss and dialogue with their peers to activate their prior geometry experience. | SMP.6 |
| 1.1 | *Starting with Definitions*<br>crazymathteacherlady | Using examples & non-examples, students complete Frayer models and collaborate on writing definitions. | SMP.6<br>SMP.7 |
| 1.2 | *Construction Design Project*<br>crazymathteacherlady | This activity provides an opportunity for students to familiarize themselves with the precision that can be generated using a straightedge and compass | SMP.1<br>SMP.8 |
| 1.2 | *Construction Castles*<br>Cheesemonkey | " I created this Constructions Castle project to give students plenty of practice doing constructions while also giving them a chance to develop their understanding of how shapes and angles fit together." | SMP.1<br>SMP.8 |
| 1.2 | Ancient Greek geometry,<br>science vs magic | A beautifully simple online tool that allows students to experiment with circles & lines to develop understanding of the capabilities of constructions. It's deceptively simple, and quite challenging. Can you construct a regular pentagon in 15 moves or less? And can you construct other regular polygons that are not shown in the challenges, like the 15-gon and 17-gon? | SMP.5 |
| 1.2 | Euclid, the Game!<br>Geogebra | This activity is a great introduction to geogebra as well as the basics of constructions while allowing students to develop methods instead of coping steps. Each level introduces a new geometric challenge to construct with only a virtual compass, ruler, and the previous abilities you've discovered. | SMP.5 |
| 1.2 | *Pizza Delivery Region*<br>NCTM Illuminations | The trick to this task is in constructing perpendicular bisectors between locations to ensure customers receive pizzas from the nearest location. Students must notice this structure and figure out how to apply bisector constructions to increasingly challenging models in to precisely divide the city grid for the pizza company. | SMP.7<br>SMP.6 |
| 1.2 | *Constructing Shapes*<br>High Tech High | This activity builds on Introduction to Constructions but here students must make sense of the problem at hand and must attend to precision in explaining why their construction makes the given shape based on how it was constructed and how this connects to the definition of the figure. | SMP.1<br>SMP.6 |

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| 1.2 | *Constructing digitally*<br>High Tech High | Students use their prior knowledge of how to construct the given figures by hand to understand how to use geometric software. | SMP.5 |
| 1.3 | *MATH*<br>High Tech High | Activate students' prior understanding of how to rotate, reflect and translate a given figure. In order to complete the fourth problem, students must look for and make use of structure found in the previous problems. | SMP.7 |
| 1.3 | *Mrs. Pac Man*, Robert Kaplinsky | This lesson provides a real-life context for transformations including rotations, reflections, and translations, which are the foundation for students understanding congruence and similarity. Rather than begin the lesson by defining the terms and identifying them in the game, the goal is to let students initially describe the movements in their own words and then guide them towards a mathematically precise definition. | SMP.6 |
| 1.3 | *Transforming a Pentagon* &<br>*Answer Key*, High Tech High | This activity is useful in case students still struggle with visualizing given transformations and need more practice; this can provide students with an opportunity to demonstrate repeated reasoning and regularity in transformations. | SMP.8 |
| 1.3 | *Reflected Triangles*<br>Illustrative Mathematics | This activity has students demonstrate their understanding of the line of reflection as the perpendicular bisector between any two corresponding points as well as a precise and accurate construction of a perpendicular bisector. | SMP.6 |
| 1.4 | *Defining Reflections*<br>Illustrative Mathematics | This task helps students transition to a technical mathematical definition of reflection. This task requires time and patience and is ideally suited for in class group work. If there are mirrors present in the classroom the teacher may wish to have students experiment so that they can see first-hand how the mirror image is similar and how it differs from the original. | SMP.5<br>SMP.6 |
| 1.4 | *Defining Rotations*<br>Illustrative Mathematics | At this point in the unit, students should be very familiar with the visual representation of rotation and should be able to use this task to help transition to the technical mathematical definition. By providing four possible definitions and having students work through the validity and precision of each. | SMP.6 |
| 1.3<br>1.5 | *Transforming 2D Figures*, MARS | Students describe transformations through writing and images and also see transformations as functions that take points in the plane as inputs and give other points as outputs. | SMP.1<br>SMP.7<br>SMP.6 |
| 1.5 | *Horizontal Stretch of the Plane*,<br>Illustrative Mathematics | Students compare a transformation of the plane (translation) which preserves distances and angles to a transformation of the plane (horizontal stretch) which does not preserve either distances or angles. | SMP.2 |
| 1.3<br>1.4 | *Face Value*, Mathalicious | Here students are provided with an opportunity to grapple with the idea of something being symmetric and reflecting onto itself and must persevere through the calculations and analysis of the symmetry score. This activity also provides students with an opportunity to model the ideas facial symmetry through reflection. | SMP.1<br>SMP.4 |

| Unit 2: Congruence & proof | CCSS |
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| 2.1 Specify sequences of rigid motions that will carry a figure onto another | G.CO.5 |
| 2.2 Use the definition of congruence in terms of rigid motions to decide if two figures are congruent or not | G.CO.6 |
| 2.3 Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent (CPCTC) | G.CO.7 |
| 2.4 Can explain how the criteria for triangle congruence follow from the definition of congruence in terms of rigid motions | G.CO.8 |
| 2.5 Prove theorems about lines and angles | G.CO.9 |
| 2.6 Prove theorems about parallelograms | G.CO.11 |
| 2.7 Prove base angles of isosceles triangles are congruent | G.CO.10 |

| Enduring Understandings | Essential Questions |
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| ● **Objects in space can be transformed in an infinite number of ways and those transformations can be described and analyzed mathematically.**<br>o *The concept of congruence and its connection to rigid motion.*<br>o *Congruence of two objects can be established through a series of rigid motions.*<br>● **Representation of geometric ideas and relationships allow multiple approaches to geometric problems and connect geometric interpretations to other contexts.**<br>o *Attributes and relationships of geometric objects can be applied to diverse context.*<br>o *Properties of geometric objects can be analyzed and verified through geometric constructions.*<br>● **Judging, constructing, and communicating mathematically appropriate arguments are central to the study of mathematics.**<br>o *Assumptions about geometric objects must be proven to be true before the assumptions are accepted as facts.*<br>o *The truth of a conjecture requires communication of a series of logical steps based on previously proven statements.*<br>o *A valid proof contains a sequence of steps based on principles of logic.* | ● **How is visualization essential to the study of geometry?**<br>o *How does the concept of rigid motion connect to the concept of congruence?*<br>● **How does geometry explain or describe the structure of our world?**<br>o *How do geometric constructions enhance understanding of the geometric properties of objects?*<br>● **How can reasoning be used to establish or refute conjectures?**<br>o *What are the characteristics of a valid argument?*<br>o *What is the role of deductive or inductive reasoning in validating a conjecture?*<br>o *What facts need to be verified in order to establish that two figures are congruent?* |

**Learning Target, Instructional task & Standards for Math Practice**

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| 2.1 | Rigid motions & congruence (specifically the activity part of this lesson)<br>Better lesson | To investigate congruence through rigid motions, students are given a diagram with four congruent triangles. Students will work individually to Identify the rigid motion(s) that can be used to show congruence. They will then write congruency statements for corresponding parts of the triangles and label all congruent parts on the diagram. | SMP 1<br>SMP 3<br>SMP 5<br>SMP 6 |
| 2.1 | *Sequences of Rigid Motions*, High Tech High | The purpose of this activity is to allow students to build on their understandings of single rigid motions before moving directly into congruence. Here, students must attend to precision in their transformations and must also construct viable arguments when explaining how a certain sequence of transformations can be completed in fewer steps. Additionally, students must use tools appropriately to help them precisely complete the sequence of rigid motions. | SMP 3<br>SMP 5<br>SMP 6 |
| 2.1 | *Sequences of Rigid Motions 2*,<br>U of A/High Tech High | Before learning the definition of congruence through rigid motions, it is important that students are familiar with sequences of rigid motions and the idea that there can be multiple ways to carry a given figure onto another. The activity helps students to look for and express regularity in repeated reasoning in carrying out sequences of rigid transformations. Additionally, students must attend to precision when completing the | SMP 6<br>SMP 8 |

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| | | transformations to ensure that when comparing different possible sequences the transformed figure is in fact in the correct location. | |
| 2.2 | Same size, same shape?, Illustrative mathematics project and description here: Arguing about Shapes Kate Nowak | The purpose of the task is to help students transition from the informal notion of congruence as "same size, same shape" that they learn in elementary school and begin to develop a definition of congruence in terms of rigid transformations. The task can also be used to illustrate the importance of crafting shared mathematical definitions. Note that the term "congruence" is not used in the task; it should be introduced at the end of the discussion as the word we use to capture a more precise meaning of "same size, same shape." | SMP 3<br>SMP 6 |
| 2.3 | *Properties of Congruent Triangles*, Illustrative Mathematics | At this point, students have experience with sequences of rigid motions and what congruence is.  This problem extends those ideas to begin to build the understanding of properties that congruent triangles have.  As explained on the IM website, "The goal of this task is to understand how congruence of triangles, defined in terms of rigid motions, relates to the corresponding sides and angles of these triangles. In particular, there is a sequence of rigid motions mapping one triangle to another if and only if these two triangles have congruent corresponding sides and angles." Additionally, students will need to reason abstractly and quantitatively while completing this problem; working between the sequence of rigid motions to map one triangle to the other while keeping track of the different parts of the triangles and how they are related. | SMP 2 |
| 2.3<br>2.4 | *Congruence Theorems*, NCTM Illuminations | The purpose of this activity is to provide students an opportunity to experiment with different arrangements of triangle parts (sides and angles) to see what is necessary for triangle congruence.  The goal is that after testing all possible arrangements, students will be able to explain which arrangements provide triangle congruence and which do not.  Through the testing phase, students must persevere through all possible arrangements and should begin to look for repeated reasoning through the different trials. | SMP 1<br>SMP 8 |
| 2.3<br>2.4 | *Analyzing Congruency Proofs*, MARS | At this point in the unit, students should be familiar with both CPCTC and criteria for triangle congruence from the previous sample activities.  In their explanations about if the given triangles are congruent or not, students must construct viable arguments to support their ideas.  Through this activity and repeated exposure to different triangle criteria, students should be able to look for and make use of structure in identifying whether triangles are congruent or not. | SMP.3<br>SMP.7 |
| 2.4 | *Why does SAS Work?*, *Why does ASA work?*, *When does SSA work to determine triangle congruence?*, *Why does SSS work?*, *Illustrative Mathematics* | These four tasks are grouped together because they all show triangle congruence, each spotlighting one of the criteria for triangle congruence.  In the above activities, students were exposed to the different criteria so some or all of the activities here can be used as needed to ensure that students understand the different criteria.  Because students have seen these ideas in the previous activities, this is a great place for students to look for and express regularity in repeated reasoning through these ideas. | SMP 8 |
| 2.4 | *Angle bisection and midpoints of line segments*, Illustrative Mathematics | This problem allows students to use the constructions they know along with criteria for triangle congruence to prove bisectors and midpoints in the given activity.  Students should be able to model with precision the angle and line bisection constructions needed to represent the conditions presented in this task. | SMP 6 |
| 2.7 | *Isosceles Triangle Theorem*, Illustrative Mathematics | This task provides students with an opportunity to use their understandings about triangle congruence in a very specific case; the base angles of an isosceles triangle are congruent. | |
| 2.5 | *Angles Between Intersecting and Parallel Lines*, Khan Academy | The purpose of this section is to provide students with several examples of congruent angles in given contexts.  Depending on where students are and how much practice they need, teachers can either work through all of the provided examples and videos or only those that they see best fit for their students.  Through the various examples and proofs, students should begin to look for and make use of structure relating to a transversal crossed by parallel lines and vertical angles. | SMP 7 |
| 2.5 | *Lines, Transversals, and Angles*, *Desmos Activity* | In this activity, students explore the relationship among angles formed by a transversal and a system of two lines. In particular, they consider what happens when the two lines are parallel vs when they are not. | SMP 2<br>SMP 3<br>SMP7<br>SMP 8 |

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| 2.5 | Parallel line & angle mazes Daniel Schneider | All high school geometry proofs are essentially one big **maze**. You're told where to start and where to end – you just gotta connect all the dots and make the jumps in between. So, I experimented with presenting angle relationships with parallel lines that way as well. **Where this leads**: I love the fact that there are multiple answers – almost any student can generate their own path and justify their answers. You can also ask some interesting questions – **what is the shortest path. Find a path that uses every angle exactly one. Find a path that doesn't use the same rule twice in a row** | SMP 1<br>SMP 2<br>SMP 3 |
| 2.5 | *Points Equidistant from a two points in the plane*, Illustrative Mathematics | Students should be comfortable with perpendicular bisectors so the open nature of this problem allows students to explore the distance between the endpoints of the line segment to points on the perpendicular line in a familiar context as the build to the understanding of the above proof. This provides a good opportunity for students to engage in "Construct Viable Arguments and Critique the Reasoning of Others.'' Also, students working on this task have multiple opportunities to engage in ''Use Appropriate Tools Strategically'' as the task makes use of geogebra. | SMP 3<br>SMP 5 |
| 2.5 | Origami Angles, Tina Cardone | There are 31 angles to find in the diagram (excluding 180 degree angles but including sums of smaller angles. In each case students are asked to find more than the 'easy' angles. They will need to continue working past the point where angle measures are obvious and this is where some students' ingenuity shines through. | SMP 3 |
| 2.6 | Quadrilaterals, Khan Academy | This activity explores definitions, conditions and proofs relating to quadrilaterals. Specifically, there are videos provided to show that opposite sides and opposite angles of a parallelogram are congruent as well as that diagonals of a parallelogram bisect each other The purpose of this activity is to provide students with an introduction to the congruence properties found within a parallelogram. | SMP 7 |
| 2.6 | Quadrilateral dots (paper) Fawn Nguyen via Don Steward<br>Desmos Activity | "Join the dots to complete these quadrilaterals — where there are options, try to find the one on the grid with the largest possible area." This task reinforces quadrilateral definitions, properties and area. Leads to student discussions of congruence criteria. (UPDATE: I made this into a desmos activity that you can access here) | SMP 1<br>SMP 3 |
| 2.6 | Congruence of Parallelograms, Illustrative Mathematics | The purpose of this activity is to connect students' prior learnings about proving congruence in triangles and applying this to parallelograms. Students can also use their understandings from the previous activity (Quadrilaterals) as they explore different criteria of parallelograms. As stated on the IM website "This task is ideal for hands-on work or work with a computer to help visualize the possibilities….This task would be ideally suited for group work since it is open ended and calls for experimentation. Thus it provides a good opportunity for students to engage in "Construct Viable Arguments and Critique the Reasoning of Others.'' Also, students working on this task have multiple opportunities to engage in ''Use Appropriate Tools Strategically'' as they can use manipulatives or computer software to experiment with constructing different parallelograms." | SMP 3<br>SMP 5 |
| 2.1 - 2.7 | Proof Blocks, Proof Blocks<br><br>A blog post on how I've used them | The purpose of this activity is to provide students with a formalized written look at the visual work they have done in this unit. There are several instructional suggestions for how the proof blocks can be used in the classroom but however they are used, they help students to construct viable arguments and critique the reasoning of others while looking for and making use of the structure necessary for geometric proofs. | SMP 3<br>SMP 7 |

| Unit 3: Similarity | CCSS |
|---|---|
| 3.1 I can describe the properties of dilations (non-rigid transformation) | G-SRT.1 |
| 3.2 I can apply similar triangles to calculate measurements. | G.SRT.2 |
| 3.3 I am able to prove that two figures are similar through a series of transformations. | G-SRT.2 |
| 3.4 I can use criterion for proving similar triangles | G-SRT.3 |
| 3.5 I can prove and use some theorems about triangles | G-SRT.4, G-SRT.5, G-CO.10 |
| 3.6 I can prove and use slope criteria for parallel & perpendicular lines | G-GPE.5 |
| 3.7 I can construct points that divide a given segment into specified ratios. | G-GPE.6, G-SRT.5 |

| Enduring Understandings | Essential Questions |
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| • Similar geometric figures have angles that are congruent and segments that are proportional in length.<br>• Similar geometric figures can be created by transformations. All transformations create similar geometric figures. Dilations, in particular, create figures that are similar, but may not be congruent.<br>• Congruence is also similarity. It is just a more specifically defined similarity where the ratio of lengths is 1:1.<br>• The processes of proving include a variety of activities, such as developing conjectures, considering the general case, exploring with examples, looking for structural similarities across cases, and searching for counterexamples.<br>• Making sense of others' arguments and determining their validity are proof-related activities.<br>• A proof can have many different valid representational forms, including narrative, picture, diagram, two-column presentation, or algebraic form. | • How can transformations help me to understand similarity?<br>• What strategy can be used to prove similarity theorems?<br>• How do you solve problems using congruent and similar triangles?<br>• How do you prove congruence and similarity relationships in geometric figures?<br>• How is visualization essential to the study of geometry?<br>• How do geometric constructions enhance understanding of the geometric properties of objects?<br>• How can reasoning be used to establish or refute conjectures?<br>• What are the characteristics of a valid argument?<br>• What facts need to be verified in order to establish that two figures are congruent?<br>• How can transformations be used to explain similarity?<br>• How is similarity of geometric figures applied and verified?<br>• What is the relationship between transformations that produce congruent figures and transformations that produce similar figures |

**Learning Target, Instructional task & Standards for Math Practice**

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| 3.1 | Photocopy Faux Pas (page 4), Math Vision Project | The purpose of this activity is to provide an open space for the exploration of the properties of dilations without the need for precise definitions just yet. | SMP 1<br>SMP 2 |
| 3.1 | Perform Dilations on objects, Engage NY (grade 8 mod 3 lesson 2) | Students learn how to use a compass and a ruler to perform dilations. Students learn that dilations map lines to lines, segments to segments, and rays to rays. Students know that dilations are degree preserving. | SMP 5 |
| 3.1 | Dilations using technology, Khan academy | In most assessments, students will be using technology and so, placed here, this task provides them with the opportunity to digest their understanding of dilations and do so in a technology based environment where they are building on previous knowledge built up earlier in the section. Computer based softwares are excellent for problem solving in geometry and this may also provide an opportunity to introduce students to other tools that will be extremely useful as they progress in their geometric thinking. | SMP 5 |
| 3.1 | Who is the fairest?, NRICH | A more open activity than some of the previous ones, this task could be used in lieu of some of the previous activities to get at some of the same ideas about properties of dilations and what happens when lines and figures are dilated by a point not on themselves. | SMP 7<br>SMP 8 |
| | Flip Family (page 13) | The purpose of this activity is to take students' understandings of dilations and apply it to a situation on the coordinate plane and extend their understanding to the ways that dilations of a specific size can partition a given line segment. Placed here, this | SMP.5<br>SMP.7<br>SMP.8 |

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| | | activity could serve as a formative assessment to see where students are with dilations, or as another solidifying understanding task to wrap up this section | |
| 3.2<br>3.3 | Triangle Dilations (pages 9-11) Math Vision Project | One purpose of this task is to solidify and formalize the definition of dilation. A second purpose of this task is to examine proportionality relationships between sides of similar figures by identifying and writing proportionality statements based on corresponding sides of the similar figures. A third purpose is to examine a similarity theorem that can be proved using dilation: a line parallel to one side of a triangle divides the other two proportionally. | SMP.1<br>SMP.7 |
| 3.1<br>3.7 | Scaling a Triangle in Coordinate Plane, Illustrative Mathematics | The goal of this task is to apply dilations to a triangle in the coordinate plane. Students will need to find the coordinates of a point which cuts a given segment into one third (part a) and into two thirds (part b). Because the centers for the two dilations are vertices of $\triangle ABC$ and the sum of the dilation factors (one third and two thirds) is one, the two dilated triangles share a vertex | |
| 3.3 | Defining similarity through angle preserving transformations, Khan Academy | Placed here, this activity's purpose is to further interact with the precise nature of rotations, reflections, translations, and dilations with support from khan's interface. It has the extra motivating factor of seeming like a puzzle where students' attention to precision and detail are extremely important as students describe the rotations, reflection, rotations, and dilations that are occurring. | SMP 5<br>SMP 6 |
| 3.5 | Golf Ball Problem, Fawn Nguyen | Standard G-SRT.5 calls for students to "use congruence and similarity criteria for triangles to solve problems." Both of these task asks students to use similarity to solve a problem in a modeling context that will be familiar to many (Golf and Pool).In order to solve this problem, students must use the fact that when an object bounces off of a wall, the angle of incidence equals the angle of reflection; that is, the angle at which the object hits the wall is equal to the angle at which the object ricochets from the wall forming similar triangles which can help to solve the given problems | SMP 4 |
| 3.5 | Similar Circles, Illustrative Mathematics | This task explores the proof for all circles being similar meaning that there is a sequence of transformations of the plane (reflections, rotations, translations, and dilations) transforming one to the other. If we give the plane a coordinate system, then the circles have equations and the transformations can be described explicitly with equations. The goal of this task is to work on showing that all circles are similar using these two different methods, the first visual and the second algebraic. Part (a) of this problem will require students to make sense of a seemingly challenging problem. Part (b) provides an opportunity to look for repeated reasoning between the argument for part (a) and part (b). | SMP 1<br>SMP 8 |
| 3.5 | Pigs in a Blanket, Geoff (Emergent Math) | In this investigation, students will take a different look at triangles and do some investigating, exploring, and modeling using their knowledge of similar triangles and hopefully come to some previously unknown ideas about midpoints of triangles, namely that connecting them results in 4 congruent triangles that are similar to the larger triangle. | SMP 1<br>SMP 4 |
| 3.3 | Similarity transformations, Engage NY HS Geometry, mod 2 lesson 12 | Students define a similarity transformation as the composition of basic rigid motions and dilations. Students define two figures to be similar if there is a similarity transformation that takes one to the other. Students can describe a similarity transformation applied to an arbitrary figure (i.e., not just triangles) and can use similarity to distinguish between figures that resemble each other versus those that are actually similar. | SMP 3<br>SMP 6 |
| 3.4 | Identifying Similar Triangles<br>Math Assessment Project | 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. | SMP 1<br>SMP 2<br>SMP 3 |
| 3.5 | Rolling Cups,<br>Math Assessment Project<br>Read this first by Dan Meyer<br>How I implement this lesson | This open-ended modeling task has students experiment with rolling cups to develop a formula to determine the radius of the circle formed when rolling a cup given the cup dimensions. Applications of proportions and similar triangles are usually employed. Students are also asked to analyze the responses of others and critique their approaches. | SMP 1<br>SMP 2<br>SMP 3<br>SMP 4 |

| Unit 4: Right Triangles & Coordinate Proofs | CCSS |
|---|---|
| 4.1 I can use the Pythagorean theorem to determine the lengths of sides of a right triangle. | G.SRT.8 |
| 4.2 I can find the coordinates of points that divide given segments into specified ratios. | G.GPE.6<br>G.SRT.5 |
| 4.3 I can calculate & use the distance between two coordinates. | G.GPE.7 |
| 4.4 I can prove that 2 lines are parallel, perpendicular or neither, given coordinates of points on each line. | G.GPE.5 |
| 4.5 Given four coordinates, I can determine & prove the specific quadrilateral formed by connecting the coordinates. | G.CO.11 |
| 4.6 I can use sin, cos tan and their inverses to determine lengths of sides and angles in right triangles. | G.SRT.6 |

| Enduring Understandings | Essential Questions |
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| • The special properties of right triangles can be used to solve real world problems.<br>• Use a variety of representations to describe geometric relationships and solve problems involving triangles Analyze properties and describe relationships in quadrilaterals.<br>• Apply logical reasoning to justify and prove mathematical statements involving quadrilaterals. | • How are right triangles used to measure indirectly?<br>• How do you use coordinate geometry to find relationships within triangles?<br>• How do you find a side length or angle measure in a right triangle?<br>• How do trigonometric ratios relate to similar right triangles? |

**Learning Target, Instructional task & Standards for Math Practice**

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| 4.1 | TV Space<br>Timon Piccini | A 3-act application of the Pythagorean theorem where students try to determine if a TV will fit in the space provided. | SMP 2<br>SMP 3 |
| 4.1 | Viewmongous<br>Mathalicious<br>& How it went in my class | Televisions (indeed, all screens) are measured diagonally. When Best Buy lists a TV as having a 42-inch screen, it means 42 inches on the diagonal. Yet even though this is advertised as the screen's size, the diagonal only tells us part of the story about how much screen there is.<br>In this lesson, students use the Pythagorean Theorem along with some proportional reasoning to investigate the relationship between the diagonal length, aspect ratio, and screen area of a TV. | SMP 1<br>SMP 2<br>SMP 4 |
| 4.1 | Wizard of Oz<br>Kaplinsky | If you play the clip prior to exploring the proof, students will hear the Scarecrow's statement and have no idea what he is saying. Then ask students, "How can we correct the Scarecrow's statement so it is mathematically precise?" Again, they will have no idea how to answer that question. The whole process will take about five minutes.<br>From there you can use any one of a number of good strategies for exploring the proof of the Pythagorean Theorem. Along the way students may start to make connections to the clip and realize it is related to what they are learning. Once the exploration is complete, you can return to this problem, play the video clip again, and again ask students, "How can we correct the Scarecrow's statement so it is mathematically precise?" | SMP 3<br>SMP 6 |
| 4.1 | Taco Cart<br>Dan Meyer<br>My class, Fawn | Given the location of 2 people and their routes and walking speeds determine who will get to the taco cart first. Great low floor, initial task with lots of room for high ceiling extension questions including: 1) Find the fastest path to the Taco stand.<br>2) Figure out where the Taco stand would have to be located on the path so that both Dan & Ben get there at the same time. | SMP 1<br>SMP 4 |
| 4.2 | Midpoint discovery,<br>Misscalcul8 | I made up a set of 6 graphs with segments graphed on it. Then I asked students to write the ordered pair of each end point and finally to guess the ordered pair of the midpoint. We did #1 together and then I asked them to go through and do #2-6 on their own. | SMP 2<br>SMP 6<br>SMP 7 |
| 4.2 | Midpoints & dividing segments, EngageNY | When we find the location of the midpoint, we are dividing a segment into two congruent segments and, therefore, need to calculate half of the vertical and horizontal distances. We then added or subtracted these values from the | SMP 2<br>SMP 6 |

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| | | coordinates of one of the endpoints of the segment. In this lesson we divided the segment into two segments of different lengths. We had to determine vertical and horizontal distances other than 12 and then use these values to determine the location of the point. We could use either endpoint to do this, but we had to be careful to add and/or subtract depending on whether we were moving right/left or up/down along the segment and which endpoint the point was closest to. | |
| 4.2 | Math Vision Project, Math 2, Module 6: pgs 49-53 | This task is for students to apply their understanding of similar triangles and proportionality to find the point on a line segment that partitions the segment in a given ratio. Students are first asked to find the midpoint of a segment using two possible strategies that involve congruent triangles. The task continues by asking students to extend those strategies and use similar triangles to find segments in ratios other than 1:1. The formula for finding the midpoint of a segment is formalized during the discussion. The discussion can also be extended to derive a formula for finding the point that partitions a segment in any given ratio. | SMP 1<br>SMP 2<br>SMP 7 |
| 4.3 | Distance formula relate to Pythagorean theorem, Jessie Hester | A progression of introductory interactive notebook activities that walk students from the pythagorean theorem to distances on maps to distances on a coordinate plane. | SMP 6<br>SMP 8 |
| 4.3 | Where's The Nearest Toys R Us?, Kaplinsky | Students use the Pythagorean theorem & distance formula using GPS coordinates and a spreadsheet to determine the distance to various Toys R Us store locations. | SMP 2<br>SMP 4 |
| 4.2<br>4.3 | Distance & midpoint on a map, Pam Wilson | Rather than having students work a gazillion problems – I've decided to use a school map. I ran a copy of grid paper on a transparency and overlaid on a map of school – copied, added a rough set of axes. Placed points throughout.<br>Sample questions: Calculate the distance between Room 137 & Room 114.<br>Find the coordinates between Room 137 & Room 114. What room are you closest to at this point? | SMP 1<br>SMP 4 |
| 4.4 | Parallel & perpendicular lines, Fawn Nguyen | A simple yet beautiful way to allow students to apply their intuition about parallel and perpendicular lines and then study and formalize their findings. | SMP 3<br>SMP 6<br>SMP 8 |
| 4.1<br>4.2<br>4.3<br>4.4<br>4.5 | Squares on a Grid, Illustrative mathematics & my implementation | The purpose of this task is to use the Pythagorean Theorem and knowledge about quadrilaterals in order to construct squares of different sizes on a coordinate grid. In addition to the Pythagorean Theorem, students will need to show that the shapes they have constructed are squares. This can be done by using the Pythagorean Theorem a second time to check that, in addition to having four congruent sides, the quadrilaterals also have congruent diagonals. | SMP 1<br>SMP 3<br>SMP 8 |
| 4.5 | Coordinate Quadrilateral Proofs, Mathy McMatherson | Give just 4 coordinates, what kind of quadrilateral is it? Justify your answer – be sure to give evidence about why you believe you shape is what it is, as well as why your shape isn't something else".<br>There is a method of organizing and categorizing objects such that they split into defining categories, all of which have a common property or defining characteristic – and, anything underneath these categories have all the properties of the objects above them and continue to become specialized. It is useful, in my opinion, to make this method of organization explicit and teach my students how to understand this method of classification. | SMP 2<br>SMP 3<br>SMP 6 |
| 4.5 | Is this a Rectangle?, Illustrated Mathematics | The goal of this task is to provide an opportunity for students to apply a wide range of ideas from geometry and algebra in order to show that a given quadrilateral is a rectangle. One of the advantages to open-ended tasks like this one is that they allow for multiple, creative solutions and, in so doing, show how the different strands of the curriculum are related. This task supports the transformational approach to geometry adapted in the CCSS in a very strong way: the second solution uses rotations and translations in a fundamental way while the fourth solution requires an understanding of similar triangles and consequently of dilations of the plane. At the same time, it gives an opportunity to relate these new ideas to classical approaches using the Pythagorean Theorem and slopes of lines. | SMP 1<br>SMP 3 |
| 4.5 | Prove it(pdf), Math Vision Project (math 1, module 8: pg 15-18) | In this task you need to use all the things you know about quadrilaterals, distance, and slope to prove that the shapes are parallelograms, rectangles, rhombi, or squares. Be systematic and be sure that you give all the evidence necessary to verify your claim. | SMP 2<br>SMP 3<br>SMP 6 |

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| 4.6 | Discovering Trigonometry, Lisa B & Tina C | An introductory exploration using Geogebra where students relate trigonometric ratios to similar triangles. | SMP 5<br>SMP 7 |
| 4.6 | Intro to trigonometry, Sam Shah | A series of 4 packets that guide students through discovering trigonometric ratios through the study of similar triangles and then extending this to the special right triangles. | SMP 6<br>SMP 7 |
| 4.6 | Do Kids really understand trigonometry once Sin/Cos/Tan are introduced?, Sam Shah | For my kids, at this level, I want each term (sin/cos/tan) to be a ratio generates a class of similar triangles — which all look the same, but have different sizes. And I want kids to conjure that up, when they think of sin(40)=0.6428. But I fear that 0.6428 will stop losing meaning as a ratio of sides… that 0.6428 won't mean anything geometric or visual to them. Why? Because the words "sine" "cosine" and "tangent" start acting as masks, and kids start thinking procedurally when using them in geometry. | SMP 6<br>SMP 8 |
| 4.6 | Triangle pile up, Great Maths teaching ideas | This resource is a challenging puzzle to consolidate learning on trigonometry. The idea is that pupils have to start with the information they have in the bottom triangle and work their way up through the stack, finding missing side lengths to allow them to calculate the length of the hypotenuse of the top triangle. The puzzle can be solved with trigonometry alone (finding missing sides and missing angles) or Pythagoras' Theorem can be used at some points as well.<br>This puzzle can also be used to clearly demonstrate why you shouldn't round numbers mid-way through a calculation. It might be quite nice to get one group to round their answers at each stage to compare with the others and demonstrate how the rounding error accumulates through the puzzle.<br>There are lots of extension opportunities for this puzzle such as: what is the area of the whole compound shape?, what is the perimeter of the compound shape?, what proportion of the page is occupied by the triangles? | SMP 1<br>SMP 6<br>SMP 8 |
| 4.6 | Breaking handicap laws & Creating Trigonometry, Michael Pershan | In this sequence of activities, students necessitate the trig ratios by first exploring handicap ramps and looking more broadly at angles of inclination given height and width. In the second post, the students build toward a handmade trigonometric table to use to solve problems. | SMP 1<br>SMP 8 |

| Hex 5: Applied Trigonometry & Solids | CCSS |
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| 5.1 I can use trigonometry to solve a variety of modeling problems. | G.SRT.6 |
| 5.2 I can use dissection arguments to show where the formulas for surface area of cylinders, prisms & pyramids come from. | G.GMD.1 |
| 5.3 I can compute perimeters of polygons and areas of triangles and rectangles on a coordinate grid. | G.GPE.7 |
| 5.4 I can derive & apply volume formulas for cylinders, prisms, cones & pyramids | G.MG.1 |
| 5.5 I can solve real-world and mathematical situations involving volume and surface area. | G.GMD.3 |
| 5.6 I can identify 2D cross sections & 3D objects generated from rotating 2D shapes | G.GMD.4 |

| Enduring Understandings | Essential Questions |
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| • The formulas for area, perimeter, and volume for various shapes and solids represent real properties of the shape or solid, and finding area and volume is essential to learning and applying the size and weight of real world objects. | • What can we measure about figures? How do we measure these qualities? How do measurements change when we change dimensions?<br>• How do you find the surface area and volume of a solid?<br>• How do the surface areas and volumes of similar solids compare?<br>• How are the surface areas and volumes of solids related and applied? |

| Learning Target, Instructional task & Standards for Math Practice | | | |
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| 5.1 | Using trigonometry to measure a Flagpole, FracTad's Fractopia | Using a clinometer, to estimate the flagpole height, we needed the angle of elevation, which is measured from the horizontal. So, some geometry needs to be applied to figure out the angle of elevation... | SMP 1<br>SMP 4<br>SMP 5 |
| 5.1 | Diamond Building, Lisa B via Jeff De Varona's | I used this lesson as a summary to a unit on right triangles, a few days after doing a clinometer activity based on this. My favorite part was listening to students try to determine how to find the height of 1 diamond using only the fact that it is constructed of 2 equilateral triangles with sides length 7 feet. Some students constructed 30-60-90 triangles and used trigonometry, which is exciting because I did not explicitly teach special right triangles in this geometry class. Most students realized they could use the Pythagorean theorem. | SMP 1<br>SMP 5<br>SMP 7 |
| 5.1 | 51-Foot Ladder, Mathalicious | In 2005, when discussing the proposed border wall between the United States and Mexico, then- Arizona governor Janet Napolitano said, "You show me a fifty foot wall. I'll show you a fifty-one foot ladder." Politics aside, would a 51-foot ladder actually be long enough to climb a 50-foot wall?<br>In this lesson, students combine OSHA's recommendations for ladder safety with the Pythagorean Theorem and/or trigonometric ratios to explore how high you can really climb. | SMP 1<br>SMP 4<br>SMP 7 |
| 5.1 | Sofa Away from Me, Mathalicious | Given a television of a certain size, where's the best place to put the couch? This lesson uses right triangle trigonometry and a rational function to explore the percent of your visual field that is occupied by the area of a television. Students use right triangle trigonometry to find the visible width, height, and viewing area for various distances from the television. They will find and plot the percent of a person's field of view filled by a 60-in TV and write a rational function for the percent they find. Finally, they will solve, algebraically or by graphing, the function to find the distance where the TV fills 100% of your view | SMP 4<br>SMP 8 |
| 5.1 | Satellite, Illustrative Mathematics | This task is an example of applying geometric methods to solve design problems and satisfy physical constraints. This task models a satellite orbiting the earth in communication with two control stations located miles apart on earth's surface. Students determine distances between various locations and given a rate of travel, students determine the time it takes to travel between two specified locations. Part c here introduces the law of cosines and is beyond the scope of this section but the teacher could make the choice to include it here. | SMP 1<br>SMP 4 |

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| 5.2 | Introducing Surface area with Pop Box Design, Timon Piccini and My Adaptations | The lesson will hopefully cause the students to ask more questions about surface area and will provide a higher level of engagement for the rest of the unit where students will be deriving formulas like this one. This activity also provides a nice bridge between the geometry work of this unit and some more algebraic topics. | SMP 3<br>SMP 4<br>SMP 6 |
| 5.2 | Tin Man, Miss Calcul8 | Each pair of students built a tin man out of boxes, toilet paper rolls, paper towel rolls, Styrofoam balls, and cones. They had to use a formula sheet to first measure the surface area of the parts, showing all of their work for each part. Next they had to tape the parts together. The tin man had to have all parts attached and be sitting or standing on its own. Then I would give them the exact amount of foil they measured for, no more and no less. They had to cover their tin man as completely as possible without running out of tinfoil or having extra leftover. | SMP 1<br>SMP 5<br>SMP 6 |
| 5.5 | Greenhouse Management, Achieve the Core | This task requires a scale drawing and calculations related to area and volume for a greenhouse project. Students are called upon in the prompt to show their work and thinking so they can make a presentation to the manager about their solution This task is linked to CTE standards and was designed with agriculture sciences educators to provide a link between mathematics and the field of agriculture. The purpose of this task is to give students a modeling task in which to use apply their knowledge of the area and volume formulas. | SMP 1<br>SMP 2<br>SMP 3<br>SMP 6 |
| 5.4 | *Tap into teen minds: Prisms & Pyramids, a 3- act task There is no link here :-( is this it?* | In this multi-step 3 act math task, the teacher will show three sets of 3 Act Math Style tasks involving comparisons between rectangular prisms and pyramids, triangular base prisms and pyramids, and cylinders and cones. | SMP 5<br>SMP 8 |
| 5.2 | Fawn & NCTM: I am a Doughnut | An activity in measurement and geometry in which students explore the volume and surface area of a donut. Through calculation, creative thinking, and discovery, the students enhanced their geometric vocabulary and reasoning. | SMP 2<br>SMP 3<br>SMP 4 |
| 5.5 | Kaplinsky: Gumball Machine<br>Kaplinsky: Drug Money<br>*Kaplinsky: Cigarette Butts*<br>Dan Meyer: You Pour I choose<br>Dan Meyer: Water Tank<br>Dan Meyer: Meatballs | Engaging tasks to develop student understanding of the application of the concept of volume of a variety of solids. | SMP 1<br>SMP 2<br>SMP 3 |
| 5.5 | MARS: Calculating volumes of Compound objects | This task challenges students to find the volumes of 3 different cups and then critique the work of other students who did the same task. | SMP 3<br>SMP 5 |
| 5.4 | Open Middle: Find 3 different cylinders that hold between 110 and 115 cu. ft. of water. | This problem helps students think strategically and work backwards to determine possible dimensions of a cylinder so that its volume is in a specified range. | SMP 2<br>SMP 3<br>SMP 8 |
| 5.5 | Kate Nowak: Spiky Door | A 3 day task that requires students to construct a pyramid or cone with a specified pre determined range for its volume and surface area. Effective gets students to reliably distinguish both slant height from height, and volume from surface area. | SMP 2<br>SMP 4<br>SMP 6 |
| 5.5 | MARS: Evaluating statements about enlargements | This lesson unit is intended to help you assess how well students are able to solve problems involving area and volume, and in particular, to help you identify and assist students who have difficulties with:<br>-Computing perimeters, areas, and volumes using formulas.<br>-Finding the relationships between perimeters, areas, and volumes of shapes after scaling. | SMP 1<br>SMP 3<br>SMP 7<br>SMP 8 |
| 5.5 | MARS: Designing Candy Boxes | This lesson unit is intended to help you assess how well students are able to:<br>Select appropriate mathematical methods to use for an unstructured problem.<br>Interpret a problem situation, identifying constraints and variables and specify assumptions.<br>Work with 2- and 3-dimensional shapes to solve a problem involving capacity and surface area.<br>Communicate their reasoning clearly. | SMP 2<br>SMP 3<br>SMP 8 |

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| 5.6 | Identifying 3D figure from 2D Rotation, Renton Schools | This activity provides some practice with foundational visualization tools that will be extremely useful throughout the rest of the unit. This also provides a nice opportunity for students to include various entry points and requires that the students look for and make use of structure while investigating the shapes. | SMP 1<br>SMP 5<br>SMP 7 |

**update summer 2017: this is what I prefer for the last unit of the year**

| Hex 6: circles | CCSS |
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| 6.1 I can determine and apply circumference and area of a circle | G.GMD.A.1 |
| 6.2 I can use the Pythagorean Theorem to derive and apply an equation for a circle of given center and radius | G.GPE.A.1 |
| 6.3 I can measure angles using both degrees and radians. | G.C.B.5 |
| 6.4 I can determine the length of an arc of a circle. | G.C.B.5 |
| 6.5 I can derive and use a formula to determine the area of a sector of a circle | G.C.B.5 |
| 6.6 I can use properties and relationships of chords, secants and tangents to solve for various lengths and angles | G.C.A.2 |

| Enduring Understandings | Essential Questions |
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| ● Relationships exist among the radius, secant, tangent, and chords of a circle.<br>● The the radius of a circle is perpendicular to the tangent where the radius intersects the circle.<br>● The length of the arc intercepted by an angle is proportional to the radius.<br>● You can find the length of part of a circle's circumference (an arc) by relating it to an angle in the circle.<br>● You can use an arc length to find the area of the sector formed by the arc and the radii of the circle. | ● What relationships are formed when lines intersect circles?<br>● How can you find the measures of angles, arcs, and segments of a circle using the lines intersecting the circle, the center of the circle, and within the circle?<br>● How can you use the arcs and intersecting lines on and within a circle to determine the measurements of arcs, segments, and areas of sectors of the circle? |

| Learning Target, Instructional task & Standards for Math Practice | | | |
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| 6.1 | Stained Glass, Illustrative math | Students find the area and perimeter of geometric figures whose boundaries are segments and fractions of circles and to combine that information to calculate the cost of a project. (7-G.4) The shape of the regions in the stained glass window are left purposefully unspecified, as one component skill of modeling with mathematics is for students to make simplifying assumptions themselves. | SMP 4<br>SMP 7 |
| 6.2 | *Equations of Circles Desmos* | In this activity, students practice writing equations of circles (in standard and general form) to match various descriptions and constraints. | SMP 1<br>SMP 7 |
| 6.2 | *Equations of Circles 1, Shell Center* | Using only their knowledge of the Pythagorean Theorem, and the fact that any (x,y) that satisfies an equation in terms of x and y is a point on its graph, students proceed through this lesson to derive the equation of a circle. They are asked questions they have not been shown how to solve yet, and must access their prior knowledge along with their perseverance to make sense of, and make progress on, problems. They start with specific questions about specific circles, but then complete a matching activity where they must look for and make use of structure to discern a circle's center and radius from given equations. | SMP 1<br>SMP 2<br>SMP 5<br>SMP 7 |
| 6.2 | *Sprinkler system design with Desmos.* | I imported a Google earth screenshot of my school's campus and challenged my students to diagram a sprinkler system using the least number of sprinklers possible. This forced them to practice using equations of circles. Next year I'd like to add cost info for sprinkler lines, heads and water usage and have students calculate the total cost and employ the distance formula too. | SMP 4<br>SMP 5 |
| 6.2 | Equations of circles 2 Shell Center | This lesson unit is intended to help you assess how well students are able to:<br>Translate between the equations of circles and their geometric features.<br>Sketch a circle from its equation. | SMP 5<br>SMP 6 |

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| 6.4 | Rotunda West, Dan Meyer info here | A 3 act task where students have to calculate the fastest route from one point to another either by going through the circle or driving on the circumference. This task is a great introduction to calculating arc length. | SMP 1<br>SMP 3<br>SMP 6 |
| 6.4 | *Arc Lengths and Sector Areas*, Cathy Jones | In this task, students will discover the relationships between arc length, central angle measure, and circumference. They will also discover the relationship between circle area, central angle measures, and sector area. Lastly, students can create formulas for calculating arc length and sector area. | SMP 2<br>SMP 7 |
| 6.3<br>6.4<br>6.5 | Sectors of circles, Shell center | his lesson unit is intended to help you assess how well students are able to solve problems involving area and arc length of a sector of a circle using radians. It assumes familiarity with radians and should not be treated as an introduction to the topic. This lesson is intended to help you identify and assist students who have difficulties in:<br>Computing perimeters, areas, and arc lengths of sectors using formulas.<br>Finding the relationships between arc lengths, and areas of sectors after scaling. | SMP 5<br>SMP 7 |
| 6.1<br>6.5 | Circles Galore, Fawn Nguyen | In this task, you will look at a pattern of black and white circles and describe, mathematically, what is happening to the areas of black and white as the pattern develops. | SMP 2<br>SMP 3<br>SMP 7 |
| 6.4<br>6.6 | Lucky Cow, Dan Meyer | This task asks students to ponder what line will cut a wedge (sector) of Lucky Cow cheese exactly in half. Rather than finding the obvious vertical line that would divide the area, students are asked to find the horizontal line that cuts the area in half. At first students might use their intuition and a method of guessing and checking to estimate a solution. Once students have grappled with the general premise and possible estimated solution to the problem, they can move into more precise solutions using sector area (in either radians or degrees), trigonometry, and proportional reasoning. Alternative solutions may also involve trapezoids, segments, and some algebraic manipulation. The purpose of this task is to contextualize finding the area of a sector, or a proportion of a sector, and to apply that area formula in a richer context that requires thinking across multiple mathematical concepts. One solution of this task is a really nice use of the area of a sector in terms of radians as well. However, there are several valid approaches to solve this problem, so students should be encouraged to compare and contrast their methods. Students may need a refresher on right triangle trigonometry to precisely complete this task. | SMP 1<br>SMP 4<br>SMp 6<br>SMP 7 |
| 6.4 | Triplets of Cellville, Mathalicious & my blog post about it here. | In this lesson, students describe the location information provided by a cell phone tower, explain why loci from at least three towers are required to pinpoint a customer's location, and consider the tradeoff between coverage and "locatability" when a cell phone company chooses a new tower location. | SMP 3<br>SMP 6 |
| + | Inscribed & Circumscribed Right triangles, Shell Center | This lesson unit is intended to help you assess how well students are able to use geometric properties to solve problems. In particular, it will help you identify and help students who have difficulty:<br>Decomposing complex shapes into simpler ones in order to solve a problem.<br>Bringing together several geometric concepts to solve a problem.<br>Finding the relationship between radii of inscribed and circumscribed circles of right triangles. | SMP 1<br>SMP 2<br>SMP 3 |
| 6.4 | Axle Roads, Mathalicious | when a car turns, the outer wheel has to move farther than the inner wheel. But how is that possible if the wheels are connected by an axle?<br>In this lesson, students use the geometry of circles to understand how we get from point A to point B when the path isn't a straight one. | SMP 1<br>SMP 4 |