Unit 1: Basics of Geometry, Reasoning, and Proofs

Course Time Prior to Keystone/PSSA: 10 Blocks, 20 Periods

Overview: Students will identify and name figures such as point, lines, planes, and rays. They will measure line segments, compare lengths, and identify congruent segments. They will apply the distance formula and midpoint formula. Students will compare and contrast inductive reasoning and deductive reasoning. Students will disprove statements using counterexamples. Students will analyze conditional statements and identify the hypothesis and conclusion of a statement. Students will write the converse, inverse, and contrapositive of conditional statements. Students will write two column proofs about segments and angles, about angles formed by intersecting lines, and about angle pair relationships.

Unit Essential Questions:
- How can we identify and classify shapes and structures that we see in our everyday lives, what are their properties, and how can we use information about those shapes to discover things about them that are not immediately obvious? How do you use inductive reasoning in mathematics?

Keystone Content Module/Assessment Anchor:
- **G.1.3.2** Write formals and/or use logic statements to construct or validate arguments.
- **G.2.1.2** Solve problems using analytic geometry.
- **G.2.2.1** Use and/or compare measurements of angles.

Keystone Eligible Content:
- **G.1.3.2.1** Write, analyze, complete, or identify formal proofs (e.g., direct and/or indirect proofs/proofs by contradiction).
- **G.2.1.2.1** Calculate the distance and/or midpoint between two points on a number line or on a coordinate plane.
- **G.2.1.2.3** Use slope, distance, and/or midpoint between two points on a coordinate plane to establish properties of a 2-dimensional shape.
- **G.2.2.1.1** Use properties of angles formed by intersecting lines to find the measures of angles.

Pennsylvania Common Core Standard(s):
- **CC.2.3.HS.A.11** Apply coordinate geometry to prove simple geometric theorems algebraically.

National Common Core Standard(s):
Experiment with transformations in the plane
- **CC.9-12.G.CO.1** Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.

Make geometric constructions
- **CC.9-12.G.CO.12** Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.

Expressing Geometric Properties with Equations
- **CC.9-12.G.GPE.6** Find the point on a directed line segment between two given points that partitions the segment in a given ratio.

- **CC.9-12.G.GPE.7** Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.

Understand solving equations as a process of reasoning and explain the reasoning

- **CC.9-12.A.REI.1** Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

ISTE Standards:

1. Creativity and Innovation – Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology.
    b. Create original works as a means of personal or group expression
    c. Use models and simulations to explore complex systems and issues
2. Communication and Collaboration – Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
    a. Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media
    b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats
    d. Contribute to project teams to produce original works or solve problems
3. Research and Information Fluency – Students apply digital tools to gather, evaluate, and use information.
    a. Plan strategies to guide inquiry
    b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media
    c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks
    d. Process data and report results
4. Critical Thinking, Problem Solving, and Decision Making – Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
    a. Identify and define authentic problems and significant questions for investigation
    b. Plan and manage activities to develop a solution or complete a project
    c. Collect and analyze data to identify solutions and/or make informed decisions
    d. Use multiple processes and diverse perspectives to explore alternative solutions
5. Digital Citizenship – Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.
    a. Advocate and practice safe, legal, and responsible use of information and technology
    b. Exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity
    c. Demonstrate personal responsibility for lifelong learning
    d. Exhibit leadership for digital citizenship
6. Technology Operations and Concepts – Students demonstrate a sound understanding of technology concepts, systems, and operations.
    a. Understand and use technology systems
    b. Select and use applications effectively and productively

Career Education and Work Standards:

- 13.1.11.A Relate careers to individual interests, abilities, and aptitudes.
- 13.1.11.E Justify the selection of a career.

- 13.1.11.H Review personal high school plan against current personal career goals and select postsecondary opportunities based upon personal career interests.

Connecting to Common Core and Other Standards:

PA Standards found at www.pdesas.org/standards/standardsdownloads
National Common Core found at www.corestandards.org
ISTE found at www.iste.org/standards/nets-for-students.aspx
Career Education and Work found at www.pacareerstandards.com/
*See Appendix for complete documents.

ELL Differentiation:

- Math & LA specifics found at www.pde.sas.org/module/sas/curriculumframework/elloverlay.aspx
- Generic found at http://www.easad.net/esl
- http://www.todos-math.org

Enrichment:

- Nets, analytic geometry in three dimensions, isometric graphing
- Internet/Research Activities
  - www.studyIsland.com
  - https://www.thelearningodyssey.com/
  - http://www.khanacademy.org/
  - http://www.classzone.com/cz/login.htm
- Group/Research Projects

Remediation:

- Operations with rational numbers
- Classify and compare real numbers
- Use order of operations to simplify and evaluate expressions and formulas
- Using a ruler, compass, and protractor
- Calculate area, perimeter, and circumference
- Find slope when given a graph of a line and/or two points on a line

IEP/GIEP: Refer to individual student's education plan under specially designed instruction.

Keystone Anchors & Eligible Content	**Unit Concept** What students need to know	**Unit Competencies** What students need to be able to do (skills): (Students will:)	**Content Vocabulary**	**Materials, Resources, & Instructional Activities**	**Assessments**

G.1.3.2.1
 	
G.2.1.2.1
 	
G.2.1.2.3
 	
G.2.2.1.1
	• Write, analyze, complete, or identify formal proofs (e.g., direct and/or indirect proofs/proofs by contradiction).
	• Calculate the distance and/or midpoint between two points on a number line or on a coordinate plane.
	• Use slope, distance, and/or midpoint between two points on a coordinate plane to establish properties of a 2-dimensional shape.
	• Use and/or compare measurements of angles.
		• Define and draw the basic geometric figures, and corresponding geometric symbols when applicable
		  ○ Point
		  ○ Line
		  ○ Plane
		  ○ Segment
		  ○ Line Segment
		  ○ Endpoints
		  ○ Ray
		  ○ Opposite Rays
		  ○ Angles
		• Calculate the length of various segments
		• Use segment postulates to identify congruent segments
		  ○ Ruler Postulate
		  ○ Segment Addition Postulate
		• Find the midpoint using algebra
		• Find the midpoint using the Midpoint Formula
		• Find the distance between two points on the coordinate plane using the Distance Formula
		• Construct various geometric figures using a straight edge and protractor
		• Use properties of angles formed by intersecting lines to find the measures of missing angles
		• Compare and contrast
			• Point
			• Endpoint
			• Line
			• Collinear Points
			• Coplanar Points
			• Defined Terms
			• Undefined Terms
			• Intersection
			• Plane
			• Coordinate Plane
			• Coordinate
			• Distance (Between Points)
			• Number Line
			• Parallel Lines
			• Parallel
			• Perpendicular Lines
			• Perpendicular
			• Segment
			• Line Segment
			• Ray
			• Opposite Ray
			• Postulate
			• Conjecture
			• Axiom
			• Distance Formula
			• Midpoint
			• Midpoint Formula
			• Length
			• Congruent
				• Geometry – Concepts and Skills – McDougal Littell, 2005
				• Geometry Prentice Hall, 2007
				• Geometry McDougal Littell, 2008
				• Geometry Teacher's Activity Kit
				• Straightedge
				• Protractor
				• Calculators
				• CPS
				• Supplemental resources
				• Geometry software, i.e. "Geometer's Sketchpad"
				• Spiral Review and Project Binder
				• Bell Ringers
				• Study Island
				• PSSA Coach Grade 10
				• Measuring Up
				• Appendix
				• YouTube
				• ESASD Valuable Video Library
					• Tests
					• Quizzes
					• CDTs
					• Compass Learning
					• Study Island
					• Observation
					• Homework
					• Projects
					• Journals
					• Bell Ringers
					• Notebooks

		complementary and supplementary angles • Solve real-world problems	Segments • Sides of an Angle • Vertex • Congruent Angles		

Keystone Anchors & Eligible Content	**Unit Concepts What students need to know**	**Unit Competencies What students need to be able to do (skills): (Students will:)**	**Content Vocabulary (Continued from Above)**	**Materials, Resources, & Instructional Activities**	**Assessments**
G.1.3.2.1 G.2.1.2.1 G.2.1.2.3 G.2.2.1.1	• Write, analyze, complete, or identify formal proofs (e.g., direct and/or indirect proofs/proofs by contradiction). • Calculate the distance and/or midpoint between two points on a number line or on a coordinate plane. • Use slope, distance, and/or midpoint between two points on a coordinate plane to establish properties of a 2-dimensional shape. • Use and/or compare measurements of angles.	• Calculate the complement or supplement of an angle • Classify angles using characteristics ○ Acute Angle ○ Right Angle ○ Obtuse Angle ○ Straight Angle • Estimate the measure of an angle as acute, right, obtuse, or straight • Verify angle measures with a protractor ○ Protractor Postulate • Solve problems using the Angle Addition Postulate • Find angle measures using algebra • Solve real world problems involving geometric figures • Complete numerical patterns • Compare and contrast inductive and deductive reasoning • Determine the type of reasoning used to solve a problem • Rewrite a statement in if-then form • For a given conditional statement, write the ○ Converse ○ Inverse ○ Contrapositive • Write a biconditional statement	• Acute, Right, Obtuse, Straight Angles • Segment Bisector • Bisect • Angle Bisector • Complimentary Angles • Supplementary Angles • Adjacent Angles • Theorem • Vertical Angles • Linear Pair • Patterns • Inductive Reasoning • Deductive Reasoning • Conditional Statement • If-Then Form • Hypothesis • Conclusion • Negation • Converse • Inverse • Contrapositive • Equivalent Statements	• Geometry – Concepts and Skills – McDougal Littell, 2005 • Geometry Prentice Hall, 2007 • Geometry McDougal Littell, 2008 • Geometry Teacher's Activity Kit • Straightedge • Protractor • Calculators • CPS • Supplemental resources • Geometry software, i.e. "Geometer's Sketchpad" • Spiral Review and Project Binder • Bell Ringers • Study Island • PSSA Coach Grade 10 • Measuring Up • Appendix • YouTube • ESASD Valuable	• Tests • Quizzes • CDTs • Compass Learning • Study Island • Observation • Homework • Projects • Journals • Bell Ringers • Notebooks

		and its converse • Use the Law of Detachment and Syllogism to write statements and conclusions • Create and populate truth tables	• Biconditional Statement • Law of Syllogism • Law of Detachment • Truth Table • Truth Value	Video Library	

Unit 2: Parallel and Perpendicular Lines

Course Time Prior to Keystone/PSSA: 10 Blocks, 20 Periods

Overview: Students will reason using parallel lines and perpendicular lines. Students will identify corresponding, consecutive, interior, exterior, same side, and alternate angles. They will use postulates and theorems that apply to parallel lines with transversals. Students will prove lines are parallel using two column proofs. Students will find the slope of parallel and perpendicular lines.

Unit Essential Questions:
- What are the most basic building blocks of all geometric figures, and how can we accurately and precisely describe those building blocks to one another? What angle pairs are formed by transversals? How do you prove lines are parallel? How do you prove lines are perpendicular?

Keystone Content Module/Assessment Anchor:
- **G.1.3.2** Write formal proofs and/or use logic statements to construct or validate arguments.
- **G.2.1.2** Solve problems using analytic geometry.
- **G.2.2.1** Use and/or compare measurements of angles.

Keystone Eligible Content:
- **G.1.3.2.1** Write, analyze, complete or identify formal proofs (e.g. direct and/or indirect proof/proofs by contradiction).
- **G.2.1.2.2** Relate slope to perpendicularity and/or parallelism (limit to linear algebraic equations).
- **G.2.2.1.1** Use properties of angles formed by intersecting lines to find the measure of missing angles.
- **G.2.2.1.2** Use properties of angles formed when two parallel lines are cut by a transversal to find the measures of missing angles.

Pennsylvania Common Core Standard(s):
- **CC.2.1.HS.F.2** Apply properties of rational and irrational numbers to solve real world or mathematical problems.
- **CC.2.1.HS.F.3** Apply quantitative reasoning to choose and Interpret units and scales in formulas, graphs and data displays.
- **CC.2.1.HS.F.4** Use units as a way to understand problems and to guide the solution of multi-step problems
- **CC.2.1.HS.F.6** Extend the knowledge of arithmetic operations and apply to complex numbers.
- **CC.2.2.HS.D.2** Write expressions in equivalent forms to solve problems.
- **CC.2.2.HS.D.6** Extend the knowledge of rational functions to rewrite in equivalent forms
- **CC.2.2.HS.D.8** Apply inverse operations to solve equations or formulas for a given variable.
- **CC.2.3.HS.A.3** Verify and apply geometric theorems as they relate to geometric figures.
- **CC.2.3.HS.A.6** Verify and apply theorems involving similarity as they relate to plane figures.
- **CC.2.3.HS.A.11** Apply coordinate geometry to prove simple geometric theorems algebraically.

National Common Core Standard(s):
Crete equations that describe numbers or relationships
- **CC.9-12.A-CED.2** Create equations in two or more variables to represent relationships between two quantities; graph equations on coordinate axes with labels and scales.

Experiment with transformations in the plane

- **CC.9-12.G.CO.1** Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.

Prove geometric theorems

- **CC.9-12.G.CO.9** Prove theorems about lines and angles.

Make geometric constructions

- **CC.9-12.G.CO.12** Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.).

Use coordinates to prove simple geometric theorems algebraically

- **CC.9-12.G.GPE.4** Use coordinates to prove simple geometric theorems algebraically.
- **CC.9-12.G.GPE.5** Prove the slope criteria for parallel and perpendicular lines and uses them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).
- **CC.9-12.G.GPE.6** Find the point on a directed line segment between two given points that partitions the segment in a given ratio.

ISTE Standards:

1. Creativity and Innovation – Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology.
    b. Create original works as a means of personal or group expression
    c. Use models and simulations to explore complex systems and issues
2. Communication and Collaboration – Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
    a. Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media
    b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats
    d. Contribute to project teams to produce original works or solve problems
3. Research and Information Fluency – Students apply digital tools to gather, evaluate, and use information.
    a. Plan strategies to guide inquiry
    b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media
    c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks
    d. Process data and report results
4. Critical Thinking, Problem Solving, and Decision Making – Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
    a. Identify and define authentic problems and significant questions for investigation
    b. Plan and manage activities to develop a solution or complete a project
    c. Collect and analyze data to identify solutions and/or make informed decisions
    d. Use multiple processes and diverse perspectives to explore alternative solutions
5. Digital Citizenship – Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.
    a. Advocate and practice safe, legal, and responsible use of information and technology
    b. Exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity
    c. Demonstrate personal responsibility for lifelong learning

d. Exhibit leadership for digital citizenship

6. Technology Operations and Concepts – Students demonstrate a sound understanding of technology concepts, systems, and operations.
   a. Understand and use technology systems
   b. Select and use applications effectively and productively

Career Education and Work Standards:
- 13.1.11.A Relate careers to individual interests, abilities, and aptitudes.
- 13.1.11.E Justify the selection of a career.
- 13.1.11.H Review personal high school plan against current personal career goals and select postsecondary opportunities based upon personal career interests.

Connecting to Common Core and Other Standards:

PA Standards found at www.pdesas.org/standards/standardsdownloads
National Common Core found at www.corestandards.org
ISTE found at www.iste.org/standards/nets-for-students.aspx
Career Education and Work found at www.pacareerstandards.com/
*See Appendix for complete documents.

ELL Differentiation:
- Math & LA specifics found at www.pde.sas.org/module/sas/curriculumframework/elloverlay.aspx
- Generic found at http://www.easad.net/esl
- http://www.todos-math.org

Enrichment:
- Internet/Research Activities
  - www.studyIsland.com
  - https://www.thelearningodyssey.com/
  - http://www.khanacademy.org/
  - http://www.classzone.com/cz/login.htm
- Group/Research Projects

Remediation:
- Solving equations
- Evaluating expressions
- Notating geometric figures
- Operations with real numbers

IEP/GIEP: Refer to individual student's education plan under specially designed instruction.

Keystone Anchors & Eligible Content	**Unit Concepts** What students need to know	**Unit Competencies** What students need to be able to do (skills): (Students will:)	**Content Vocabulary**	**Materials, Resources, & Instructional Activities**	**Assessments**

G.1.3.2.1
 	
G.2.1.2.2
 	
G.2.2.1.1
 	
G.2.2.1.2
	• Write, analyze, complete or identify formal proofs (e.g. direct and/or indirect proof/proofs by contradiction)
	• Relate slope to perpendicularity and/or parallelism (limit to linear algebraic equations).
	• Use properties of angles formed by intersecting lines to find the measure of missing angles
	• Use properties of angles formed when two parallel lines are cut by a transversal to find the measures of missing angles
		• Identify relationships between lines or line segments in diagrams of 3-dimensional figures
		  ○ Parallel
		  ○ Perpendicular
		  ○ Skew
		• Construct parallel and perpendicular lines
		• Apply the Parallel Postulate and Perpendicular Postulate in problem-solving
		• Construct lines cut by a transversal
		• Identify angle pairs when given two lines cut by a transversal
		  ○ Corresponding
		  ○ Alternate Interior
		  ○ Alternate Exterior
		  ○ Consecutive Interior
		  ○ Vertical
		  ○ Same Side Interior
		• Find the measure of angles formed by lines cut by a transversal
		• Identify skew lines
		• Use vertical angles to find missing measures
		• Identify parallel and perpendicular planes
		• Identify angle pairs and congruent angles in figures containing transversals
		  ○ Justify using theorems
		• Prove two lines are parallel using two column proofs
		• Use geometric theorems to prove lines are parallel
			• Postulates
			• Theorems
			• Two Column Proof
			• Parallel Lines
			• Perpendicular Lines
			• Coplanar
			• Skew Lines
			• Parallel Planes
			• Transversal
			• Corresponding Angles
			• Alternate Interior Angles
			• Same Side Interior Angles
			• Consecutive Angles
			• Exterior Angles
			• Vertical Angles
			• Slope
			• Slope-Intercept Form
			• Standard Form
			• Distance
			• Paragraph Proof
			• Converse
				• Geometry – Concepts and Skills – McDougal Littell, 2005
				• Geometry Prentice Hall, 2007
				• Geometry McDougal Littell, 2008
				• Geometry Teacher's Activity Kit
				• Straightedge
				• Protractor
				• Calculators
				• CPS
				• Supplemental resources
				• Geometry software, i.e. "Geometer's Sketchpad"
				• Spiral Review and Project Binder
				• Bell Ringers
				• Study Island
				• PSSA Coach Grade 10
				• Measuring Up
				• Appendix
					• Tests
					• Quizzes
					• CDTs
					• Compass Learning
					• Study Island
					• Observation
					• Homework
					• Projects
					• Journals
					• Bell Ringers
					• Notebooks

		• Use the transitive property of parallel lines		• YouTube • ESASD Valuable Video Library	

Keystone Anchors & Eligible Content	Unit Concepts What students need to know	Unit Competencies What students need to be able to do (skills): (Students will:)	Content Vocabulary	Materials, Resources, & Instructional Activities	Assessments

G.1.3.2.1
 	
G.2.1.2.2
 	
G.2.2.1.1
 	
G.2.2.1.2
	• Write, analyze, complete or identify formal proofs (e.g. direct and/or indirect proof/proofs by contradiction)
	• Relate slope to perpendicularity and/or parallelism (limit to linear algebraic equations).
	• Use properties of angles formed by intersecting lines to find the measure of missing angles
	• Use properties of angles formed when two parallel lines are cut by a transversal to find the measures of missing angles
		• Find the measure of angles using algebraic expressions using:
		  ○ Angle Pairs
		  ○ Parallel Lines
		  ○ Perpendicular Lines
		  ○ Geometric Figures
		• Use and apply the converse of the angle theorems
		• Calculate the slope between two points
		• Find and compare slopes of lines
		  ○ Negative Slope
		  ○ Positive Slope
		  ○ Zero Slope
		  ○ Undefined Slope
		• Identify parallel and perpendicular lines from a graph
		• Graph a line when given two points
		  ○ Graph a perpendicular line when given a 3rd point
		• Write an equation of a line from a graph or its equation
		  ○ Write an equation of a parallel line
		  ○ Write an equation of a perpendicular line
		• Given an equation, write an equation of line that is parallel and/or perpendicular to the given line
		• Find the distance between a point and a line
		• Find the distance between two parallel lines
		• Solve real-world problems
			• Postulates
			• Theorems
			• Two Column Proof
			• Parallel Lines
			• Perpendicular Lines
			• Coplanar
			• Skew Lines
			• Parallel Planes
			• Transversal
			• Corresponding Angles
			• Alternate Interior Angles
			• Same Side Interior Angles
			• Consecutive Angles
			• Exterior Angles
			• Vertical Angles
			• Slope
			• Slope-Intercept Form
			• Standard Form
			• Distance
			• Paragraph Proof
			• Converse
				• Geometry – Concepts and Skills – McDougal Littell, 2005
				• Geometry Prentice Hall, 2007
				• Geometry McDougal Littell, 2008
				• Geometry Teacher's Activity Kit
				• Straightedge
				• Protractor
				• Calculators
				• CPS
				• Supplemental resources
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				• Spiral Review and Project Binder
				• Bell Ringers
				• Study Island
				• PSSA Coach Grade 10
				• Measuring Up
					• Tests
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					• Study Island
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					• Bell Ringers
					• Notebooks

				• Appendix • YouTube • ESASD Valuable Video Library	

Unit 3: Triangles

Course Time Prior to Keystone/PSSA: 10 Blocks, 20 Periods

Overview: Students will identify congruent and similar triangles using the similarity and congruence theorems. Students will use transformations to show congruence. Students will classify triangles using the sides and angles. Students will write two column proofs using the congruence and similarity theorems. Students will construct altitudes, medians, bisectors, and centroids.

Unit Essential Questions: What characteristics of triangles can guide us in making useful generalizations about plane geometry and how do those generalizations give us tools to solve real-world problems? How are the sides and angles of a triangle related if there are two or more congruent sides or angles?

Keystone Content Module/Assessment Anchor:

- **G.1.2.1** Recognize and/or apply properties of angles, polygons, and polyhedra.
- **G.1.3.1** Use properties of congruence, correspondence, and similarity in problem-solving settings involving 2- and 3-dimensionalfigures.
- **G.1.3.2** Write formal proofs and/or use logic statements to construct or validate arguments.
- **G.2.2.1** Use and/or compare measurements of angles.

Keystone Eligible Content:

- **G.1.2.1.1** Identify and/or use properties of triangles.
- **G.1.2.1.3** Identify and/or use properties of isosceles and equilateral triangles.
- **G.1.3.1.1** Identify and/or use properties of congruent and similar polygons or solids.
- **G.1.3.1.2** Identify and/or use proportional relationships in similar figures.
- **G.1.3.2.1** Write, analyze, complete, or identify formal proofs (e.g., direct and/or indirect proofs/proofs by contradiction)
- **G.2.2.1.1** Use properties of angles formed by intersecting lines to find the measures of missing angles.
- **G.2.2.1.2** Use properties of angles formed when two parallel lines are cut by a transversal to find the measures of missing angles.

Pennsylvania Common Core Standard(s):

- **CC.2.3.HS.A.2** Apply rigid transformation to determine and explain congruence.
- **CC.2.3.HS.A.3** Verify and apply geometric theorems as they relate to geometric figures.
- **CC.2.3.HS.A.5** Create justifications based on transformations to establish similarity of plane figures.
- **CC.2.3.HS.A.6** Verify and apply theorems involving similarity as they relate to plane figures.

National Common Core Standard(s):

Experiment with transformations in the plane

- **CC.9-12.G.CO.2** Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).

Understand congruence in terms of rigid motions

- **CC.9-12.G.CO.6** Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.
- **CC.9-12.G.CO.7** 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.
- **CC.9-12.G.CO.8** Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.

Prove geometric theorems

- **CC.9-12.G.CO.10** Prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180º; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.

Make geometric constructions

- **CC.9-12.G.CO.12** Mare formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.).

Understand similarity in terms of similarity transformations

- **CC.9-12.G.SRT.1** Verify experimentally the properties of dilations given by a center and a scale factor:
  - **a.** A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.
  - **b.** The dilation of a line segment is longer or shorter in the ratio given by the scale factor.
- **CC.9-12.G.SRT.2** Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.
- **CC.9-12.G.SRT.3** Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.

Prove theorems involving similarity

- **CC.9-12.G.SRT.4** Prove theorems about triangles.
- **CC.9-12.G.SRT.5** Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

Use coordinates to prove simple geometric theorems algebraically

- **CC.9-12.G.GPE.4** Use coordinates to prove simple geometric theorems algebraically.
- **CC.9-12.G.GPE.6** Find the point on a directed line segment between two given points that partitions the segment in a given ratio.

Apply geometric concepts in modeling situations

- **CC.9-12.G.MG.3** Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

ISTE Standards:

1. Creativity and Innovation – Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology.
   - b. Create original works as a means of personal or group expression
   - c. Use models and simulations to explore complex systems and issues
2. Communication and Collaboration – Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
   - a. Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media

b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats
d. Contribute to project teams to produce original works or solve problems

3. Research and Information Fluency – Students apply digital tools to gather, evaluate, and use information.
   a. Plan strategies to guide inquiry
   b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media
   c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks
   d. Process data and report results
4. Critical Thinking, Problem Solving, and Decision Making – Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
   a. Identify and define authentic problems and significant questions for investigation
   b. Plan and manage activities to develop a solution or complete a project
   c. Collect and analyze data to identify solutions and/or make informed decisions
   d. Use multiple processes and diverse perspectives to explore alternative solutions
5. Digital Citizenship – Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.
   a. Advocate and practice safe, legal, and responsible use of information and technology
   b. Exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity
   c. Demonstrate personal responsibility for lifelong learning
   d. Exhibit leadership for digital citizenship
6. Technology Operations and Concepts – Students demonstrate a sound understanding of technology concepts, systems, and operations.
   a. Understand and use technology systems
   b. Select and use applications effectively and productively

Career Education and Work Standards:

- 13.1.11.A Relate careers to individual interests, abilities, and aptitudes.
- 13.1.11.E Justify the selection of a career.
- 13.1.11.H Review personal high school plan against current personal career goals and select postsecondary opportunities based upon personal career interests.

Connecting to Common Core and Other Standards:

PA Standards found at www.pdesas.org/standards/standardsdownloads
National Common Core found at www.corestandards.org
ISTE found at www.iste.org/standards/nets-for-students.aspx
Career Education and Work found at www.pacareerstandards.com/
*See Appendix for complete documents.

ELL Differentiation:

- Math & LA specifics found at www.pde.sas.org/module/sas/curriculumframework/elloverlay.aspx
- Generic found at http://www.easad.net/esl
- http://www.todos-math.org

Enrichment:

- Internet/Research Activities
  - www.studyIsland.com
  - https://www.thelearningodyssey.com/
  - http://www.khanacademy.org/
  - http://www.classzone.com/cz/login.htm
- Group/Research Projects

Remediation:

- Properties of Real Numbers
- Algebraic Properties
- Solving Single Variable Equations
- Basic Transformations

IEP/GIEP: Refer to individual student's education plan under specially designed instruction.

Keystone Anchors & Eligible Content	**Unit Concepts** What students need to know	**Unit Competencies** What students need to be able to do (skills): (Students will:)	**Content Vocabulary**	**Materials, Resources, & Instructional Activities**	**Assessments**
G.1.2.1.1 G.1.2.1.3 G.1.3.1.1 G.1.3.1.2 G.1.3.2.1 G.2.2.1.1 G.2.2.1.2	• Identify and/or use properties of triangles. • Identify and/or use properties of isosceles and equilateral triangles. • Identify and/or use properties of congruent and similar polygons or solids. • Identify and/or use proportional relationships in similar figures. • Write, analyze, complete, or identify formal proofs (e.g., direct and/or indirect proofs/proofs by contradiction) • Use properties of angles formed by intersecting lines to find the measures of missing angles. • Use properties of angles formed when two parallel lines are cut by a transversal to find the measures of missing angles.	• Classify the various types of triangles by sides and by angles • Find the measures of the angles of a triangle • Apply angle sum properties • Use algebra to calculate the measure of angles in triangles • Define and construct medians, altitudes, bisectors, and mid-segments • Label congruent parts of triangles with tick marks • Identify congruent figures and their corresponding parts • Write congruence statements for any figures that can be proved congruent • Use and describe, using appropriate vocabulary, transformations to show congruence with geometric figures • Show that figures are not congruent using transformations • Translate a figure in the coordinate plane • Reflect a figure in the x-axis • Identify a rotation • Find the point on the original figure when give the corresponding point on the image • Use triangle side lengths to prove	• Polygon • Triangle • Transformation • Rigid Motion • Translation • Reflection • Rotation • Corollary • Corresponding Parts • CPCTC • Congruent Figures • Tick Marks • Similar Figures • Proof • Acute Triangles • Obtuse Triangles • Right Triangles • Equilateral Triangles • Isosceles Triangles • Scalene Triangles • Equiangular • Interior Angles • Exterior Angles • Vertex Angle • Leg • Base • Base Angles • Altitude • Median • Bisector	• Geometry – Concepts and Skills – McDougal Littell, 2005 • Geometry Prentice Hall, 2007 • Geometry McDougal Littell, 2008 • Geometry Teacher's Activity Kit • Straightedge • Protractor • Calculators • CPS • Supplemental resources • Geometry software, i.e. "Geometer's Sketchpad" • Spiral Review and Project Binder • Bell Ringers • Study Island • PSSA Coach Grade 10 • Measuring Up • Appendix • YouTube	• Tests • Quizzes • CDTs • Compass Learning • Study Island • Observation • Homework • Projects • Journals • Bell Ringers • Notebooks

		triangles are congruent by SSS • Use triangle sides and angles to prove that triangles are congruent: SAS, AAS, ASA, HL	• Perpendicular Bisector • Centroid • Midsegment	• ESASD Valuable Video Library	

Keystone Anchors & Eligible Content	**Unit Concepts** What students need to know	**Unit Competencies** What students need to be able to do (skills): (Students will:)	**Content Vocabulary (Continued from Above)**	**Materials, Resources, & Instructional Activities**	**Assessments**

G.1.2.1.1
 	
G.1.2.1.3
 	
G.1.3.1.1
 	
G.1.3.1.2
 	
G.1.3.2.1
 	
G.2.2.1.1
 	
G.2.2.1.2
	• Identify and/or use properties of triangles.
	• Identify and/or use properties of isosceles and equilateral triangles.
	• Identify and/or use properties of congruent and similar polygons or solids.
	• Identify and/or use proportional relationships in similar figures.
	• Write, analyze, complete, or identify formal proofs (e.g., direct and/or indirect proofs/proofs by contradiction)
	• Use properties of angles formed by intersecting lines to find the measures of missing angles.
	• Use properties of angles formed when two parallel lines are cut by a transversal to find the measures of missing angles.
		• Prove parts of triangles congruent using CPCTC (Corresponding Parts of Congruent Triangles are Congruent)
		• Prove isosceles and equilateral triangles are congruent using theorems
		• Use the properties of midsegments to find lengths
		• Use perpendicular bisectors to solve problems
		• Use angle bisectors to find distance relationships
		• Define, find and/or construct:
		  ○ Altitudes
		  ○ Medians
		  ○ Bisectors
		  ○ Mid-Segments
		  ○ Orthocenter
		  ○ Centroids
		• Solve real-world problems applying the definitions of geometric terms
		• Classify a triangle by its angles using the triangle inequality theorems
		• Determine what triangles are possible using triangle inequalities
		• Find possible side lengths of a triangle
		• Contrast inductive and deductive reasoning
			• SSS
			• SAS
			• AAS
			• ASA
			• HL
			• Orthocenter
			• Equidistant
			• Point of Concurrency
			• Circumcenter
			• Incenter
			• Indirect Proof
				• Geometry – Concepts and Skills – McDougal Littell, 2005
				• Geometry Prentice Hall, 2007
				• Geometry McDougal Littell, 2008
				• Geometry Teacher's Activity Kit
				• Straightedge
				• Protractor
				• Calculators
				• CPS
				• Supplemental resources
				• Geometry software, i.e. "Geometer's Sketchpad"
				• Spiral Review and Project Binder
				• Bell Ringers
				• Study Island
				• PSSA Coach Grade 10
				• Measuring Up
				• Appendix
					• Tests
					• Quizzes
					• CDTs
					• Compass Learning
					• Study Island
					• Observation
					• Homework
					• Projects
					• Journals
					• Bell Ringers
					• Notebooks

		• Determine the type of reasoning used to solve a problem • Write indirect proofs and explore the converse of theorems		• YouTube • ESASD Valuable Video Library	

Keystone Anchors & Eligible Content	**Unit Concepts** What students need to know	**Unit Competencies** What students need to be able to do (skills): (Students will:)	**Content Vocabulary (Continued from Above)**	**Materials, Resources, & Instructional Activities**	**Assessments**
G.1.2.1.1 G.1.2.1.3 G.1.3.1.1 G.1.3.1.2 G.1.3.2.1 G.2.2.1.1 G.2.2.1.2	• Identify and/or use properties of triangles. • Identify and/or use properties of isosceles and equilateral triangles. • Identify and/or use properties of congruent and similar polygons or solids. • Identify and/or use proportional relationships in similar figures. • Write, analyze, complete, or identify formal proofs (e.g., direct and/or indirect proofs/proofs by contradiction) • Use properties of angles formed by intersecting lines to find the measures of missing angles. • Use properties of angles formed when two parallel lines are cut by a transversal to find the measures of missing angles.	• Solve proportions • Use proportions to identify similar polygons • Find the scale factor of similar figures • Find perimeters of similar figures • Identify dilations, or similarity transformations • Describe a combination of transformations • Use transformations to show figures are not similar • Use symbolic notation for geometric terms • Prove triangles are similar by AA, SSS, and SAS • Use proportions with a triangle of parallel lines to solve problems	• Proportions • Cross-Multiplication • Similar • Dilation • Similar Polygons • Scale Factor • Reduction • Enlargement	• Geometry – Concepts and Skills – McDougal Littell, 2005 • Geometry Prentice Hall, 2007 • Geometry McDougal Littell, 2008 • Geometry Teacher's Activity Kit • Straightedge • Protractor • Calculators • CPS • Supplemental resources • Geometry software, i.e. "Geometer's Sketchpad" • Spiral Review and Project Binder • Bell Ringers • Study Island • PSSA Coach Grade 10 • Measuring Up • Appendix	• Tests • Quizzes • CDTs • Compass Learning • Study Island • Observation • Homework • Projects • Journals • Bell Ringers • Notebooks

				• YouTube • ESASD Valuable Video Library	

Unit 4: Right Triangles and Trigonometry

Course Time Prior to Keystone/PSSA: 10 Blocks, 20 Periods

Overview: Students will use and apply the Pythagorean Theorem, and then the Converse of the Pythagorean Theorem. A key discovery for students is that the sum of the squares of the lengths of the legs of a right triangle is equal to the square of the length of the hypotenuse. Students will explore special triangles and the theorems relating to them. Students will apply trigonometric ratios, the Law of Sines, and the Law of Cosines to find side lengths and angle measures in triangles.

Unit Essential Questions:

- If you know the lengths of two sides of a right triangle, how do you find the length of the third side? How can you explain the relationship between congruence and similarity in both two and three dimensions? How are coordinates manipulated algebraically to represent, interpret, and verify geometric relationships? In a right triangle, how can you find all the sides and angles of the triangle?

Keystone Content Module/Assessment Anchor:

- **G.1.2.1** Recognize and/or apply properties of angles, polygons, and polyhedra.
- **G.1.3.2** Write formals and/or use logic statements to construct or validate arguments.
- **G.2.1.1** Solve problems involving right triangles.

Keystone Eligible Content:

- **G.1.2.1.1** Identify and/or use properties of triangles.
- **G.1.2.1.3** Identify and/or use properties of isosceles and equilateral triangles.
- **G.1.3.2.1** Write, analyze, complete, or identify formal proofs (e.g., direct and/or indirect proofs/proofs by contradiction).
- **G.2.1.1.1** Calculate the distance and/or midpoint between two points on a number line or on a coordinate plane.
- **G.2.1.1.2** Use trigonometric ratios to write and/or solve problems involving right triangles.

Pennsylvania Common Core Standard(s):

- **CC.2.3.HS.A.3** Verify and apply geometric theorems as they relate to geometric figures.
- **CC.2.3.HS.A.6** Verify and apply theorems involving similarity as they relate to plane figures.
- **CC.2.3.HS.A.7** Apply trigonometric ratios to solve problems involving right triangles.
- **CC.2.2.HS.C.9** Prove the Pythagorean identity and use it to calculate trigonometric ratios.

National Common Core Standard(s):

Prove theorems involving similarity

- **CC.9-12.G.SRT.4** Prove theorems about triangles.
- **CC.9-12.G.SRT.5** Use congruence and similarity criteria for triangles to solve problems and prove relationships in geometric figures.

Define trigonometric ratios and solve problems involving right triangles

- **CC.9-12.G.SRT.6** Define trigonometric ratios and solve problems involving right triangles. Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles

- **CC.9-12.G.SRT.7** Define trigonometric ratios and solve problems involving right triangles. Explain and use the relationship between the sine and cosine of complementary angles
- **CC.9-12.G.SRT.8** Define trigonometric ratios and solve problems involving right triangles. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

Apply trigonometry to general triangles

- **CC.9-12.G.SRT.9** Derive the formula A = 1/2*ab*sin(C) for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.
- **CC.9-12.G.SRT.11** Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).

Apply geometric concepts in modeling situations

- **CC.9-12.G.MG.1** Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).

ISTE Standards:

1. Creativity and Innovation – Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology.
   b. Create original works as a means of personal or group expression
   c. Use models and simulations to explore complex systems and issues
2. Communication and Collaboration – Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
   a. Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media
   b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats
   d. Contribute to project teams to produce original works or solve problems
3. Research and Information Fluency – Students apply digital tools to gather, evaluate, and use information.
   a. Plan strategies to guide inquiry
   b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media
   c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks
   d. Process data and report results
4. Critical Thinking, Problem Solving, and Decision Making – Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
   a. Identify and define authentic problems and significant questions for investigation
   b. Plan and manage activities to develop a solution or complete a project
   c. Collect and analyze data to identify solutions and/or make informed decisions
   d. Use multiple processes and diverse perspectives to explore alternative solutions
5. Digital Citizenship – Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.
   a. Advocate and practice safe, legal, and responsible use of information and technology
   b. Exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity
   c. Demonstrate personal responsibility for lifelong learning
   d. Exhibit leadership for digital citizenship
6. Technology Operations and Concepts – Students demonstrate a sound understanding of technology concepts, systems, and operations.

a. Understand and use technology systems
b. Select and use applications effectively and productively

Career Education and Work Standards:
- 13.1.11.A Relate careers to individual interests, abilities, and aptitudes.
- 13.1.11.E Justify the selection of a career.
- 13.1.11.H Review personal high school plan against current personal career goals and select postsecondary opportunities based upon personal career interests.

Connecting to Common Core and Other Standards:

PA Standards found at www.pdesas.org/standards/standardsdownloads
National Common Core found at www.corestandards.org
ISTE found at www.iste.org/standards/nets-for-students.aspx
Career Education and Work found at www.pacareerstandards.com/
*See Appendix for complete documents.

ELL Differentiation:
- Math & LA specifics found at www.pde.sas.org/module/sas/curriculumframework/elloverlay.aspx
- Generic found at http://www.easad.net/esl
- http://www.todos-math.org

Enrichment:
- Internet/Research Activities
  - www.studyIsland.com
  - https://www.thelearningodyssey.com/
  - http://www.khanacademy.org/
  - http://www.classzone.com/cz/login.htm
- Group/Research Projects

Remediation:
- Operations on real numbers
- Solving Equations
- Notation of basic geometric figures
- Parts of triangles
- Classifying triangles
- Calculating area and perimeter of triangles

IEP/GIEP: Refer to individual student's education plan under specially designed instruction.

Keystone Anchors & Eligible Content	**Unit Concepts** What students need to know	**Unit Competencies** What students need to be able to do (skills): (Students will:)	**Content Vocabulary**	**Materials, Resources, & Instructional Activities**	**Assessments**

G.1.2.1.1
 	
G.1.2.1.3
 	
G.1.3.2.1
 	
G.2.1.1.1
 	
G.2.1.1.2
	• Identify and/or use properties of triangles.
	• Identify and/or use properties of isosceles and equilateral triangles.
	• Write, analyze, complete, or identify formal proofs (e.g., direct and/or indirect proofs/proofs by contradiction).
	• Calculate the distance and/or midpoint between two points on a number line or on a coordinate plane.
	• Use trigonometric ratios to write and/or solve problems involving right triangles.
		• Simplify and rationalize radicals
		• Identify the parts of a right triangle
		• Apply the Pythagorean Theorem to solve for a missing side in a right triangle
		• Use the Converse of the Pythagorean Theorem to determine if a triangle is a right triangle
		• Classify triangles as acute, obtuse, or right triangles using the Triangle Inequality Theorem and the Converse of the Pythagorean Theorem
		• Write and/or complete proofs applying new and previously learned theorems and definitions
		• Find the area of a triangle after finding the base or height
		• Write and solve proportions for similar triangles
		• Use the properties of the altitude of a right triangle
		  ○ Identify the similar triangles after drawing the altitude to the hypotenuse of a right triangle
		  ○ Use similar triangles to write proportions and find the measure of the height,
			• Pythagorean Triple
			• Pythagorean Theorem
			• Converse of the Pythagorean Theorem
			• Angle of Elevation
			• Angle of Depression
			• Right Triangle
			• Isosceles Triangle
			• Equilateral Triangle
			• Height
			• Solve a Right Triangle
			• Trigonometric Ratio
			• Median
			• Hypotenuse
			• Leg
			• Similar
			• Cross Product
			• Cross Products Property
			• Sine
			• Inverse Sine
			• Cosine
			• Inverse Cosine
			• Tangent
			• Inverse Tangent
			• SOCAHTOA
			• Radical
			• Radicand
			• Distance
				• Geometry – Concepts and Skills – McDougal Littell, 2005
				• Geometry Prentice Hall, 2007
				• Geometry McDougal Littell, 2008
				• Geometry Teacher's Activity Kit
				• Straightedge
				• Protractor
				• Calculators
				• CPS
				• Supplemental resources
				• Geometry software, i.e. "Geometer's Sketchpad"
				• Spiral Review and Project Binder
				• Bell Ringers
				• Study Island
				• PSSA Coach Grade 10
				• Measuring Up
				• Appendix
				• YouTube
				• ESASD Valuable
					• Tests
					• Quizzes
					• CDTs
					• Compass Learning
					• Study Island
					• Observation
					• Homework
					• Projects
					• Journals
					• Bell Ringers
					• Notebooks

		leg, or hypotenuse • Solve real-world problems	• 45-45-90 • 30-60-90	Video Library	

Keystone Anchors & Eligible Content	Unit Concepts What students need to know	Unit Competencies What students need to be able to do (skills): (Students will:)	Content Vocabulary	Materials, Resources, & Instructional Activities	Assessments
G.1.2.1.1 G.1.2.1.3 G.1.3.2.1 G.2.1.1.1 G.2.1.1.2	• Identify and/or use properties of triangles. • Identify and/or use properties of isosceles and equilateral triangles. • Write, analyze, complete, or identify formal proofs (e.g., direct and/or indirect proofs/proofs by contradiction). • Calculate the distance and/or midpoint between two points on a number line or on a coordinate plane. • Use trigonometric ratios to write and/or solve problems involving right triangles.	• Apply the theorems for 45-45-90 triangles to solve for a missing side in a triangle • Apply the theorems for 30-60-90 triangles to solve for a missing side in a triangle • Write and/or complete proofs involving special right triangles • Identify and draw the median of a triangle • Write the trigonometric ratios of right triangles • Use the trigonometric ratios to find the missing side in a right triangle • Use special right triangles to find a tangent, sine, and cosine • Apply trigonometric ratios to find the area and/or perimeter of a triangle • Solve real-world problems	• Pythagorean Triple • Pythagorean Theorem • Converse of the Pythagorean Theorem • Angle of Elevation • Angle of Depression • Right Triangle • Isosceles Triangle • Equilateral Triangle • Height • Solve a Right Triangle • Trigonometric Ratio • Median • Hypotenuse • Leg • Similar • Cross Product • Cross Products Property • Sine • Inverse Sine • Cosine • Inverse Cosine • Tangent • Inverse Tangent • SOCAHTOA • Radical • Radicand • Distance	• Geometry – Concepts and Skills – McDougal Littell, 2005 • Geometry Prentice Hall, 2007 • Geometry McDougal Littell, 2008 • Geometry Teacher's Activity Kit • Straightedge • Protractor • Calculators • CPS • Supplemental resources • Geometry software, i.e. "Geometer's Sketchpad" • Spiral Review and Project Binder • Bell Ringers • Study Island • PSSA Coach Grade 10 • Measuring Up • Appendix • YouTube	• Tests • Quizzes • CDTs • Compass Learning • Study Island • Observation • Homework • Projects • Journals • Bell Ringers • Notebooks

			• 45-45-90 • 30-60-90	• ESASD Valuable Video Library	

Unit 5: Quadrilaterals and Polygons

Course Time Prior to Keystone/PSSA: 10 Blocks, 20 Periods

Overview: Student will be able to find the sum of the angle measures in a polygon. Students will be able to determine individual angle measures. Students will be able to apply the properties of parallelograms to make conclusions and determine measurements. Students will classify a quadrilateral as a rectangle, square, rhombus, trapezoid, parallelogram, or kite by analyzing their properties.

Unit Essential Questions: How do you find a missing angle measure in a convex polygon? How do you find angle and side measures in a parallelogram? How can you prove that a quadrilateral is a parallelogram? What are the properties of parallelograms that have all sides or all angles congruent? What are the main properties of trapezoids and kites? How can you identify special quadrilaterals?

Keystone Content Module/Assessment Anchor:

- **G.1.2.1** Recognize and/or apply properties of angles, polygons, and polyhedral.
- **G.1.3.1** Use properties of congruence, correspondence, and similarity in problem-solving settings involving 2 and 3 dimensional figures.
- **G.1.3.2** Write formals and/or use logic statements to construct or validate arguments.

Keystone Eligible Content:

- **G.1.2.1.2** Identify and/or use properties of quadrilaterals.
- **G.1.2.1.4** Identify and/or use properties of regular polygons.
- **G.1.3.1.1** Identify and/or use properties of congruent and similar polygons.
- **G.1.3.1.2** Identify and/or use proportional relationships in similar figures.
- **G.1.3.2.1** Write, analyze, complete, or identify formal proofs (e.g., direct and/or indirect proofs/proofs by contradiction).

Pennsylvania Common Core Standard(s):

- **CC.2.3.HS.A.3** Verify and apply geometric theorems as they relate to geometric figures.
- **CC.2.3.HS.A.6** Verify and apply theorems involving similarity as they relate to plane figures.
- **CC.2.3.HS.A.13** Analyze relationships between two-dimensional and three-dimensional objects.

National Common Core Standard(s):

Visualize relationships between two-dimensional and three-dimensional objects

- **CC.9-12.G.GMD.4** Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.

Prove geometric theorems

- **CC.9-12.G.CO.11** Prove theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.

Make geometric constructions

- **CC.9-12.G.CO.13** Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.

Use coordinates to prove simple geometric theorems algebraically

- **CC.9-12.G.GPE.4** Use coordinates to prove simple geometric theorems algebraically. For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle.
- **CC.9-12.G.GPE.7** Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.

Prove theorems involving similarity

- **CC.9-12.G.SRT.5** Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

Apply geometric concepts in modeling situations

- **CC.9-12.G.MG.1** Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).

ISTE Standards:

1. Creativity and Innovation – Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology.
    b. Create original works as a means of personal or group expression
    c. Use models and simulations to explore complex systems and issues
2. Communication and Collaboration – Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
    a. Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media
    b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats
    d. Contribute to project teams to produce original works or solve problems
3. Research and Information Fluency – Students apply digital tools to gather, evaluate, and use information.
    a. Plan strategies to guide inquiry
    b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media
    c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks
    d. Process data and report results
4. Critical Thinking, Problem Solving, and Decision Making – Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
    a. Identify and define authentic problems and significant questions for investigation
    b. Plan and manage activities to develop a solution or complete a project
    c. Collect and analyze data to identify solutions and/or make informed decisions
    d. Use multiple processes and diverse perspectives to explore alternative solutions
5. Digital Citizenship – Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.
    a. Advocate and practice safe, legal, and responsible use of information and technology
    b. Exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity
    c. Demonstrate personal responsibility for lifelong learning
    d. Exhibit leadership for digital citizenship
6. Technology Operations and Concepts – Students demonstrate a sound understanding of technology concepts, systems, and operations.
    a. Understand and use technology systems
    b. Select and use applications effectively and productively

Career Education and Work Standards:

- 13.1.11.A Relate careers to individual interests, abilities, and aptitudes.
- 13.1.11.E Justify the selection of a career.
- 13.1.11.H Review personal high school plan against current personal career goals and select postsecondary opportunities based upon personal career interests.

Connecting to Common Core and Other Standards:

PA Standards found at www.pdesas.org/standards/standardsdownloads
National Common Core found at www.corestandards.org
ISTE found at www.iste.org/standards/nets-for-students.aspx
Career Education and Work found at www.pacareerstandards.com/
*See Appendix for complete documents.

ELL Differentiation:

- Math & LA specifics found at www.pde.sas.org/module/sas/curriculumframework/elloverlay.aspx
- Generic found at http://www.easad.net/esl
- http://www.todos-math.org

Enrichment:

- Nets, analytic geometry in three dimensions, isometric graphing.
- Internet/Research Activities
  - www.studyIsland.com
  - https://www.thelearningodyssey.com/
  - http://www.khanacademy.org/
  - http://www.classzone.com/cz/login.htm
- Group/Research Projects

Remediation:

- Operations with rational numbers
- Classify and compare real numbers
- Use order of operations to simplify and evaluate expressions and formulas
- Angle relationships given parallel lines and a transversal
- Simplify algebraic expressions
- Solving variable equations

IEP/GIEP: Refer to individual student's education plan under specially designed instruction.

Keystone Anchors & Eligible Content	**Unit Concepts** What students need to know	**Unit Competencies** What students need to be able to do (skills): (Students will:)	**Content Vocabulary**	**Materials, Resources, & Instructional Activities**	**Assessments**
G.1.2.1.2 G.1.2.1.4 G.1.3.1.1 G.1.3.1.2 G.1.3.2.1	• Recognize and/or apply properties of angles, polygons, and polyhedral. • Use properties of congruence, correspondence, and similarity in problem-solving settings involving two- and three-dimensional figures. • Identify and/or use properties of quadrilaterals. • Identify and/or use properties of regular polygons. • Identify and/or use properties of pyramids and prisms. • Identify and/or use properties of congruent and similar polygons. • Identify and/or use proportional relationships in similar figures. • Write, analyze, complete, or identify formal proofs (e.g., direct and/or indirect proofs/proofs by contradiction).	• Identify polygons as convex or concave • Classify polygons by the number of sides • Use algebra to find side lengths of polygons • Identify real world examples of polygons • Find the sum of angle measures in a polygon • Calculate and use interior and exterior angles in polygons to solve problems • Find the number of sides of a polygon • Find an unknown interior angle measure of a polygon • Find and use angle measures in regular polygons • Determine the measures of interior and exterior angles of polygons • Solve problems using properties of parallelograms • Compare and contrast quadrilaterals • Solve problems using properties of quadrilaterals • Show that a quadrilateral is a parallelogram using its properties • Use the properties of rhombuses, rectangles, and squares to solve problems • Solve real-world problems	• Polygon • Concave Polygons • Convex Polygons • Irregular Polygons • Equiangular Polygons • Equilateral Polygon • Regular Polygons • Triangle • Quadrilaterals • Parallelograms • Rectangle • Square • Pentagon • Hexagon • Heptagon • Nonagon • Decagon • Dodecagon • N-gon • Diagonal • Base • Base Angles • Diagonals of a Polygon • Legs • Rhombus • Trapezoid • Isosceles Trapezoid • Kite • Midsegment of a Trapezoid • Distance Formula	• Geometry – Concepts and Skills – McDougal Littell, 2005 • Geometry Prentice Hall, 2007 • Geometry McDougal Littell, 2008 • Geometry Teacher's Activity Kit • Straightedge • Protractor • Calculators • CPS • Supplemental resources • Geometry software, i.e. "Geometer's Sketchpad" • Spiral Review and Project Binder • Bell Ringers • Study Island • PSSA Coach Grade 10 • Measuring Up • Appendix • YouTube • ESASD Valuable Video Library	• Tests • Quizzes • CDTs • Compass Learning • Study Island • Observation • Homework • Projects • Journals • Bell Ringers • Notebooks

Keystone Anchors & Eligible Content	**Unit Concepts** What students need to know	**Unit Competencies** What students need to be able to do (skills): (Students will:)	**Content Vocabulary**	**Materials, Resources, & Instructional Activities**	**Assessments**
G.1.2.1.2 G.1.2.1.4 G.1.3.1.1 G.1.3.1.2 G.1.3.2.1	• Recognize and/or apply properties of angles, polygons, and polyhedral. • Use properties of congruence, correspondence, and similarity in problem-solving settings involving two- and three-dimensional figures. • Identify and/or use properties of quadrilaterals. • Identify and/or use properties of regular polygons. • Identify and/or use properties of pyramids and prisms. • Identify and/or use properties of congruent and similar polygons. • Identify and/or use proportional relationships in similar figures. • Write, analyze, complete, or identify formal proofs (e.g., direct and/or indirect proofs/proofs by contradiction).	• Use diagonals of special quadrilateral to solve problems • Classify and list properties of special parallelograms • Use the properties of kites, trapezoids, and isosceles trapezoids to solve problems • Calculate the sides, diagonals, angles, and medians of quadrilaterals • Use coordinate geometry to prove quadrilaterals are parallelograms • Find and use the midsegment of a trapezoid to solve problems • Find the angles and diagonals of kites • Prove similarity of geometric figures • Write and/or complete proofs using theorems relating to quadrilaterals • Classify quadrilaterals by their properties • Solve real-world problems	• Polygon • Concave Polygons • Convex Polygons • Irregular Polygons • Equiangular Polygons • Equilateral Polygon • Regular Polygons • Triangle • Quadrilaterals • Parallelograms • Rectangle • Square • Pentagon • Hexagon • Heptagon • Nonagon • Decagon • Dodecagon • N-gon • Diagonal • Base • Base Angles • Diagonals of a Polygon • Legs • Rhombus • Trapezoid • Isosceles Trapezoid • Kite • Midsegment of a Trapezoid • Distance Formula	• Geometry – Concepts and Skills – McDougal Littell, 2005 • Geometry Prentice Hall, 2007 • Geometry McDougal Littell, 2008 • Geometry Teacher's Activity Kit • Straightedge • Protractor • Calculators • CPS • Supplemental resources • Geometry software, i.e. "Geometer's Sketchpad" • Spiral Review and Project Binder • Bell Ringers • Study Island • PSSA Coach Grade 10 • Measuring Up • Appendix • YouTube • ESASD Valuable	• Tests • Quizzes • CDTs • Compass Learning • Study Island • Observation • Homework • Projects • Journals • Bell Ringers • Notebooks

				Video Library	

Unit 6: Circles

Course Time Prior to Keystone/PSSA: 10 Blocks, 20 Periods

Overview: Students will identify tangents, secants, chords, arc-measures, inscribed angles, inscribed polygons, lengths of segments, arcs, points of tangency, and radii. Students will write the equations of circles. Students will compute areas of circles and sectors. Students will calculate arc-length. Students will use properties of segments that intersect circles, as well as apply angle relationships in circles. Students will use the equation of a circle to graph the circle on the coordinate plane.

Unit Essential Questions:

- What are the different characteristics of circles and how can they be used to solve problems.
- How can you prove relationships between angles and arcs in a circle?
- When lines intersect a circle or within a circle, how do you find the measures of resulting angles, arcs, and segments?
- How can coordinate geometry apply to circles?

Keystone Content Module/Assessment Anchor:

- **G.1.1.1** Identify and/or use parts of circles and segments associated with circles, spheres, and cylinders.
- **G.2.2.1** Use and/or compare measurements of angles.
- **G.2.2.2** Use and/or develop procedures to determine or describe measures of perimeter, circumference, and/or area. (May require conversions within the same system.)
- **G.2.2.3** Describe how a change in one dimension of a 2-dimensional figure affects other measurements of that figure.

Keystone Eligible Content:

- **G.1.1.1.1** Identify, determine, and/or use the radius, diameter, segment, and/or tangent of a circle.
- **G.1.1.1.2** Identify, determine, and/or use the arcs, semicircles, sectors, and/or angles of a circle.
- **G.1.1.1.3** Use chords, tangents, and secants to find missing arc measures or missing segment measures.
- **G.1.1.1.4** Identify and/or use the properties of a sphere or cylinder.
- **G.2.2.2.1** Estimate the area, perimeter, or circumference of an irregular figure.
- **G.2.2.2.2** Find the measurement of a missing length, given the perimeter, circumference, or area.
- **G.2.2.2.5** Find the area of a sector of a circle.
- **G.2.2.3.1** Describe how a change in the linear dimension of a figure affects its perimeter, circumference, and area (e.g., How does changing the length of the radius of a circle affect the circumference of the circle?).

Pennsylvania Common Core Standard(s):

- **CC.2.3.HS.A.3** Verify and apply geometric theorems as they relate to geometric figures.
- **CC.2.3.HS.A.8** Apply geometric theorems to verify properties of circles.
- **CC.2.3.HS.A.9** Extend the concept of similarity to determine arc lengths and areas of sectors of circles.
- **CC.2.3.HS.A.10** Translate between the geometric description and the equation for a conic section.
- **CC.2.3.HS.A.13** Analyze relationships between tow-dimensional and three-dimensional objects.

- **CC.2.3.HS.A.14** Apply geometric concepts to model and solve real world problems

National Common Core Standard(s):

Experiment with transformations in the plane

- **CC.9-12.G.CO.1** Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.

Make geometric constructions

- **CC.9-12.G.CO.12** Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometry software, etc.).

Understand and apply theorems about circles

- **CC.9-12.G.C.1** Prove that all circles are similar.
- **CC.9-12.G.C.2** Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle
- **CC.9-12.G.C.3** Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.
- **CC.9-12.G.C.4** Construct a tangent line from a point outside a given circle to the circle.

Find arc lengths and areas of sectors of circles

- **CC.9-12.G.C.5** Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.

Translate between the geometric description and the equation for a conic section

- **CC.9-12.G.GPE.1** Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.

Use coordinates to prove simple geometric theorems algebraically

- **CC.9-12.G.GPE.4** Use coordinates to prove simple geometric theorems algebraically. For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point $(1, \sqrt{3})$ lies on the circle centered at the origin and containing the point (0, 2).

Apply geometric concepts in modeling situations

- **CC.9-12.G.MG.1** Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).

Explain volume formulas and use them to solve problems

- **CC.9-12.G.GMD.1** Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone.

ISTE Standards:

1. Creativity and Innovation – Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology.
   b. Create original works as a means of personal or group expression
   c. Use models and simulations to explore complex systems and issues

2. Communication and Collaboration – Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
    a. Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media
    b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats
    d. Contribute to project teams to produce original works or solve problems
3. Research and Information Fluency – Students apply digital tools to gather, evaluate, and use information.
    a. Plan strategies to guide inquiry
    b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media
    c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks
    d. Process data and report results
4. Critical Thinking, Problem Solving, and Decision Making – Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
    a. Identify and define authentic problems and significant questions for investigation
    b. Plan and manage activities to develop a solution or complete a project
    c. Collect and analyze data to identify solutions and/or make informed decisions
    d. Use multiple processes and diverse perspectives to explore alternative solutions
5. Digital Citizenship – Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.
    a. Advocate and practice safe, legal, and responsible use of information and technology
    b. Exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity
    c. Demonstrate personal responsibility for lifelong learning
    d. Exhibit leadership for digital citizenship
6. Technology Operations and Concepts – Students demonstrate a sound understanding of technology concepts, systems, and operations.
    a. Understand and use technology systems
    b. Select and use applications effectively and productively

Career Education and Work Standards:

- 13.1.11.A Relate careers to individual interests, abilities, and aptitudes.
- 13.1.11.E Justify the selection of a career.
- 13.1.11.H Review personal high school plan against current personal career goals and select postsecondary opportunities based upon personal career interests.

Connecting to Common Core and Other Standards:

PA Standards found at www.pdesas.org/standards/standardsdownloads
National Common Core found at www.corestandards.org
ISTE found at www.iste.org/standards/nets-for-students.aspx
Career Education and Work found at www.pacareerstandards.com/
*See Appendix for complete documents.

ELL Differentiation:

- Math & LA specifics found at www.pde.sas.org/module/sas/curriculumframework/elloverlay.aspx

- Generic found at http://www.easad.net/esl
- http://www.todos-math.org

Enrichment:

- Internet/Research Activities
  - www.studyIsland.com
  - https://www.thelearningodyssey.com/
  - http://www.khanacademy.org/
  - http://www.classzone.com/cz/login.htm
- Group/Research Projects

Remediation:

- Solving Equations in One Variable
- Graphing Points on the Coordinate Plane
- Notating Geometric Figures
- Evaluating Algebraic Expressions

IEP/GIEP: Refer to individual student's education plan under specially designed instruction.

Keystone Anchors & Eligible Content	**Unit Concepts** What students need to know	**Unit Competencies** What students need to be able to do (skills): (Students will:)	**Content Vocabulary**	**Materials, Resources, & Instructional Activities**	**Assessments**
G.1.1.1.1 G.1.1.1.2 G.1.1.1.3 G.1.1.1.4 G.2.2.1 G.2.2.2.1 G.2.2.2.2 G.2.2.2.5	• Identify and/or use parts of circles and segments associated with circles, spheres, and cylinders. • Use and/or compare measurements of angles. • Use and/or develop procedures to determine or describe measures of perimeter, circumference, and/or area. (May require conversions within the same system.) • Describe how a change in one dimension of a 2-dimensional figure affects other measurements of that figure.	• Identify the parts of a circle: center, diameter, radius, chord, secant, tangent, ray, and point of tangency • Find lengths of chords, radii, and diameters in circles in a coordinate plane • Draw common tangents • Verify a tangent to a circle • Use problem-solving strategies to find the radius or diameter from provided diagrams of circles • Use properties of tangents to solve problems • Find the measures of central angles and inscribes angles • Find the measure of major and minor arcs • Identify congruent arcs and explain why the arcs are or are not congruent • Use congruent chords to find arc measures • Use perpendicular bisectors in problems involving circles • Use algebraic expressions in solving problems involving circles • Find the circumference of a circle • Use circumference to find distance traveled • Use arc length to find the circumference	• Circle • Pi or π • Center • Radius • Diameter • Chord • Segments of the Chord • Secant • Tangent • Ray • Point of Tangency • Coplanar • Tangent Circles • Concentric Circles • Circumference • Central Angle • Inscribed Angle • Arc • Major Arc • Minor Arc • Semi-Circle • Sector • Arc-Length • Inscribed Polygon • Congruent	• Geometry – Concepts and Skills – McDougal Littell, 2005 • Geometry Prentice Hall, 2007 • Geometry McDougal Littell, 2008 • Geometry Teacher's Activity Kit • Straightedge • Protractor • Calculators • CPS • Supplemental resources • Geometry software, i.e. "Geometer's Sketchpad" • Spiral Review and Project Binder • Bell Ringers • Study Island • PSSA Coach	• Tests • Quizzes • CDTs • Compass Learning • Study Island • Observation • Homework • Projects • Journals • Bell Ringers • Notebooks

		• Find the area of a circle • Find the area of the sector of a circle • Use and apply the Area of a Sector Theorem • Explore similarity relating to circles and the area of circles	• Congruent Circles • Congruent Arcs • Intercepted Arc • Standard Equation of a Circle	Grade 10 • Measuring Up • Appendix • YouTube • ESASD Valuable Video Library	

Keystone Anchors & Eligible Content	**Unit Concepts** What students need to know	**Unit Competencies** What students need to be able to do (skills): (Students will:)	**Content Vocabulary**	**Materials, Resources, & Instructional Activities**	**Assessments**
G.1.1.1 G.1.1.1.1 G.1.1.1.2 G.1.1.1.3 G.1.1.1.4 G.2.2.1 G.2.2.2 G.2.2.2.1 G.2.2.2.2 G.2.2.2.5	• Identify and/or use parts of circles and segments associated with circles, spheres, and cylinders. • Use and/or compare measurements of angles. • Use and/or develop procedures to determine or describe measures of perimeter, circumference, and/or area. (May require conversions within the same system.) • Describe how a change in one dimension of a 2-dimensional figure affects other measurements of that figure.	• Use properties of tangents to find lengths outside a circle • Use inscribes angles to find the measures of arcs • Use properties of inscribed quadrilaterals and other polygons to find missing measures • Find the measures of angles inside or outside of a circle • Use properties of chords to find measures of segments • Use the Segments of Secants and/or Segments of Tangents Theorems to solve problems • Write equations of circles in the coordinate plane • Graph a circle using the equation • Write the equation of a circle given the center and radius • Write the equation of a circle given the center and a point on the circle • Use algebraic expressions in solving problems involving circles • Solve real-world problems involving circles • Refer to page 1 of Keystone Geometry Formula Sheet to use and apply all circle formulas	• Circle • Pi or π • Center • Radius • Diameter • Chord • Segments of the Chord • Secant • Tangent • Ray • Point of Tangency • Coplanar • Tangent Circles • Concentric Circles • Circumference • Central Angle • Inscribed Angle • Arc • Major Arc • Minor Arc • Semi-Circle • Sector • Arc-Length • Inscribed	• Geometry – Concepts and Skills – McDougal Littell, 2005 • Geometry Prentice Hall, 2007 • Geometry McDougal Littell, 2008 • Geometry Teacher's Activity Kit • Straightedge • Protractor • Calculators • CPS • Supplemental resources • Geometry software, i.e. "Geometer's Sketchpad" • Spiral Review and Project Binder • Bell Ringers	• Tests • Quizzes • CDTs • Compass Learning • Study Island • Observation • Homework • Projects • Journals • Bell Ringers • Notebooks

			Polygon • Congruent • Congruent Circles • Congruent Arcs • Intercepted Arc • Standard Equation of a Circle	• Study Island • PSSA Coach Grade 10 • Measuring Up • Appendix • YouTube • ESASD Valuable Video Library	

Unit 7: Area, Surface Area, and Volume

Course Time Prior to Keystone/PSSA: 10 Blocks, 20 Periods

Overview: Students will identify, describe, and measure solids. Students will justify and apply formulas for finding the area of plane figures. The Pythagorean Theorem and trigonometry are applied as students find areas of regular polygons. Students will solve problems involving composite figures. Students will classify and sketch solids, describe cross sections and apply Euler's Theorem. The students will justify formulas for volume of prisms, cylinders, pyramids, cones, and spheres. Students will also determine the surface area and volume of composite solids.

Unit Essential Questions: How do you find the area of a regular polygon? When is a solid a polyhedron? How do you find the volume of a right prism or right cylinder? How do you find the volume of a pyramid or cone? How do you find the volume of a sphere? If two solids are similar, what is the ratio of their surface areas and what is the ratio of their volumes? How are the properties of geometric shapes applicable when solving problems?

Keystone Content Module/Assessment Anchor:

- **G.1.1.1** Identify and/or use parts of circles and segments associated with circles, spheres, and cylinders.
- **G.1.2.1** Recognize and/or apply properties of angles, polygons, and polyhedra.
- **G.1.3.1** Use properties of congruence, correspondence, and similarity in problem-solving settings involving two- and three-dimensional figures.
- **G.2.1.1** Solve problems involving right triangles.
- **G.2.2.1** Use and/or compare measurements of angles.
- **G.2.2.2** Use and/or develop procedures to determine or describe measures of perimeter, circumference, and/or area. (May require conversions within the same system.)
- **G.2.2.3** Describe how a change in one dimension of a 2-dimensional figure affects other measurements of that figure.
- **G.2.2.4** Apply probability to practical situations.
- **G.2.3.1** Use and/or develop procedures to determine or describe measures of surface area and/or volume. (May require conversions within the same system.)
- **G.2.3.2** Describe how a change in one dimension of a 3-dimensional figure affects other measurements of that figure.

Keystone Eligible Content:

- **G.1.1.1.1** Identify, determine, and/or use the radius, diameter, segment, and/or tangent of a circle.
- **G.1.1.1.2** Identify, determine, and/or use the arcs, semicircles, sectors, and/or angles of a circle.
- **G.1.1.1.3** Use chords, tangents, and secants to find missing arc measures or missing segment measures.
- **G.1.1.1.4** Identify and/or use the properties of a sphere or cylinder.
- **G.1.2.1.1** Identify and/or use properties of triangles.
- **G.1.2.1.2** Identify and/or use properties of quadrilaterals.
- **G.1.2.1.3** Identify and/or use properties of isosceles and equilateral triangles.
- **G.1.2.1.4** Identify and/or use properties of regular polygons.
- **G.1.2.1.5** Identify and/or use properties of pyramids and prisms.
- **G.1.3.1.1** Identify and/or use properties of congruent and similar polygons or solids.

- **G.1.3.1.2** Identify and/or use proportional relationships in similar figures.
- **G.2.1.1.1** Use the Pythagorean theorem to write and/or solve problems involving right triangles.
- **G.2.1.1.2** Use trigonometric ratios two write and/or solve problems involving right triangles.
- **G.2.2.1.1** Use properties of angles formed by intersecting lines to find measures of missing angles.
- **G.2.2.2.1** Estimate area, perimeter, or circumference of an irregular figure.
- **G.2.2.2.2** Find the measurement of a missing length, given the perimeter, circumference, or area.
- **G.2.2.2.3** Find the side lengths of a polygon with a given perimeter to maximize the area of a polygon.
- **G.2.2.2.4** Develop and/or use strategies to estimate the area of a compound/composite figure.
- **G.2.2.2.5** Find the area of a sector of a circle.
- **G.2.2.4.1** Use area models to find probabilities.
- **G.2.3.1.1** Calculate the surface area of prisms, cylinders, cones, pyramids, and/or spheres. Formulas are provided on a reference sheet.
- **G.2.3.1.2** Calculate the volume of prisms, cylinders, cones, pyramids, and/or spheres. Formulas are provided on a reference sheet.
- **G.2.3.1.3** Find the measurement of a missing length, given the surface area or volume.
- **G.2.3.2.1** Describe how a change in the linear dimension of a figure affects its surface area or volume.

Pennsylvania Common Core Standard(s):

- **CC.2.3.HS.A.1** Use geometric figures and their properties to represent transformations in the plane.
- **CC.2.3.HS.A.2** Apply rigid transformations to determine and explain congruence.
- **CC.2.3.HS.A.3** Verify and apply geometric theorems as they relate to geometric figures.
- **CC.2.3.HS.A.5** Create justifications based on transformations to establish similarity of plane figures.
- **CC.2.3.HS.A.6** Verify and apply theorems involving similarity as they relate to plane figures.
- **CC.2.3.HS.A.7** Apply trigonometric ratios to solve problems involving right triangles.
- **CC.2.3.HS.A.8** Apply geometric theorems to verify properties of circles.
- **CC.2.3.HS.A.9** Extend the concept of similarity to determine arc lengths and areas of sectors of circles.
- **CC.2.3.HS.A.12** Explain volume formulas and use them to solve problems.
- **CC.2.3.HS.A.13** Analyze relationships between two-dimensional and three-dimensional objects.
- **CC.2.3.HS.A.14** Apply geometric concepts to model and solve real world problems.

National Common Core Standard(s):

Find arc lengths and areas of sectors of circles

- **CC.9-12.G.C.5** Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.

Experiment with transformations in the plane

- **CC.9-12.G.CO.3** Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.

Make geometric constructions

- **CC.9-12.G.CO.12** Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.).
- **CC.9-12.G.CO.13** Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.

Define trigonometric ratios and solve problems involving right triangles

- **CC.9-12.G.SRT.8** Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

Explain volume formulas and use them to solve problems

- **CC.9-12.G.GMD.1** Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. Use dissection arguments, Cavalieri's principle, and informal limit arguments.
- **CC.9-12.G.GMD.3** Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.

Visualize relationships between two-dimensional and three-dimensional objects

- **CC.9-12.G.GMD.4** Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.

Apply geometric concepts in modeling situations

- **CC.9-12.G.MG.1** Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
- **CC.9-12.G.MG.2** Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).
- **CC.9-12.G.MG.3** Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

Use coordinates to prove simple geometric theorems algebraically

- **CC.9-12.G.GPE.7** Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.

Understand independence and conditional probability and use them to interpret data

- **CC.9-12.S.CP.1** Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or", "and," "not").

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   b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats
   d. Contribute to project teams to produce original works or solve problems
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   b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media
   c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks
   d. Process data and report results

4. Critical Thinking, Problem Solving, and Decision Making – Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
    a. Identify and define authentic problems and significant questions for investigation
    b. Plan and manage activities to develop a solution or complete a project
    c. Collect and analyze data to identify solutions and/or make informed decisions
    d. Use multiple processes and diverse perspectives to explore alternative solutions
5. Digital Citizenship – Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.
    a. Advocate and practice safe, legal, and responsible use of information and technology
    b. Exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity
    c. Demonstrate personal responsibility for lifelong learning
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    a. Understand and use technology systems
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- 13.1.11.A Relate careers to individual interests, abilities, and aptitudes.
- 13.1.11.E Justify the selection of a career.
- 13.1.11.H Review personal high school plan against current personal career goals and select postsecondary opportunities based upon personal career interests.

Connecting to Common Core and Other Standards:

PA Standards found at www.pdesas.org/standards/standardsdownloads
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Career Education and Work found at www.pacareerstandards.com/
*See Appendix for complete documents.

ELL Differentiation:

- Math & LA specifics found at www.pde.sas.org/module/sas/curriculumframework/elloverlay.aspx
- Generic found at http://www.easad.net/esl
- http://www.todos-math.org

Enrichment:

- Nets, analytic geometry in three dimensions, isometric graphing
- Group/Research Projects

- Internet/Research Activities
  - www.studyIsland.com
  - https://www.thelearningodyssey.com/
  - http://www.khanacademy.org/
  - http://www.classzone.com/cz/login.htm

Remediation:
- Operations with rational numbers
- Evaluate variable expressions
- Use order of operations to simplify and evaluate expressions and formulas
- Vocabulary of polygons
- Solving proportions
- Operations with percents
- Use inverse operations to find a missing measure when given the area or volume of a figure

IEP/GIEP: Refer to individual student's education plan under specially designed instruction.

Keystone Anchors & Eligible Content	**Unit Concepts** What students need to know	**Unit Competencies** What students need to be able to do (skills): (Students will:)	**Content Vocabulary**	**Materials, Resources, & Instructional Activities**	**Assessments**

G.1.1.1.1
G.1.1.1.2
G.1.1.1.3
G.1.1.1.4
G.1.2.1.1
G.1.2.1.2
G.1.2.1.3
G.1.2.1.4
G.1.2.1.5
G.1.3.1.1
G.1.3.1.2
G.2.1.1.1
G.2.1.1.2
G.2.2.1.1
G.2.2.2.1
G.2.2.2.2
G.2.2.2.3
G.2.2.2.4
G.2.2.2.5
G.2.2.4.1
G.2.3.1.1
G.2.3.1.2
G.2.3.1.3
G.2.3.2.1
	• Identify and/or use parts of circles and segments associated with circles, spheres, and cylinders.
	• Recognize and/or apply properties of angles, polygons, and polyhedra.
	• Solve problems involving right triangles.
	• Use and/or develop procedures to determine or describe measures of surface area and/or volume. (May require conversions within the same system.)
	• Describe how a change in one dimension of a 3-dimensional figure affects other measurements of that figure.
		• Solve problems involving circles
		  ○ Area
		  ○ Perimeter
		  ○ Arc Length
		  ○ Find missing measures when given an image or scenario
		• Use and apply all of the formula and images on the Keystone Geometry Formula sheet involving the Properties of Circles – inscribed angles, tangent-chord, 2 chords, tangent-secant, 2 secants, 2 tangents
		• Identify features of regular polygons – center, radius, apothem, central angle
		• Find angle measures in regular polygons
		• Find the perimeter and area of regular polygons
		• Calculate areas of regular polygons inscribed in circles
		• Use lengths and areas to find geometric probabilities
		• Use grids to estimate area and find probabilities
		• Identify solids and their nets
		• Identify and name polyhedra; find the number of
		  ○ Faces
			• Circumference
			• Arc length
			• Radian
			• Sector
			• Center
			• Radius
			• Apothem
			• Central Angle
			• Geometric Probability
			• Polyhedron
			• Face
			• Edge
			• Vertex
			• Base
			• Height
			• Side
			• Pi or π
			• Platonic Solids
			• Regular
			• Convex
			• Concave
			• Cross Section
			• Volume
			• Density
			• Sphere
			• Great Circle
			• Hemisphere
			• Similar Solids
				• Geometry – Concepts and Skills – McDougal Littell, 2005
				• Geometry Prentice Hall, 2007
				• Geometry McDougal Littell, 2008
				• Geometry Teacher's Activity Kit
				• Straightedge
				• Protractor
				• Calculators
				• CPS
				• Supplemental resources
				• Geometry software, i.e. "Geometer's Sketchpad"
				• Spiral Review and Project Binder
				• Bell Ringers
				• Study Island
				• PSSA Coach Grade 10
				• Measuring Up
					• Tests
					• Quizzes
					• CDTs
					• Compass Learning
					• Study Island
					• Observation
					• Homework
					• Projects
					• Journals
					• Bell Ringers
					• Notebooks

		○ Vertices ○ Edges • Use Euler's Theorem with platonic solids • Solve real-world problems	• Surface Area • Plane • Plane Figure • Solid Figure • Euler's Theorem • Oblique	• Appendix • YouTube • ESASD Valuable Video Library	

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G.1.1.1.1 G.1.1.1.2 G.1.1.1.3 G.1.1.1.4 G.1.2.1.1 G.1.2.1.2 G.1.2.1.3 G.1.2.1.4 G.1.2.1.5 G.1.3.1.1 G.1.3.1.2 G.2.1.1.1 G.2.1.1.2 G.2.2.1.1 G.2.2.2.1 G.2.2.2.2 G.2.2.2.3 G.2.2.2.4 G.2.2.2.5 G.2.2.4.1 G.2.3.1.1 G.2.3.1.2 G.2.3.1.3 G.2.3.2.1	• Identify and/or use parts of circles and segments associated with circles, spheres, and cylinders. • Recognize and/or apply properties of angles, polygons, and polyhedra. • Solve problems involving right triangles. • Use and/or develop procedures to determine or describe measures of surface area and/or volume. (May require conversions within the same system.) • Describe how a change in one dimension of a 3-dimensional figure affects other measurements of that figure.	• Draw and describe cross sections • Find the surface area and volume of prisms and cylinders, including oblique figures • Find the surface area and volume of pyramids and cones • Find the volume of composite solids • Find the surface area and volume of spheres • Identify and use the properties of similar solids to solve problems ○ Find the scale factor ○ Compare similar solids • Solve real-world problems	• Circumference • Arc length • Radian • Sector • Center • Radius • Apothem • Central Angle • Geometric Probability • Polyhedron • Face • Edge • Vertex • Base • Height • Side • Pi or π • Platonic Solids • Regular • Convex • Concave • Cross Section • Volume • Density • Sphere • Great Circle	• Geometry – Concepts and Skills – McDougal Littell, 2005 • Geometry Prentice Hall, 2007 • Geometry McDougal Littell, 2008 • Geometry Teacher's Activity Kit • Straightedge • Protractor • Calculators • CPS • Supplemental resources • Geometry software, i.e. "Geometer's Sketchpad" • Spiral Review and Project Binder • Bell Ringers • Study Island	• Tests • Quizzes • CDTs • Compass Learning • Study Island • Observation • Homework • Projects • Journals • Bell Ringers • Notebooks

			• Hemisphere • Similar Solids • Surface Area • Plane • Plane Figure • Solid Figure • Euler's Theorem • Oblique	• PSSA Coach Grade 10 • Measuring Up • Appendix • YouTube • ESASD Valuable Video Library	

Unit 8: Transformations

Course Time Prior to Keystone/PSSA: 10 Blocks, 20 Periods

Overview: Students will perform congruence transformations on figures using translations, reflections, and rotations. Students will perform dilations. Students will identify symmetry, image, pre-image, isometry.

Unit Essential Questions:

- How can coordinate plane help me understand properties of reflections, rotations, and translations?
- What is the relationship between reflections, rotations, and translations?
- How do you understand and represent translations, reflections, rotations, and dilations of objects in the plane by using sketches, coordinates, function notation, and matrices?
- How is symmetry used to understand transformations?

Keystone Content Module/Assessment Anchor:

- **G.1.3.1** Use properties of congruence, correspondence, and similarity in problem-solving settings involving two- and three-dimensional figures.

Keystone Eligible Content:

- **G.1.3.1.1** Identify and/or use properties of congruent and similar polygons or solids.
- **G.1.3.1.2** Identify and/or use proportional relationships in similar figures.

Pennsylvania Common Core Standard(s):

- **CC.2.3.HS.A.1** Use geometric figures and their properties to represent transformations in the plane.
- **CC.2.3.HS.A.2** Apply rigid transformations to determine and explain congruence.
- **CC.2.3.HS.A.3** Verify and apply geometric theorems as they relate to geometric figures.
- **CC.2.3.HS.A.5** Create justifications based on transformations to establish similarity of plane figures.
- **CC.2.3.HS.A.6** Verify and apply theorems involving similarity as they relate to plane figures.
- **CC.2.3.HS.A.7** Apply trigonometric ratios to solve problems involving right triangles.
- **CC.2.3.HS.A.13** Analyze relationships between two-dimensional and three-dimensional objects.

National Common Core Standard(s):

Experiment with transformations in the plane.

- **CC.9-12.G.CO.1** Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.
- **CC.9-12.G.CO.2** Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).
- **CC.9-12.G.CO.3** Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.

- **CC.9-12.G.CO.4** Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
- **CC.9-12.G.CO.5** Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.
- **CC.9-12.G.SRT.1** Verify experimentally the properties of dilations given by a center and a scale factor:
    a. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.
    b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.
- **CC.9-12.G.SRT.2** Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides
- **CC.9-12.G.SRT.3** Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.

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- http://www.todos-math.org

Enrichment:

- Internet/Research Activities
  - www.studyIsland.com
  - https://www.thelearningodyssey.com/
  - http://www.khanacademy.org/
  - http://www.classzone.com/cz/login.htm
- Group/Research Projects

Remediation:

- Distance Formula
- Perimeter Formulas
- Circumference
- Slope
- Parallel Lines
- Perpendicular Lines

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