Essentials of Geometry / 10-12 / Discovering Geometry

Subject	Grade	Unit	Suggested Timeline
Mathematics	10/11/12	1- Discovering Geometry	10 days

Grade Level Summary

The Essentials of Geometry course is designed to provide vocational and technical applications of mathematical concepts from diverse occupational fields. The most influential research shows that students' best learn geometry through visualization, analysis, informal deduction, deduction and rigor. This course aims to incorporate these best practices to ensure students leave high school with a working geometry knowledge for the workforce.

Grade Level Units

Unit 1-Discovering Geometry
Unit 2- Reasoning and Proof
Unit 3- Triangle Theorems
Unit 4- Similar Triangles
Unit 5- Right Triangles
Unit 6- Polygons and Quadrilaterals
Unit 7- Coordinate Geometry
Unit 8- Perimeter and Area
Unit 9- Circles
Unit 10- Surface Area and Volume
Unit 11- Transformational Geometry

Unit Title

Discovering Geometry

Unit Overview

One of the most important skills in today's workplace is the ability to visualize spatial relationships involving locations, positions, directions, sizes and shapes. People skilled at translating these relationships from a drawing into a finished product are highly valued. In this chapter students will learn how to identify geometric figures and how to correctly measure angles and lines. Students will also learn about special pairs of angles and how to make geometric constructions. Geometry is the study of the world around us. The prefix of the word, geo means earth and the suffix, metry, means to measure; the word literally means to measure the earth. Foundations in defining basic building blocks of geometry will help students to progress through this course.

Unit Essential Questions

1. How do we draw, name and describe basic geometric figures?
2. How do we measure line segments?
3. How do we measure, classify and identify angles?
4. How do we perform basic geometric constructions using a compass and a straight edge?
5. How do we identify parallel and perpendicular lines?

Key Understandings

1. Draw, name and describe characteristics of points, lines and planes.
2. Define, draw, and name line segments and rays.
3. Define and name angles.
4. Find the length of a line segment using a ruler.
5. Find the distance between two points given a number line.
6. Use segment addition to solve problems.
7. Find the midpoint of a line segment.
8. Find the measure of an angle using a protractor.
9. Classify angles as acute, obtuse, right or straight.
10. Solve problems using angle addition.
11. Conjecture that vertical angles have equal measure.
12. Identify complementary and supplementary angles.
13. Perform basic constructions of Euclidean Geometry, including copying and bisecting line segments and angles.
14. Identify parallel and perpendicular lines.
15. Draw parallel and perpendicular lines using a straightedge and protractor.
16. Classify angle pair relationships formed by the intersection of parallel lines and a transversal.

Focus Standards Addressed in the Unit	
CC.2.3.7.A.2	Visualize and represent geometric figures and describe the relationships between them.
CC.2.2.HS.D.8	Apply inverse operations to solve equations or formulas for a given variable.
CC.2.2.HS.D.9	Use reasoning to solve equations and justify the solution method.
CC.2.2.HS.D.10	Represent, solve, and interpret equations algebraically and graphically.

Important Standards Addressed in the Unit	
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.HS.G.CO.C.9	Prove theorems about lines and angles.
CC.HS.G.C.D.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.1.2.1-12.J	Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

Misconceptions	**Proper Conceptions**
1. A ray can be named using the letters in either order.	1. A ray must be named starting with the endpoint first in the label.
2. Students will misinterpret diagrams and labels of points, lines, and planes.	2. Students must understand that capital letters identify points, a line may be named by any two points on a line or by using a single lower case script letter, and a plane may be named by a single Capital letter or three noncollinear points.
3. An angle can be named using the letters in any order.	3. When naming an angle the vertex must be in the middle of the label.
4. Not using the absolute value of the difference of coordinates when finding the length of a segment, which results in a negative distance.	4. Stress that length and distance are always expressed as a positive number (or zero). The absolute value is important because it ensures that our distance will be positive.
5. Students will confuse when to use the inner and outer scale of a protractor. They may use the wrong scale and get an incorrect answer.	5. Point out that the scale used on a protractor depends upon whether one side of the angels is lined up with zero degrees on the right or the left. If you start with the side of the angle lined up on the left then you use the inner scale. If you start with the side of the angle line up on the right the outer scale should be used.
6. Students will assume perpendicular bisectors and segment bisectors are the same.	6. Emphasize that a perpendicular bisector is always a segment bisector, while a segment bisector is always a perpendicular bisector. A segment bisector intersects the midpoint of a segment, separating it into two congruent segments. If the segment bisector is also perpendicular to the segment then it is a perpendicular bisector.
7.Students will assume that the corresponding angles, alternate exterior angles, and alternate exterior angles are congruent between any two lines, as well as the consecutive interior angles are supplementary.	7. For these postulates to hold true, lines must cut by a transversal must be parallel. If a two parallel lines are cut be a transversal the alternate interior, alternate exterior and corresponding angles are congruent. If two parallel lines are cut by a transversal, the consecutive interior angles are supplementary. Without knowing the lines are parallel we cannot assume congruency or supplementary angles.

Concepts	**Competencies**	**Vocabulary/ Postulates/Theorems**
• Basic Geometric Figures • Distance and Midpoint	• In Geometry there are fundamental geometric figures: a point, a line, a plane and an angle. A point identifies a location, but has no size or shape. A line has infinite length,	Angle Collinear

• Segment Addition • Angle Relationships • Angle Addition	no width or thickness. A plane is named with three noncollinear points. A segment of a line is two points on a line and all the points between those endpoints. A ray is part of a line, consisting of one endpoint and all the points of one side of that endpoint. An angle is formed by two rays with a common endpoint, named with the letter at the vertex. • On a number line the distance between any two points A and B with coordinates a and b is $a-b$. If the coordinate of point A is a and the coordinate of point B is b then the coordinate of the midpoint AB is $a+b2.$ • If A, B and C are collinear, and B is between A and C, then $AB+BC=AC$. • There are many angle relationships students must understand as building blocks. First and foremost the classification of angles: Acute angles are less than 90°. Obtuse angles are greater than 90° and less than 180°. Right angles are exactly 90°. Straight angles are exactly 180°. Secondly relationships between angles: Adjacent angles are two angles that share a common vertex, common side and have no common interior points. Vertical angles are two angles formed by intersecting lines which are nonadjacent but share a common vertex. Supplementary angles are two angles whose sum is 180°. If two angles are adjacent and supplementary then they form a linear pair. Complementary Angles are two angles whose sum is 90°. Thirdly the relationship between angles formed by lines: Corresponding angles are two angles in the same corresponding position when two lines are cut by a transversal. Alternate Exterior Angles are two angles located on the exterior of two lines cut by a transversal on opposite sides of the transversal. Alternate Interior Angles are two angles located on the interior of two lines cut by a transversal on opposite sides of the transversal. Consecutive Interior Angles are two angles on the interior and same side of a transversal when two lines are cut by a transversal. When the two lines cut by a transversal are parallel the following angle postulates hold true: If a two parallel lines are cut be a transversal the alternate interior, alternate exterior and corresponding angles are congruent. If two parallel lines are cut by a transversal, the consecutive interior angles are supplementary. • If CD is between CA and CB then, $m\angle ACD+m\angle DCB=m\angle ACB$	Coplanar Endpoints Euclidean Geometry Intersection Line Line Segment Plane Points Ray Sides Vertex Distance between two points Measure of a Line Segment Midpoint Midpoint Formula Segment Addition Acute Angle Adjacent Angles Angle Addition Complementary Angles Conjecture Linear Pair Obtuse Angle Protractor Right Angle Straight Angle Supplementary Vertical Angles Vertical Angles Theorem Angle Bisector Congruence Construction Perpendicular Bisector Segment Bisector Alternate Exterior Angles Alt. Ext. Angles Theorem Alternate Interior Angles Alt. Int. Angles Theorem Corresponding Angles Corr. Angles Postulate Parallel Parallel Lines Perpendicular Perpendicular Lines Postulate Skew Lines Theorems Transversal

Assessments

Homework- Students will be given homework which reinforces classroom concepts. Homework will be evaluated on completeness. Homework is used informally to address student misconceptions, and reteach. Homework is sometimes evaluated formally as a grade.

Class Notebook Checks- Students maintain a formal set of student notes aligned to learning outcomes. They will be evaluated for completeness with level of documentation considered.

Quizzes- Within each unit, competencies will be assessed in smaller chunks as a grade and for the purpose of evaluating student understanding.

Unit Test- Each unit will include a summative written test.

Class Activities- Students will be expected to participate in class activities relating content to real life. Students understanding or concepts or discovery of concepts will be both informally and formally graded based on participation, completion and adequate use of previously learned knowledge.

Suggested Strategies to Support Design of Coherent Instruction

Charlotte Danielson's Framework for Teaching: Domain 3 Instruction

3a- Student assignment sheets communicate expectations for learning.
3b-Using questioning and discussion techniques.
3c-Instructonal materials and class activities engage students in learning.
3d-Daily informal assessments of student understanding is provided through skeletal classroom notes, homework, and continued student/teacher interaction.
3e-Adjustment to pacing and additional examples/and or practice is used as feedback merits.

Differentiation:

- Provide graphic organizers
- Provide multiple concrete examples
- Permit projects to be completed over extended period of time
- Provide lessons via visual presentation (smart board) as well as in notebook formats.
- Provide manipulatives for students to problem solve with.
- Pair stronger students with struggling students for peer assistance

Interdisciplinary Connections:

Algebra Applications
Art- Modeling, and Application
Technical Drawing- Modeling and Application

Additional Resources:

Kahn Academy
Textbook Ancillary Materials

Created By:

Olivia L. Weidemann

Essentials of Geometry / 10-12 / Reasoning and Proof

Subject	Grade	Unit	Suggested Timeline
Mathematics	10/11/12	2- Reasoning and Proof	15 days

Grade Level Units

Unit 1-Discovering Geometry
Unit 2- Reasoning and Proof
Unit 3- Triangle Theorems
Unit 4- Similar Triangles
Unit 5- Right Triangles
Unit 6- Polygons and Quadrilaterals
Unit 7- Coordinate Geometry
Unit 8- Perimeter and Area
Unit 9- Circles
Unit 10- Surface Area and Volume
Unit 11- Transformational Geometry

Unit Title

Reasoning and Proof

Unit Overview

Success in life is the result of making the right decisions. Successful decision-makers use inductive and deductive reasoning to make good decisions in their careers, sports, and in their personal lives. This chapter gives students the tools to apply logic and reasoning to their life and future career. In this chapter students will learn to use both inductive and deductive reasoning. They will learn about conditional statements, and how to create the converse, inverse and contrapositive of the original conditional statement. Students will construct logical arguments, construct two-column proofs and paragraph proofs. Students will use proofs to prove algebraic statements, theorems about segment, theorems about angles, and prove parallel and perpendicular lines.

Unit Essential Questions

1. How do we use inductive reasoning?
2. How do we use deductive reasoning?
3. How do we write the converse, inverse and contrapositive of a conditional statement?
4. How do we construct valid arguments?
5. What types of proof are used in mathematics?
6. How do we write Algebraic proofs?
7. How do we prove theorems about angles?
8. How do we prove lines are perpendicular and parallel?

Key Understandings

1. Use inductive reasoning to make conjectures.
2. Find unknown terms in a pattern by making a conjecture.
3. Use a counterexample to prove a conjecture is false.
4. Use deductive reasoning to draw conclusions.
5. Identify the hypothesis and conclusion of a conditional statement.
6. Write conditional statements.
7. Write the converse, inverse and contrapositive of a conditional.
8. Determine if a syllogism is a valid argument, is so identify the rule of logic that makes the argument valid.
9. Use the law of syllogism to write proofs.
10. Write flowchart, two-column and paragraph proofs.
11. Use properties of algebraic statements.
12. Prove the Overlapping Segments Theorem and use it as well as properties of equality and definitions you have learned to prove geometric statements.
13. Prove the Supplementary and Complementary Angles Theorems and use them to solve problems.
14. Prove the Overlapping Angles Theorem.
15. Investigate the relationship between perpendicular lines and right angles.
16. Construct parallel lines by constructing congruent and corresponding angles.
17. Prove lines are parallel by using the relationships of angles formed by the intersection of two parallel lines and a transversal.

Focus Standards Addressed in the Unit	
CC.2.3.7.A.2	Visualize and represent geometric figures and describe the relationships between them.
CC.2.2.HS.D.8	Apply inverse operations to solve equations or formulas for a given variable.
CC.2.2.HS.D.9	Use reasoning to solve equations and justify the solution method.

Important Standards Addressed in the Unit	
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.HS.G.CO.C.9	Prove theorems about lines and angles.
CC.1.2.1-12.J	Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

Misconceptions	**Proper Conceptions**
1. Students often confuse inductive and deductive reasoning.	1. Inductive reasoning is reasoning based observing data, recognizing patterns and making conjectures. Deductive Reasoning is based on logic and facts. Be sure to provide concrete examples of each type of reasoning so that students know the distinctions of each type of reasoning.
2. Students will assume that just because a pattern works for the first couple numbers in a sequence, it works for all of them.	2. Students should test their conjecture with all the numbers that are given in the sequence to determine if their conjectured pattern is true.
3. You must have multiple counterexamples to prove a conjecture false.	3. Only one counterexample is needed to prove a conjecture is false.
4. Students often look at a conditional statement and assume the first part of the statement is the hypotheses.	4. The part of the statement with the word 'if' is the hypothesis of a conditional statement. The 'if' part may come first or second. Some conditional statements reverse the order of a statement, so have students read them carefully.
5. If the hypothesis is true, the conclusion can be false.	5. In a conditional statement if the hypothesis is known to be true, then the conclusion is true whether they believe it or not. If a conditional is known to be true, and the conclusion is believed to be true, the hypothesis may or may not be true.
6. Students confuse the inverse, converse and contrapositive.	6. Stress that inverse is the negation, converse is the opposite, and contrapositive is the negation of the converse.
7. Students may not understand the properties of equality in notation form.	7. To ensure students understand the properties of equality practice by giving examples of each property and having students create their own examples before using them in a proof. Emphasize that the next step the reason is the property you used to get there.
8. Students may have difficulty formulating the next step of the proof.	8. Encourage students to use the given as a starting place. In addition to the given have students use the given drawing. If no drawing is given, show students how to draw an accurate drawing. The drawing and subsequent steps will helps students with formulating new steps to arrive at the prove statement.

Concepts	**Competencies**	**Vocabulary/Postulates/ Theorems**
• Inductive vs Deductive Reasoning • Conditional statements • Law of syllogism and law of detachment • Types of Proof • Algebraic Proofs • Geometric Proofs	• Identify examples as inductive or deductive reasoning. • Identify hypotheses and conclusion of a conditional statement. Write conditional statements. Use a statement to write the converse, inverse and contrapositive. If both the conditional and converse are true, create a bi-conditional statement. • Determine if a two conditional statements are a result of syllogism or detachment. Draw a valid conclusion based on	Counterexample Inductive reasoning Sequences Conclusion Conditional statement Deductive reasoning Hypothesis

• Prove Theorems about Angles • Prove lines are parallel and perpendicular	the conditional statements based on the law of syllogism or detachment. • Understand the basic elements of a proof. Use these basic elements to write flow proofs, paragraph proofs and two-column proofs. • Use the properties of equality to construct a proof for an algebraic equation. • Use properties of equality, segment addition and angle addition to form logical geometric proofs. • Use pre-existing knowledge of angle relationships to prove theorems about angles. • Use the angle relationships resulting from two parallel lines and transversal to prove lines are parallel. The converse of the theorems/postulates allows us to prove lines are parallel and/or perpendicular.	Theorem Biconditional Contrapositive Converse Inverse Venn diagram Argument Law of detachment Law of syllogism Premise Syllogism Valid argument If-Then Transitive Property Paragraph Proof Proof Two-column proof Overlapping segments Overlapping Seg. Theorem Overlapping angles Overlapping angles Thm. Supp. Angles Thm. Comp. Angles Thm. Perp. Lines. Thm. Corr. Angles Converse Alt. Ext. Angles Converse Alt. Int. Angles Converse Perp-Parallel Theorem.

Assessments

Homework- Students will be given homework which reinforces classroom concepts. Homework will be evaluated on completeness. Homework is used informally to address student misconceptions, and reteach. Homework is sometimes evaluated formally as a grade.

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Unit Test- Each unit will include a summative written test.

Class Activities- Students will be expected to participate in class activities relating content to real life. Students understanding or concepts or discovery of concepts will be both informally and formally graded based on participation, completion and adequate use of previously learned knowledge.

Suggested Strategies to Support Design of Coherent Instruction

Charlotte Danielson's Framework for Teaching: Domain 3 Instruction

3a- Student assignment sheets communicate expectations for learning.

3b-Using questioning and discussion techniques.

3c-Instructonal materials and class activities engage students in learning. Highlighting when working with conditional statements to differentiate pieces of conditional statements.

3d-Daily informal assessments of student understanding is provided through skeletal classroom notes, homework, and continued student/teacher interaction.

3e-Adjustment to pacing and additional examples/and or practice is used as feedback merits.

Differentiation:

- Provide graphic organizers
- Provide multiple concrete examples
- Permit projects to be completed over extended period of time
- Provide lessons via visual presentation (smart board) as well as in notebook formats.
- Provide manipulatives for students to problem solve with.
- Pair stronger students with struggling students for peer assistance

Interdisciplinary Connections:
Art- Patterns, Modeling,
English- Deductive and Inductive Reasoning, Hypotheses, Conclusions, Conjectures (Prediction)
Algebra- Algebraic Proofs, Algebraic Properties
Science- Scientific Method, Four-Step Plan
History/Geography- Maps, Modeling

Additional Resources:
Kahn Academy
Textbook Ancillary Materials

Created By:
Olivia L. Weidemann

Essentials of Geometry / 10-12 / Triangle Theorems

Subject	Grade	Unit	Suggested Timeline
Mathematics	10/11/12	3- Triangle Theorems	14 days

Grade Level Units
Unit 1-Discovering Geometry
Unit 2- Reasoning and Proof
Unit 3- Triangle Theorems
Unit 4- Similar Triangles
Unit 5- Right Triangles
Unit 6- Polygons and Quadrilaterals
Unit 7- Coordinate Geometry
Unit 8- Perimeter and Area
Unit 9- Circles
Unit 10- Surface Area and Volume
Unit 11- Transformational Geometry

Unit Title
Triangle Theorems

Unit Overview
The ability to recognize and prove triangle congruence is an essential skill in construction, manufacturing, and telecommunication careers. Congruent triangles are used to support structures, in architectural designs, and to test satellites. In this chapter students will solve problems using the triangle sum theorem, exterior angle sum theorem, and triangle inequality theorem. Students will learn how to identify corresponding parts of triangles to prove triangles are congruent. Students will solve problems using the isosceles triangle, the Hypotenuse-Leg, perpendicular bisector and angle bisector theorems. Students will also learn about the properties of altitudes, medians, and perpendicular bisectors and use these properties to solve problems.

Unit Essential Questions	Key Understandings
1. How do we find missing angle measures in a triangle? 2. How do we find the shortest and longest sides of a triangle? 3. How do know if three segments form a triangle? 4. How do we know if triangles are congruent? 5. How do we prove triangles are congruent using SSS and SAS? 6. How do we prove triangles are congruent using AAS and ASA? 7. How do we use corresponding parts of congruent triangles to solve problems? 8. How do we apply properties of isosceles and right triangles to solve problems and write proofs? 9. How do we find the altitude, median, perpendicular bisector and angle bisector of a triangle?	1. Classify triangles by their sides and by their angles. 2. Identify the sum of the angles of a triangle. 3. Identify the relationships between interior and exterior angles of a triangle. 4. Use the triangle sum theorem to find missing interior and exterior angles measure of a triangle. 5. Identify properties of inequality. 6. Use the relationships between the angles and sides of a triangle to solve problems. 7. Determine if three line segments can form a triangle. 8. Use the triangle inequality theorem to solve problems. 9. Identify the corresponding parts of congruent triangles. 10. Prove triangles are congruent using the Side-Side-Side Postulate or Side-Angle-Side Postulate. 11. Prove triangles are congruent using the Angle-Side-Angle Postulate, or Angle-Angle-Side Postulate. 12. Write proofs to prove triangles are congruent. 13. Use corresponding parts of congruent triangles to solve problems. 14. Apply properties of isosceles and right triangles to solve problems and write proofs. 15. Distinguish between altitudes, medians, perpendicular bisectors, and angle bisectors. 16. Apply properties of bisectors to solve problems. 17. Identify circumcenters, incenters, centroids and orthocenters.

Focus Standards Addressed in the Unit	
CC.2.3.7.A.2	Visualize and represent geometric figures and describe the relationships between them.
CC.2.2.HS.D.8	Apply inverse operations to solve equations or formulas for a given variable.
CC.2.2.HS.D.9	Use reasoning to solve equations and justify the solution method.
CC.2.2.HS.D.10	Represent, solve, and interpret equations algebraically and graphically.

Important Standards Addressed in the Unit	
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.1.2.1-12.J	Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.
CC.HS.G.CO.C.9	Prove theorems about lines and angles.
CC.2.3.HS.A.3	Verify and apply geometric theorems as they relate to geometric figures.

Misconceptions	Proper Conceptions
1. The exterior angle of a triangle is equal to the sum of any two interior angles.	1. The exterior angle of a triangles is equal to the sum of the two non-adjacent interior angles. After the exterior angle is identified students should find the sum of the two remote (or nonadjacent) interior angles to know what the exterior angle's measure is.
2. Students will check the sum of only one set of two sides' lengths to see if it is greater than the third side.	2. Students must check all three sums of two side lengths to ensure that a triangle exists.
3. Students may have forgotten how to solve inequalities from Algebra.	3. Remind students that linear inequalities are solved in the same fashion as linear equations. The only exception is when multiplying or dividing both sides of an inequality by a negative number, the inequality symbol reverses direction.
4. Students often confuse corresponding parts in given diagrams.	4. Focus on the marking of the corresponding parts because diagrams will often be rotated. Remind students that the corresponding vertices are congruent if given, for example: $\Delta ABC \cong \Delta DEF$. Since these two triangles are congruent I now know $\angle A$ and $\angle D$ are congruent, $\angle B$ and $\angle E$ are congruent and $\angle C$ and $\angle F$ are congruent. I also know the sides between congruent angles will be corresponding and congruent. Stress that the corresponding parts for each triangle must match up.
5. Students often assume if they have any side, angle or side they can prove triangles are congruent using side-angle-side.	5. It is important for students to know that the triangle congruence methods SAS, SSS, ASA and AAS must be proved in direct order. For SAS, you must have a side, included angle and a side that are congruent in consecutive order on both triangles. The angle must be adjacent to both the sides being used, not opposite. Suggest that students list the congruent parts in the same order as that of the congruence statement being used.
6. Differentiating between AAS and ASA when proving triangles congruent.	6. Stress the order that congruent parts are in is important. Marking the congruent parts in a diagram should help.
7. Student confuse congruent or corresponding parts of figures with overlapping or embedded triangles.	7. Have students outline the figures in different colors, or draw the triangles as separate figures to see distinctly which parts are congruent.
8. Students will struggle to develop proofs.	8. Have students form a plan before they write their proof. Useful steps that may help are: a) Draw a diagram or mark the diagram. b) Highlight parts you need to prove are congruent. c) Decide which triangles you need to prove congruent. d) Decide postulates, theorems, definitions or properties you need to use in your proof. e) Try to work backwards.
9. Students may assume pieces in a diagram are congruent without proof.	9. Emphasize that if corresponding parts cannot be proven

10. Students will see that with right triangles you can use the method ASS, and then assume you can use that for any type of triangle. 11. Students will assume triangles are equilateral, isosceles or right because of the way the look, not because of the way they are labeled. 12. Students will assume any line drawn from a vertex to the opposite side of a triangle is a perpendicular bisector.	using a postulate, theorem, definition or property then students must first prove triangles are congruent, to prove corresponding parts are congruent. 10. You need a right angle, a leg and a hypotenuse for a right triangle to prove two triangles are congruent. Stress that it is a Hypotenuse-Leg and there must be a right angle. Do not abbreviate letters because this may confuse students. 11. Remind students to only use specializes information that is given in a diagram or writing about the given triangle. 12. A perpendicular bisector must cut the segment at its midpoint making two congruent segments AND must form a right angle with the side it is bisecting. Perpendicular bisectors do not need to go through the opposite vertex.

Concepts	**Competencies**	**Vocabulary/Postulates/Theorems**
• Triangle Sum Theorem • Exterior Angle Theorem • Opposite Angle-Side Theorem • Opposite Side-Angle Theorem • Triangle Inequality Theorem • Congruent Triangles • Prove corresponding parts are congruent. • Isosceles Triangle Theorem • Special Segments in a Triangle	• Find the missing angles of a triangle using the triangle sum theorem. • Find the exterior angle of a triangle using the remote interior angles. Find the missing remote interior angle of a triangle using one remote interior angle and the exterior angle of a triangle. • Determine the shortest and longest sides of a triangle using the smallest and largest angle and vice versa. • Given 3 side lengths determine if a triangle is possible to construct using the • Given two triangles are congruent, identify the corresponding parts. • Use SSS, SAS, AAS, ASA and HL to prove triangles are congruent. • Use congruent triangles to show corresponding parts of triangles are congruent. • Use the isosceles triangle theorem to find the measures of the base angles of an isosceles triangle. • Construct and identify altitudes, medians, perpendicular bisectors and angle bisectors in a triangle.	Acute triangle Base Base angles Equiangular triangle Equilateral triangle Exterior angle Exterior Angle Theorem Interior angle Isosceles triangle Legs Obtuse triangle Parallel Postulate Right triangle Scalene triangle Spherical geometry Triangle Triangle Sum Theorem Contradiction Hypotenuse Opposite Side-Angle Thm. Opposite Angle-Side Thm. Properties of Inequality Triangle Inequality Thm. Perpendicular Postulate Common segment Congruent Congruent Triangles Corresponding parts CPCTC Included angle SAS Postulate SSS Postulate AAS Postulate ASA Postulate Included Side Corollary Hypotenuse-Leg Thm Isosceles Triangle Thm Postulate Theorem Trans. Prop. of Congruence Vertex Angle Altitude Angle Bisector

		Angle Bisector Theorem Centroid Circumcenter Incenter Median Orthocenter Perpendicular Bisector Perpendicular Bisector Thm.

Assessments

Homework- Students will be given homework which reinforces classroom concepts. Homework will be evaluated on completeness. Homework is used informally to address student misconceptions, and reteach. Homework is sometimes evaluated formally as a grade.

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Differentiation:

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- Provide multiple concrete examples
- Permit projects to be completed over extended period of time
- Provide lessons via visual presentation (smart board) as well as in notebook formats.
- Provide manipulatives for students to problem solve with.
- Pair stronger students with struggling students for peer assistance

Interdisciplinary Connections:

Art- Modeling
Technical Drawing- Modeling, Scale Drawings, blueprints
Algebra- Solving Inequalities
Science- Scientific Method
Language Arts- prefixes and roots of words.

Additional Resources:

Kahn Academy
Textbook Ancillary Materials

Created By:

Olivia L. Weidemann

Essentials of Geometry / 10-12 / Similar Triangles

Subject	Grade	Unit	Suggested Timeline
Mathematics	10/11/12	4-Similar Triangles	12 Days

Grade Level Units
Unit 1-Discovering Geometry
Unit 2- Reasoning and Proof
Unit 3- Triangle Theorems
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Unit 5- Right Triangles
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Unit Title
Similar Triangles

Unit Overview
Industry needs people who are trained in the use of ratio and proportion to create new products to improve lives. Cartographers use rations and proportions to find distances for maps. Artists use the concepts of similarity and proportion to create sketches and scale drawings for their creations. Bankers use ratios and proportions to apply exchange rates when converting foreign currency. Architects and carpenters use scale models and drawings to design and build houses, schools, museums and buildings. In this chapter students will learn about similarity. They will learn how to identify and then use ratios and proportions to solve problems. Students will use ratios in similar triangles to calculate indirect measure and examine proportions in right triangles.

Unit Essential Questions	Key Understandings
1. How do we solve proportions? 2. What does it mean for two figures to be similar? 3. How do we determine if two triangles are similar? 4. How do we apply indirect measurement to make similar triangles? 5. How do we use proportions in right triangles?	1. Set up proportions to solve problems. 2. Use proportions to find actual dimensions of scale drawings and scale dimensions of actual items. 3. Determine if two polygons are similar. 4. Find the scale factor of similar triangles. 5. Prove triangles are similar using corresponding angles. 6. Prove triangles are similar using corresponding angles and sides. 7. Use parallel lines to divide a segment into equal parts. 8. Apply similar triangles to make indirect measurements. 9. Identify the similar triangles formed by the altitude drawn to the hypotenuse of a right triangle. 10. Find the geometric mean of two numbers.

Focus Standards Addressed in the Unit

CC.2.3.7.A.2	Visualize and represent geometric figures and describe the relationships between them.
CC.2.2.HS.D.8	Apply inverse operations to solve equations or formulas for a given variable.
CC.2.2.HS.D.9	Use reasoning to solve equations and justify the solution method.
CC.2.2.HS.D.10	Represent, solve, and interpret equations algebraically and graphically.

Important Standards Addressed in the Unit

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.A.CED.1	Create equations and inequalities in one variable and use them to solve problems.
CC.9-12.A.REI.3	Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
CC.HS.G.CO.C.9	Prove theorems about lines and angles.
CC.9-12.G.SRT.5	Use congruence and similarity criteria for triangles to solve problems and prove relationships in geometric figures.
CC.2.3.HS.A.6	Verify and apply theorems involving similarity as they relate to plane figures.
CC.1.2.1-12.J	Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

Misconceptions	**Proper Conceptions**
1. Students assume that any two ratios are written using an equal sign are a proportion.	1. Students should not assume equality unless the cross-products are equal or a statement is made verifying the two ratios form a proportion.
2. Students assume similarity and congruence are the same.	2. Spend time contrasting similarity and congruence. Similarity is same shape and proportional parts. Congruency is same shape and size parts.
3. Students forget that figures can be rotated to align corresponding parts. This leads to students jumping to the conclusion that figures are not similar because corresponding parts are on different sides of a figure.	3. Remind students to test all possible proportions before determining whether or not figures are similar.
4. Students do not properly line up known information in the proportion.	4. Make sure students properly line of corresponding sides in the same location within the ratio. This will cause less errors in student solutions.
5. Students have difficulty with triangles embedded in on another.	5. Practice outlining the smaller and larger triangles, as well as setting up the correct proportion with sides of both triangles.

Concepts	**Competencies**	**Vocabulary/Postulates/Theorems**
• Ratios and proportions. • Similar Polygons • Indirect Measurement • Proportions in Right Triangles	• Reading, writing and solving proportions. Ratio is a fraction comparing two numbers. A proportion sets two ratios equal to another. Ratios are used in creating and interpreting scale drawings. • Understand properties of similar polygons. Similar Polygons have corresponding angles congruent and corresponding sides are proportional. • Determine if triangles are similar using similarity postulates. • Find measurements by using mathematical knowledge relationships instead of directly measuring with a tool.	Cross-products Extremes Means Proportion Ratio Scale factor Proportional Similar polygons AA Similarity Postulate SSS Similarity Postulate SAS Similarity Postulate Triangle Proportionality Thm. Fractal Geometric mean Right Triangle Similarity Thm.

Assessments

Homework- Students will be given homework which reinforces classroom concepts. Homework will be evaluated on completeness. Homework is used informally to address student misconceptions, and reteach. Homework is sometimes evaluated formally as a grade.

Class Notebook Checks- Students maintain a formal set of student notes aligned to learning outcomes. They will be evaluated for completeness with level of documentation considered.

Quizzes- Within each unit, competencies will be assessed in smaller chunks as a grade and for the purpose of evaluating student understanding.

Unit Test- Each unit will include a summative written test.

Class Activities- Students will be expected to participate in class activities relating content to real life. Students understanding

or concepts or discovery of concepts will be both informally and formally graded based on participation, completion and adequate use of previously learned knowledge.

Suggested Strategies to Support Design of Coherent Instruction

Charlotte Danielson's Framework for Teaching: Domain 3 Instruction

3a- Student assignment sheets communicate expectations for learning.
3b-Using questioning and discussion techniques.
3c-Instructonal materials and class activities engage students in learning.
3d-Daily informal assessments of student understanding is provided through skeletal classroom notes, homework, and continued student/teacher interaction.
3e-Adjustment to pacing and additional examples/and or practice is used as feedback merits.

Differentiation:

- Provide graphic organizers
- Provide multiple concrete examples
- Permit projects to be completed over extended period of time
- Provide lessons via visual presentation (smart board) as well as in notebook formats.
- Provide manipulatives for students to problem solve with.
- Pair stronger students with struggling students for peer assistance
- Use color for visual learners.

Interdisciplinary Connections:

Art- Golden Ratio, Ratios in art.
Technical Drawing- Scale Drawings
Algebra- Solving ratios and proportions.

Additional Resources:

Kahn Academy
Textbook Ancillary Materials

Created By:

Olivia L. Weidemann

Essentials of Geometry / 10-12 / Right Triangles

Subject	Grade	Unit	Suggested Timeline
Mathematics	10/11/12	5- Right Triangles	18 days

Grade Level Units

Unit 1-Discovering Geometry
Unit 2- Reasoning and Proof
Unit 3- Triangle Theorems
Unit 4- Similar Triangles
Unit 5- Right Triangles
Unit 6- Polygons and Quadrilaterals
Unit 7- Coordinate Geometry
Unit 8- Perimeter and Area
Unit 9- Circles
Unit 10- Surface Area and Volume
Unit 11- Transformational Geometry

Unit Title

Right Triangles

Unit Overview

Designing airports, chemical plants, and other high-technology facilities requires a solid understanding of geometric relationships. These relationships are valuable tools that skilled workers use to solve problems and create innovative products. Whether you become an engineer or an artist, it is likely that you will often experience right angle relationships that involve lines and triangles. In this chapter students will learn about right triangles. Students will learn the Pythagorean theorem, and how to apply the Pythagorean theorem. Students will also identify special right triangles and learn how to use trigonometric ratios to solve problems involving right triangles.

Unit Essential Questions

1. How do we estimate and simplify square roots?
2. How do we use the Pythagorean theorem?
3. What are the properties of special right triangles?
4. How do we calculate the tangent ratio in a right triangle?
5. How do we calculate sine and cosine ratios in a right triangle?
6. How do we use the law of sines and cosines to find missing side and angle measures in oblique triangles?

Key Understandings

1. Estimate the square root of a number.
2. Simplify radical expressions.
3. Identify the relationship between the legs and hypotenuse of a right triangle.
4. Use the Pythagorean theorem to solve problems
5. Determine if a set of three number is a Pythagorean triple.
6. Identify the relationships between the lengths to the sides of 45-45-90 and 30-60-90 triangles.
7. Use the properties of special right triangles to solve problems.
8. Calculate the tangent ratio in a right triangle.
9. Use tangents and inverse tangents to solve problems.
10. Calculate the sine ratio in a right triangle.
11. Calculate the cosine ratio in a right triangle.
12. Use sines, cosines, and their inverses to solve problems.
13. Use the law of sines to find missing side and angle measures in oblique triangles.
14. Use the law of cosines to find missing side and angle measures in an oblique triangle.

Focus Standards Addressed in the Unit

CC.2.3.7.A.2	Visualize and represent geometric figures and describe the relationships between them.
CC.HS.G.CO.C.9	Prove theorems about lines and angles.
CC.2.3.HS.A.3	Verify and apply geometric theorems as they relate to geometric figures.

CC.2.2.HS.D.8	Apply inverse operations to solve equations or formulas for a given variable.
CC.2.2.HS.D.9	Use reasoning to solve equations and justify the solution method.
CC.2.2.HS.D.10	Represent, solve, and interpret equations algebraically and graphically.

Important Standards Addressed in the Unit	
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.1.2.1-12.J	Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.
CC.9-12.G.SRT.5	Use congruence and similarity criteria for triangles to solve problems and prove relationships in geometric figures.
C.C.9-12.G.SRT.6	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.
C.C.9-12.G.SRT.8	Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

Misconceptions	**Proper Conceptions**
1. Students misinterpret the word simplify for approximate when working with square roots.	1. Explain the difference between approximating a square root and simplifying a square root. Approximate means to round the number to a decimal. Simplify means to break a radical down in to simplest form by pulling out all square numbers from underneath the square root. Ensure students understand properties of radicals before moving on to the next section.
2. Not being aware of why the variables a, b and c are typically used in the statement of the Pythagorean Theorem.	2. Draw a right triangle, label the vertices with A, B and C to correspond with the labels of the sides (a, b and c) and tell students that this is a common way to label the vertices and side of a right triangle.
3. Thinking the two given values for a right triangle are the legs.	3. Remind students that they can rearrange the formula for the Pythagorean Theorem to solve for either one of the legs. Students should also pay attention to the diagrams and the wording of the problems.
4. Students often do not use the relationship between a^2, b^2 and c^2 correctly when determining if a triangle is right, acute or obtuse.	4. Stress that students should always identify the longest side of a given triangle and identify that as the input for c in the equation. Then students should apply the inequality to determine if it is right, acute or obtuse.
5. Students may think $\sqrt{3}$ is greater than 2 and that the hypotenuse is a multiple of $\sqrt{3}$.	5. Have students use a calculator to find the value of $\sqrt{3}$ and compare it to 2.
6. Not writing answers in simplest radical form.	6. Remind students that all answers in radical form should be simplified.
7. Students tend to make mistakes when trying to identify the two legs of a right triangle by confusing which is the adjacent leg.	7. Stress that students identify the hypotenuse first. The hypotenuse of a right triangle is usually the easiest side to identify in a diagram. Then they should focus on a particular angle in the right triangle and identify the leg opposite that angle. The remaining leg must be the adjacent one, if everything else was identified correctly.
8. When using a calculator to solve trigonometric ratio problems, students have their calculators set to radian mode.	8. Make sure all students calculators are set to degree mod as opposed to radian mode. On most calculators, this is an option under the mode menu.

9. Be sure to explain all abbreviations to students. Don't just assume they will know what "leg opp ∠A" is.	9. Make a list of abbreviations for trigonometric ratios for students to reference so that they get used to the abbreviations. Explain that "opp" is an abbreviation for leg opposite and "adj" is an abbreviation for leg adjacent.
10. Students have difficulty remembering the formulas for sine, cosine and tangent.	10. Teach student tricks and tips for memorizing the formulas. "SOH CAH TOA".
11. Not using the inverse trigonometric functions on their calculator correctly.	11. Students need to practice interpreting and using the inverse trigonometric functions on their calculators. Give students decimal values and a function and ask them to find the angle measure. You should also have them practice using just a trig table.
12. Not checking answers. Students will write answers that do not logically make sense, due to small miscalculations.	12. Stress that students check their answers when solving a right triangle. Use the Triangle Sum Theorem to check that the sum of the measures of the interior angles of a triangle is 180. Use the Pythagorean Theorem to check that the lengths of the sides are correct.

Concepts	Competencies	Vocabulary/Postulates/Theorems
• Square Roots • Pythagorean Theorem • Pythagorean Converse • Trigonometric Ratio • Tangent Ratio • Sine Ratio • Cosine Ratio • Inverse Tangent • Inverse Sine • Inverse Cosine • Law of Sines • Law of Cosines	• Estimate, simplify, add, subtract, multiply and divide with radicals. • Determine the length of the hypotenuse and sides of a right triangle. • Determine if a triangle is right by using the Pythagorean Theorem. Identify is the triangle is right or obtuse, by using side lengths in an inequality. • Use the properties of special right triangles to determine sides and angles of a right triangle. • Determine side lengths of a right triangle using the tangent, cosine and sine trigonometric ratios. • Determine angles of a right triangles by using the inverse tangent, inverse cosine and inverse sine. • Use the law of sines and cosines to find unknown side lengths when you have more than one angle or side of oblique triangles.	Perfect square Radicand Rationalizing the denominator Square root Pythagorean theorem Pythagorean triples Pythagorean theorem converse 45°-45°-90° triangle theorem 30°-60°-90° triangle theorem Angle of inclination Inverse tangent Tangent ratio Trigonometry Sine ratio Cosine ratio Identity Law of Cosines Law of Sines Oblique triangle

Assessments

Homework- Students will be given homework which reinforces classroom concepts. Homework will be evaluated on completeness. Homework is used informally to address student misconceptions, and reteach. Homework is sometimes evaluated formally as a grade.

Class Notebook Checks- Students maintain a formal set of student notes aligned to learning outcomes. They will be evaluated for completeness with level of documentation considered.

Quizzes- Within each unit, competencies will be assessed in smaller chunks as a grade and for the purpose of evaluating student understanding.

Unit Test- Each unit will include a summative written test.

Class Activities- Students will be expected to participate in class activities relating content to real life. Students understanding or concepts or discovery of concepts will be both informally and formally graded based on participation, completion and adequate use of previously learned knowledge.

Suggested Strategies to Support Design of Coherent Instruction

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3d-Daily informal assessments of student understanding is provided through skeletal classroom notes, homework, and continued

student/teacher interaction.
3e-Adjustment to pacing and additional examples/and or practice is used as feedback merits.

Differentiation:

- Provide graphic organizers
- Provide multiple concrete examples
- Permit projects to be completed over extended period of time
- Provide lessons via visual presentation (smart board) as well as in notebook formats.
- Provide manipulatives for students to problem solve with.
- Pair stronger students with struggling students for peer assistance

Interdisciplinary Connections:

Algebra- Simplifying Radicals
Physical Education- Distance on sports fields
Technical Drawing- Architecture, Blueprints, angle of inclination

Additional Resources:

Kahn Academy
Textbook Ancillary Materials

Created By:

Olivia L. Weidemann

Essentials of Geometry / 10-12 / Polygons & Quadrilaterals

Subject	Grade	Unit	Suggested Timeline
Mathematics	10/11/12	6- Polygons & Quadrilaterals	14 days

Grade Level Units
Unit 1-Discovering Geometry
Unit 2- Reasoning and Proof
Unit 3- Triangle Theorems
Unit 4- Similar Triangles
Unit 5- Right Triangles
Unit 6- Polygons and Quadrilaterals
Unit 7- Coordinate Geometry
Unit 8- Perimeter and Area
Unit 9- Circles
Unit 10- Surface Area and Volume
Unit 11- Transformational Geometry

Unit Title
Polygons and Quadrilaterals

Unit Overview
As the demand for modern structures and designs grows, the skills and knowledge of geometric shapes and properties are in ever increasing demand. In this chapter students learn how to identify and define polygons, quadrilaterals, and parallelograms. Student will then use properties to solve problems. Students will also learn about the relationships between the measure of interior and exterior angles of a convex polygons.

Unit Essential Questions	Key Understandings
1. How do we name a polygon? 2. How do we find the sum of the measures of angles of a polygon? 3. What are the properties of quadrilaterals? 4. What are the properties of parallelograms? 5. How do we distinguish the difference between rectangles, squares and rhombi? 6. What are the properties of trapezoids?	1. Classify polygons by the number of sides. 2. Classify polygons as concave or convex, regular or not regular. 3. Name and draw diagonals of a polygon. 4. Find the perimeter of a polygon. 5. Use the Fundamental Counting Principle to Solve Problems 6. Find the sum of the measures of the interior angles of a convex polygon. 7. Find the measure of each interior and exterior angle of a regular polygon. 8. Use the sum of the measures of a convex polygon's exterior angles to solve problems. 9. Classify Quadrilaterals 10. Use the sum of the measure of a quadrilaterals interior angles to solve problems. 11. Use properties of parallelograms to solve problems. 12. Prove a quadrilateral is a parallelogram. 13. Identify the properties of rectangles and use them to solve problems. 14. Use the properties of trapezoids to solve problems. 15. Use the Midsegment Theorems for Trapezoids and Triangles to solve problems.

Focus Standards Addressed in the Unit

CC.2.3.7.A.2	Visualize and represent geometric figures and describe the relationships between them.
CC.2.2.HS.D.8	Apply inverse operations to solve equations or formulas for a given variable.
CC.2.2.HS.D.9	Use reasoning to solve equations and justify the solution method.
CC.2.2.HS.D.10	Represent, solve, and interpret equations algebraically and graphically.

Important Standards Addressed in the Unit	
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.1.2.1-12.J	Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.
CC.9-12.G.CO.11	Prove theorems about parallelograms.
CC.9-12.G.SRT.5	Use congruence and similarity for triangles to solve problems and prove relationships in geometric figures.
CC.9-12.G.MG.1	Use geometric shapes, their measures and their properties to describe objects.

Misconceptions	**Proper Conceptions**
1. Students will sometimes identify a figure as a polygon that does not satisfy the requirements of the definition.	1. Stress that, by definition, a polygon is a closed and the sides must be straight segments. Provide students with examples and non-examples so that they can distinguish the properties of a polygon.
2. Students confuse the polygon interior and exterior angles theorem.	2. Stress that the sum of the measures of the exterior angles of a convex polygon is always 360. However, the sum of the measures of the interior angles of a convex polygon is determined by the number of sides using the expression $(n-2)\cdot 180°$
3. Assuming the diagonals of a parallelogram are congruent.	3. Stress that the diagonals of a parallelogram bisect each other but are not always congruent.
4. When drawing trapezoids, students often draw a general trapezoid that has the general appearance of an isosceles trapezoid.	4. To assist students in avoiding this tendency, make it a point to exaggerate your diagrams when you draw a general trapezoid.
5. Assuming diagonals of all quadrilaterals bisect opposite angles.	5. Only the opposite angles of rhombus are bisected by its diagonals. Draw examples to show when angles are bisected and when they are not bisected.
6. Students will determine the type of quadrilateral base on the appearance of the figure, instead of the given information.	6. Stress that students know the minimum requirements for each quadrilateral. Looks alone are not enough to determine the type of quadrilateral, students must know the properties to know what identify the type of quadrilateral.

Concepts	**Competencies**	**Vocabulary/Postulates/Theorems**
• Polygons • Angles of Polygons • Properties of Quadrilaterals • Properties of Parallelograms • Special Parallelograms • Properties of Trapezoids	• Classify Polygons • Determine the sum of interior and exterior angles for convex polygons. • Determine individual interior and exterior angles for convex polygons. • Classify Quadrilaterals. • Use properties of polygons to solve problems.	Adjacent sides Concave Convex Diagonals Equiangular Equilateral Exterior angle Interior angle Polygon Regular Sides Vertices Polygon Interior Angles Thm Polygon Exterior Angles Thm Consecutive angles Opposite angles Opposite sides

		Parallelogram Quadrilateral Rectangle Rhombus Square Trapezoid Quadrilateral sum theorem House builder's Theorem Rhombus Diagonals Thm. Isosceles Trapezoid Thm. Midsegment Thm for Trapezoids Midsegment Thm for Triangles

Assessments

Homework- Students will be given homework which reinforces classroom concepts. Homework will be evaluated on completeness. Homework is used informally to address student misconceptions, and reteach. Homework is sometimes evaluated formally as a grade.

Class Notebook Checks- Students maintain a formal set of student notes aligned to learning outcomes. They will be evaluated for completeness with level of documentation considered.

Quizzes- Within each unit, competencies will be assessed in smaller chunks as a grade and for the purpose of evaluating student understanding.

Unit Test- Each unit will include a summative written test.

Class Activities- Students will be expected to participate in class activities relating content to real life. Students understanding or concepts or discovery of concepts will be both informally and formally graded based on participation, completion and adequate use of previously learned knowledge.

Suggested Strategies to Support Design of Coherent Instruction

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3e-Adjustment to pacing and additional examples/and or practice is used as feedback merits.

Differentiation:

- Provide graphic organizers
- Provide multiple concrete examples
- Permit projects to be completed over extended period of time
- Provide lessons via visual presentation (smart board) as well as in notebook formats.
- Provide manipulatives for students to problem solve with.
- Pair stronger students with struggling students for peer assistance

Interdisciplinary Connections:

English- Prefixes in names of polygons.
Tech Drawing- Blueprints, shapes, measurement.

Additional Resources:

Kahn Academy
Textbook Ancillary Materials

Created By:

Olivia L. Weidemann

Essentials of Geometry / 10-12 / Coordinate Geometry

Subject	Grade	Unit	Suggested Timeline
Mathematics	10/11/12	7- Coordinate Geometry	16 days

Grade Level Units
Unit 1-Discovering Geometry
Unit 2- Reasoning and Proof
Unit 3- Triangle Theorems
Unit 4- Similar Triangles
Unit 5- Right Triangles
Unit 6- Polygons and Quadrilaterals
Unit 7- Coordinate Geometry
Unit 8- Perimeter and Area
Unit 9- Circles
Unit 10- Surface Area and Volume
Unit 11- Transformational Geometry

Unit Title
Coordinate Geometry

Unit Overview
In this chapter, students will learn how to find distances and midpoints on a coordinate plane. They will then study vectors on a coordinate plane and in 3 dimensions. Students will also learn linear equations and slope to solve problems. Finally students will be introduced to and use coordinate proofs.

Unit Essential Questions
1. How do we find the distance between two points in the coordinate plane?
2. What is the resultant vector and how do we find its magnitude?
3. How do we find the slope of a line?
4. How do we write the equation of a line?
5. How do we write a coordinate proof?
6. How do we find the distance between two points in space?

Key Understandings
1. Use the distance formula to solve problems.
2. Use the midpoint formula to solve problems.
3. Find the terminal point given the initial point and direction of displacement of a vector.
4. Determine the magnitude of a vector
5. Determine the sum of two vectors.
6. Find the slopes of the vectors and lines.
7. Graph a line based on information given in a real world situation and use the line to find additional information.
8. Model real world situations with line graphs.
9. Write the equation of a line given two points on the line or one point on the line and the slope.
10. Write equations of lines that perpendicular and parallel to a given line.
11. Organize corresponding sets of data into a scatter plot and approximate line of best fit.
12. Prove geometric statements using coordinates.
13. Classify a polygon defined by a set of coordinate points.
14. Use coordinate geometry to prove properties of polygons.
15. Draw a 3 dimensional figure using isometric dot paper.
16. Find the distance between two points in space.
17. Find the sum of vectors in space.

Focus Standards Addressed in the Unit

CC.2.3.7.A.2	Visualize and represent geometric figures and describe the relationships between them.

CC.2.2.HS.D.8	Apply inverse operations to solve equations or formulas for a given variable.
CC.2.2.HS.D.9	Use reasoning to solve equations and justify the solution method.
CC.2.2.HS.D.10	Represent, solve, and interpret equations algebraically and graphically.

Important Standards Addressed in the Unit	
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.1.2.1-12.J	Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.
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.*
CC.9-12.G.GPE.5	Prove the slope criteria for parallel and perpendicular lines and use 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.A.CED.2	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.*
CC.9-12.G.GPE.4	Use coordinates to prove simple geometric theorems algebraically

Misconceptions	**Proper Conceptions**
1. When simplifying radical expressions to find the distance using the distance formula, students often forget or ignore the order of operations. 2. Students make errors in calculations when finding the midpoint of a line which results in a point that is not on the point they are finding the midpoint of. 3. Computational errors are frequent when working with the midpoint, distance formula and with vectors. 4. Students should be aware of the properties of equal vectors. 5. Differing opinions on how to solve for slope and write equations. 6. Coordinate proofs do not come as easily to some students because of a lack of algebra skills. Students may struggle with positioning the figure, calculations and reasoning. 7. It is common for students to transpose values for x, y and z when substituting into the distance formula.	1. Review order of operations and properties or radical expressions before using the distance formula. Show students how to input equation into a calculator correctly. 2. Remind students that in order to be a midpoint of a segment, the point must be *on* the segment, just as the average of two number must be between two numbers. A good way to check the solution to a midpoint question is to graph the endpoints and the midpoint and verify that the midpoint is found *on* the segment and *between* the endpoints. 3. Stress caution when working with negative coordinates. In addition the concept of vectors deals with both magnitude and direction make sure students use the correct values to correspond with *x1,x2, y1* and *y2*. If coordinates are interchanged the direction of the vector will change. 4. Stress that equal vectors must have the same magnitude and direction. The need not, however have the same initial and terminal points. If the topic of parallel vectors comes up, note that vectors can be parallel without having the same magnitude and direction. 5. Since students may be coming from varying levels of Algebra, or perhaps geometry, they may have multiple ways to solve a problem. Suggest students brainstorm on how to solve a problem before attacking it. 6. Stress organization and a plan of action before beginning the formal part of the proof. It is important not to assume anything but what you are given. Students should use the origin and x- and y- axes when placing a figure in a coordinate plane for a proof. 7. Encourage students to label each number in both ordered pairs with an x, y or z to minimize errors.

Concepts	**Competencies**	**Vocabulary/Postulates/Theorems**
• Distance vs. Displacement • Magnitude and sum of vectors • Slope	• Determine the distance on a coordinate plane • Use vectors in a coordinate plane • Graph lines in a coordinate plane • Model world situations using	• Distance Formula • Midpoint • Midpoint Formula • Components • Displacement Vector

• Linear Equations • Coordinates in Space	equations of lines. • Write a coordinate proof. • Draw three-dimensional figures.	• Equal Vectors • Initial Point • Magnitude of a Vector • Resultant Vector • Terminal Point • Vector • Slope • Slope Formula • Line of best fit • Point-Slope Formula • Scatter plot • Slope-Intercept form • Coordinate Proofs

Assessments

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3b-Using questioning and discussion techniques.
3c-Instructonal materials and class activities engage students in learning.
3d-Daily informal assessments of student understanding is provided through skeletal classroom notes, homework, and continued student/teacher interaction.
3e-Adjustment to pacing and additional examples/and or practice is used as feedback merits.

Differentiation:

- Provide graphic organizers
- Provide multiple concrete examples
- Permit projects to be completed over extended period of time
- Provide lessons via visual presentation (smart board) as well as in notebook formats.
- Provide manipulatives for students to problem solve with.
- Pair stronger students with struggling students for peer assistance

Interdisciplinary Connections:

Algebra- Slope and equations of lines.
Business- Scatter plots and graphs using income, and profit.

Additional Resources:

Kahn Academy, Textbook Ancillary Materials

Created By:

Olivia L. Weidemann

Subject	Grade	Unit	Suggested Timeline
Mathematics	10/11/12	8- Perimeter and Area	14 days

Grade Level Units
Unit 1-Discovering Geometry
Unit 2- Reasoning and Proof
Unit 3- Triangle Theorems
Unit 4- Similar Triangles
Unit 5- Right Triangles
Unit 6- Polygons and Quadrilaterals
Unit 7- Coordinate Geometry
Unit 8- Perimeter and Area
Unit 9- Circles
Unit 10- Surface Area and Volume
Unit 11- Transformational Geometry

Unit Title
Perimeter and Area

Unit Overview
In this chapter students learn how to solve problems involving areas of polygons and circles. They will learn to find the area of a sector of a circle and solve problems involving the circumference and area of circles. Finally, students will use geometric properties to find the probability of an event.

Unit Essential Questions	Key Understandings
1. How do we find the area of polygons? 2. How do we find the area of circles? 3. How do we use the proportions of areas in similar figures?	1. Find the areas of squares, rectangles, and irregular figures 2. Model multiplication using area. 3. Find areas of trapezoids 4. Find circumference and area of circles. 5. Determine the relationship of areas of similar figures.

Focus Standards Addressed in the Unit

CC.2.3.7.A.2	Visualize and represent geometric figures and describe the relationships between them.
C.C.2.3.HS.A.14	Apply geometric concepts to model and solve real world problems.
C.C.2.5.G.A	Develop a plan to analyze a problem, identify the information needed to solve the problem, carry out the plan, check whether the answer makes sense, and explain how the problem was solved in grade appropriate contexts.

Important Standards Addressed in the Unit

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.1.2.1-12.J	Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.
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.
CC.2.3.HS.G.2.2.2	Use and/or develop procedures to determine or describe measures of perimeter, circumference, and/or area.

Misconceptions	Proper Conceptions
1. When working with area formulas that contain *12* such as $\frac{1}{2}bh$ students may incorrectly use the factor twice.	1. To assist the students in avoiding such error, write the formula in words. The area of the triangle is one-half the product of the base *b* and height h. Refer students to the formula sheet created for essentials of geometry.
2. When working with the diagram of a parallelogram in which the students measure the side adjacent to the base is also known, students may mistakenly use the measure of the adjacent side in the area formula.	2. Draw a picture to show students which are the proper pieces of the parallelogram to substitute in the area equation. Stress that it is the base and height.
3. Students assume there is a limited number of altitudes in a trapezoid because of previous knowledge of altitudes in triangles.	3. Since, by definition the altitude of a triangle is the segment from the vertex of a triangle to the opposite side that measures height, there are three altitudes in a triangle. Emphasize that the altitude of a trapezoid refers to any segment from one base perpendicular to the other base. There is no limit to the number of such segments that can be drawn. The length of each segment is the height of the trapezoid.
4. Students think and base and height are different than length and width.	4. It is important to explain to students that base and height are often used more than length and width. Show students how they compare and what happens when you interchange the length and width.
5. Students may be asked to calculate areas of irregular figures.	5. Show students how to divide irregular shapes to find the area. Use the area addition property and blueprints to engage students.

Concepts	Competencies	Vocabulary/Postulates/ Theorems
• Area • Perimeter • Solid Geometry • Physical properties	• Determine the area of basic shapes, and connect this to more complex shapes. • Find the perimeter of basic shapes. • Write functions as full sentences, to understand meaning of equations.	Area Altitude Base Apothem Center Central Angle Radius Chord Circle Circumference Diameter Scale Factor

Assessments

Homework- Students will be given homework which reinforces classroom concepts. Homework will be evaluated on completeness. Homework is used informally to address student misconceptions, and reteach. Homework is sometimes evaluated formally as a grade.

Class Notebook Checks- Students maintain a formal set of student notes aligned to learning outcomes. They will be evaluated for completeness with level of documentation considered.

Quizzes- Within each unit, competencies will be assessed in smaller chunks as a grade and for the purpose of evaluating student understanding.

Unit Test- Each unit will include a summative written test.

Class Activities- Students will be expected to participate in class activities relating content to real life. Students understanding or concepts or discovery of concepts will be both informally and formally graded based on participation, completion and adequate use of previously learned knowledge.

Suggested Strategies to Support Design of Coherent Instruction

Charlotte Danielson's Framework for Teaching: Domain 3 Instruction

3a- Student assignment sheets communicate expectations for learning.
3b-Using questioning and discussion techniques.
3c-Instructonal materials and class activities engage students in learning. Use real world objects to calculate area, and perimeter.
3d-Daily informal assessments of student understanding is provided through skeletal classroom notes, homework, and continued

student/teacher interaction.
3e-Adjustment to pacing and additional examples/and or practice is used as feedback merits.

Differentiation:

- Provide graphic organizers.
- Provide multiple concrete examples.
- Permit projects to be completed over extended period of time.
- Provide lessons via visual presentation (smart board) as well as in notebook formats.
- Provide manipulatives for students to problem solve with.
- Pair stronger students with struggling students for peer assistance

Interdisciplinary Connections:

Additional Resources:
Kahn Academy
Textbook Ancillary Materials

Created By:
Olivia L. Weidemann

Subject	Grade	Unit	Suggested Timeline
Mathematics	10/11/12	9-Circles	17 days

Grade Level Units

Unit 1-Discovering Geometry
Unit 2- Reasoning and Proof
Unit 3- Triangle Theorems
Unit 4- Similar Triangles
Unit 5- Right Triangles
Unit 6- Polygons and Quadrilaterals
Unit 7- Coordinate Geometry
Unit 8- Perimeter and Area
Unit 9- Circles
Unit 10- Surface Area and Volume
Unit 11- Transformational Geometry

Unit Title

Circles

Unit Overview

The geometric properties of circles are important tools in many high-technology workplaces. Skilled workers use properties of circles to store data on compact disks, design automotive break systems and tires, and plumbers use properties of circles to determine how to fit pipes together in structural foundations. In this chapter, students will learn how to write and solve equations of a circle. They will also learn about the properties of circles, and use the relationships found in circles to solve problems.

Unit Essential Questions

1. How do we write the equation of a circle in the coordinate plane?
2. How do we find the length of tangent lines to a circle?
3. How do we find the measure of arc length?
4. How do we find the measures of tangent and secant lines?
5. How do we find the measures of angles formed by chords, tangents and secants?

Key Understandings

1. Write the equations of a circle.
2. Use equations of circles to solve problems.
3. Write the equation of a line tangent to a circle.
4. Use properties of tangents to solve a problem.
5. Use the tangents segments theorems to solve a problems.
6. Determine the relationship between the measure of a central angle and the measure of its intercepted arc.
7. Create a circle graph.
8. Use properties of chords to solve problems.
9. Find the length of an arc given the central angle and radius of a circle.
10. Determine the relationship between the measure of an inscribed angle and the measure of its intercepted arc.
11. Use properties of inscribed angles to solve problems.
12. Find the areas of inscribed polygons and the circles that circumscribe them.
13. Use the intersecting Chords Angle Theorem to solve problems.
14. Use the Angle Theorems for Tangents and Secants to solve problems.
15. Describe the locus of a given condition or set of conditions.
16. Write the equation of a sphere given the center and radius of the sphere.
17. Use the equation of a sphere to solve problems.

Focus Standards Addressed in the Unit

CC.2.3.7.A.2	Visualize and represent geometric figures and describe the relationships between them.
C.C.2.3.HS.A.14	Apply geometric concepts to model and solve real world problems.

C.C.2.5.G.A	Develop a plan to analyze a problem, identify the information needed to solve the problem, carry out the plan, check whether the answer makes sense, and explain how the problem was solved in grade appropriate contexts.

Important Standards Addressed in the Unit	
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.1.2.1-12.J	Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.
CC. G.1.1.1	Identify and/or use parts of circles and segments associated with circles, spheres, and cylinders
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.

Misconceptions	**Proper Conceptions**
1. Forgetting the equation for a circle subtracts h and k. 2. Since an arc is part of a circle, students may think an arc should be measures as a length, as a fraction of the circumference of the circle. 3. Students will assume arcs are congruent because they have the same measure. 4. Prior to analyzing or performing calculations, students might guess the lengths of segments, arcs or angles. 5. Students may become visually confused when looking at many segments in a circle at one time. 6. Students forget key information about the sum of the measures of the interior angles of triangle and quadrilaterals. 7. Students fail to apply prior knowledge about right triangles, angles, and lines to properties pertaining to chords of circles. 8. Assuming any angle in a circle is an inscribed angle. 9. Students will confuse the Inscribed Angle Theorem and the measure of an arc of a central angle.	1. Stress that the equation of a circle subtracts the values of h and k. Practice writing the standard form of the equation and substituting several values of *(h, k)*. This equation is also on the course formula sheet. 2. Be sure to define an arc as a central angle, its measure does not depend on the size (radius) of the circle. Draw an example with three concentric circles, and one common central angle for all three. Show that they have the same measure. The distance along the circle defined by an arc is arc length. Arc lengths are different then measures of an arc. 3. Remind students that congruent arcs must have the same measure and be on the same circle or congruent circles. 4. Remind students of the dangers of using the appearance of a diagram to make assumptions about the measurements in a geometric diagram. 5. Have students focus on one angle at a time and identify the type of angle and intercepted arc. 6. Review information about the sum of the measures of interior angles of triangles and quadrilaterals before discussing inscribed polygons. 7. Remind students that when drawing a perpendicular bisector to a chord, the Pythagorean theorem and right angle theorems can be used to solve for unknown values. Drawing visuals helps. 8. For an angle to be inscribed, two conditions must exist: (1) The vertex must be on the circle, and (2) sides of the angles must be chords of the circle. 9. The following two statements will help students to clarify the relationship between these two important properties of circles. (a) An inscribed angle in a circle will cut out an arc in the circle that is twice the size of an inscribed angle. For example, if an inscribed angle has a degree of 40°, it will cut an arc of 80° in the circle. (b) If an inscribed angle and a central angle cut out the same arc in a circle, then the central angle will be twice as large as the inscribed angle.

Concepts	**Competencies**	**Vocabulary/Postulates/Theorems**
• Equations of Circles • Properties of Circles • Angles in Circles • Segments in Circles	• Write equations of circles • Determine tangents and secants of circles • Find the length of chords, and arc length in circles • Determine the measure of central angles, and inscribed angles.	• Concentric circles • Congruent circles • Equation of a circle • Circumscribed about • Inscribed in • Point of tangency • Tangent

		• Tangent segment • Adjacent • Arc • Central angle • Major arc • Minor arc • Semicircle • Inscribed angles • Intercepted arc • Secant • Circle • Locus • Sphere

Assessments

Homework- Students will be given homework which reinforces classroom concepts. Homework will be evaluated on completeness. Homework is used informally to address student misconceptions, and reteach. Homework is sometimes evaluated formally as a grade.

Class Notebook Checks- Students maintain a formal set of student notes aligned to learning outcomes. They will be evaluated for completeness with level of documentation considered.

Quizzes- Within each unit, competencies will be assessed in smaller chunks as a grade and for the purpose of evaluating student understanding.

Unit Test- Each unit will include a summative written test.

Class Activities- Students will be expected to participate in class activities relating content to real life. Students understanding or concepts or discovery of concepts will be both informally and formally graded based on participation, completion and adequate use of previously learned knowledge.

Suggested Strategies to Support Design of Coherent Instruction

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3a- Student assignment sheets communicate expectations for learning.
3b-Using questioning and discussion techniques.
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3e-Adjustment to pacing and additional examples/and or practice is used as feedback merits.

Differentiation:

- Provide graphic organizers
- Provide multiple concrete examples
- Permit projects to be completed over extended period of time
- Provide lessons via visual presentation (smart board) as well as in notebook formats.
- Provide manipulatives for students to problem solve with.
- Pair stronger students with struggling students for peer assistance

Interdisciplinary Connections:

Algebra- Equation of a circle.

Additional Resources:

Kahn Academy
Textbook Ancillary Materials

Created By:

Olivia L. Weidemann

Essentials of Geometry / 10-12 / Surface Area & Volume

Subject	Grade	Unit	Suggested Timeline
Mathematics	10/11/12	10 Surface Area & Volume	20 days

Grade Level Units
Unit 1-Discovering Geometry
Unit 2- Reasoning and Proof
Unit 3- Triangle Theorems
Unit 4- Similar Triangles
Unit 5- Right Triangles
Unit 6- Polygons and Quadrilaterals
Unit 7- Coordinate Geometry
Unit 8- Perimeter and Area
Unit 9- Circles
Unit 10- Surface Area and Volume
Unit 11- Transformational Geometry

Unit Title
Surface Area and Volume

Unit Overview
People who understand and can apply the properties of three-dimensional figures are highly valued in today's workplace. Skilled workers in many industries-including automotive, energy, pharmaceutical, and biotechnology- use area and volume formulas to create innovative products. This chapter explores surface area and volume of three-dimensional objects. Students will learn how to draw orthographic, isometric, and perspective drawings. They will also learn to solve problems involving surface area and volume of solids.

Unit Essential Questions
1. How do we draw orthographic projections and isometric drawings of three-dimensional objects??
2. How do we find the surface areas and volumes of prisms and cylinders?
3. How do we find the lateral areas and surface areas of pyramids and cones?
4. How do we find the volume of pyramids and cones?
5. How do we find the surface area and volume of spheres?
6. How do we describe the cross section of solids?

Key Understandings
1. Draw top, side, and front orthographic projections of a three dimensional object.
2. Create an isometric drawing of a three dimensional object.
3. Draw a three-dimensional object using one- and two-point perspective.
4. Find surface areas of prisms and cylinders.
5. Find volumes of prisms and cylinders.
6. Find lateral areas and surface areas of pyramids.
7. Find lateral areas and surface areas of cones.
8. Find volumes of pyramids.
9. Find volumes of cones.
10. Find surface areas and volumes of spheres.
11. Determine the relationship of volumes and similar solids.
12. Describe cross sections of solids.

Focus Standards Addressed in the Unit

CC.2.3.7.A.2	Visualize and represent geometric figures and describe the relationships between them.
C.C.2.3.HS.A.14	Apply geometric concepts to model and solve real world problems.
C.C.2.5.G.A	Develop a plan to analyze a problem, identify the information needed to solve the problem, carry out the plan, check whether the answer makes sense, and explain how the problem was solved in grade appropriate contexts.

Important Standards Addressed in the Unit

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.1.2.1-12.J	Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.
CC.9-12.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.)
CC.9-12.G.2.3.2	Describe how a change in one dimension of a three- dimensional figure affects other measurements of that figure
CC.2.3.8.A.1.	Apply the concepts of volume of cylinders, cones, and spheres to solve real-world and mathematical problems
CC.2.3.HS.A.12	Explain volume formulas and use them to solve problems.

Misconceptions

1. Students often leave off units of measure or possibly use square units instead of cubic units.

2. Students tend to think the volume of a pyramid or cone is one half the volume of the related prism or cylinder.
3. Students confuse slant height with pyramid or cone height.
4. Students will use the radius squared rather than the radius cubed when finding the volume.
5. When determining if two solids are similar students forget to express the scale factor or ratio in simplest form.

Proper Conceptions

1. Remind students to write units of measure and that all measurements should be in the same units. Stress that area is in square units and volume is cubic units.
2. Remind students that both pyramid and cone use *13* not *12*.
3. Remind students that slant height is the height of the lateral surface, not the height of the solid.
4. Remind students that the radius is cubed to find volume. Refer students to the formula sheet.
5. Remind students that expressing the scale factor in simplest form will make calculations involving surface area ration and volume ratio easier.

Concepts

- Perspective Drawing
- Volume
- Lateral Area
- Surface Area
- Similar Solids
- Cross Sections

Competencies

- Draw orthographic projections, and perspective drawings.
- Determine the lateral area of solids
- Determine the surface area of solids
- Determine the volume of various solids.
- Determine if two solids are similar

Vocabulary/Postulates/Theorems

- Isometric drawings
- Orthographic projections
- One-point perspective
- Perspective drawing
- Two-point perspective
- Vanishing point
- Bases
- Cylinder
- Height
- Lateral area
- Lateral faces
- Net
- Polyhedron
- Prism
- Right prism
- Surface area
- Volume
- Cone
- Pyramid
- Right cone
- Right regular pyramid
- Slant height
- Tetrahedron
- Sphere
- Conic sections
- Cross sections
- Ellipse
- Great circle

Assessments

Homework- Students will be given homework which reinforces classroom concepts. Homework will be evaluated on completeness. Homework is used informally to address student misconceptions, and reteach. Homework is sometimes evaluated formally as a grade.

Class Notebook Checks- Students maintain a formal set of student notes aligned to learning outcomes. They will be evaluated for completeness with level of documentation considered.
Quizzes- Within each unit, competencies will be assessed in smaller chunks as a grade and for the purpose of evaluating student understanding.
Unit Test- Each unit will include a summative written test.
Class Activities- Students will be expected to participate in class activities relating content to real life. Students understanding or concepts or discovery of concepts will be both informally and formally graded based on participation, completion and adequate use of previously learned knowledge.

Suggested Strategies to Support Design of Coherent Instruction

Charlotte Danielson's Framework for Teaching: Domain 3 Instruction

3a- Student assignment sheets communicate expectations for learning.
3b-Using questioning and discussion techniques.
3c-Instructonal materials and class activities engage students in learning. Highlighting when working with conditional statements to differentiate pieces of conditional statements.
3d-Daily informal assessments of student understanding is provided through skeletal classroom notes, homework, and continued student/teacher interaction.
3e-Adjustment to pacing and additional examples/and or practice is used as feedback merits.

Differentiation:

- Provide graphic organizers
- Provide multiple concrete examples
- Permit projects to be completed over extended period of time
- Provide lessons via visual presentation (smart board) as well as in notebook formats.
- Provide manipulatives for students to problem solve with.
- Pair stronger students with struggling students for peer assistance

Interdisciplinary Connections:

Art- Perspective drawings
Tech Drawing- 3 dimensional figures, blueprints,

Additional Resources:

Kahn Academy
Textbook Ancillary Materials

Created By:

Olivia L. Weidemann

Essentials of Geometry / 10-12 / Transformational Geometry

Subject	Grade	Unit	Suggested Timeline
Mathematics	10/11/12	11- Transformational Geometry	19 days

Grade Level Units
Unit 1-Discovering Geometry
Unit 2- Reasoning and Proof
Unit 3- Triangle Theorems
Unit 4- Similar Triangles
Unit 5- Right Triangles
Unit 6- Polygons and Quadrilaterals
Unit 7- Coordinate Geometry
Unit 8- Perimeter and Area
Unit 9- Circles
Unit 10- Surface Area and Volume
Unit 11- Transformational Geometry

Unit Title
Transformational Geometry

Unit Overview
Computer Aided Design (CAD) has revolutionized manufacturing worldwide. The heart of CAD is the software that performs complex transformations, changing the position, orientation or size of geometric shapes. Designers and manufacturers must have a thorough understanding of how to apply these transformations. Studying the concepts in this chapter will well equip students for fields in architecture, design, engineering, landscape and construction. In this chapter, students will learn properties of transformation to map pre-images to images. Students will also use coordinate geometry to transform shapes, perform compositions of transformations and dilations of shapes.

Unit Essential Questions
1. How do we reflect a figure in the coordinate plane?
2. How do we translate a figure in the coordinate plane?
3. How do we rotate a figure given an angle of rotation and center point?
4. How do we draw compositions of transformations?
5. How do we perform tessellations in a plane?
6. How do we dilate a figure given a scale factor and center of dilation?

Key Understandings
1. Draw the reflection of a figure over a given line of reflection.
2. Determine if a figure is a reflection of another.
3. Identify the lines of symmetry of a figure.
4. Use reflections to solve problems.
5. Draw the translation of a figure given a translation vector.
6. Determine if a figure is a translation of another.
7. Solve problems using double reflection theorem for translations.
8. Draw the rotation of a figure given the angle of rotation and center of rotation.
9. Determine if a figure is a rotation of another.
10. Identify the order of rotational symmetry of a figure.
11. Solve problems using the double reflection theorem for rotations.
12. Draw compositions given a series of transformations.
13. Describe the series of transformations that form a composition.
14. Chart reflections, translations, and rotations on the coordinate axes.
15. Discover which regular polygons tessellate a plane.
16. Tessellate a plane with polygonal or non-polygonal shapes.
17. Draw the dilation of a figure given a scale factor and a center of dilation.
18. Find the center of dilation and the scale factor or a dilation.
19. Chart a dilation on the coordinate axes.

Focus Standards Addressed in the Unit

CC.2.3.7.A.2	Visualize and represent geometric figures and describe the relationships between them.

Important Standards Addressed in the Unit	
CC.G.1.31	Use properties of congruence, correspondence and similarity in problem solving settings involving two- and three-dimensional figures
CC.HS.2.9.G.B	Use arguments based on transformations to establish congruence or similarity of 2-dimensional shapes.
CC.9-12.G.CO.3 9-6	Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
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

Misconceptions	Proper Conceptions
1. Students often confuse vectors and rays, particularly since their drawings may look identical.	1. Vectors are distinguished by both direction and magnitude. In contrast, a ray has only direction. So vectors are not rays because vectors have a fixed length, while rays go on without end. Although vectors can be named by two upper case letters, it is more common to name a vector with a single lower case letter. Notation for a ray contains a full arrowhead, while notation for a vector contains a partial arrowhead.
2. When reflecting about the y-axis, students may reflect the figure in the wrong axis. This occurs because when they reflect a figure in the line $y = a$, they reflect the figure vertically. So, when they have to reflect in the y-axis, they may accidentally reflect the figure in the x-axis. The same could happen when reflecting in the x-axis	2. Practice reflecting over both the x-axis and y-axis. Also present the difference between reflecting over a line $y=$ and $x=$.
3. Students think that the Preimage of a rotation must have positive coordinates	3. Remind students that in the coordinate plane rules for rotations about the origin, the coordinate of the point (a, b) that is to be rotated can be positive, negative or zero.
4. Students do not match up corresponding sides.	4. Remind students to make sure that they are using the corresponding sides that have the same length and not the sides that are both on the left, or both on the top, etc.
5. When performing a composition of transformations, students may perform one or both transformations incorrectly.	5. Have students check their work after performing each transformation before performing the next transformation. This will help ensure that each transformation is correct.
6. When finding a scale factor for a problem that gives the preimage and the image, be sure to always put the image side length as the numerator. Do not place the larger side length as the numerator. Also, always compare corresponding sides of figures.	6. The properties of a dilation indicate that the scale factor k should not equal 1. Be prepared for students to ask what would happen if k did equal 1. Any point P would map onto itself when k 5 1. The resulting dilation image would simply be the same as the preimage. You should be aware that a dilation with a scale factor of 1 is an example of an identity transformation, which is not covered in this course, but may be encountered in future studies of mathematics

Concepts	Competencies	Vocabulary/Postulates/Theorems
• Reflection • Rotation • Translation • Tessellation • Dilation • Composition of Transformations	• Reflect figures over lines in coordinate plane. • Translate figures on the coordinate plane. • Rotate a figure given an angle of rotation and center of rotation. • Draw tessellations of images. • Identify and draw compositions of transformations. • Dilate an image given a center of dilation.	• Image • Invariant • Isometry • Line of reflection • Line of symmetry • Reflection • Reflectional symmetry • Transformation • Translation • Translation vector • Angle of rotation • Center of rotation • Double reflection • Order of symmetry • Point symmetry • Rotation • Rotational symmetry

		• Composition • Glide reflection • Tessellation • Regular tessellations • Semi regular tessellations • Tessellation vertex • Center of dilation • dilation

Assessments

Homework- Students will be given homework which reinforces classroom concepts. Homework will be evaluated on completeness. Homework is used informally to address student misconceptions, and reteach. Homework is sometimes evaluated formally as a grade.

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- Provide manipulatives for students to problem solve with.
- Pair stronger students with struggling students for peer assistance

Interdisciplinary Connections:

Art- Transformations of images, tessellations
Science- Vectors in physics, and biology
History- History of the first computer graphic system

Additional Resources:

Kahn Academy
Textbook Ancillary Materials

Created By:

Olivia L. Weidemann