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Unit Plan

EDC 292B

Ms. Slaine

Content Area: Geometry

Grade Level: High School Course

**Unifying Concepts: Transformation, Congruence, Proof and Constructions**

**Grade Level Expectations**

CO.A.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.

CO.A.2

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

CO.A.3

Given a rectangle, parallelogram, trapezoid, or regular polygons, describe the rotations and reflections that carry it onto itself.

CO.A.4

Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.

CO.A.5

Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.

CO.B.6

Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.

CO.B.7

Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.

CO.B.8

Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.

CO.C.9

Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment’s endpoints.

CO.C.10

Prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.

CO.C.11

Prove theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.

Mathematically proficient students:

SMP 3. Construct viable arguments and critique

the reasoning of others.

SMP 4. Model with mathematics.

SMP 5. Use appropriate tools strategically.

SMP 6. Attend to precision.

**21st Century Skills Critical Thinking and Reasoning**

Thinking Deeply, Thinking Differently, Information Literacy

**Mathematical Practices**

1. Make sense of problems and persevere in solving them.

2. Reason abstractly and quantitatively.

3. Construct viable arguments and critique the reasoning of others.

4. Model with mathematics.

5. Use appropriate tools strategically.

6. Attend to precision.

7. Look for and make use of structure.

8. Look for and express regularity in repeated reasoning.

**Unit Title: Transformation, Congruence, Proof and Constructions**

Focus: Measurement and Transformation of Geometric Figures, Congruency and Proof Concepts provides a foundation for analytical and physical problem solving in the real world.

**Inquiry Questions**

How can we transform geometric figures?

How do we know if geometric figures are the same?

How can we prove geometric figure are congruent?

**Unit Strands**

Transformations: Rotations, Reflections, Translations, Dilation

Congruency: Triangles, Parallelogram,

Proof: Lines, Angles, Triangles, Parallelogram

**Generalizations**

My students will understand the relationship between Transformations, Congruency and Proof.

My students will learn to draw and measure different polygons.

My students will the nature of a geometric proof and be able to give statements and reasons in a proof.

**Questions**

1. How do define basic geometric terms?
2. How do we distinguish between translation, rotation and reflection?
3. How do we carry one geometric figure onto itself?
4. How do we define congruency?
5. How do we use sides and angles of figures to prove congruency?
6. Why use line and angle theorems to deduce measurements and make measurements?
7. What is a geometric model?
8. How can we use basic geometric formulas to solve beginning and advanced problems?

**Key Knowledge and Skills**

1. Transformations in the Coordinate Plane requires the use of the distance formula and the skill of graphing and using technical definitions of point, line and related figures to transform figures.
2. Congruency requires the ability to draw figures of the same shape and size and the ability to identify mathematical expressions for congruency.
3. Proof requires the ability to memorize statements and reasons in a logical order.

**Vocabulary**

AAS (angle-angle-side congruence)—triangle proof reason

Acute triangle—angles less than 90

alternate exterior angles—opposite sides exterior to parallel lines

angle—basic unit

angle of rotation—number up to 360

arc— part of a circle

ASA (angle-side-angle)—triangle proof reason

base—part of a polygon

base angles—angles near the base of a figure

bisect—cut in two

bisector—cut in two

center of rotation—fixed point

circle—figure with same radius, area

circumcenter

circumference—perimeter of a circle

dilation—non isometric transformation; growing or shrinking

distance— from point A to point B

end point—ray or segment

equiangular—same angles

equiangular triangle—triangle with same angles

equidistant—same distance

equilateral—same side length

equilateral triangle—same sides and angles

expansion—grow; get larger

exterior angle; on the outside

horizontal stretch—dilation in horizontal direction

hypotenuse—opposite 90 degree angle

image—of

incenter

initial point—starting point

input

midpoint; middle point between points

midsegment—middle segment between two segments

non-rigid transformation—does not preserve length and angle

obtuse triangle—angle greater than 90

orthocenter

output—transformed input

parallel lines—lines that never intersect

parallelogram

perpendicular

perpendicular lines

plane

point

point of symmetry

pre-image

quadrilateral

radius

rigid motion

rigid transformation

rotation

rotational symmetry

rotations

same-side interior angles

SAS (side-angle-side)

**Unit Description**

This unit focuses on transformations, congruency, proof and measurement in Geometry. Students explore various types of constructions and calculations that allow them to identify different types of geometric figures and the relationships between those figures. As they explore these different types of figures, they are motivated to solve measurement problems using algebraic and drawing techniques.

**Performance Assessment:** The summative assessment for this unit. Students will be able to answer the following questions:

Define angles, circles, parallel lines and line segments?

What is the difference between a rigid transformation and a non

-rigid transformation?

What transformations are isometries?

How is symmetry defined?

Can a figure have more than one type of symmetry?

How do you draw the image of a figure under a reflection,

rotation, and translation?

What mathematical definitions do we use to rotate, reflect, and/or translate so

that we can transform figures?

What sequence of transformations will carry a figure onto another?

How can congruence be represented through the

transformations of figures?

What is required to show that two triangles are congruent?

What can we conclude about two triangles that are congruent?

How do triangle congruence criteria follow from the rigid motion definition of

congruence?

What relationships between angles formed by intersections of lines are always

true?

What is true about the endpoints of a segment and its perpendicular bisector?

What relationships among angles, sides, and other segments in a triangle are

always true?

 **Differentiation: Multiple Modes for Student Expression**

1. Students can express their interpretations by verbally explaining the steps they used to complete transformation, congruency and proof problems involving line, angle, triangle and parallelogram formulas and theorems.
2. Students can work in collaborative groups on geometric problems building on each other’s strengths to solve problems and can present those problems in a presentation, poster, or explanation in class
3. Students can use a graphing calculator to graph and obtain solutions.
4. Students can extend geometric analysis to solve geometric problems in a table format.
5. Students can interpret mathematical solutions using everyday English vocabulary and can write down their interpretations.

**Ongoing Specific Learning Experiences**

1. Students can express geometric solutions mathematically and can critique the reasoning and steps of others by providing a justification for a solution through a series of logical steps using reasons and statements.
2. Students can engage in the practice of mathematical modeling to express the solution to real world problems by mapping figures through transformations onto other figures and interpreting the sequence of transformations on the coordinate plane.
3. Students are fluent with translating between different types of polygons and know the basic features of different types of figures.

**Anticipatory Set/Prior Knowledge and Experiences**

Students have studied Algebra I and know how to graph functions and make a chart of points on the coordinate plane. This ability to create a table of values and then graph a function will serve as a building block for manipulating and solving a wide variety of geometric problems.

**Learning Experience #1**

Baking a recipe calls for different measurements based on the number of guests expected. A recipe calls for flour and serves 8. Students can estimate the amount of flour needed depending on the number of expected guests and can then make a table and graph on the coordinate plane showing the relationship between guests and flour.

Assessment: Students mastering the concept and skills of this lesson will be able to answer questions such as:

Students will be able to estimate the difference in cups of flour needed between two recipes, one smaller and the second larger.

What does the formula relating flour to guests show about the nature of algebraic equations and graphs?

Differentiation: Teacher provides the steps to derive answers using a two column format; Teacher models how to use the graphing calculator and input guests and flour data; Teacher models how to create a graph and title based on the chart.

Extensions: Students can view videos on baking.

Saxon, p.52.

**Learning Experience #2**

Taylor finds a piece of property in which the hypotenuse is 20m longer than the longer leg. The shorter leg is 10 m shorter than twice the length of the shorter leg. What is the area of the property?

Students can estimate what the dimensions need to be to determine the area. They can make a chart showing length, width and area and can use a graphing calculator to determine the shape of the area function and different sizes of yard.

Assessment: Students mastering the concept and skills of this lesson will be able to answer questions such as:

When does the area reach a maximum based on the dimensions?

What are the reasons for measuring side lengths?

Differentiation: Teacher provides the steps to derive the area using Algebra; Teacher models how to use the graphing calculator to plot the area as a function of base and height; Teacher models how to create a chart of values to plot so that students can solve problems using algebraic manipulation and a graphing calculator.

Extensions: Students can view videos on property.

https://www.youtube.com/watch?v=LAnrHu-wjm8

**Learning Experience #3**

I will identify different positions of the clock hands that represent different times. The teacher can relate angles of a clock hands to different times so that students can see the full gamut of angles that can be made in a circle ranging from 0 to 360.

Students can master the different angles in relation to different positions and can determine the frequency of angles occurring in a 24 hour period.

Assessment: Students mastering the concept and skills of this lesson will be able to answer questions such as:

What is the angle of the hands when school ends?

What is the angle of the hands when school begins?

How are important events that happen daily related to different angles?

Differentiation: Teacher provides the steps to derive answers using Algebra; Teacher models how to relate different angles to different events; Teacher uses a calculator to show different solutions.

Extensions: Students can view videos on time in different solar systems.

Reference: Personal Example from Classroom

Learning Experience #4

I will identify different congruency shortcuts including side-angle-side, hypotenuse-leg, side-side-side, angle-angle-side. I will then have students draw different triangles with a compass and straight edge representing congruent triangles for each of the different shortcuts.

Students can master the different shortcuts by measuring each of the angles and each of the sides with identical angle and side measurements. They can then superimpose one congruent triangle on another using patty paper.

Assessment: Students mastering the concept and skills of this lesson will be able to answer questions such as:

What is the length of the side and measure of the angles in the first pair of congruent triangles?

Which shortcut did you use to make this pair of congruent triangles?

How are triangles used in the construction business?

Differentiation: Teacher provides the steps to derive answers using shortcuts; Teacher models how to relate different triangles to different shortcuts; Teacher has students make posters.

Extensions: Students can view videos on construction.

Reference: Holt-McDougal Section 4.4 https://www.youtube.com/watch?v=0Pey40FefGw

References

Colorado Department of Education. *Teacher Instructional Unit Samples. Algebra II Unit Title: Logarithmic Log Jams (Lake County School District)*Retrieved from: <https://www.cde.state.co.us/standardsandinstruction/instructionalunits-math>

Holt McDougal Geometry. Retrieved from: <http://www.doe.in.gov/sites/default/files/curriculum/holtgeo1.pdf>

Saxon Geometry. 2009. *Student Edition*. Saxon Geometry:Austin.

Tucson Unified School District. 2017-2018. *Geometry Curriculum Map. Retrieved from:*<http://www.tusd1.org/resources/curriculum/math3/>

 MATHCMQ1Geometry.pdf