ACCESS GEOMETRY SCOPE & SEQUENCE

From this careful planning, the *Access Geometry* Scope and Sequence was developed (in collaboration with Dr. Drew Polly). The Scope and Sequence provides an overview of the priority standards of the five CCSC math domains represented by the units of instruction, the NCTM standards and expectations, and related workforce skills connected to Workforce Innovation and Opportunity Act (WIOA) goals. In addition, foundational concepts, vocabulary/symbols, essential understandings, and learning objectives that align to the unit's standards are provided. Objectives that challenge learners who could benefit from more complex problems are also listed.

This organizational framework for each unit applies Saunders, Bethune, Spooner, and Browder's (2013) five steps for accessing standards for students in this population:

1. **Select a topic and create objectives.**
2. **Identify real-life activities using the skill.**
3. **Incorporate evidence-based practices using the skill.**
4. **Include instructional supports.**
5. **Monitor progress.**

SCOPE AND SEQUENCE

Unit 1: Properties of Geometric Figures

NCTM Standards and Expectations*

Apply transformations and use symmetry to analyze mathematical situations

- Describe sizes, positions, and orientations of shapes under informal transformations such as flips, turns, slides, and scaling
- Examine the congruence, similarity, and line of rotational symmetry of objects using transformations
- Understand and represent translations, reflections, rotations, and dilations of objects in the plane by using sketches, coordinates, vectors, function notations, and matrices
- Use various representations to help understand the effects of simple transformations and their compositions
- Specify locations and describe spatial relationships using coordinate geometry and other representational systems
- Use Cartesian coordinates and other coordinate systems, such as navigational, polar, or spherical systems, to analyze geometric situations

Common Core State Standards**

Domain: Congruence

Experiment with transformations in the plane

- Represent transformations in the plane. CCSS.MATH.CONTENT.HSG.CO.A.2
- Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself. CCSS.MATH.CONTENT.HSG.CO.A.3
- Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments. CCSS.MATH.CONTENT.HSG.CO.A.4
- 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. CCSS.MATH.CONTENT.HSG.CO.A.5

Understand congruence in terms of rigid motions

- 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. CCSS.MATH.CONTENT.HSG.CO.B.6

Related Workforce Skills Aligned With the Intentions of the Workforce Innovation and Opportunity Act (WIOA)

- Use a coordinate plan to investigate how video game designers use transformations to create images on screen
- Use computer software to transform the position of objects (flip, mirror, or turn a shape) in computer programming

*National Council of Teachers of Math (NCTM) **www.nctm.org/Standards-and-Positions/Principles-and-Standards/Geometry/**

Common Core State Standards (CCSS) **www.corestandards.org/Math/Content/HSG/introduction/

Unit 1: Properties of Geometric Figures

Foundational Concepts

A coordinate plane is a plane containing an x-axis and a y-axis.

Numbers can be positive or negative on the coordinate plane.

Points can be plotted on a coordinate plane.

Coordinates are pairs of numbers that tell an exact location on a coordinate plane.

Horizontal, vertical, diagonal, clockwise, and *counterclockwise* are direction words.

Foundational vocabulary: *clockwise, coordinate plane, coordinates (x, y), counterclockwise, diagonal, flip, horizontal, negative number, origin point, positive number, slide, symmetry, turn, vertical, x-axis, y-axis*

Learning Objectives

Identify vocabulary words that help discuss unit concepts: *reflection, rotation, transformation, translation*

Identify two types of transformations: translations and reflections

Demonstrate a translation by sliding a figure

Demonstrate a reflection by flipping a figure

Identify a third type of transformation: rotation

Demonstrate clockwise and counterclockwise rotations around a central point

Given origin and ending points, complete a rotation transformation

Determine the direction of a rotation and the degrees of the rotation (i.e., 90°, 180°, 270°)

Translate a figure horizontally, vertically, or diagonally

Perform reflections across a line of symmetry

Perform rotations clockwise or counterclockwise at 90°, 180°, or 270°

Complete a series of transformations and determine the ending point of the figure

Essential Understandings / Big Ideas

A transformation is a movement of a shape on a plane.

A translation slides and a reflection flips.

A rotation is a transformation that turns.

Rotations turn clockwise or counterclockwise.

Three types of transformations are translations, reflections, and rotations.

Translations slide, reflections flip, and rotations turn.

Challenge Objectives

Given origin points and directions for movement, complete a translation and a reflection and determine the ending points

Given origin points, complete a rotation transformation and determine the ending points

Plan how to translate, reflect, or rotate a figure to transform it to a given point

SCOPE AND SEQUENCE

Unit 2: Geometric Proofs

NCTM Standards and Expectations*

Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships

- Analyze properties and determine attributes of two- and three-dimensional objects
- Explore relationships (including congruence and similarity) among classes of two- and three-dimensional geometric objects, make and test conjectures about them, and solve problems involving them
- Establish the validity of geometric conjectures using deduction, prove theorems, and critique arguments made by others
- Use trigonometric relationships to determine lengths and angle measures

Related Workforce Skills Aligned With the Intentions of the Workforce Innovation and Opportunity Act (WIOA)

- Use geometric proofs and right triangles to complete practical building tasks, such as build a corner shelf or replace a broken corner kitchen floor tile
- Apply OSHA safety requirements for usage of a ladder against a brick wall (angle of ladder/wall/ground)

Common Core State Standards**

Domain: Congruence

Prove geometric theorems

- Prove theorems about lines and angles. CCSS.MATH.CONTENT.HSG.CO.C.9
- Prove theorems about triangles. CCSS.MATH.CONTENT.HSG.CO.C.10

Domain: Similarity, Right Triangles, and Trigonometry

Define trigonometric ratios and solve problems involving right triangles

- Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. CCSS.MATH.CONTENT.HSG.SRT.C.8

Prove theorems involving similarity

- Prove theorems about triangles. CCSS.MATH.CONTENT.HSG.SRT.B.4
- Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures. CCSS.MATH.CONTENT.HSG.SRT.B.5

Understand similarity in terms of similarity transformations.

- Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides. CCSS.MATH.CONTENT.HSG.SRT.A.2
- Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar. CCSS.MATH.CONTENT.HSG.SRT.A.3

*National Council of Teachers of Math (NCTM) **www.nctm.org/Standards-and-Positions/Principles-and-Standards/Geometry/***

Common Core State Standards (CCSS) **www.corestandards.org/Math/Content/HSG/introduction/

Unit 2: Geometric Proofs

Foundational Concepts

A triangle has three sides and three angles.

Triangles can be named using the points and line segments that connect the points.

The interior angles of a triangle always add up to 180°.

A right angle is an angle of 90°.

A triangle with a right angle is called a *right triangle*.

Similar triangles are triangles whose inside angles are the same size.

Congruent triangles are identical triangles with exactly the same three sides and the same three angles.

Shapes have attributes that define them.

Foundational symbols and vocabulary: ∠ angle, ≅ is congruent to, ° degree, ~ is similar to, △ triangle, *angle, degree, equation, interior angle, line segment, right angle, right triangle, triangle*

Learning Objectives

Identify vocabulary words that help discuss unit concepts: *congruent triangles, definition, given, postulate, proof, property, reason, similar triangles, statement, theorem*

Identify attributes of given shapes

Select statements and reasons to construct a proof that a shape with given attributes is a right triangle

Select statements and reasons to construct a proof that two triangles with given attributes are congruent triangles

Select statements and reasons to construct a proof that two triangles with given attributes are similar triangles

Select theorems, postulates, and definitions that support observed attributes

Construct a geometric proof to solve a problem

Essential Understandings / Big Ideas

Shapes have attributes that can be measured and compared to other shapes.

Shapes have properties, or rules about their attributes, that are always true.

Proofs are explanations that use what we know about attributes of shapes to solve problems.

Challenge Objective

Apply the Pythagorean Theorem to solve for an unknown side length of a right triangle

SCOPE AND SEQUENCE

Unit 3: Geometric Measurement

NCTM Standards and Expectations*

Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships

- Understand relationships around the angles, side lengths, perimeters, areas, and volumes of similar objects
- Explore relationships among classes of two- and three- dimensional geometric objects, make and test conjectures about them, and solve problems involving them

Common Core State Standards**

Domain: Geometric Measurement and Dimension

Explain formulas and use them to solve problems

- Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. HSG-GMD.A.1
- Use volume formulas for cylinders, pyramids, cones and spheres to solve problems. HSG-GMD.A.3

Workforce Skills Aligned With the Intentions of the Workforce Innovation and Opportunity Act (WIOA)

- Calculate the volume of containers, including cylinders and cones, used for packaging
- Repackage materials from one container to another, including the conceptual use of volume to planning number of new containers needed for a specific task
- Complete cost analyses of packaging for specific purposes

*National Council of Teachers of Math (NCTM) **www.nctm.org/Standards-and-Positions/Principles-and-Standards/Geometry/***

Common Core State Standards (CCSS) **www.corestandards.org/Math/Content/HSG/introduction/*

Unit 3: Geometric Measurement

Foundational Concepts

Distance, length, height, and capacity can be measured.

Numerals represent concepts of *more* or *less*.

Radius is the distance from the center of a circle to the edge.

Height is the measurement of vertical distance or position.

Volume is the amount of space something occupies.

Foundational symbols and vocabulary: *=, π, /, base, double, full, half full, largest, more, less, smallest*

Learning Objectives

Identify vocabulary words that help discuss unit concepts: *capacity, cone, cubic units, cylinder, formula, height, radius, volume*

Identify the radius and height of a cylinder

Use volume formulas to explore the relationships between different-sized cylinders

Use formulas and relationships among cylinders to give an informal argument

Use volume formulas to explore the relationships between full and half-full cylinders

Essential Understandings / Big Ideas

Formulas help us measure 3-D objects.

We can use a formula to measure the volume of an object.

Different formulas measure the volume of different shapes.

Challenge Objectives

Use Cavalieri's Principle to give an informal argument

Apply the knowledge of formulas to determine the volume of ⅓ or ¼ of a filled container

Apply the knowledge of formulas to determine the volume of a cone doubled or tripled

SCOPE AND SEQUENCE

Unit 4: Representations of Geometry

NCTM Standards and Expectations*

- Apply transformations and use symmetry to analyze mathematical situations
- Use various representations to help understand the effects of simple transformations and their compositions
- Use visualizations, spatial reasoning, and geometric modeling to solve problems
- Use geometric ideas to solve problems in, and gain insights into, other disciplines and other areas of interest such as art and architecture

Common Core State Standards**

Domain: Modeling with Geometry

Apply geometric concepts in modeling situations

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

Experiment with transformations in the plane

- Represent transformations in the plane. HSG-CO.A.2

Related Workforce Skills Aligned With the Intentions of the Workforce Innovation and Opportunity Act (WIOA)

- Use polygons to extend patterns through transformations to build and construct work-related jobs (tile floors, build walls).
- Use rules of tessellations to provide quality control of jobs, and structural soundness of buildings (e.g., walls; no gaps/overlaps).

*National Council of Teachers of Math (NCTM) ***www.nctm.org/Standards-and-Positions/Principles-and-Standards/Geometry/***

Common Core State Standards (CCSS) ***www.corestandards.org/Math/Content/HSG/introduction/*

Unit 4: Representations of Geometry

Foundational Concepts

A pattern is a repeated design.

Patterns occur in our everyday lives.

Transformations can be used to make different patterns.

Shapes are named by the number of sides and angles they have.

Shapes can be different sizes.

Foundational vocabulary: *equilateral triangle, extend, hexagon, less than, more than, octagon, polygon, rectangle, reflection, rotation, row, semi-, square, transformation, translation*

Learning Objectives

Identify vocabulary words that help discuss unit concepts: *gap, overlap, pattern, plane, regular polygon, tessellation, vertex*

Identify a regular tessellation

Use translations to extend a regular tessellation

Identify a semi-regular tessellation

Use translations and reflections to extend a semi-regular tessellation

Identify three types of transformations

Recognize that other tessellations (beyond regular and semi-regular) exist

Use translations, reflections, and rotations to extend a tessellation

Essential Understandings / Big Ideas

Shapes are used to design patterns in everyday life.

Tessellations have no overlaps or gaps.

Regular tessellations use one shape.

Semi-regular tessellations use more than one shape.

A transformation is a movement of a shape on a plane.

More than one transformation can be used to make a tessellation.

Challenge Objectives

Create and extend a regular tessellation using equilateral triangles

Identify how to transform a shape to create a regular tessellation

Create and extend a semi-regular tessellation

Use three transformations to create a tessellation

Create a tessellation without a repeating pattern (non-periodic tessellation)