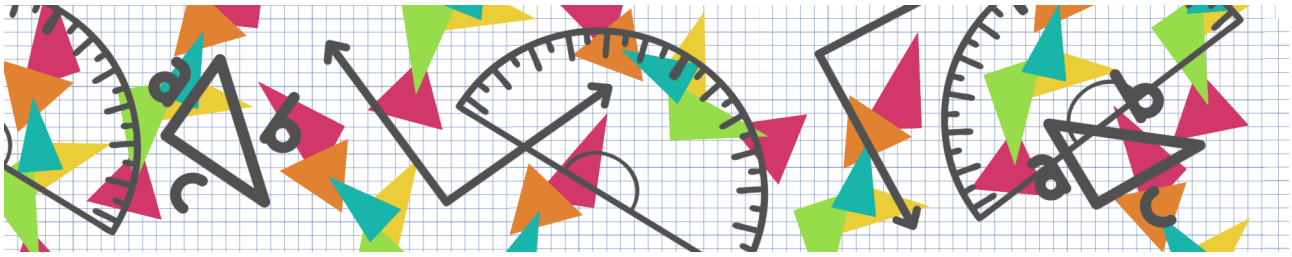
CREATIVE GEOMETRY - SCULPTING WITH MATH
Grade Band: 6-8
Content Focus: Visual Arts & Math



LEARNING DESCRIPTION

In this lesson, students will utilize mathematical concepts such as ratios, proportions, and graphing to create a Stabile sculpture inspired by the artist, Alexander Calder.

LEARNING TARGETS

Essential Questions	"I Can" Statements
How can I use mathematical concepts to create the parts of a Stabile sculpture? How can I combine two dimensional shapes to create a three-dimensional form?	I can use mathematical concepts to create the parts of a Stabile sculpture. I can combine two-dimensional shapes to create a three-dimensional form.

GEORGIA STANDARDS

Curriculum Standards	Arts Standards

Grade 6 6.RP.1 Interpret the concept of a ratio as the relationship between two quantities, including part to part and part to whole. 6.RP.3 Apply the concepts of ratios and rates to solve real-world and mathematical problems. 6.PAR.8.3 Solve problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same x-coordinate or the same y-coordinate. 6.PAR.8.4 Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same x-coordinate or the same y-coordinate. **7th Grade** 7.PAR.4.4 Identify, represent, and use proportional relationships. 7.PAR.4.6 Solve everyday problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale. 7.GSR.5.2 Measure angles in whole number degrees using a protractor 7.GSR.5.3 Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve equations for an unknown angle in a figure. **8th Grade** 8.GSR.8.1 Explain a proof of the Pythagorean Theorem and its converse using visual models. 8.GSR.8.2 Apply the Pythagorean Theorem to determine unknown side lengths in right triangles within authentic, mathematical problems in two and three dimensions. 8.GSR.8.3 Apply the Pythagorean Theorem to find the distance between two points in a coordinate system in practical, mathematical problems.	**Grade 6** VA6.CR.1 Visualize and generate ideas for creating works of art. VA6.CR.2 Choose from a range of materials and/or methods of traditional and contemporary artistic practices to plan and create works of art. VA6.CR.3 Engage in an array of processes, media, techniques, and/or technology through experimentation, practice, and persistence. VA6.CR.4 Incorporate formal and informal components to create works of art. **Grade 7** VA7.CR.1 Visualize and generate ideas for creating works of art. VA7.CR.2 Choose from a range of materials and/or methods of traditional and contemporary artistic practices to plan and create works of art. VA7.CR.3 Engage in an array of processes, media, techniques, and/or technology through experimentation, practice, and persistence. VA7.CR.4 Incorporate formal and informal components to create works of art. **Grade 8** VA8.CR.1 Visualize and generate ideas for creating works of art. VA8.CR.2 Choose from a range of materials and/or methods of traditional and contemporary artistic practices to plan and create works of art. VA8.CR.3 Engage in an array of processes, media, techniques, and/or technology through experimentation, practice, and persistence. VA8.CR.4 Incorporate formal and informal components to create works of art.

SOUTH CAROLINA STANDARDS

Curriculum Standards	Arts Standards
6th Grade 6.NS.8 Extend knowledge of the coordinate plane to solve real-world and mathematical problems involving rational numbers. 6.RP.1 Interpret the concept of a ratio as the relationship between two quantities, including part to part and part to whole. **7th Grade** 7.RP.2 Identify and model proportional relationships given multiple representations, including tables, graphs, equations, diagrams, verbal descriptions, and real-world situations. 7.RP.3 Solve real-world and mathematical problems involving ratios and percentages using proportional reasoning. 7.GM.2 Construct triangles and special quadrilaterals using a variety of tools (e.g., freehand, ruler and protractor, technology). **8th Grade** 8.F.4 Apply the concepts of linear functions to real-world and mathematical situations. 8.EEI.5 Apply concepts of proportional relationships to real-world and mathematical situations. 8.EEI.6 Apply concepts of slope and y-intercept to graphs, equations, and proportional relationships. 8.GM.7 Apply the Pythagorean Theorem to model and solve real-world and mathematical problems in two and three dimensions involving right triangles. 8.GM.8 Find the distance between any two points in the coordinate plane using the Pythagorean Theorem.	**Anchor Standard 1:** I can use the elements and principles of art to create artwork. **Anchor Standard 2**: I can use different materials, techniques, and processes to make art. **Anchor Standard 7:** I can relate visual arts ideas to other arts disciplines, content areas, and careers.

KEY VOCABULARY

Content Vocabulary	Arts Vocabulary
• Isosceles triangle - A triangle that has two sides of the same length • Equilateral triangle - A triangle whose sides are all the same length	• Shape - One of the seven elements of art; an object that has two dimensions • Form - One of the seven elements of art; an object that has three dimensions

- Scalene triangle - A triangle whose sides are all different lengths
- Right triangle - A triangle with one right angle
- Proportional - The relationship between two variables has the same ratio
- Slope - The steepness of a line that can be measured using a coordinate plane
- Pythagorean theorem - A formula to find the hypotenuse of a right triangle $a^2 + b^2 = c^2$
- Sculpture - A type of art that is three-dimensional
- Stabiles - Large-scale sculptures that are abstract; they are made up of large two-dimensional shapes put together; they were created by the artist, Alexander Calder

MATERIALS

- White chipboard
- Rulers
- Pencils
- Graph paper
- Markers or paint
- Clear tape
- Protractors
- Scratch white paper
- Scissors

INSTRUCTIONAL DESIGN

Opening/Activating Strategy

- Have students get into pairs. One partner should be the “artist” and one should be the describer.
  - The artist must turn away from the board. The describer will have two minutes to describe the image from Alexander Calder’s Stabile installation in Paris, 1959 to their partner using mathematical vocabulary.
  - Students can talk about lines, shapes, angles, types of triangles, etc. to describe the image.
  - The “artist” partner must draw what is being described.
- After two minutes, all students should turn and look at the board to compare the drawings to the photo.
  - Facilitate a discussion around the process–what challenges did each partner face? What vocabulary did they use?

- Tell students that this is an image from an art exhibit in Paris showing sculptures by the artist, Alexander Calder. Sculptures are any artform that take up three dimensions. Contrast sculptures to two-dimensional artworks like paintings and drawings.
    - These sculptures are called Stabiles. Stabiles are large-scale sculptures that are abstract; they are made up of large two-dimensional shapes put together.
- In this lesson, students will be using mathematical concepts to create their own Stabiles.

Work Session

Teacher note: *The process to determine the method for creating the triangles that students will use to create their sculptures will vary depending on grade level.*

METHOD 1: GRAPHING COORDINATES

- Review with students how to graph coordinates on a coordinate plane.
- Put students into groups of two to three.
- Provide each group with six sets of three coordinates that when graphed will create a triangle. Students should have six triangles total.
    - Students must plot the three coordinates. Each must be plotted on a different coordinate plane.
    - Using a ruler, students should connect the points to create triangles.
    - Students should use a protractor to measure each of the angles of each of the triangles. Students should record their findings.
    - Students will then cut out each of the triangles that they drew.
    - Students will trace these triangles onto white chipboard.
    - Students will then cut out each of the triangles.
    - Students will add color and design to the triangles for visual interest.
- Students should then draw a plan for their Stabiles to show how they will put the triangles together in an interesting way.
    - Students will then put the triangles together to make a Stabile. Demonstrate how to cut small slits into two triangles to connect them. Students can use tape to reinforce the connections. The Stabile should be able to stand by itself without additional support.

METHOD 2: USING RATIOS, SLOPE AND ANGLES

- Review ratios, slope, and angles with students.
- Put students into groups of two to three.
- Give each group one triangle.
    - Students should use their understanding of slope, angles, and ratios to create six additional proportional triangles drawn on chipboard.
        - Students should check their work by measuring the angles of the triangles using a protractor.
    - Students will cut out triangles.
    - Students will add color and design to the triangles for visual interest.
- Students should then draw a plan for their Stabiles to show how they will put the triangles together in an interesting way.
    - Students will then put the triangles together to make a Stabile. Demonstrate how to cut small slits into two triangles to connect them. Students can use tape to reinforce the connections. The Stabile should be able to stand by itself without additional support.

METHOD 3: USING RIGHT ANGLES AND PYTHAGOREAN THEOREM

- Review right angles and how to solve equations using the pythagorean theorem.
- Put students in groups of two to three.
    - Give each group three right triangles with measurements for two sides. Students must use the pythagorean theorem to solve for the third side of each triangle.
    - Students should use their understanding of slope, angles, and ratios to create three more proportional triangles on chipboard.
    - Students will cut out triangles.
    - Students will add color and design to the triangles for visual interest.
- Students should then draw a plan for their Stabiles.
    - Students will then put the triangles together to make a Stabile. Demonstrate how to cut small slits into two triangles to connect them. Students can use tape to reinforce the connections. The Stabile should be able to stand by itself without additional support.

Closing/Reflection

- Students should set up Stabiles at their desks. Next to their Stabiles, students should display their calculations. Students should then conduct a gallery walk to view other's work.
- Facilitate a discussion about how mathematical concepts can be used to create art. Ask students how they think Alexander Calder used math to plan his Stabiles.

ASSESSMENTS

Formative

Teachers will assess students' understanding by observing whether students are able to use mathematical vocabulary to describe the Calder Stabile exhibit and students' ability to accurately complete mathematical calculations for their sculptures.

Summative

CHECKLIST

- Students can correctly use mathematical concepts to create the parts of a Stabile sculpture.
- Students can combine two-dimensional shapes to create a three-dimensional form.

DIFFERENTIATION

Acceleration: Students should select an image of a Calder Stabile to use as inspiration for a new sculpture. Students should then conduct the mathematical equations to provide the dimensions of the sides and measurements of the angles in the geometric shapes they use to create their sculptures.

Remediation:

- Reduce the number of triangles/calculations required to create sculpture.
- Allow students to complete calculations for two triangles. Students will then trace the two triangles two times each to create their Stabile.

ADDITIONAL RESOURCES

- Alexander Calder's Stabile installation in Paris, 1959
- Examples of Calder's Stabiles

**This integrated lesson provides differentiated ideas and activities for educators that are aligned to a sampling of standards. Standards referenced at the time of publishing may differ based on each state's adoption of new standards.*

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