Geometry in Art and Architecture

Grade Level: 6th Grade
Presented by: Lu H. Stanley, Oglethorpe Academy, Savannah, GA
Length of Unit: Approximately two weeks

I. Abstract

This unit will focus on the use of geometric concepts in creating works of art. A mathematical foundation can be found in a variety of artistic styles, from the earliest known periods to modern times. Students will learn to recognize various geometric concepts within works of art, including architecture. Various forms will be used to demonstrate the use of geometry in the design and construction of buildings, monuments, and other architectural features. Various art forms will be included to further broaden understanding of the connections between geometry and art.

II. Overview

A. Concept Objectives
   1. Students will understand various geometric symbols and figures, such as the circle, triangle, square, rectangle, trapezoid, kite, octagon, and hexagon.
   2. Students will be able to construct various geometric symbols and figures, and use them in their own designs.
   3. Students will understand the concepts of balance and proportion, and its use in art and architecture.
   4. Students will understand the connections between geometry and design, and the importance of that connection to art and architecture.

B. Content from the Core Knowledge Sequence:
   1. Measurement
   2. Geometry
   3. Art History – Periods and Schools

C. Skills to be taught:
   1. Measurement, scale, proportion
   2. Geometric constructions
   3. Characteristics of angles
   4. Properties of triangles
   5. Properties of circles
   6. Properties of polygons
   7. Similarity and congruency
   8. Area and volume
   9. Polyhedrons

III. Background Knowledge

A. For Teachers: *What Your Sixth Grader Needs To Know* by E. D. Hirsch, *Math User's Handbook* by Creative Publications.

B. For Students: Background knowledge in geometry figures and construction would be helpful.

IV. Resources

Hirsch, Jr. E. D. *What Your Sixth Grader Needs to Know.* New York: Dell Publishing, 1993, ISBN 0-385-31467-1.

Math User's Handbook. Chicago: Creative Publications, 1998, ISBN 0-7622-0627-6.

Teacher-created transparencies will be utilized depicting numerous examples of the use of geometry in works of art and varied architectural styles.

V. Lessons

Lesson One: Introduction; The Beginning of Geometry

A. Objectives:
   1. Students will understand how the study of geometry began.
   2. Students will identify various geometric figures and understand the characteristics of those figures.

B. Materials:
   1. *Math User's Handbook* by Creative Publications
   2. Examples of plane figures and platonic solids
   3. Transparencies of various geometric figures used in art and architecture

C. Vocabulary:
   1. Geometry
   2. Properties
   3. Polygon

D. Procedures:
   1. Have students brainstorm what the term *geometry* means to them. Record ideas and thoughts on chart paper or marker board.
   2. Have students look up the term *geometry* in the mathematics text and brainstorm properties of geometric figures and record.
   3. Brainstorm with students the ways in which geometry is useful in our world and record.
   4. Have students use the classroom and adjacent hallway to list as many different geometric figures as possible they see used in any form in the building and furnishings. Come together as a group and compare lists.

E. Evaluation:
   1. Brainstorm
   2. Class discussion

Lesson Two: Use of Geometric Symbols in Geometry

A. Objectives:
   1. Students will be able to recognize the use of geometric properties in the art and architecture of various religions.
   2. Students will identify the purpose and meaning of geometric symbols in the art and architecture of those religions.

B. Materials:
   1. Pictures, books, and transparencies showing the use of geometric forms in religious art and architecture

C. Vocabulary:
   1. Symmetry
   2. Balance
   3. Proportion
   4. Mandala
   5. Pentagram
   6. Tessellations

D. Procedures:
   1. Display and discuss pictures and transparencies of religious symbols and ask students to identify the geometric figures found in those symbols.
   2. Display and discuss pictures of religious architecture and ask students to identify geometric properties found in the buildings.
   3. Have students research various religions and find geometric symbols in the art and architecture associated with those religions.

4. Have students sketch the symbols and give a written summary of the specific purpose of the symbol in the given religion. Students will present findings to the class.

E. Evaluation:
   1. Class discussion
   2. Research
   3. Student presentation

Lesson Three: Polygons, Tilings, Tessellations

A. Objectives:
   1. Students will be able to identify the geometric properties of polygons.
   2. Students will identify polygons used in tilings and tessellations and the properties that allow for those patterns.
   3. Students will identify the use of tilings and tessellations in art works and architectural designs.
   4. Students will design and construct tiling and tessellation patterns.

B. Materials:
   1. Examples of tilings and tessellations
   2. Pattern blocks
   3. Graph paper
   4. Poster board
   5. Construction paper

C. Vocabulary:
   1. Tiling
   2. Tessellation

D. Procedures:
   1. Display and discuss a variety of tilings and tessellations for students to see how the geometric properties work to allow for patterns to occur.
   2. Using pattern blocks, show how tiling patterns are created.
   3. Allow students to work together in small groups to create a tiling pattern. Discuss with groups the properties that allow for the pattern to occur.
   4. Model the use of small poster board squares to design a tiling or tessellation pattern.
   5. Instruct students to design their own tiling or tessellation pattern. Each pattern will be mounted for classroom display.

E. Evaluation:
   1. Discussion
   2. Student models

Lesson Four: The Circle in Art and Architecture

A. Objectives:
   1. Students will be able to identify the geometric properties of a circle.
   2. Students will understand the symbolism of the circle as it appears in various art forms and architectural styles.

B. Materials:
   1. Circular regions of different sizes
   2. Measuring tapes
   3. Calculators
   4. Art and architecture books showing the use of circles, arcs, and arches in designs

C. Vocabulary:
   1. Circumference
   2. Diameter

3. Radius
4. Arc
5. Rotational symmetry

D. Procedure:

1. Distribute circular regions of various sizes to pairs of students. Using measuring tapes, have students record the distance around the circular regions and the distance across the regions at their widest points. Complete the calculations as directed on the sheet labeled Appendix A. When students finish the activity, have them list their findings on the overhead. The students will discover the relationship between circumference and diameter is pi.
2. Display and discuss pictures and transparencies of the use of circles, arcs, and arches in art and architecture.
3. Have students research, summarize, and discuss the symbolism of circles in art and architectural styles, as well as in religious symbols.

E. Evaluation:

1. Circle activity
2. Discussion

Lesson Five: Geometry in Renaissance Art and Architecture

A. Objectives:

1. Students will understand the connection between mathematics, geometric properties, and artistic forms used during the Renaissance period.
2. Students will understand the connection between the Renaissance period and the development of the ideas of perspective, chaos, and fractals.

B. Materials:

1. Pictures, books, and transparencies showing various works of art from the Renaissance period
2. Examples of perspective drawings
3. Examples of fractals
4. Drawing paper
5. Rulers

C. Vocabulary:

1. Renaissance
2. Perspective
3. Chaos
4. Fractal

D. Procedure:

1. Students will view examples of Renaissance art and architecture and identify geometric properties and themes found in various Renaissance art works.
2. Have students research an artist of the Renaissance period and summarize geometric properties found in that artist's works.
3. Display examples of perspective, chaos, and fractals and discuss the properties of each. Distribute drawing paper and allow students to create their own example of a perspective drawing or fractal design.

E. Evaluation:

1. Discussion
2. Research summary

Lesson Six: Geometry in Twentieth Century Art and Architecture

A. Objectives:

1. Students will understand the impact of geometric properties on the development of art and architecture in the twentieth century.

2. Students will identify geometric themes in the artistic styles of various twentieth century artists.

B. Materials:
   1. Books, pictures, and transparencies of twentieth century art and architecture
   2. Drawing paper
   3. Compass
   4. Rulers
   5. Protractors

C. Vocabulary:
   1. Abstraction
   2. Cubism
   3. Constructivism
   4. Transformations

D. Procedure:
   1. Display and discuss books, pictures, and transparencies of examples of twentieth century art and architecture and ask students to identify geometric properties observed in examples.
   2. Define the elements of abstraction, cubism, and constructivism and display examples of each style. Ask students to identify recurring themes found in each style.
   3. Identify and discuss artists associated with different styles of twentieth century art and architecture and ask students to identify specific geometric properties the artists use in their designs.
   4. Instruct students to create an original design using geometric properties as a recurring theme in the design.

E. Evaluation:
   1. Discussion
   2. Student design

Lesson Seven: Geometry in the Art and Architecture of Savannah

A. Objectives:
   1. Students will observe and understand the use of geometric properties in the art and architecture of Savannah.

B. Materials:
   1. Books, maps, pictures, and transparencies of art and architecture found in the Savannah area
   2. Paper for observation lists
   3. Polaroid cameras
   4. Poster board

C. Procedures:
   1. Students will take a field trip to observe historic Savannah from a geometric perspective. Students will be asked to list all the different geometric forms and properties they see as they walk through several of Savannah's historic squares.
   2. Students will photograph the geometric forms they observe during the field trip. Students will create a display of their pictures with a description of their observations from a geometric perspective.

D. Evaluation:
   1. Observation lists
   2. Picture display

VI. Unit Extensions

1. Have students create a *Geometry Notebook*. Have students create a notebook giving examples they have chosen that appropriately define selected geometric terms. Students may use pictures from magazines or photographs that give clear examples of a list of terms given by the teacher. Each page will include the term, the definition of the term, and the picture with the example outlined.
2. Have a *Geometry Fair* that features student designs using geometric properties. Categories of designs can include tessellations, tilings, original designs using various drawing tools, etc. Displays can be featured at school open houses or parent meetings.

VII. Bibliography:

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Appendix A

Circular region 1:

Circumference (C): _____
Diameter (D): _____

C + D = _____

C - D = _____

C x D = _____

C ÷ D = _____

Circular region 2:

Circumference (C): _____
Diameter (D): _____

C + D = _____

C - D = _____

C x D = _____

C ÷ D = _____