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# Ideas with IMPACT

**STEM/STEAM**

## Exploring Radial Symmetry and Negative Space

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# Radial Wonders

## Exploring Geometric and Nature-Inspired Designs

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# Goals and Objectives

This workshop introduces Radial Designs, an exhilarating STEAM lesson designed to ignite students' passion for spatial reasoning, fractions, and geometric concepts by seamlessly blending engineering and art into an engaging, hands-on experience.

Workshop Goals for Teachers:

By the end of this workshop, participating teachers will be able to:

* Understand and teach the principles of radial symmetry using a hands-on, constructivist approach.

* Guide students in creating a radial design that demonstrates balance, repetition, and the interplay of positive and negative space.

* Integrate key mathematics, science, and art concepts into a single, cohesive project.

* Adapt the lesson for various grade levels and diverse student needs, including English Language Learners.

* Effectively assess student work based on both the creative process and the final product.

Learning Objectives for Students:

Upon completing this lesson in the classroom, students will be able to:

* Define radial symmetry and identify examples in art and nature.

* Create a complex radial design using either geometric or organic themes that radiates from a central point.

* Demonstrate an understanding of positive and negative space by cutting and mounting their design.

* Exhibit craftsmanship and psychomotor skills through precise folding, drawing, and cutting.

* Develop spatial reasoning skills and a deeper understanding of geometric and fractional concepts.

Teachers attending this workshop will discover a dynamic tool to cultivate both cognitive and affective skills in their students, leaving them eager to adapt it into their classrooms for unforgettable learning adventures.

# **Florida B.E.S.T. Standards Alignment** (Grades 3–5)

This lesson directly supports the following Florida Benchmarks for Excellent Student Thinking (B.E.S.T.) Standards across multiple disciplines.

## Visual Arts

* VA.3.C.1.2: Use prior knowledge and observation skills to reflect on and interpret works of art.

* VA.3.S.1.2: Explore various art media with craftsmanship.

* VA.4.C.2.2: Analyze works of art to understand how artists communicate meaning.

* VA.4.O.1.1: Use elements of art and principles of design to create unified artworks.

* VA.5.S.3.3: Demonstrate craftsmanship and technical skills when using media, tools, and techniques.

## Mathematics (Geometry Strand)

* MA.3.GR.1.1: Describe and draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.

* MA.4.GR.1.1: Identify and classify two-dimensional figures according to their angle measures and sides. Classify triangles right, acute, or obtuse.

* MA.5.GR.3.1: Identify line symmetry and rotational symmetry in two-dimensional figures.

# Overview

Radial symmetry is a design principle where elements are arranged equally around a central point—like the spokes of a wheel or the petals of a daisy. Every part of the design radiates outward from the center, creating a sense of balance, harmony, and movement. This powerful design principle is found everywhere, from sacred mandalas and cathedral rose windows to the intricate patterns of snowflakes and starfish.

## Classroom Application

In the classroom, this lesson is a fantastic tool for teaching young artists about order, repetition, and visual balance. It provides a clear structure that empowers students to explore their creativity while introducing key mathematical concepts like fractions (folding paper into halves, fourths, eighths), angles, rotation, and pattern recognition. This project encourages precision and problem-solving as students must ensure their designs are connected to create a single, unified piece.

## Added Benefits of This Activity:

* Enhances Psychomotor Skills: The processes of folding, drawing, and cutting complex shapes improve fine motor control and hand-eye coordination.

* Boosts Student Achievement: The activity contributes to measurable achievements in both cognitive domains (math, art) and affective domains (patience, self-esteem, creative confidence).

# Lesson Plan

Radial Wonders: Exploring Geometric and Nature-Inspired Design

Adaptable for Grades 3 through 5. Time Allotment: 4 contact hours

After a brief introduction to radial design, students will create a circular art piece. They will fold a circular paper into eighths, draw a design using either organic motifs or geometric patterns, and then carefully cut out the negative spaces. The final design is mounted on a contrasting background color.

Engage (Teacher -15 minutes)

- Begin with a visual presentation showing examples of radial symmetry in nature (flowers, snowflakes, shells), architecture (rose windows), and art (mandalas)
- Facilitate a brief discussion: "What do all these images have in common?" Introduce the term radial design.

Demonstration | Model (Teacher -30 minutes)

- Start with a 12"x12" circular paper. Fold it in half and then twice more on the diagonal to create a triangular wedge representing 1/8th of the circle.
- Explain that the "open" edges of the triangle correspond to the outer circumference of the circle and the "closed" point is the center.
- Show how to draw a design emphasizing that shapes must connect to each other to ensure the final piece doesn't fall apart. Discuss organic vs. geometric shapes.
- Demonstrate how to carefully cut out the negative spaces.

Explore & Create (2.5 hours)

Student will:

- receive two complimentary colors of 12"x12" construction paper, scissors, and a glue stick.
- fold their primary paper into a triangular wedge.
- sketch their design, paying close attention to positive and negative space and structural connections.
- Color their design using preferred medium, ex: markers
- cut out their design.
- apply glue to the back of their design and mount it onto the second, contrasting sheet of paper.

Assessment & Reflection | Share & Evaluate (45 minutes)

- Gallery Walk: Participants display their finished pieces. Everyone walks around to observe the variety of solutions.
- Performance Assessment: The final project serves as the primary assessment, evaluated on:
    - Understanding of radial design and symmetry.
    - Craftsmanship (neatness of cuts and gluing).
    - Unity of design (all parts are connected).
    - Use of positive/negative space.

Key Vocabulary

- Symmetry: A visual balance achieved when one side of an object is a mirror image of the other.
- Radial Symmetry: Symmetry around a central axis, where elements radiate from the center point (e.g., a starfish or a wheel).
- Organic Shapes: Irregular, free-flowing shapes often found in nature, such as leaves, clouds, or flowers.
- Geometric Shapes: Precise, regular shapes that can be described with mathematical formulas, such as circles, squares, triangles, and rhombuses.
- Positive Space: The main focus of a picture; the area taken up by the subject or object. In this project, it is the paper that remains after cutting.
- Negative Space: The space around and between the subject(s) of an image. In this project, it is the areas that are cut away.
- Orthogonal: Relating to or involving right angles; perpendicular.
- Diagonal: A straight line joining two opposite corners of a square, rectangle, or other straight-sided shape.
- Two-Dimensional: Having the dimensions of height and width only.
- Three-Dimensional: Having height, width, and depth.

Differentiation and Cross-Curricular Connections

This lesson is easily adaptable for learners with diverse needs and provides rich opportunities for interdisciplinary connections.

Accommodations & ESOL Strategies

- B5 - Visuals: Use numerous examples of radial designs and a finished model piece.
- B14 - Demonstrations: Model each step of the folding, drawing, and cutting process clearly and slowly. Repeat as needed.
- A4 - Whole Language Approach: Integrate new vocabulary naturally within the demonstration and discussion.
- C1 - Peer Buddy: Pair students to help each other with challenging steps like folding or cutting.
- F4 - Varied Activities: The lesson includes listening (instruction), watching (demonstration), and doing (creating), appealing to multiple learning styles.
- E5 - Use of Home Language: Allow students to discuss ideas and concepts in their native language (e.g., Spanish) to ensure comprehension.
- Scaffolding for Younger Students: Use pre-folded paper or provide simple templates for drawing.
- Extension for Older/Advanced Students: Challenge students to create a multi-layered design with three or more colors.
- Cross-Curricular Connections
- Mathematics: Directly teaches fractions (1/2, 1/4, 1/8), angles, and the geometric properties of shapes. Discuss rotational symmetry in degrees (45^\\circ, 90^\\circ, 180^\\circ).
- Science: Connect to biology by studying examples of radial symmetry in plants (flowers, dandelions) and animals (starfish, sea anemones, jellyfish). Study crystallography and the formation of snowflakes.

# Materials and Budget

The following materials are required for a workshop of 30 participants. Prices are estimates based on suggested provider Blick Art.

Core Materials

* Construction Paper: Two 12" x 12" sheets per participant in two complimentary colors. One for the design, one for the background.

* Scissors: One pair per participant.

* Glue Sticks: One stick per participant is ideal, or one per table group.

Embellishments

* Crayons, colored pencils, markers, color sharpies, puff paint (optional)

## Suggested Order

Item Description | Unit Price | Quantity | Item Subtotal

| | |
|---|---|
| Pacon Tru-Ray Construction Paper, 12"x18", 50 Sheets/Pack 1 for each color) | ($5.45 ea) (2 packs - $10.90 |
| Elmer's All-Purpose Washable Glue Sticks, Pkg of 30 | $11.99 |
| Estimated Order Total: | **$22.89** |

# Visual Resources

Visual Resources for Introduction

To enhance the introductory phase of the lesson, the use of high-quality visuals is recommended. A slideshow or collection of printed images should include:

* Nature: Sunflowers, daisies, snowflakes, starfish, sand dollars, cross-sections of fruits (kiwi, orange).

* Art & Architecture: Tibetan sand mandalas, rose windows from cathedrals (Notre Dame, Chartres), Islamic tile work, and works by M.C. Escher that feature tessellations and symmetry.

* Culture: Images of the Aztec sun stone or other cultural artifacts that use radial balance.