

Polymer Clay and Geometric Forms:

An Integrated Lesson combining Art and Math



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An Integrated Lesson: Math and Visual Art



Young
Audiences
Arts for
Learning

Northeast Ohio



Lesson Title: ***Polymer Clay and Geometric Forms***

Grade Level lesson and standards addressed for students in grade 6

Academic Subject Area(s) in this lesson: **Math**

Art Form(s) in this lesson: **Visual Art**

Brief description of lesson: This lesson looks at the historical and cultural use of non-objective patterns in art from around the world. It allows students to dissect designs and identify the critical geometric patterns incorporated within the designs and patterns. The lesson introduces and reinforces the terms and concepts used to describe geometric figures by allowing the students to manipulate them using polymer clay. The students will design flat two-dimensional patterns based on a variety of color schemes and transform those designs into three-dimensional canes using polymer clay. The clay patterns can then be sliced and used in a variety of art forms.

Academic Objectives:

Math standards addressed for grade 6:

Geometry and Spatial Sense

Benchmark D. Identify, describe and classify types of line pairs, angles, two-dimensional figures and three-dimensional objects using their properties.

- Classify and describe two-dimensional and three-dimensional geometric figures and objects by using their properties; e.g., interior angle measures, perpendicular/parallel sides, congruent angles/sides.
- Use standard language to define geometric vocabulary: vertex, face, altitude, diagonal, isosceles, equilateral, acute, obtuse, etc.
- Identify and define relationships between planes; i.e., parallel, perpendicular and intersecting.

Benchmark G. Describe and use properties of triangles to solve problems involving angle measures and side lengths of right

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triangles.

- Use multiple classification criteria to classify triangles; e.g., right scalene triangle.

Benchmark I. Identify and draw three-dimensional objects from different views (top, side, front and perspective).

- Build three-dimensional objects built with cubes and sketch the two-dimensional representations of each side; i.e., projection sets.

Artistic Objectives:

Historical, Cultural and Social Contexts

Benchmark B: Create a work of art, which incorporates the style or characteristics of artwork from a culture other than their own.

Creative Expression and Communication

Benchmark A: Apply knowledge of materials, tools, media, techniques and processes to communicate subject matter, themes or ideas in a variety of visual forms.

Benchmark C: Achieve artistic purpose and communicate intent by selection and use of appropriate media.

Connections, Relationships and Applications

Benchmark A: Demonstrate the role of visual art in solving an interdisciplinary problem.

Benchmark C: Use key concepts, issues and themes to connect visual art to various content areas.

Art from Around the World

Materials:

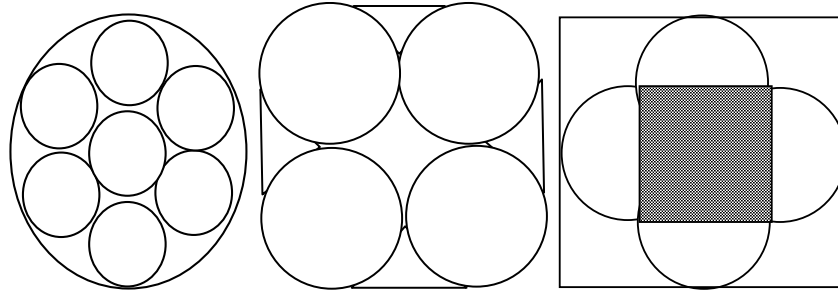
- non-objective patterns from around the world
- Scholastic Art** and **Art & Man** student publications
- library books, online sites
- sketchbooks or handouts on color
- colored pencils
- three-dimensional blocks, cylinders, triangular and rectangular prisms, half cylinders
- thick foam that can be rolled

- Use reference materials, online sites and publications to introduce the students to non-objective patterns from around the world whose designs are based on geometric shapes. These could be Native American, African, Islamic, Celtic or other designs from indigenous cultures. The lesson could focus on one culture or cross several. Similarities and differences could be incorporated, if several are used.

- Read about the patterns, their origins, meanings, symbolism and use. Dissect the designs and patterns, simplifying them into their most basic shapes. Show how many patterns demonstrate reflective or radial symmetry. Look for congruent shapes, variations in triangles, presence of ovals, ellipses, parallelograms, acute and obtuse angles, etc. Use the three-dimensional blocks and foam pieces to show how these shapes are actually the ends of geometric objects and forms.

- Have students combine simple two-dimensional geometric shapes to create circular and square designs that emphasize a cohesive composition, demonstrate repetition of shape, and show either reflective or radial symmetry.

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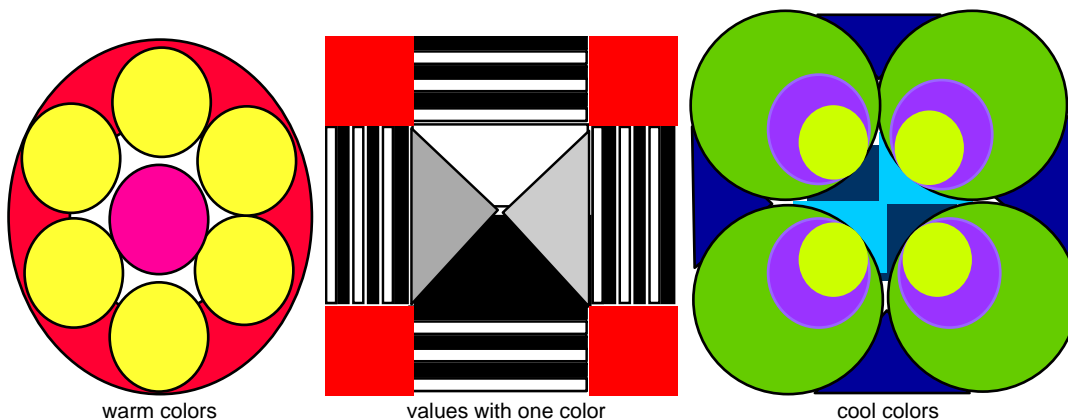


possible designs created from simple shapes

• Review colors and color theory, the logical arrangement of hues on the color wheel, the use of black and white, and how colors can impact artwork. Review and define color schemes using sketchbooks or handouts to take notes:

- **primary colors:** red, blue & yellow; the three colors from which all others are made
- **secondary colors:** orange, violet & green; achieved by mixing two primary colors
- **tertiary or intermediate colors:** made by mixing one primary with one of its adjacent secondary colors: red-orange, orange-red, violet-red, red-violet, etc.
- **warm colors:** colors on the red, orange and yellow side of the color wheel: visually advance in space
- **cool colors:** colors that contain blue and are on the violet, blue and green side of the color wheel; visually recede in space
- **tints:** a color mixed with white, sometimes referred to as pastel colors
- **shades:** colors mixed with black
- **values;** blacks, white and grays
- **neutrals;** browns, grays
- **monochromatic colors:** tints and shades of one color
- **analogous colors:** neighbors on the color wheel
- **complementary colors:** colors opposite or across from each other on the color wheel: when mixed they neutralize each other, ultimately creating a variation of brown.

• Have students add colors to their geometric designs that visually define these schemes and show student comprehension. As the students add colors, have them purposely plan the colors to add emphasis, repetition, variation, visual interest and to reflect a planned symmetry.



warm colors

values with one color

cool colors

Converting two-dimensional designs into three-dimensional polymer clay canes

-Sculpey™, Premo™, the soft Fimo™ or other soft polymer clay

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- cutting tools such as dull single-edged razor blades or thin hard aluminum sheets
- waxed paper
- small rulers
- wallpaper rollers or small cylindrical rollers
- plastic containers (such as those used to hold blueberries or fast food sandwiches)
Use the containers to store the students' work between classes so the clay doesn't smash. I use cat litter boxes to store all the boxes from one table to minimize jiggling.
- sketches

A note before you begin: It is easier to work with polymer clays that have been kneaded and softened. When colors are distributed, students soften their clay by pinching and folding it before they attempt to mix the colors needed for their designs.

A note of caution: Students must be instructed in the correct use of single-edged razor blades to avoid injuries. Have students wrap and store their blades with their clay to avoid excessive handling.

- A **cane** is a length of polymer clay that encapsulates a design the length of the clay. Think of how a baker assembles a pumpkin roll or nut roll. The cookie's design is at both ends as well as through the middle. When the baker slices the cookies the pattern is consistent throughout the length of the cookie dough. Creating polymer clay canes will provide a large amount of one single design. There are many good online resources (<http://www.polymerclaycentral.com/> and Youtube videos) and most libraries have instructional books (**400 Polymer Clay Designs**, Lark Books; **Creating with Polymer Clay**, Steven Ford & Leslie Dierks; **Creative Clay Jewelry**, Leslie Dierks) that can help the novice.

- Demonstrate approximating the amounts of colors that will be needed to mix the colors used in the students' designs. This is a good time to remind students that small amounts of dark colors are added a little at a time, just like in painting. Knead all the clay, mix all the colors and roll into spheres.

- Demonstrate how simple geometric forms can be made from the clay and how the students' designs will be converted from flat two-dimensional shape designs on their papers into three-dimensional forms that will fit together creating their color patterns. I find it easiest to roll clay from a sphere into a cylinder and then into the additional three-dimensional objects. Triangular prisms can be pinched from cylinders and rectangular prisms can be rolled from cylinders using a light touch on the wallpaper roller. Half cylinders can be cut lengthwise from a cylinder. Elliptical prisms, long thin rectangular prisms and long thin isosceles triangular prisms can be curved around a cylinder. The geometric characteristics of the flat end of each color should be maintained at all times to minimize distortion of the original design.



preparing the clay forming geometric objects assembling the forms radial symmetry cut in the center of the cane

- As the students dissect their designs, refer to the types of triangles and shapes they must replicate as three-dimensional forms. Ask for descriptive identifications, angle awareness and side lengths.

- It is important for students to understand that their clay objects need to be exactly equal in size and in shape. This site can help student review the rules and determine if their clay objects are congruent. (<http://www.mathwords.com/c/congruent.htm>)

Side-side-side congruence: When two triangles have corresponding sides that are congruent, the triangles are congruent.

Side-angle-side congruence: When two triangles have corresponding angles and sides that are congruent, the triangles are congruent.

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Angle-angle-side congruence: When two triangles have corresponding angles and sides that are congruent, the triangles are congruent.

Hypotenuse-leg congruence: When two right triangles have corresponding sides that are congruent, the triangles are congruent.



Students working on design transformations

- Have each student dissect their designs and:

1. Mix colors and roll into spheres.
2. Roll spheres into cylinders.
3. Transform cylinders into needed three-dimensional objects, limiting the cane size to about 1" in length. As the students begin to assemble their designs the cane should be about 1" in diameter.
4. Continue to assemble clay objects to replicate the designs in their sketchbooks.
5. Compress canes. Use an equal amount of pressure the entire length of the cane and slowly stretch the design. Do not be concerned if the designs on the ends of the cane become distorted. The slices from the cane will first be removed from the middle of the length of the cane.



cylinders and prisms



assembling parts



filling with prisms



stretched and rolled



cut to expose interior pattern

Applications of polymer clay cane slices

- waxed paper
- razor blades
- rollers

When several canes with coordinating or complementary designs have been formed, compressed, and stretched so they are about 1/2" in diameter and 3-4 inches long, it is time to decide what to do with these designs.

Most applications require the canes to be sliced. To ease the slicing process, chill the clay canes in the

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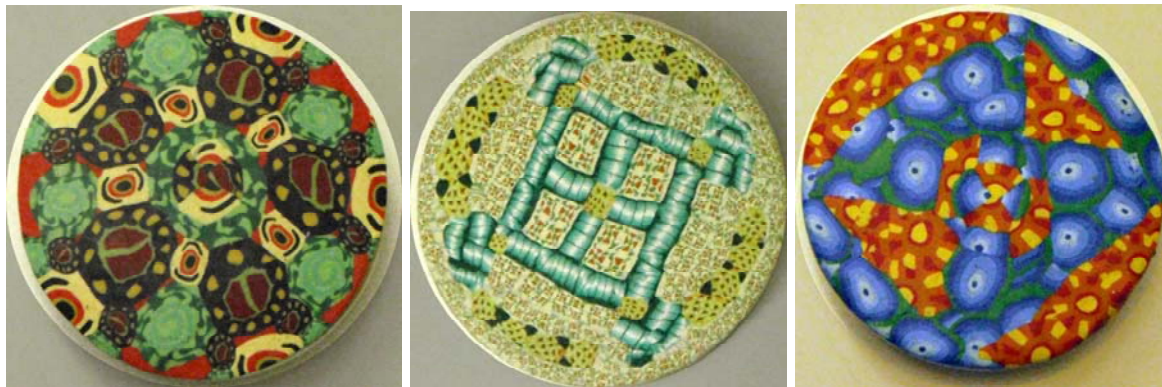
refrigerator or on a cool windowsill. Slices of canes about 1/16-1/8" thick can be used in a variety of art forms. Slices can be laid on a sheet of waxed paper and arranged into a design, so the slices abut with no space in between. Cover with additional waxed paper and gently roll with a roller until they merge forming one sheet of clay. This sheet of cane designs can be trimmed and applied directly over an **Altoids™** tin or **York Mint™** tin and baked in a 325° oven for about 15 minutes. (All baking should be done in a regular oven on a foil covered cookie sheet in a well-ventilated space. Most work can be baked at 325°F for 15-20 minutes.) A bit of **GOOP™** or **E6000™** adhesive will hold it securely once it has cooled.

Six thinner slices can be molded over cubes of "ugly" clay, compressed and gently rolled into small balls to create beads, which can then be strung together. Use a paper clip to add stringing holes before baking.

Thin slices can be molded on the outside of a glass votive candleholder, smoothed together until they merge using the wallpaper roller, and baked in the oven for a beautiful stained glass votive. Bake about 15 minutes. Cool slowly so the glass does not crack.

Some fun alternatives include:

- Covering glass salt and pepper shakers with cane patterns
- Covering thick ceramic wall hooks
- Covering metal ball point pen cases
- Making buttons
- Making pins
- Using cookie cutters to make ornaments or pins
- Creating picture frames
- Making light switch plate covers
- Covering barrettes
- Building vessels with slabs



York Mint™ tins with designs on the lids

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pins, switch plate, hook, ornaments



monochromatic necklace and beads



beads

Polymer Clay Rubric

Name _____

Date _____

Criteria	(4) Exceeds Expectations	(3) Meets Expectations	(2) Approaches Expectations	(1) Needs Improvement
Completion	Work is complete and finished to an outstanding degree.	Work is complete and finished	Work is in progress	Work is incomplete
Understanding of concepts	Superior understanding of concepts evident in work. Awareness of geometric forms & color theory evident in work	Understanding of concepts evident in work. Most geometric forms and color schemes are identifiable	Minimal understanding of concepts evident in work. Minimal identification of geometric forms or color scheme is observed	Work is random without consideration of geometric forms or color schemes
Craftsmanship/ Skills	Clay designs show understanding of color, select use of color, and interrelatedness of geometric forms: exemplary use of materials	Finished work shows good use of color, careful use of clay, materials used wisely	Use of color skills are lacking, experimented with materials, weak patterns and designs with little regard to geometric objects	Materials wasted, no patterns, designs or color understanding