

MATH CONNECTIONS

Enhance Math Knowledge with Art

PROFESSIONAL DEVELOPMENT RESOURCE FOR EDUCATORS



NOMA

New Orleans Museum of Art

Visual art can be used to promote student learning of mathematic skills and concepts. Enhancing math lessons with art enables students to make cross-curricular connections and discoveries related to math domains including geometry, measurement, ratios and proportion, fractions, and base ten. Art projects and visible project-based learning can help abstract math concepts become more tangible and may increase student understanding and retention of information.

The educator resources provided by the New Orleans Museum of Art include short descriptions and images of seven artworks from NOMA's permanent collection. Guiding questions are included to aid and encourage conversation and discussion within the classroom setting. Finally, these resources also include several lesson plans, including activities that are adaptable for most ages and abilities.

LIST OF WORKS

Alexander Calder (American, 1898 - 1976), *Mobile*, 1960, Painted metal, Bequest of Victor K. Kiam, 77.286

Wassily Kandinsky (Russian, 1866 - 1944), *Sketch for "Several Circles,"* c. 1926, Oil on canvas, Gift of Mrs. Edgar B. Stern, 64.31

Bernar Venet (French, 1941) *11 Acutes Unequal Angles*, 2016, Cor-ten steel, Museum purchase with funds provided by Sydney and Walda Besthoff, 2016.132

Joan Miró, (Spanish, 1893-1983), *Portrait of a Young Girl*, 1935, Oil with sand on cardboard, Bequest of Victor K. Kiam, 77.294

Odili Donald Odita (Nigerian, b. 1966), *Forever*, 2011, Acrylic on wall, Museum purchase: Robert P. Gordy Fund, 2011.4

Claes Oldenburg (American, born Sweden 1929) and Coosje van Bruggen (American, born Netherlands 1942), *Corridor Pin, Blue*, 1999, Stainless steel, Gift of the Sydney and Walda Besthoff Foundation, 2004.118

Frank Stella (American, born 1936), *Scramble: Ascending Yellow Values, Descending Spectrum*, 1978, Acrylic on canvas, Promised gift of Donna Perret Rosen and Benjamin M. Rosen, EL.2011.234

ON THE COVER

Frank Stella, American, 1936–2024, *Alu Truss Star*, 2016, Milled aluminium, Gift of Sydney and Walda Besthoff, 2017.229

WASSILY KANDINSKY



Wassily Kandinsky (1866-1944), *Sketch for "Several Circles,"* c. 1946, Oil on canvas, Gift of Mrs. Edgar B. Stern, 64.31

Born in Russia in 1866, Kandinsky was among the first artists to eliminate recognizable objects from his paintings, creating non-figurative works of art with mystical overtones. In 1896 Kandinsky abandoned law studies in Russia and went to Munich to learn painting. In Munich he became a founding member of the German Expressionist group *Der Blau Reiter* (*the Blue Rider*) which consisted of artists who explored the emotional and spiritual dimensions of art, emphasising abstraction, symbolism and expressive mark-making.

Like the ancient Greeks and the Europeans of the Renaissance, Kandinsky believed the arts were important for the development of humanity. To Kandinsky, art was a matter of using rhythmic lines, colors, and shapes, rather than creating a narrative. He likened these elements of painting to the combination of notes and melodies that make up a symphony. *Sketch for "Several Circles"* demonstrates a late period in which the artist began to experiment with simplified geometric forms. The combination of the opaque background with the well-lit circular forms and the transparency of the intersecting and overlapping circles implies movement and depth of the shapes.

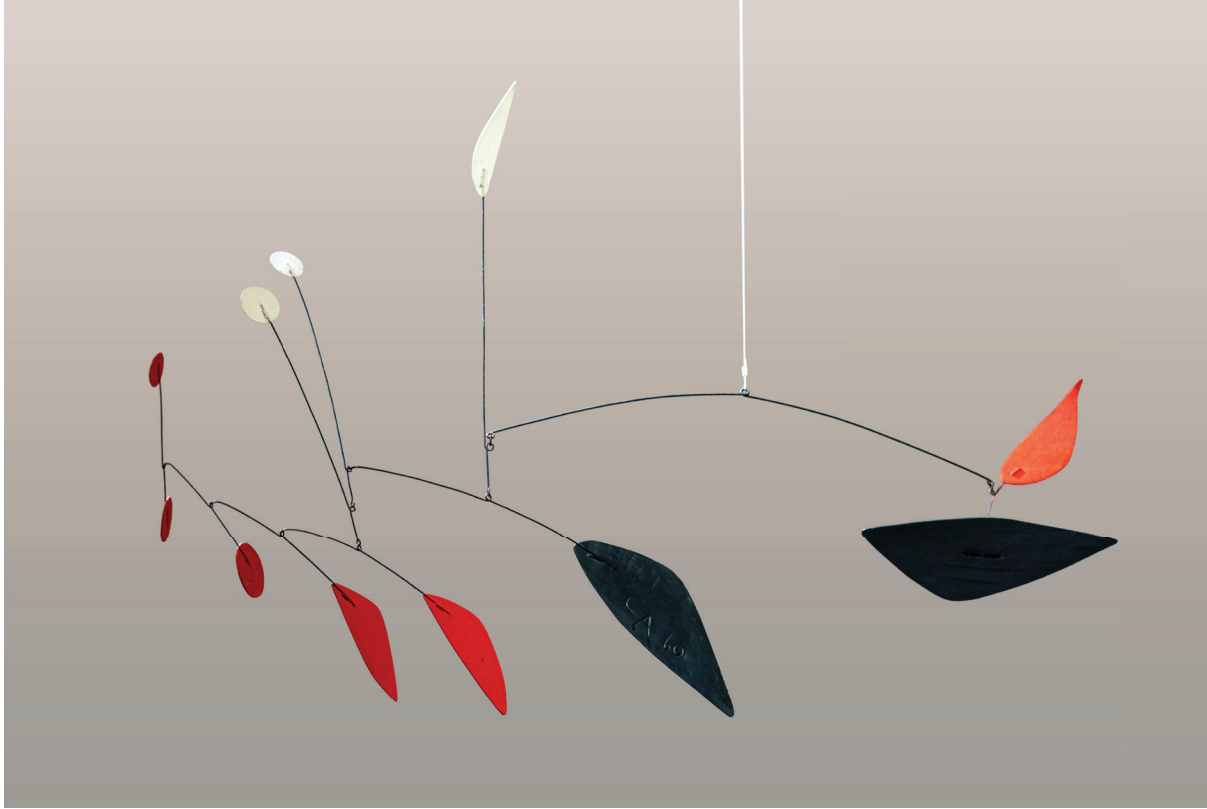
GUIDED QUESTIONS

- What shapes do you see?
- How do they interact?
- Identify an emotion that can be related to this composition.
- What does it mean for an artwork to be abstract?
- Why do you think the artist chose the particular colors and shapes in this piece?

SUGGESTED ACTIVITIES

Pattern Prints

ALEXANDER CALDER



Alexander Calder
(American, 1898–1976),
Mobile, 1960, Painted metal,
Bequest of Victor K. Kiam,
77.286

Alexander Calder came from a Pennsylvania family of artists. His father and grandfather were both sculptors and his mother was a painter.

Calder's first interest was in engineering and mechanics. He attended Stevens Institute of Technology and graduated in 1919. After receiving this degree, Calder enrolled in the Art Student's League in New York and worked as a freelance illustrator. He exhibited paintings and sculptures in New York before moving to Paris in 1926. He became known for the *Calder Circus*, a mechanical installation that included wire figures combined with cork and wood. Calder travelled in Europe and America to display the work and set in motion the individual figures and components of the *Circus*.

Inspired by contemporary artists Joan Miró and Piet Mondrian, Calder worked toward a simplification of organic forms. He introduced motion to his sculpture first by adding mechanized parts, but he eventually relied on wind or human touch to set the works in motion. Surrealist artist Marcel Duchamp was the first to call these works "mobiles," a pun derived from the French words "to move" and "motive." These kinetic sculptures were in opposition to the traditional definition of sculpture. Mobiles rely on chance and the interplay of wind and gravity. Using colorful abstract forms and balance, Calder established a unique form of art whose success requires balance, engineering, and mathematics in addition to aesthetically satisfying combinations of color, form, line, and shape.

GUIDED QUESTIONS

How do you imagine the artwork moves in space?

Does the fact that the sculpture moves change its meaning or impact?

How do you think Calder balanced this mobile?

SUGGESTED ACTIVITIES

Creating Balance

Patterns in Art

BERNAR VENET



Bernar Venet (French, 1941) *11 Acute Unequal Angles*, 2016, Cor-ten steel, Museum purchase with funds provided by Sydney and Walda Besthoff, 2016.132

Bernar Venet, a French conceptual artist, is known for his sculptures and paintings that integrate mathematical and scientific concepts. His monumental steel sculptures often feature multiple arcs, angles, and lines. His interest in art began at a young age, excelling in drawing and painting after discovering a book about Pierre-August Renoir and being supported and coached by a local artist in Château-Arnoux-Saint-Auban in France. Venet's artistic development continued after his first visit to New York in 1966, where he was introduced to Minimalist and Conceptual art. While the artist is renowned for his multidisciplinary works, his monumental steel sculptures developed in the early 1980s.

Venet's sculptural series, which includes *11 Acute Unequal Angles*, feature corten steel assemblages of acute angles, varying in heights and angular degrees. The starting point for this sculpture is a single acute angle, which is one that measures less than 90-degrees. Venet then shows this angle in different stages of expansion and contraction, staggering the forms so that the work appears to grow and shift as the viewer moves around it. While geometry provides the framework from *11 Acute Unequal Angles*, the earth-tone material pushes the sculpture's resemblance to more organic formations. The sculpture balances both visual chaos and control, as well as a tangible sense of energy.

GUIDED QUESTIONS

What types of lines do you see in these sculptures?

Why do you think there are eleven angles?

Can you hypothesize the meaning of including eleven?

How does this sculpture express time?

Can you share examples of how opposites can provide balance?

SUGGESTED ACTIVITIES

What's the Angle?
Geometric Constructions

JOAN MIRÓ



Joan Miró, (Spanish, 1893-1983), *Portrait of a Young Girl*, 1935, Oil with sand on cardboard, Bequest of Victor K. Kiam, 77.294

Joan Miró drew on memory, fantasy, and the irrational to create works of art that are visual analogues of Surrealist poetry. Forms are painted in a limited range of bright colors, especially blue, red, yellow, green, and black.

Portrait of a Young Girl is representative of the artist's gradual move from works of complete organic abstraction in 1925 and 1926 toward a more recognizable surreal fantasy. This 1935 painting recalls Miró's earlier Imaginary Portraits, although in this case, he did not use the work of another artist as a starting point for his own composition.

In *Portrait of a Young Girl*, Miró applied paint mixed with sand on cardboard, silhouetting an abstracted figure against a bright yellow background. The artist's lively wit is seen in this piece, reducing the young girl with her large hat, emphasized eyelashes, and blushing cheek to lines and biomorphic shapes. He used a few bold colors, red, yellow, and orange, with black to recreate the memory of a young girl to an image of power. Miró's painting represents his quote: "I feel the need of attaining the maximum of intensity with the minimum of means."

GUIDED QUESTIONS

How does this painting balance the real and the surreal?

How does *Portrait of a Young Girl* encourage you to use your own imagination and perception?

Why do you think the artist changes the color when the shapes overlap?

How can stylizing an object change the way you view it?

SUGGESTED ACTIVITIES

Shape Portraits

ODILI DONALD ODITA



Odili Donald Odita (Nigerian, b. 1966), *Forever*, 2011, Acrylic on wall, Museum purchase: R0bert P. Gordy Fund, 2011.4

Philadelphia-based, Nigerian-born artist Odili Donald Odita is well known for his hard-edged abstract paintings and murals in bright hues, reminiscent of African textiles. Shards of color streak across canvas and walls in carefully selected colors. Odita is inspired by an array of sources, including contemporary media-centered culture and the duality of growing up under both Nigerian and traditional American influences.

His site-specific works are designed to enliven and enhance the space in which they exist. “I like to get a feeling for a space,” Odita explains, “and then try to capture the dynamics of the space. This means not only what the space looks like, but also how it is used, how people travel and walk through it.” The selection of colors is essential to his work.

Odita was commissioned to create the wall painting *Forever* to commemorate the centennial of the New Orleans Museum of Art. Extending along the wall of the first floor McDermott Lobby, *Forever* consists of three zones separated by gallery doors. On the southern end, bright tones streak in like rays of morning light, conveying the impression of beginning. On the center wall, two planes of color converge at a centerfold, in a butterfly or mask pattern. The third section, on the northern end, consists of vertical vectors emanating from the ground reminiscent of vegetation or city lights. The artist describes the work as representing a “crossroad of class, race, culture, and space.” Odita believes that “Color in itself has the possibility of mirroring the complexity of the world as much as it has the potential for being distinct.” *Forever* includes eighty-seven hues which celebrate the vitality and diversity of New Orleans.

GUIDED QUESTIONS

How does the scale of this piece affect the way you view it?

How does the direction of the lines and angles communicate movement?

How does that relate to the title of the piece?

If you were to describe yourself as a series of different colors, what colors would they be and why?

SUGGESTED ACTIVITIES

What's the Angle?

CLAES OLDENBURG

COOSJE VAN BRUGGEN



Claes Oldenburg (American, 1929-2022) and Coosje van Bruggen (American, 1942-2009), *Corridor Pin, Blue*, 1999

Claes Oldenburg and Coosje van Bruggen's artistic practice is inspired by popular culture and mass marketing. The husband and wife artistic team are famous for monumentalizing day-to-day objects such as clothespins, rubber stamps, and safety pins. Born in Stockholm, Sweden, Oldenburg arrived in Chicago in 1937. He attended Yale University studying art and literature and then took night classes at the Art Institute of Chicago. By 1956, Oldenburg moved to New York City.

In 1960 Oldenburg established *The Store*, an installation piece in which he filled a vacant shop with sculpted parodies of consumer goods including pastries, ice cream sundaes, and articles of clothing made from painted, plaster-dipped burlap. When the exhibit closed in 1961, the shop became his studio. Oldenburg began creating large-scale, soft, collapsible sculptures of common objects made from vinyl and canvas.

Van Bruggen was born in the Netherlands and studied art history. When she met Oldenburg in 1970, they began to work as a team. Oldenburg drew the models while van Bruggen selected the colors and materials. Oldenburg and van Bruggen translated the previous giant soft sculptures into solid forms using fiberglass and bronze to create large-scale outdoor sculptures. Their inputs become so integrated that no matter what the sculpture may depict, the most important aspect of their work was their partnership.

The couple's radically large-scale objects such as *Corridor Pin, Blue* cause viewers to rethink their relationship to everyday commodities. NOMA's sculpture extends 21 feet above the garden path as visitors to the Sydney and Walda Besthoff Sculpture Garden walk underneath the outstretched arm of the pin. Oldenburg and van Bruggen's work intrigues viewers who recognize the familiar form, yet become awe-struck by its excessive size.

GUIDED QUESTIONS

What do you think Oldenburg and van Bruggen are trying to communicate by enlarging the scale of these types of objects?

How do you feel to see or stand near an object that has been enlarged in this way?

How does the artwork make you think differently about everyday objects?

How does the exaggerated scale of Oldenburg's sculptures affect your perception of the ordinary objects they represent?

SUGGESTED ACTIVITY

Scale Modeling

FRANK STELLA



Frank Stella (American, born 1936), *Scramble: Ascending Yellow Values, Descending Spectrum*, 1978, Acrylic on canvas, Gift of Donna Perret Rosen and Benjamin M. Rosen, in honor of Susan M. Taylor, 2023.53

“All I want anyone to get out of my paintings, and all I ever get out of them,” Stella said, “is the fact that you can see the whole idea without any confusion.” Frank Stella’s geometric studies of color, shape, and form, intentionally broke from the narrative traditions of easel paintings, as well as the emotionally charged Abstract Expressionist movement that directly predated his work. Stella’s work was indicative of the Hard Edge art style, which combines a clear visual composition of geometric abstraction with an intense study of color. This movement, like many of Frank Stella’s paintings, is known for its studies in shape and form, fullness of color, an impersonal execution, and its smooth surface appearance.

Scramble: Ascending Yellow Values, Descending Spectrum, created in 1977, is from Frank Stella’s *Scramble* series, which explores subtle changes in color, their relationships to other colors, and slight illusions through the appearance of concentric squares. This painting takes its title from Stella’s 1967 collaboration with modern dancer and choreographer, Merce Cunningham, for whom he designed stage sets. The painting’s rhythmic color patterns reflect the influence of music and dance. The interplay of color patterns showcasing yellow hues increasing in intensity as they move to the center of the piece paired with the descending display of the color spectrum, create a contrasting three-dimensional effect, which supports the concept of movement. Although Stella rejected the loaded, emotionally fraught nature of abstract expressionism, his works were not without meaning, incorporating the body and all of the senses into a new form of art.

GUIDED QUESTIONS

How do the two sets of color patterns provide balance to the painting?

How do these two color sequences interact within the concentric squares?

Are there any other visual elements, besides color, that contribute to the painting’s optical effects?

SUGGESTED ACTIVITY

Graphing a Design

Concentric Measurements

LESSON PLANS

The following lesson plans are designed to be partnered with the aforementioned artworks. Each lesson includes content standards, as well as the National Core Art Standards that are met. While the lesson plans are organized by grade levels, they can be modified or enhanced to reach all age groups.

ELEMENTARY EDUCATION

Pattern Prints

Shape Portrait

Creating Balance

MIDDLE SCHOOL EDUCATION

Graphing a Design

Concentric Measurements

What's the Angle?

HIGH SCHOOL EDUCATION

Scale Modeling

Patterns in Art

Geometric Constructions

PATTERN PRINTS



This lesson is in reference to Wassily Kandinsky's *Sketch for "Several Circles"*. Teachers will explain that a **sketch** is usually a quick way of drawing, developing one's ideas, and not the final work. Please encourage students to compare the circles in the painting by size, color, whether they are empty or full, etc. Explain that a **shape** is a form or outline of an object. Help the students notice how some of the shapes overlap, and the tiny dots that make a mist effect around the larger circles.

Point out how some of the **space** in the picture is plain and dark, while in other areas, the space is full of shapes and colors. **Space** is the empty place in or around something. It can be **positive** (filled) or **negative** (empty).

Introductory Questions Time: 5 min.

What do you notice about the circles?

Why do you think this artist chose to paint circles?

What do you notice about the colors?

Why do you think the artist used those colors that way?

Introduction to activity Time: 10 min.

Explain to the students that they will be making **prints** of circles, using paint and the tubes. Show them the various-sized tubes and implements to be used for **printmaking**, pressing the tools to make and remaking the circle shapes. Model the action during your explanation. Encourage them to consider using different sizes, colors, and other elements as they create their painting.

Materials

Black paper, cardboard tubes of various diameters, corks, ink daubers, circle-dot stickers, tempera paint (multiple colors), paper plates (pallets), paper towels

Lesson Extension

Provide various stencils and let the students trace different shapes onto paper.

Place shapes on a tray and cover them. Take away and have the students guess, based on the change in form, what shape was removed.

Observe their surroundings and find shapes within the environment. Encourage students to sketch their findings.

Sort buttons by size or color. Count the amount in each grouping.

Activity Time: 25 minutes

This activity can be modified to work in small groups, at centers, or as a whole-class activity. Each student will need a sheet of black paper, several colors of paint, tubes of various sizes, corks, ink daubers, circle-dot stickers, or any other materials that will help them paint in circles on the paper.

1. Give each child a sheet of black paper. The paper can be cut in half to stretch the supply. Names of the students should be written on the reverse side before any artwork is created.
2. Ask the students to look at the colors and tools available for painting and plan how they want their works to look before they use the paint.
3. Optional: Students may practice sketching circles on the reverse side with a pencil.
4. Pour each color of paint onto a paper plate and include some tubes for each color. You can demonstrate how to dip the tube in paint and print a circle shape.
5. Encourage them to overlap and vary the circle sizes, filling up the paper.
6. Let them try several versions, as artists often repeat the process multiple times.
7. Set the paintings aside to dry.

Reflection Time: 5 minutes

View the finished paintings together. Compare and contrast the circles in the different paintings as they did when they were introduced to the painting. Encourage the students to count specific categories of circles. For example, "Can you count all the orange circles?" Have some students discuss their own work, the decisions they made, and their ideas. Congratulate them on their hard work and fabulous art!

Vocabulary

Sketch • Shape • Space • Positive Space • Negative Space • Printmaking

Curriculum Standards for Pattern Prints Activity

National Visual Arts Standards

VA: Cr1.2. PKa	Engage in self-directed creative making
VA: Cr2.1. PKa	Use a variety of art-making tools
VA: Cr2.2. PKa	Share materials with others
VA: Cr1.2.Ka	Engage collaboratively in creative art-making in response to an artistic problem.
VA: Cr2.1.Ka	Through experimentation, build skills in various media and approaches to artmaking.
VA: Re.7.2.Ka	Describe what an image represents.
VA: Re8.1.Ka	Interpret art by identifying subject matter and describing relevant details.
VA: Cr1.2.1a	Use observation and investigation in preparation for making a work of art.
VA: Cr2.1.1a	Explore uses of materials and tools to create works of art or design.
VA: Cr3.1.1a	Use art vocabulary to describe choices while creating art.
VA: Cr1.2.2a	Make art or design with various materials and tools to explore personal interests, questions, and curiosity.
VA: Cr2.3.2a	Repurpose objects to make something new.
VA: Re.7.1.2a	Perceive and describe aesthetic characteristics of one's natural world and constructed environments.
VA: Cr2.1.3a	Create personally satisfying artwork using a variety of artistic processes and materials.
VA: Cr2.2.3a	Demonstrate an understanding of the safe and proficient use of materials, tools, and equipment for a variety of artistic processes.
VA:Re8.1.3a	Interpret art by analyzing use of media to create subject matter, characteristics of form, and mood.
VA:Cr1.1.4a	Brainstorm multiple approaches to a creative art or design problem.
VA:Cr2.1.4a	Explore and invent art-making techniques and approaches.
VA:Re.7.2.4a	Analyze components in visual imagery that convey messages.
VA:Re8.1.4a	Interpret art by referring to contextual information and analyzing relevant subject matter, characteristics of form, and use of media.
VA:Cr1.2.5a	Identify and demonstrate diverse methods of artistic investigation to choose an approach for beginning a work of art.
VA:Cr2.1.5a	Experiment and develop skills in multiple art-making techniques and approaches through practice.
VA:Cr2.2.5a	Demonstrate quality craftsmanship through care for and use of materials, tools, and equipment.

Louisiana State Math Standards

CM 1.3.4	Tell how many objects are in a group by giving the last number counted (cardinality).
CM 4.2.4	Identify basic shapes (e.g., circle, square, triangle, rectangle) regardless of size and orientation.
CM 4.3.4	Describe basic two- and three-dimensional shapes (e.g., a square has four sides, a ball rolls).
1.OA.C	Relate counting to addition and subtraction (e.g., by counting on 2 to add 2).
1.G.A	Reason with shapes and their attributes.
3.MD.	Geometric measurement: recognize perimeter as an attribute of plane figures and distinguish between linear and area measures.
3.G.A.1	Understand that shapes in different categories (e.g., rhombuses, rectangles, and others) may share attributes (e.g., having four sides), and that the shared attributes can define a larger category (e.g., quadrilaterals). Recognize rhombuses, rectangles, and squares as examples of quadrilaterals, and draw examples of quadrilaterals that do not belong to any of these subcategories

SHAPE PORTRAIT



This lesson is written in connection with Joan Miró's *Portrait of a Young Girl*, though it can be modified to fit with other artworks from this Math Resource. Teachers can explain and model for students how parts of the face can be simplified and stylized into more recognizable shapes. For example, the nose can be simplified and stylized into a triangle, or a rectangle and two small circles for the nostrils. Teachers can explain that a **shape** is a flat, two-dimensional area defined by its edges and outline. Teachers can encourage students to consider the **proportion** and **scale** of each shape so that it may help relate to the proportions of the face. Students can cut their own shapes while also incorporating pre-cut shapes to **collage** a portrait, inspired by Joan Miró's *Portrait of a Young Girl*.

Introductory Questions Time: 5 min.

What shapes are similar to our facial features?

What is a collage and how are they made?

How does *Portrait of a Young Girl* encourage you to use your own imagination and perception?

Introduction to activity Time: 10 min.

Students will work in pairs to create portraits of a partner. Teachers will provide cut out shapes in addition to students cutting out shapes from construction paper using templates or free-hand. Each student will need a large sheet of construction paper for the background of their portrait. Students should lay out all shapes before gluing any paper to the base. Remind students that people are symmetrical and features or the face should be in proportion to the others.

Materials

Age and ability appropriate scissors, pencils, erasers, construction paper, and glue sticks

Lesson Extensions

Encourage students to cut all shapes, free-hand, independently

The lesson can be organized into stations for more independent creation

Have students measure the shapes they create in order to maintain consistent scale

Students can complete more detailed and complex collages, like the entire figure, for example, and work with smaller shapes

Activity Time: 40 minutes

This activity can be modified to work in small groups or at centers. Teachers will demonstrate the drawing of the portrait, focusing on simplifying the features of the face and maintaining symmetry.

1. Students will then pair up to sketch their partner on a practice sheet of paper while the teacher begins to prepare materials for the next steps.
2. The teacher will distribute the construction paper background.
3. Students will compose their portrait lightly in pencil on the background paper, in order to help guide their collaged shapes.
4. Teachers will then distribute scissors and additional construction paper to be used for the cutting of shapes. Small amounts of pre-cut shapes can be distributed at this time as well.
5. Students will cut shapes and begin planning their portrait. Remind students that it is important to place shapes without glueing them down at first, to ensure proper proportions and composition.
6. Once shapes are cut and placed, Students may begin gluing the shapes to compose the portrait. Encourage students to work from the background (skin of face) to the foreground (facial features and hair).
7. Allow to dry.

Reflection Time: 5 minutes

Review the portraits with students. Have students point out the shapes that they used to compose the features of their portraits. Review concepts such as proportions and scale and ask the students how they achieved proportion in their portraits. Ask the students if the same concept of proportion was applied to Miró's *Portrait of a Young Girl*. Have students guess the student represented in the portrait.

Vocabulary

Shape • Proportion • Scale • Collage

Curriculum Standards for Shape Portrait Activity

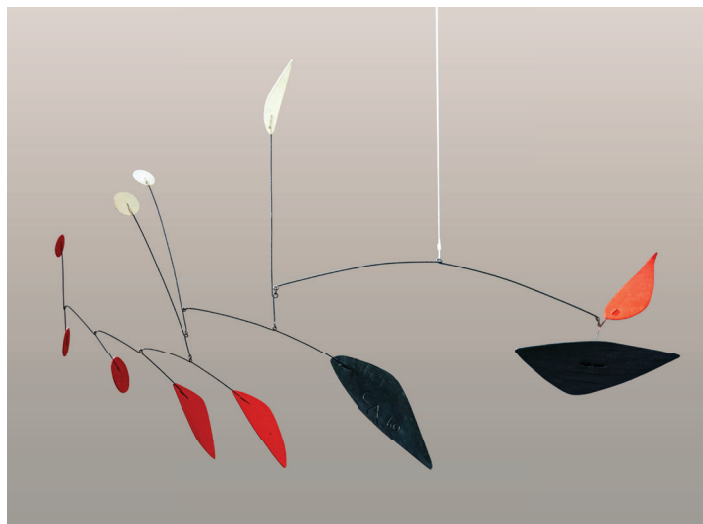
National Visual Arts Standards

VA:Cr1.1.Ka	Engage in exploration and imaginative play with materials.
VA:Cr1.2.Ka	Engage collaboratively in creative art-making in response to an artistic problem.
VA:Cr2.1.Ka	Through experimentation, build skills in various media and approaches to artmaking.
VA:Cr1.2.1a	Use observation and investigation in preparation for making a work of art.
VA:Cr2.1.1a	Explore uses of materials and tools to create works of art or design.
VA:Cr2.2.1a	Demonstrate safe and proper procedures for using materials, tools, and equipment while making art.
VA:Re.7.2.1a	Compare images that represent the same subject.
VA:Cr2.1.2a	Experiment with various materials and tools to explore personal interests in a work of art or design.
VA:Cr2.2.2a	Demonstrate safe procedures for using and cleaning art tools, equipment, and studio spaces.
VA:Cr3.1.2a	Discuss and reflect with peers about choices made in creating artwork.
VA:Cr2.1.3a	Create personally satisfying artwork using a variety of artistic processes and materials.
VA:Cr2.2.3a	Demonstrate an understanding of the safe and proficient use of materials, tools, and equipment for a variety of artistic processes
VA:Re8.1.3a	Interpret art by analyzing use of media to create subject matter, characteristics of form, and mood.
VA:Re9.1.3a	Evaluate an artwork based on given criteria.
VA:Cr1.1.4a	Brainstorm multiple approaches to a creative art or design problem.
VA:Cr2.2.4a	When making works of art, utilize and care for materials, tools, and equipment in a manner that prevents danger to oneself and others.
VA:Re8.1.4a	Interpret art by referring to contextual information and analyzing relevant subject matter, characteristics of form, and use of media.
VA:Cr2.1.5a	Experiment and develop skills in multiple art-making techniques and approaches through practice.
VA:Cr2.2.5a	Demonstrate quality craftsmanship through care for and use of materials, tools, and equipment.
VA:Re.7.1.5a	Compare one's own interpretation of a work of art with the interpretation of others.
VA:Re.7.2.5a	Identify and analyze cultural associations suggested by visual imagery.

Louisiana State Math Standards

CM 4.2.4	Identify basic shapes (e.g., circle, square, triangle, rectangle) regardless of size and orientation.
CM 4.3.4	Describe basic two- and three-dimensional shapes (e.g., a square has four sides, a ball rolls).
K.MD.A.1	Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object.
K.G.A	Identify and describe shapes (squares, circles, triangles, rectangles, hexagons, cubes, cones, cylinders, and spheres).
K.G.B	Analyze, compare, create, and compose shapes.
1.MD.C	Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another.
1.G.A	Reason with shapes and their attributes.
2.MD.A.4	Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard length unit.
1.G.A	Reason with shapes and their attributes
3.MD.C	Geometric measurement: understand concepts of area and relate area to multiplication and to addition.
3.G.A.1	Understand that shapes in different categories (e.g., rhombuses, rectangles, and others) may share attributes (e.g., having four sides), and that the shared attributes can define a larger category (e.g., quadrilaterals). Recognize rhombuses, rectangles, and squares as examples of quadrilaterals, and draw examples of quadrilaterals that do not belong to any of these subcategories
4.MD.C.5	Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement
4.G.A.2	Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence or absence of angles of a specified size. Recognize right triangles as a category, and identify right triangles

CREATING BALANCE



This lesson was inspired by Alexander Calder's *Mobile*, which was created in 1960 and can be found at the New Orleans Museum of Art. Students will build their own **mobiles** from **found objects**, foam shapes, and pipe cleaners. After discussing the **Law of Levers** with the students, they will be able to determine the weight and distance required to achieve **balance**. Younger learners may establish balance by trial and error. Older elementary students are encouraged to measure lengths and distances of the components of their mobiles.

Introductory Questions Time: 15 min.

Have you ever tried to balance on one leg?

What do you think would happen if someone gave you a heavy bag to hold in one hand while you were balancing?

How do you think Calder balances his objects included in *Mobile* when they appear to be different sizes?

Can you give examples of things that move but also can balance? (ie. a see-saw)

Introduction to activity Time: 10 min.

Students may work independently or in pairs for this activity. Those being encouraged to measure may require independent work, while those participating in trial and error may work with a partner. Teachers will introduce the concept of the Law of Levers in which a bar or horizontal line, or the **lever**, pivots around a fixed point, the **fulcrum**. The distance from the fulcrum to where the effort is applied is the effort arm, and the distance from the fulcrum to the weight or object is the load arm. You can use a longer effort arm to move a heavier load with a smaller amount of force.

Teachers will distribute materials, explaining to the students that they will use this understanding of the Law of Levers, connecting the pipe cleaners to create the levers and fulcrum, attaching found objects and foam shapes to the ends in order to create their own mobiles, maintaining a balance between the found objects and foam pieces.

As a part of the reflection, students may showcase their mobiles and test its balance.

Materials

Pipe cleaners, found objects, foam shapes, glue, string

Activity Time: 25 – 30 minutes

This lesson can be modified for independent or partner work. Teachers are encouraged to create their own mobile in order to provide visual aid to label the different parts of a mobile.

1. After the lesson's introduction, the teacher will distribute the proper amount of materials to the students.
2. Students will identify the fulcrum of their mobile, making creative decisions regarding the length of the levers before securing them to the fulcrum.
3. Older students can measure the length of their levers prior to attaching their mobile objects with glue or securing with a pipe cleaner.
4. Students can begin attaching different found objects and foam pieces to the pipe cleaners with glue or securing with the pipe cleaner, periodically lifting their mobile to check and see if there is equal balance present.
5. Students are encouraged to make revisions throughout the process, showcasing resilience and creative problem solving.
6. Students can tie a string to the center of their mobile in order to display or hold their artworks.

Reflection Time: 5 minutes

Students can either attach their completed mobiles to a secured pole or rod or they can simply display their work, holding it with one hand by the attached string. Each student or pair can display their artworks, communicating their thoughts and creative process. Students can explain which objects may weigh more than the others, or students can hypothesize and guess.

Vocabulary

Mobiles • Found Object Art • Lever • Law of Levers
Balance • Fulcrum

Curriculum Standards for Creating Balance Activity

National Visual Arts Standards

VA: Cr1.2. PKa	Engage in self-directed creative making
VA:Cr2.1. PKa	Use a variety of art-making tools
VA:Cr2.2. PKa	Share materials with others
VA:Cr1.2.Ka	Engage collaboratively in creative art-making in response to an artistic problem.
VA:Cr2.1.Ka	Through experimentation, build skills in various media and approaches to artmaking.
VA:Cr1.2.1a	Use observation and investigation in preparation for making a work of art.
VA:Cr2.1.1a	Explore uses of materials and tools to create works of art or design.
VA:Cr3.1.1a	Use art vocabulary to describe choices while creating art.
VA:Cr1.2.2a	Make art or design with various materials and tools to explore personal interests, questions, and curiosity.
VA:Cr2.1.2a	Experiment with various materials and tools to explore personal interests in a work of art or design.
VA:Cr2.3.2a	Repurpose objects to make something new.
VA:Cr2.1.3a	Create personally satisfying artwork using a variety of artistic processes and materials.
VA:Cr2.2.3a	Demonstrate an understanding of the safe and proficient use of materials, tools, and equipment for a variety of artistic processes
VA:Re9.1.3a	Evaluate an artwork based on given criteria.
VA:Cr1.1.4a	Brainstorm multiple approaches to a creative art or design problem.
VA:Cr2.2.4a	When making works of art, utilize and care for materials, tools, and equipment in a manner that prevents danger to oneself and others.
VA:Re8.1.4a	Interpret art by referring to contextual information and analyzing relevant subject matter, characteristics of form, and use of media.
VA:Cr1.2.5a	Identify and demonstrate diverse methods of artistic investigation to choose an approach for beginning a work of art.
VA:Cr2.1.5a	Experiment and develop skills in multiple art-making techniques and approaches through practice.
VA:Cr2.2.5a	Demonstrate quality craftsmanship through care for and use of materials, tools, and equipment.

Louisiana State Math Standards

AL 1.3.4	Complete multi-step tasks independently.
AL 2.1.4	Maintain focus on adult-directed activities with adult support.
AL 2.2.4	Persist with a challenging task despite interruptions and disruptions.
CM 3.1.4	Sort objects by one characteristic (attribute), then re-sort using a different characteristic, and explain the reasoning with guidance and support.
CM 3.2.4	Describe measurable attributes of objects and materials using comparative words (e.g., long, longer, longest).
K.MD.A.1	Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object.
1.MD.A.1	Order three objects by length; compare the lengths of two objects indirectly by using a third object.
1.MD.A.2	Express the length of an object as a whole number of length units, by laying multiple copies of a shorter object (the length unit) end to end; understand that the length measurement of an object is the number of same-size length units that span it with no gaps or overlaps
2.MD.A.1	Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.
2.MD.A.4	Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard length unit.
4.G.A.2	Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence or absence of angles of a specified size. Recognize right triangles as a category, and identify right triangles.
5.MD.A.1	Convert among different-sized standard measurement units within a given measurement system, and use these conversions in solving multi-step, real-world problems.

GRAPHING A DESIGN



This lesson is supported by the artwork by Frank Stella, *Scramble: Ascending Yellow Values, Descending Spectrum*. Stella's *Scramble* series showcase the qualities of the Hard Edge art style, which combines a clear visual **composition** of geometric abstraction with an intense study of color. For this lesson, students will create a geometric work of art, first on a small scale, then using their original piece as a blueprint for a much larger work. Students must exhibit an understanding of **perimeter, multiplication, and percentages or fractions** in order to complete this lesson. This lesson can be elevated for more advanced learning, or scaled back for younger learners.

Introductory Questions Time: 5 min.

What methods do you think Frank Stella used to compose these concentric squares so equally and consistently?

Why do you think the artist chose this particular shape to complete this composition?

Can you explain the contrast between the title of the work in the series, *Scramble*, with the composition of *Scramble: Ascending Yellow Values, Descending Spectrum*?

How do you think the colors used in this work impact the rigidity of the squares?

Introduction to Activity Time: 15 min.

Scramble: Ascending Yellow Values, Descending Spectrum exhibits a series of concentric squares and displays two separate sequences of colors. Students will be encouraged to compose their own geometric abstraction similar to Frank Stella's work. They will then be challenged to complete a series of mathematical assessments about their design, which will lead to their creating a large-scale version of their artwork, using the original as a type of blueprint. This work can be done with a variety of materials. For the sake of this lesson plan, post-it will be used, though construction paper can also be employed.

Materials

Graph paper, color pencils, markers, pencils, scratch paper, post-its

Lesson Extension

Students can write their equation for the array displayed in their design.

They can then determine the area and perimeter of their creations.

Students can incorporate additional mathematics, such as percentages, fractions, and multiplication in order to properly scale their designs to create large-scale works.

Teachers can pre-cut the graph paper to 10x10 squares to help younger learners with base ten counting and grouping.

Activity Time: 40 – 60 minutes

This lesson can be modified for independent or partner work. This lesson can be elevated or simplified, based on the mathematics applied throughout the lesson.

1. Once the lesson and artwork has been presented, teachers will distribute scratch paper and pencils to students.
2. Students will develop design ideas, sketching their geometric designs in pencil. Once students have developed their design, teachers will distribute graph paper and color pencils.
3. Teachers will explain that students will transfer their geometric designs onto their graph paper, filling in each square completely, excluding curved lines, using the graph paper as a guide, incorporating color inspiration from Frank Stella's artwork, into their design.
4. Students will then calculate the dimensions of their designs using post-it notes or pre-cut squares, to determine the size of their enlarged work.
5. Works can be installed on classroom walls with painters tape or post-it adhesive. Artworks could also be installed on wall space around the school, with support from school leadership.

Reflection Time: 10 minutes

Students can present their installations along with their original graph paper, discussing the mathematics used to determine the large-scale dimensions. Students may also discuss their color choices and how it is inspired by the artist's painting. Their classmates can ask questions about their choices and challenges before moving to the next installation.

Vocabulary

Composition • Perimeter • Multiplication • Percentages • Fractions • Color Theory

Curriculum Standards for Graphing a Design Activity

National Visual Arts Standards

VA:Cr1.1.5a	Combine ideas to generate an innovative idea for art making
VA:Cr1.2.5a	Identify and demonstrate diverse methods of artistic investigation to choose an approach for beginning a work of art.
VA:Re8.1.5a	Interpret art by analyzing characteristics of form and structure, contextual information, subject matter, visual elements, and use of media to identify ideas and mood conveyed.
VA:Re9.1.5a	Recognize differences in criteria used to evaluate works of art depending on styles, genres, and media as well as historical and cultural contexts.
VA:Cr2.1.6a	Demonstrate openness in trying new ideas, materials, methods, and approaches in making works of art and design.
VA:Pr5.1.6a	Individually or collaboratively, develop a visual plan for displaying works of art, analyzing exhibit space, the needs of the viewer, and the layout of the exhibit.
VA:Re9.1.6a	Develop and apply relevant criteria to evaluate a work of art.
VA:Cr1.2.7a	Develop criteria to guide making a work of art or design to meet an identified goal.
VA:Cr2.1.7a	Demonstrate persistence in developing skills with various materials, methods, and approaches in creating works of art or design.
VA:Cr2.3.7a	Apply visual organizational strategies to design and produce a work of art, design, or media that clearly communicates information or ideas.
VA:Pr5.1.7a	Based on criteria, analyze and evaluate methods for preparing and presenting art.
VA:Re.7.1.7a	Explain how the method of display, the location, and the experience of an artwork influence how it is perceived.
VA:Cr1.1.8a	Document early stages of the creative process visually and/or verbally in traditional or new media.
VA:Cr2.1.8a	Demonstrate willingness to experiment, innovate, and take risks to pursue ideas, forms, and meanings that emerge in the process of artmaking or designing.
VA:Cr3.1.8a	Apply relevant criteria to examine, reflect on, and plan revisions for a work of art or design in progress

Louisiana State Math Standards

RP.A.1	Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.
6.RP.A.3	Use ratio and rate reasoning to solve real-world and mathematical problems.
6.NS.A.1	Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions.
6.NS.B	Compute fluently with multi-digit numbers and find common factors and multiples.
6.G.A	Solve real-world and mathematical problems involving area, surface area, and volume.
7.RP.A.1	Compute unit rates associated with ratios of fractions, including ratios of lengths, areas, and other quantities measured in like or different units.
7.RP.A.2	Recognize and represent proportional relationships between quantities.
7.NS.A.2	Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers.
7.G.A.1	Solve problems involving scale drawings of geometric figures, such as computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.
7.G.A.2	Draw (freehand, with ruler and protractor, or with technology) geometric shapes with given conditions.
7.G.B	Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.
8.EE.B	Understand the connections between proportional relationships, lines, and linear equations.

CONCENTRIC MEASUREMENTS

This lesson is supported by the artwork by Frank Stella, *Scramble: Ascending Yellow Values, Descending Spectrum*. In the 1960's, Stella became known for his geometric works that employed thoughtful **color schemes** in order to create a sense of movement. Each **concentric** square of color was related to the next in either a harmonious or contrasting fashion. In this lesson, students will use a series of consecutive measurements to determine their own series of squares, with each concentric square decreasing in width. This will create the **illusion** of 3-dimensional **depth**. To reinforce this illusion, students will choose a color scheme that increases in **tint** with each concentric square.



Introductory Questions Time: 5 min.

How do the two sets of color patterns provide balance to the painting?

How can altering the width of the squares help to create movement?

Do you think that gradual change of width will alter the illusion? How?

Why do you think the artist was motivated to create this series or paintings?

Introduction to Activity Time: 15 min.

Scramble: Ascending Yellow Values, Descending Spectrum exhibits a series of concentric squares and displays two separate sequences of colors. This lesson is inspired by the use and alteration of line, shape, and color to provide the illusion of movement on a 2-dimensional surface. As a class, the teachers and students will discuss the **composition** of Frank Stella's *Scramble* series, particularly, *Scramble: Ascending Yellow Values, Descending Spectrum*. Teachers will encourage students to observe the choices and patterns used by the artist and encourage the class to consider how they would establish similar patterns to create their own works of art. The teacher will explain that students will receive a 12"x12" piece of paper and students will establish the width of their outer square, then make each concentric square increasingly thinner by a pattern of measurement established by the student. For example, if the outer square is 3" wide, the student can decrease the concentric squares by a sixteenth of an inch each time, as they work towards the center of the paper.

Materials

Pre-cut 12"x12" sheets of paper, pencils, rulers, markers, color pencils

Lesson Extension

Classes can elevate the artwork by using sheets of canvas, masking tape, and acrylic paint to create paintings inspired by *Scramble: Ascending Yellow Values, Descending Spectrum*.

Teachers can assign certain equations to have students establish how to decrease the width of each concentric square, to deepen mathematical understanding.

Students can choose more complicated shapes, such as stars, while maintaining the mathematical patterns.

If students finish early, they may create a second artwork, reversing the pattern and color scheme in order to create the opposite progression.

Activity Time: 40 – 60 minutes

1. Teachers will distribute materials while reinforcing the expectations and objectives for the lesson.
2. Students will consider a color scheme for their project that will help reinforce the illusion of depth.
3. Students will establish the width of the first outer square, using their rulers and pencils and determine the pattern of measurements required to decrease the width of the subsequent squares to create the illusion of depth.
4. Once the students establish their plan, they are encouraged to use their rulers and pencils to complete the drawing of the squares.
5. Students may use markers or color pencils to create their predetermined color scheme that will reinforce the illusion of depth.
6. Teachers will encourage students to maintain craftsmanship and neatness, as observed in Frank Stella's *Scramble: Ascending Yellow Values, Descending Spectrum* in order to create successful movement and illusions through the use of line, shape, consistent measurements, and color schemes.

Reflection Time: 10 minutes

Students will present their artworks, and classmates can guess the measurements used to create the illusion of depth. Students will also explain their color scheme choices and how it relates to Frank Stella's *Scramble: Ascending Yellow Values, Descending Spectrum*. Students are encouraged to participate in a group critique using "I think..., I see..., I wonder..." format.

Vocabulary

Color schemes • Concentric • Illusion • Depth • Tint • Composition

Curriculum Standards for Concentric Measurements Activity

National Visual Arts Standards

VA:Cr1.1.5a	Combine ideas to generate an innovative idea for artmaking
VA:Cr1.2.5a	Identify and demonstrate diverse methods of artistic investigation to choose an approach for beginning a work of art.
VA:Cr2.2.5a	Demonstrate quality craftsmanship through care for and use of materials, tools, and equipment.
VA:Re8.1.5a	Interpret art by analyzing characteristics of form and structure, contextual information, subject matter, visual elements, and use of media to identify ideas and mood conveyed.
VA:Cr2.1.6a	Demonstrate openness in trying new ideas, materials, methods, and approaches in making works of art and design.
VA:Cr3.1.6a	Reflect on whether personal artwork conveys the intended meaning and revise accordingly. VA:Re8.1.6a Interpret art by distinguishing between relevant and non-relevant contextual information and analyzing subject matter, characteristics of form and structure, and use of media to identify ideas and mood conveyed.
VA:Re9.1.6a	Develop and apply relevant criteria to evaluate a work of art.
VA:Cr1.2.7a	Develop criteria to guide making a work of art or design to meet an identified goal.
VA:Cr2.1.7a	Demonstrate persistence in developing skills with various materials, methods, and approaches in creating works of art or design.
VA:Cr2.3.7a	Apply visual organizational strategies to design and produce a work of art, design, or media that clearly communicates information or ideas.
VA:Pr5.1.7a	Based on criteria, analyze and evaluate methods for preparing and presenting art.
VA:Cr1.1.8a	Document early stages of the creative process visually and/or verbally in traditional or new media.
VA:Cr2.1.8a	Demonstrate willingness to experiment, innovate, and take risks to pursue ideas, forms, and meanings that emerge in the process of artmaking or designing.
VA:Cr3.1.8a	Apply relevant criteria to examine, reflect on, and plan revisions for a work of art or design in progress

Louisiana State Math Standards

6.RP.A.3.d	Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.
6.NS.B	Compute fluently with multi-digit numbers and find common factors and multiples.
6.EE.C	Represent and analyze quantitative relationships between dependent and independent variables.
6.G.A	Solve real-world and mathematical problems involving area, surface area, and volume
6.SP.B.5	Summarize numerical data sets in relation to their context.
7.RP.A	Analyze proportional relationships and use them to solve real-world and mathematical problems
7.RP.A.2	Recognize and represent proportional relationships between quantities
7.NS.A	Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.
7.G.A	Draw, construct, and describe geometrical figures and describe the relationships between them.
7.G.B	Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.
8.G.A.4	Explain that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them.

WHAT'S THE ANGLE?



This lesson is inspired by and can include both Bernar Venet's *11 Acute Unequal Angles* and Odili Donald Odita's *Forever*. "What's the Angle?" is a great activity that can be used either before or after a visit to NOMA. It is a wonderful way to prepare students for a visit or reflect upon a visit as a way to discuss one of the many ways in which mathematics and visual arts can enhance one another. Venet's sculpture, *11 Acute Unequal Angles*, showcases multiple **acute angles** varying in heights and degrees. Odita created *Forever* to celebrate the diversity and vitality of New Orleans, using bands of color that relate and interact with one another to create a sense of energy that is typically associated with our vibrant city. Students can use their understanding of geometry to analyze the **angles** depicted in these artworks.

Introductory Questions Time: 5 min.

What is an acute angle?

How can angles be used to create **movement** in visual arts?

What qualities do angles provide in Venet's sculpture? What about in Odita's *Forever*?

Can you draw comparisons or contrasts between the two?

What are tools that you can use to measure and record the heights and degrees of angles?

Introduction to Activity Time: 10 min.

After discussing the works, their intentions, and how the use of lines and angles helps to imply movement, teachers will distribute printed copies of the aforementioned artworks from NOMA's collection, as well as additional artworks if the teacher so chooses. Teachers will instruct students to use rulers, compasses, and protractors to measure shapes and angles within the work. Students will then calculate the area and volumes for designated shapes. Students can also propose a series of alternate angles to discuss how it would alter the dynamics of the artworks. Students will document their findings and alternate proposals and submit them to the teacher and classmates to check for accuracy.

Materials

Print outs of the artworks, rulers, compasses, protractors, pencils, scratch papers

Lesson Extension

Algebraic and geometric equations could be created to find the area of the triangles in Bernar Venet's *11 Acute Unequal Angles* or selected triangles in Odili Donald Odita's *Forever*.

Students could create a work of art inspired by these pieces with assigned angles and shapes.

Activity Time: 25 – 30 minutes

1. Class will discuss the artworks presented, noting the presence of several angles and shapes, determining their impact on the artwork.
2. Teachers will distribute the printed copies of the artworks as they are communicating the expectations.
3. Teachers will distribute measuring materials to students so that they may determine the angles and degrees present in the artworks, documenting their findings.
4. Students will use the tools provided to document the types of angles and degrees present in the artworks.
5. Students will use these measurements to then calculate the area and volumes for certain shapes presented in the work.

Reflection Time: 5 minutes

Students will reflect on their findings, submitting their findings to the teacher in order to assess their work for accuracy. Students will muse and discuss as a class what the use of these angles and shapes had in these artworks and consider where they have seen angles and lines used so intentionally in other artworks.

Vocabulary

Angles • Acute Angles • Movement

Curriculum Standards for What's the Angle Activity

National Visual Arts Standards

VA:Cr1.2.6a	Formulate an artistic investigation of personally relevant content for creating art.
VA:Cr2.1.6a	Demonstrate openness in trying new ideas, materials, methods, and approaches in making works of art and design.
VA:Cr3.1.6a	Reflect on whether personal artwork conveys the intended meaning and revise accordingly.
VA:Re8.1.6a	Interpret art by distinguishing between relevant and non-relevant contextual information and analyzing subject matter, characteristics of form and structure, and use of media to identify ideas and mood conveyed.
VA:Re9.1.6a	Develop and apply relevant criteria to evaluate a work of art.
VA:Cr1.2.7a	Develop criteria to guide making a work of art or design to meet an identified goal.
VA:Cr2.3.7a	Apply visual organizational strategies to design and produce a work of art, design, or media that clearly communicates information or ideas.
VA:Pr6.1.7a	Compare and contrast viewing and experiencing collections and exhibitions in different venues.
VA:Re.7.2.7a	Analyze multiple ways that images influence specific audiences.
VA:Re8.1.7a	Interpret art by analyzing artmaking approaches, the characteristics of form and structure, relevant contextual information, subject matter, and use of media to identify ideas and mood conveyed.
VA:Re9.1.7a	Compare and explain the difference between an evaluation of an artwork based on personal criteria and an evaluation of an artwork based on a set of established criteria.
VA:Cr2.1.8a	Demonstrate willingness to experiment, innovate, and take risks to pursue ideas, forms, and meanings that emerge in the process of artmaking or designing.
VA:Cr3.1.8a	Apply relevant criteria to examine, reflect on, and plan revisions for a work of art or design in progress.

Louisiana State Math Standards

6.EE.A	Apply and extend previous understandings of arithmetic expressions.
6.EE.C	Represent and analyze quantitative relationships between dependent and independent variables.
6.G.A	Solve real-world and mathematical problems involving area, surface area, and volume.
7.RP.A	Analyze proportional relationships and use them to solve real-world and mathematical problems.
7.RP.A.2	Recognize and represent proportional relationships between quantities.
7.EE.B.3	Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.
7.G.A.1	Solve problems involving scale drawings of geometric figures, such as computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.
7.G.A.2	Draw (freehand, with ruler and protractor, or with technology) geometric shapes with given conditions. (Focus is on triangles from three measures of angles or sides, noticing when the conditions determine one and only one triangle, more than one triangle, or no triangle.)
7.G.B	Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.
7.G.B.5	Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure.
7.G.B.6	Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.
8.EE.B	Understand the connections between proportional relationships, lines, and linear equations.
8.EE.B.6	Use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at b .
8.EE.C	Analyze and solve linear equations and pairs of simultaneous linear equations.
8.F.A	Define, evaluate, and compare functions.
8.G.B.7	Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.

GEOMETRIC CONSTRUCTION



This lesson is inspired by Bernar Venet's sculpture, *11 Acute Unequal Angles*. The artwork showcases a series of angles seemingly jutting from the earth's surface, creating a sense of power and dynamism. Venet shows the **acute angle** in different stages of expansion and contraction, staggering the forms so that the work appears to grow and shift as the viewer moves around it. For this lesson, students will be tasked with creating their own **Polylink** paper sculpture. This is composed of five polyhedra that are woven together to make a single object. A **polyhedron** (plural is polyhedra) is a three-dimensional shape with flat polygonal faces, straight edges, and sharp corners or vertices. For this exercise, students will be completing a 3-dimensional Polylink consisting of four triangles.

Introductory Questions Time: 5 min.

How can radial symmetry provide a sense of balance to an artwork?

Why do you think the artist chose acute angles?

What similarities and differences will be established by the work you create and Venet's *11 Acute Unequal Angles*?

Introduction to Activity Time: 10 min.

The teacher will introduce the **symmetric** arrangements of linked **polygons**, like triangles, that were developed and described by chemist Alan Holden in the 1970s. These polylinks showcase geometric ideas of symmetrically rotating shapes, linking the contours of these shapes to create puzzle-like sculptures. Teachers will encourage students to draw inspiration from the dynamic sculpture, *11 Acute Unequal Angles*, creating a rendition of the world that is **radially symmetrical** in nature, including on four **equilateral triangles** consisting of twelve points, nearly matching the sculpture by Bernar Venet. Students will be given a printed template to work from, and are strongly encouraged to follow the directions carefully in order to complete their sculpture.

Materials

Paper (cardstock or thick paper recommended), provided template, clear tape, scissors or x-acto knives, markers

Lesson Extension

Teachers can challenge students to create their own template to complete the sculpture.

Students can include measurements of the triangles, including angles and surface area of each.

Students can experiment with different types of triangles to discover how the sculpture can be altered.

Students can be encouraged to choose a particular **color scheme** to integrate knowledge of color theory into their sculptures.

Activity Time: 30 minutes

Teachers will print the appropriate amount of templates.

1. Once the introduction is provided, teachers will provide students with the template from which to work. The size of the template can be altered for smaller or larger sculptures.
2. Students will use scissors or x-acto knives to cut out the triangles. Remind students to remove the smaller triangles in the center, leaving the outline of each shape visible.
3. Students can color their triangles using the markers.
4. Students will make a cut through each of the triangles on one side. Do not cut in the middle of the triangle's side, or it will become more difficult to assemble the sculpture.
5. Link two of the triangles together and move the triangles so that the midpoint of one side is at the **vertex** of the triangular hole. The opposite sides should look the same.
6. Use a little tape to hold the triangles in place.
7. Students link the triangles so that each of them has another triangle side's midpoint in each of the vertices of its triangular hole. The midpoint of the side opposite this vertex is the vertex of the triangular hole of the opposing triangle.
8. Use tape to tape all side cuts back together.

Reflection Time: 5 minutes

Students are encouraged to reflect on their sculptures, sharing the challenges they overcame to create their artworks. Students are encouraged to decorate the space with their sculptures to reflect on the colors chosen as well as Venet's choice to use corten steel (resulting in a rust color).

Vocabulary

Symmetrical • Radial Symmetry • Polygons • Vertex • Equilateral Triangles • Color Scheme • Acute Angle • Polylink • Polyhedron

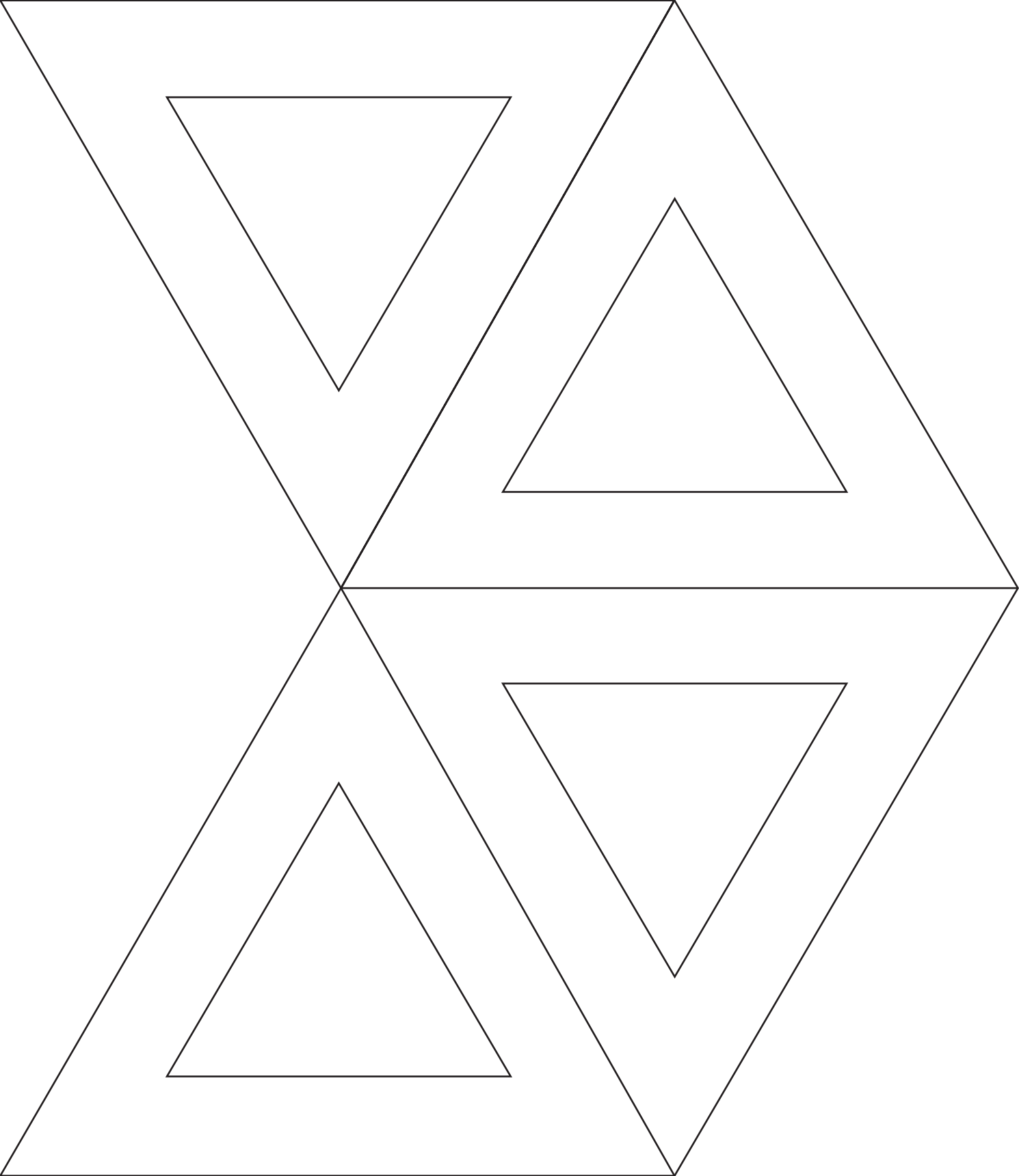
Curriculum Standards for Geometric Construction Activity

National Visual Arts Standards

- VA:Cr3.1.1a Apply relevant criteria from traditional and contemporary cultural contexts to examine, reflect on, and plan revisions for works of art and design in progress.
- VA:Cr2.1.11a Through experimentation, practice, and persistence, demonstrate acquisition of skills and knowledge in a chosen art form.
- VA:Cr3.1.11a Engage in constructive critique with peers, then reflect on, reengage, revise, and refine works of art and design in response to personal artistic vision.
- VA:Pr5.1.11a Evaluate, select, and apply methods or processes appropriate to display artwork in a specific place.
- VA:Re9.1.1a Establish relevant criteria in order to evaluate a work of art or collection of works.
- VA:Cn10.1.11a Utilize inquiry methods of observation, research, and experimentation to explore unfamiliar subjects through artmaking.

Louisiana State Math Standards

- G-CO.A Experiment with transformations in the plane.
- G-CO.D Make geometric constructions.
- G-GMD.B Visualize relationships between two-dimensional and three-dimensional objects.
- G-MG.A Apply geometric concepts in modeling situations



SCALE MODELING



Claes Oldenburg and Coosje van Bruggen's *Corridor Pin, Blue* is part of a collection of works that monumentalize everyday objects. By enlarging these objects and maintaining proper proportions, the artists challenge the viewer to see the objects in new ways, reevaluating the relationship to these items. The works' **scale** communicates the emphasis on society's reliance upon commercial objects. Inspired by this work, students will build scale models of objects of their own choice. Students will measure the object, scaling it either up or down in order to communicate an idea or message about said object. Students should be able to calculate the **surface area** and **volume** of **rectangular prisms**, **cylinders**, and **spheres** prior to beginning this lesson.

Introductory Questions Time: 5 min.

How does the exaggerated scale of Oldenburg and van Bruggen's sculptures affect your perception of the ordinary objects they represent?

What mathematical equations do you think were implemented during the development of *Corridor Pin, Blue*?

What are some possible scales you might use to manipulate the scale of your object? Will you have enough material and time to construct?

Introduction to Activity Time: 15 min.

While Claes Oldenburg and Coosje van Bruggen used scale modeling to create artwork, scale models are also used by engineers and architects to gauge the design's response to outside factors or to understand how something works. In this project, students will get to work like Oldenburg and van Bruggen and create scale sculptures. It is encouraged that students choose objects with relatively simple geometry or one with geometry that has the potential to be simplified. Developing scale models involves taking full-scale objects or designs and reducing or enlarging all of their dimensions by a common factor. Once students obtain the correct **dimensions** through measurements, students will need to explain how scaling the object affects the area of the base and the volume of the object. When creating a scale model, the student should pick an appropriate scaling factor and simply apply it to all dimensions.

Alternatively, if a specific dimension is desired for the physical scale model, one can obtain the scaling factor by dividing the original dimension by the desired scale dimension. Then this factor can be applied to all other original dimensions to produce the scale model dimensions.

Materials

Rulers, graph paper, pencils, chosen object to scale, scale modeling materials, which can be simplified or elevated based on teacher assessment (cardboard, cardstock, paper, construction paper, foam core board, markers, paint, toothpicks, contact paper, foam, papier-mâché, tape, hot glue)

Vocabulary

Scale • Surface Area • Volume • Rectangular Prisms • Cylinders • Spheres • Dimensions

Lesson Extension

This lesson can be completed in pairs, small groups, or alone, depending on the time allotted.

Teacher can assign students with particular equations for scale.

Materials can be elevated to create more substantial sculptures.

Should students have access to CAD, they can prepare CAD models of their objects.

Activity Time: 60 minutes

Present introduction as well as ensuring students understand background mathematical knowledge.

1. Students will pick an object for which they want to create a sculpture. If the item is brought from home, let the students know in advance. The object is necessary for the project.
2. Students measure and record all object dimensions that they think they need in order to scale their sculpture.
3. Based on dimensions, students pick an appropriate scaling factor.
4. Students will calculate the volume and surface area of the original object.
5. Students spend roughly 15 minutes creating mock up drawings, including the measurements documented as well as the dimensions desired for the final sculpture.
6. Students will begin construction of their sculpture, making sure that the pieces they used to construct their work are of the correct dimensions based on their calculations.
7. It is recommended that the teacher circulate the room at this time, reminding the students to "measure twice and cut once" to help avoid miscalculations and mistakes.
8. Once works are completed, must record the mathematical logic and calculations implemented in order to complete their sculpture.

Reflection Time: 30 minutes

Students will present their work to the class and explain what was challenging about their projects.

Students can provide the original dimensions as well as the scaled dimensions, challenging their classmates to figure out the ratio.

Curriculum Standards for Scale Modeling Activity

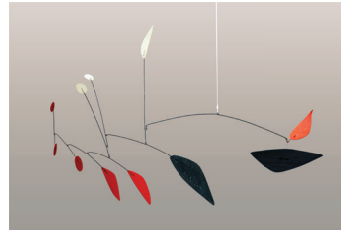
National Visual Arts Standards

VA:Cr1.1.1a	Use multiple approaches to begin creative endeavors.
VA:Cr1.2.1a	Shape an artistic investigation of an aspect of present day life using a contemporary practice of art or design.
VA:Cr1.2.1a	Choose from a range of materials and methods of traditional and contemporary artistic practices to plan works of art and design.
VA:Cr3.1.1a	of art or design considering relevant traditional and contemporary criteria as well as personal artistic vision.
VA:Pr5.1.1a	Analyze and evaluate the reasons and ways an exhibition is presented.
VA:Re.7.1.1a	Hypothesize ways in which art influences perception and understanding of human experiences.
VA:Re.7.2.1a	Analyze how one's understanding of the world is affected by experiencing visual imagery.
VA:Cn10.1.1a	Utilize inquiry methods of observation, research, and experimentation to explore unfamiliar subjects through artmaking.

Louisiana State Math Standards

G-CO.A	Experiment with transformations in the plane.
G-CO.D	Make geometric constructions.
G-GMD.B	Visualize relationships between two-dimensional and three-dimensional objects.
G-GMD.A	Explain volume formulas and use them to solve problems
G-GMD.B	Visualize relationships between two-dimensional and three-dimensional objects.
G-MG.A	Apply geometric concepts in modeling situations

PATTERNS IN ART



Alexander Calder
(American, 1898–1976),
Mobile, 1960, Painted metal,
Bequest of Victor K. Kiam,
77.286

Calder worked toward a simplification of organic forms. He introduced motion to his sculpture first by adding mechanized parts, but he eventually relied on wind or human touch to set the works in motion. While his *Mobile* is an abstract sculpture, the shapes used by Alexander Calder are **biomorphic**. These shapes resemble living things from nature, such as leaves, feathers, or flowers instead of hard-edged geometric shapes. Often, Calder would employ the **Fibonacci sequence** in his **kinetic sculptures**, which is a mathematical pattern often found in nature. His artwork, *Black, White, and Ten Red*, completed three years before *Mobile*, exhibits this spiraling sequence.

For this lesson, students will use the Fibonacci sequence to create kinetic sculptures of their own. These artworks are not required to be mobiles, but are expected to be composed of biomorphic shapes. This lesson can be modified to be completed in pairs or by individual students.

Introductory Questions Time: 5 min.

Does the fact that the sculpture moves change its meaning or impact?

How do you think Calder balanced this mobile, while also adding more to each arm of his sculptures?

Why do you think Calder worked with biomorphic shapes while simultaneously incorporating the Fibonacci sequence?

Introduction to Activity Time: 10 min.

The teacher will use Calder's *Black, White, and Ten Red* sculpture along with his 1960 piece, *Mobile* to discuss the ideas of biomorphic shapes as well as the Fibonacci sequence. The teacher will explain that the Fibonacci sequence is a series of numbers where each number is the sum of the two preceding numbers, typically starting with 0 or 1. The teacher will ask students to establish the sequence in *Black, White, and Ten Red*. Then, the teacher will ask if Calder had created one more layer to the sculpture, how many shapes would be included. With this, the teacher will explain that students will create their own Calder-inspired kinetic sculptures.

Students must establish and calculate their own version of the Fibonacci sequence, which should be correctly exhibited in the sculpture. Additionally, students will create their own biomorphic shapes and color scheme consisting of three colors.

Materials

Pencils, scratch paper to determine calculations, construction paper, glue, pipe cleaners (or sculpting wire for more mature learners, using wire cutters to cut), scissors, string/yarn.

Lesson Extension

Teachers can provide select numbers of the sequence to students, encouraging them to figure out the remaining calculation

Students may work in pairs to create large scale structures

Students may use more advanced media, such as paint, sculpture wire, or clay, to create biomorphic shapes

Activity Time: 45 minutes

1. Once the class has discussed the concepts and expectations of the project, the teacher will encourage students to choose and establish the numerical requirements for their own sculptures, using the Fibonacci sequence.
2. Once students have established the numerical requirements for their Calder-inspired sculptures, students will begin sketching and cutting the biomorphic shapes required, considering the color scheme and amount required.
3. It is encouraged that students organize these shapes into piles, so as not to lose them.
4. Once students have completed their shapes, they can begin to build the armature of their mobiles.
5. If using pipe cleaners, students can wrap the excess wire to secure the arms of the mobiles together. Remind students not to secure too tightly, to allow for movement.
6. If students are using sculpture wire, the teacher or mature student can use wire cutters and pliers to cut and secure the armature. Remind students not to secure too tightly, to allow for movement.
7. After the armature has been constructed, students may begin attaching their biomorphic shapes to the correct arm of the mobile. Students may use glue or tape to secure.
8. Remind students that the color scheme must also follow the Fibonacci sequence.
9. Students may attach yarn or string to the top of their mobile to assist in the installation and hanging of their artwork.

Reflection Time: 20 minutes

Once student mobiles are installed, students may present their work. They are encouraged to discuss their calculations regarding the Fibonacci sequence, discussing their challenges and victories with their classmates.

Vocabulary

Biomorphic • Kinetic Sculptures • Fibonacci Sequence

Curriculum Standards for Patterns in Art Activity

National Visual Arts Standards

- VA:Cr1.1.1a Use multiple approaches to begin creative endeavors.
- VA:Cr2.1.1IIa Through experimentation, practice, and persistence, demonstrate acquisition of skills and knowledge in a chosen art form.
- VA:Cr2.1.1IIIa Experiment, plan, and make multiple works of art and design that explore a personally meaningful theme, idea, or concept.
- VA:Re.7.2.1IIIa Determine the commonalities within a group of artists or visual images attributed to a particular type of art, timeframe, or culture.
- VA:Cn10.1.1a Document the process of developing ideas from early stages to fully elaborated ideas.

Louisiana State Math Standards

- A1: A-APR.A Perform arithmetic operations on polynomials.
- A1: A-CED.A Create equations that describe numbers or relationships.
- A1:A-REI.A Understand solving equations as a process of reasoning and explain the reasoning.