TITLE: Measurement, Intervals, Pattern, & Art

ESSENTIAL QUESTIONS:
What is the relationship between measurement, patterns, and intervals in art?
How can we use our understanding of math to identify and create aesthetically pleasing patterns in art?

GRADES	ACTIVATING STRATEGIES	MATERIALS	TEACHING & LEARNING ACTIVITIES	COMMON CORE STANDARDS	REFLECTION/ASSESSMENT
K-2	• Provide tactile (or visual) examples of objects with patterns for students to hold and examine. For example, gather students in a circle and pass around a honeycomb, a seashell, a snakeskin, a crocheted object, or a piece of patterned jewelry or cloth (or present pictures of these objects) and discuss the similarities among the objects, drawing attention to the similar intervals and repeating shapes. • Define pattern and discuss how each object exemplifies a pattern. Be sure to draw attention to the *intervals of measurement* on the patterns in each object. • Discuss the visually pleasing nature of patterns and present famous or traditional works of art and architecture from around the world that display these designs. • Students can note the different shapes, colors, and repeating	▪ one sheet of printed paper with a contour line design per student—for example, any simple coloring page. For more scaled up lesson, one sheet of blank 8”x11” paper per student ▪ Colored pencils, crayons, markers, or pastels to color in the designs ▪ Rulers and pencils for scaled up lesson	For K-2nd grade students, begin the teaching and learning activities with a discussion of artist Chuck Close. “Chuck Close is one of the world's leading modern artists. His art focuses on portraits of himself and his family and friends, often produced at a very large scale. Close typically begins with a photograph of a face, creating a painting or print through a complex grid-based reconstruction of the image that he accomplishes by hand” (https://www.cs.washington.edu/building/art/Chuck Close). A great way to do this is by reading to students from the self-authored book “Chuck Close: Face Book” in which the artist tells readers about his artwork and his life. “The question-and-answer format is based on real kids’ inquiries about Close’s life and work, and his answers to them.” (amazon.com) The instructor can show students other examples of Chuck Close’s work. Draw students’ attention to the grid-like nature of the art and the repeating patterns created by the circular marks within the square shapes of the grid. Ask the students some questions about the artworks: For example: What colors do you see here? What shapes do you see here? What shapes repeat within the artwork? To begin the art activity, give kindergarten students a sheet of printer paper with a contour line design printed on it. Teachers can find many simple coloring pages online that will work for this lesson and teachers can choose a design that aligns with a season or topic they are studying in class. Ask students to fold the paper in half	**Art:** National Core Arts Standards for Visual Arts - Anchor Standard 1: Generate and conceptualize artistic ideas and work Anchor Standard 1 - Essential Question: How does knowing the context history, and traditions of art forms help us create works of art and design? Enduring Understanding: People create and interact with objects, places, and design that define, shape, enhance, and empower their lives. **Math:** CCSS.Math.Content.K.MD.A.1 Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object. CCSS.Math.Content.K.MD.A.2 Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute, and describe the difference. For example, directly compare the heights of two children and describe one child as taller/shorter. CCSS.Math.Content.K.MD.B.3 Classify objects into given categories; count the numbers of objects in each category and sort the categories by count.1 CCSS.Math.Content.K.G.A.1 Describe objects in the	K: Students can be assessed in a variety of ways. Ensure students know that the lengths of each side of their paper are the same, and ask them to prove it. When speaking about the shapes they colored within the grid, ask students to identify whether there is more or less of a certain color. This is an excellent opportunity to assess their ability to quantify something much less concrete, as the intersections of the grid and the shape will provide lots of different sized and shaped pieces. You can also ask them to identify shapes, count the squares that contain a particular color, and whether the picture is 2-D or 3-D 1: Ask students similar questions as you would Kindergarten students, but focus on comparing groups of squares that do or do not contain part of the outlined image. Then ask students to identify pieces of the whole, like halves and fourths. 2: Ask second-graders similar questions as K and 1 students, but by having students measure and mark the grid lines, you can assess their ability to measure starting from zero and measure accurately. Students should be able to count the number of equal-sized pieces and to identify the correct measuring tool to create the grid. **Be sure to explore and reevaluate the answers to the essential questions throughout the activity!*

	elements they see in each work. • As an extension activity, pass around sheets of paper depicting simple patterns and ask students to work in groups to complete the pattern. Students may draw or color the rest of the pattern on pieces of paper or directly on the pattern sheet. • To scale this up for more advanced students, use whole numbers or fractions to create the pattern and ask students to complete the pattern using their understanding of intervals in math. • This can be played as a timed game, or done as a group activity with students sharing their results out to the class at the end, followed by class discussion of the results. • Students can also use manipulatives like Legos or pony beads to create patterns *or* students can complete or copy patterns from printed cards. • More advanced students can visit free-training-tutorial.com and play interactive sequence and pattern games. The difficulty of these games can be set to accommodate several upper elementary levels. • As students begin to explore pattern through your visual or tactile examples,		vertically and in half again vertically. Open the paper and ask the students to fold it in half once horizontally and once again so that they paper has been folded into sixteenths. After each fold, ask students to count how many rectangles they have folded the paper into. Students should now have a design that is overlaid with folds that divide the paper into sixteenths. Give students colored pencils, crayons, or markers, and ask students to color each square so that they overall paper displays a pattern. Students should change color schemes when coloring the object. For example, given this star coloring sheet, students can color the square by alternating background colors and then filling the squares in with alternating colors. With kindergarten students, it may be helpful for the whole class to work on the background first, and then select new colors and work on the shapes next. To scale this lesson up for older or more advanced learners, students can draw their own contour line drawing and use a ruler to measure out increments on their paper and then draw a grid along these lines. To simplify this task for students, teachers may want to cut the paper down so that it is 8 inches by 11 inches exactly. Students can use a ruler to make hash marks and then connect the marks with a light line. This will require students to demonstrate their understanding of the ruler as well as their fine motor skills. More advanced students can also create patterned design within the grid, as artist Chuck Close does with his circles inside each square.	environment using names of shapes, and describe the relative positions of these objects using terms such as above, below, beside, in front of, behind, and next to. CCSS.Math.Content.K.G.A.2 Correctly name shapes regardless of their orientations or overall size. CCSS.Math.Content.K.G.A.3 Identify shapes as two-dimensional (lying in a plane, "flat") or three-dimensional ("solid"). CCSS.Math.Content.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. Limit to contexts where the object being measured is spanned by a whole number of length units with no gaps or overlaps. CCSS.Math.Content.1.G.A.3 Partition circles and rectangles into two and four equal shares, describe the shares using the words halves, fourths, and quarters, and use the phrases half of, fourth of, and quarter of. Describe the whole as two of, or four of the shares. Understand for these examples that decomposing into more equal shares creates smaller shares. CCSS.Math.Content.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. CCSS.Math.Content.2.MD.B.6 Represent whole numbers as lengths from 0 on a number line diagram with equally spaced points corresponding to the numbers 0, 1, 2, ..., and represent whole-number sums and differences within 100 on a number line diagram.	

	you will provide an explanation of pattern that is tailored for your particular classroom and age group. You may want to review certain vocabulary as needed.			CCSS.Math.Content.2.G.A.2 Partition a rectangle into rows and columns of same-size squares and count to find the total number of them.	
3-4	• You may want to ask some of the following questions: • How do you know that you are looking at a pattern? • How can you predict what comes next when you look at a pattern? • Where can you spot some patterns in the classroom?	▪ 2 pieces of 8.5" x 11" paper and 1 piece of 8.5" x 22" paper per student ▪ markers, crayons, colored pencils, etc. to create their artwork designs ▪ rulers ▪ pencils ▪ scissors ▪ glue	For 3-4th grade students, begin the teaching and learning activities with a discussion of anamorphic art A great way to do this is by showing the students the painting by Hans Holbein the Younger of Jean de Dinteville and Georges de Selve, *The Ambassadors* (1533) Draw students attention to the object at the base of the painting—ask students if they can guess what the object is. Then, ask students to stand in front of the image and look directly to their left (or if holding a picture rather than viewing a projection, hold picture of the image close to the face and look left). See if the students can guess that the image is a skull! Discuss the significance of the skull as a reminder of mortality to Renaissance viewers. Next, to show students how pattern can play a part in anamorphic illusion, discuss the Ames Room optical illusion and show students a video from Scientific America regarding the Ames Room or this video depicting a father and son walking around the Ames Room. Discuss with your students how the Ames Room uses pattern to trick viewers and enhance the optical illusion. Finally, show students these videos to introduce the work of Yaacov Agam. Ask students: How do you think Agam creates the optical illusions in his artwork? How does Agam use measurement and intervals to create the optical illusions in his work? For 3rd grade students, give each student two pieces of 8.5" x 11" paper and one piece of 8.5" x 22" paper Ask students to align their papers horizontally and create different artworks on each 8.5" x 11" paper. Students can then flip one of their papers over, maintaining the horizontal orientation, and use their rulers to	**Art:** National Core Arts Standards for Visual Arts - Anchor Standard 1: Generate and conceptualize artistic ideas and work Anchor Standard 1 - Essential Question: How does knowing the context history, and traditions of art forms help us create works of art and design? Enduring Understanding: People create and interact with objects, places, and design that define, shape, enhance, and empower their lives. **Math:** CCSS.Math.Content.3.MD.C.6 Measure areas by counting unit squares (square cm, square m, square in, square ft, and improvised units). CCSS.Math.Content.3.MD.C.7.a Find the area of a rectangle with whole-number side lengths by tiling it, and show that the area is the same as would be found by multiplying the side lengths. CCSS.Math.Content.3.MD.C.7.d Recognize area as additive. Find areas of rectilinear figures by decomposing them into non-overlapping rectangles and adding the areas of the non-overlapping parts, applying this technique to solve real world problems. CCSS.Math.Content.3.G.A.2 Partition shapes into parts with equal areas. Express the area of each part as a unit fraction of the whole. For example, partition a shape into 4 parts with equal area,	3: Students should be able to measure the lines accurately and then find the area of one strip of paper. By adding the area of all strips of paper they should be able to find out the total area of a picture. You can also play with the idea of surface area of this partly 2-D and partly 3-D artwork by having them find the total surface area of their artwork, including both sides of the peaks and the valleys in between. Make the connection between the formula for surface area of a rectangle and the sum of the parts of their three drawings. They should also recognize the relationship between the pieces of the whole and the whole as fractional. 4: Students should be assessed on the same criteria as third grade, but also be able to find the perimeter of their three drawings as well as be able to identify and create the many parallel lines of the shape. **Be sure to explore and reevaluate the answers to the essential questions throughout the activity!*

			create vertical lines one inch apart on the back of the paper. Ask students to work left to right to number the strips on the back of their paper. Students should cut their paper into one inch wide strips along the lines they drew. Next, students can make hash marks every inch along the horizontal side of their 8.5" x 22" paper. Students can then fold the paper every inch alternating mountain and valley folds. Discuss how the alternating folds create a zig-zag pattern. Then, students can work left to right to number every other side of the folded paper. Then students can glue the cut strips of their first artwork onto their corresponding numbers on the 8.5" x 22" paper. Once the first picture is completed students can work left to right to number the other folds on the 8.5" x 22" paper and can then measure, number, cut, and glue the strips from their second picture. Ask students to consider their finished pieces and discuss how they used measurement to create intervals that allowed the work to be seen from many different perspectives. To scale this lesson up for older or more advanced students, give students 1 piece of 9”x12” paper and two pieces of 9”x11” paper. Ask the students to create three different artworks on the papers. The artworks can relate to one another thematically to help them be visually cohesive. Students may use paint, colored pencils, marker, pens, or pencils in the creation of these artworks. Give each student two pieces of 9”x18” paper and ask students to measure and then draw 9-inch lines across the blank sheet of drawing paper at 1 inch intervals. Ask the students to fold the paper along the lines they drew and then glue the paper to create 1-inch tall mountains separated by a 1-inch wide valley. Students will need to glue their 9”x18” paper together to create 12 valleys and 11 mountains. On the back of their three artworks, students should measure and then draw 9-inch lines at 1 inch intervals.	and describe the area of each part as 1/4 of the area of the shape. CCSS.Math.Content.4.MD.A.3 Apply the area and perimeter formulas for rectangles in real world and mathematical problems. For example, find the width of a rectangular room given the area of the flooring and the length, by viewing the area formula as a multiplication equation with an unknown factor. CCSS.Math.Content.4.G.A.1 Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.	

			Students can then cut the 9”x12” artwork into one inch strips along the lines they drew. They should glue this artwork to the valleys they created. It may help students to number the strips and the corresponding valleys before they cut and glue so that the strips don’t get mixed up. Next, the students can follow the same procedure with their 9”x11” artworks; however, they will glue one artwork to one side of the mountains and the other artwork to the other side—working from left to right. This process will create an artwork that displays three different images when viewing the finished work from three different perspectives!		
5-6		▪ 9”x12” pieces of black construction or cardstock paper—one per student ▪ one or two pieces of colored 9”x12” construction or cardstock paper for each student ▪ ruler ▪ scissors	. For 5-6th grade students, begin the teaching and learning activities with a discussion of Kente cloth. A great way to do this is by reading to students from “Kente Colors” by Debbi Chocolate and “The Spider Weaver” by Margaret Musgrove. These books explain the traditions, symbolism, colors, and patterns of Kente cloth. Show students several examples of Kente cloth design and discuss how the weavings are made and why they are important to the Ashanti people. Include terms such as warp and weft to describe the weavings. Ask students questions about the patterns such as: What colors do you see? What geometric shapes do you see? Where do you see patterns and which elements repeat themselves? For 5-6th grade students, begin the art activity by giving each student a 9”x12” piece of black construction or cardstock paper. Ask the students to fold the paper in half and use their rulers to make hash marks along the folded edge at every 1/2 inch except for the left and right edge which should remain at a full inch. Cut on the fold of the piece of paper being sure to keep at least an inch border on all sides of the paper. Then students can select one or two pieces of colored 9”x12” construction or cardstock paper to cut into ½ inch strips.	**Art:** National Core Arts Standards for Visual Arts - Anchor Standard 1: Generate and conceptualize artistic ideas and work Anchor Standard 1 - Essential Question: How does knowing the context history, and traditions of art forms help us create works of art and design? Enduring Understanding: People create and interact with objects, places, and design that define, shape, enhance, and empower their lives. **Math:** CCSS.Math.Content.5.NF.A.2 Solve word problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators, e.g., by using visual fraction models or equations to represent the problem. Use benchmark fractions and number sense of fractions to estimate mentally and assess the reasonableness of answers. CCSS.Math.Content.5.MD.A.1 Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use	5: Students should be able to find the total area of each color of their Kente cloth in both a fraction and a total of a given unit (inches). For example, each square is 1/2” by 1/2”, or 1/4 in^2. Students should find the area in square inches by adding the total number of 1/4 in^2 as well as finding the number of a certain color of squares out of the total number of squares. You can then scale this up by having students convert measurements to other units. 6: Ask students to perform the same assessment tasks as the fifth graders, but spend some time finding the ratio of one color to another color or colors. For example, you can find the ratio of blue squares to the total number of squares, blue to another color, or other combinations. Students should also be able to simplify these ratios. **Be sure to explore and reevaluate the answers to the essential questions throughout the activity!*

			Remind students to consider the significance of each color in traditional Kente cloth weaving. Ask students to create patterns by alternating the intervals for weaving their weft over and under through the warp. Students can consider what percentage of each color paper is exposed in the final design as a Math assessment that accompanies this project.	these conversions in solving multi-step, real world problems. CCSS.Math.Content.6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.	