Where Geometry and Art Live As One

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INTRODUCTION

Just hearing the word "geometry" makes me anxious and conjures up memories of Mrs. Cannon's sophomore geometry class where I listened to a daily dialogue between Mrs. Cannon and Terry Templeton, now a Massachusetts Institute of Technology graduate. It was a less than stellar learning experience for fourteen frustrated class members and me. Fortunately, times have changed and teachers now employ better methods to address varied learning styles, and effective cross-curriculum lessons are more frequent. To optimize the learning experience students need to feel comfortable and competent in all their classes from art to math. One way to achieve this goal is to use the language of the discipline correctly in implementing projects and correlate terms to enable the student to apply knowledge between disciplines.

There is a close working relationship between math and art. All math-minded students should automatically have a level of comfort in art class, and all art-minded students should feel a sense of competency in math class, but that rarely happens. Many times students categorize themselves as artists or mathematicians, but seldom do they claim to be both. Past experiences factor into their thinking and they reach an intellectual comfort level as they enter their adolescent years. Exposure to other art forms opens new avenues of expression and creates a different paradigm. Throughout their elementary years of social science and geography, each student learned about different cultures on an age appropriate level. Some activities probably included the introduction of motifs indicative of a specific culture, but only brief comments were made about these designs so more of the importance of the culture could be explored in depth. Most of my sixth-grade students recognize the Aztec calendar, or a blanket woven by a Native American tribe of the Southwest United States. Few, if any, are capable of explaining the symmetry and importance of the patterning in a specific society. Many think that primitive cultures obtained most of their pattern ideas from nature, but experts know that cultural patterning is specific to cultures and does not necessarily pertain to nature in any way. In the sixth grade, their fine motor skills and mental acuity are ready to accept more complex thinking regarding design itself, but must be closely monitored so as not to exceed their developmental abilities. Shape and color have communicated ideas and traditions throughout recorded history. These two design elements combined with principles of art such as balance, proportion and symmetry the students learn fundamentals that enable them to create their own perception of art and sound principles to visually implement their ideas. Supposedly, Pablo Picasso, one of the fathers of the twentieth century Cubist movement, once stated an artist must know the rules before he can break the rules. Picasso, a classically trained artist, learned about the history of art from many cultures,

and with this knowledge he was able to transform the familiar and create a fresh, vital movement in contemporary art.

Learning more about specific elements of a culture, and the depth of craftsmanship and precision planning included in crafting each artifact add to the depth of the lesson. It also prepares them to create their own patterns based on traditional, timeless designs. Lessons included in this series are divided to include more advanced lessons for eighth grade students and more basic project concepts for the sixth grade students. Skill appropriate projects designed for the sixth grade students highlight geometry in art while introducing the elements and principles of design. The principles and elements of design we study extensively are line, shape, color, texture, balance, symmetry, proportion, and value. Projects offer a wide range of experience and expose students to the proper use of tools to implement their projects correctly; however, most projects are more accepting of varied fine motor skills. More advanced lessons where keenly developed fine motor skills are required are also a part of my teaching approach for this series of lessons, but reserved for the eighth grade students. An example of a project requiring better fine motor skills is an Op Art painting, but the same project is available to lesser skilled students using colored markers or colored pencils.

Our school represents a cross section of the entire Houston Independent School District from every nationality and socio-economic group. We differ from a neighborhood school where students have known each other in other grade levels. Few of our incoming sixth grade students know more that two fellow sixth graders when the year begins. It is imperative that we engage each student in the learning process, and clearly one way to achieve this goal is by introducing the influences of the art and architecture of numerous, varied nationalities. Many of our students are first generation Americans who are limited in their exposure to the other cultures represented in our diverse American society. They enjoy learning about their fellow classmate's cultures.

AN OVERVIEW OF THE UNIT

One way to achieve the goal of making students with varied learning styles appreciate the close relationship between math and art is through hands-on learning experiences that show cultural principles that are common to geometry and art. Patterns and symmetry exist in every culture and the children enjoy seeing the various methods employed to create distinctive, culturally rich works of art. In the past, we have focused more on the Greco-Roman mosaic art form to introduce symmetry when discussing the elements of design. This limits the scope and omits many significant art endeavors that display symmetry. One reference that gave a tremendous insight into varied cultural symmetries is *Decorative Patterns from Historic Sources*, written by James Spero and published in 1986 by Dover Publications. Another source is *Symmetries of Culture* written by Dorothy K. Washington and Donald W. Crowe and published in 1988 by the University of Washington Press.

Islamic tiling is one I will include in the cultural introduction to the unit. The intricately symmetrical designs are excellent and offer examples of every form of symmetry. Scholars proclaim that all seventeen Islamic wallpaper-repeating patterns are represented at Granada. In North and Central America, the Anasazi are another culture rich in symmetrical, repeating patterns, as are their Native American tribal descendents of the Southwestern United States. Anthropologists unearth relics at Pueblo Bonito that clearly indicate the patterns they used were not by chance, but a cultural statement. Tribes including Zuni, Navaho, Apache, Mimbres, and Pueblo offer fine examples of craftsmanship and symmetrical ornamentation in their pottery, textiles, sand paintings and petraglyphs dating back over a thousand years. In the twentieth century Maria and Julian Martinez and their descendents, Native American potters from San Ildefonso Pueblo, continue Pueblo traditions today through her black on black pottery that combines matte and gloss finishes in symmetrical motifs. The National Museum of Ireland displays a well-worn, carved spiral pattern, and Celtic Knots offer another culture's approach to patterning. Although not a culture, but certainly cultural icons, one of Frank Lloyd Wright's stained glass patterns, *Oak Park Skylight*, or Louis Comfort Tiffany's *A Wooded Landscape in Three Panels,* bridge a contemporary approach to symmetry through the medium of stained glass. These two men each use patterning that is strikingly geometric, and both are excellent ways of introducing the triangle, circle, square, rectangle, and oval, which are the five basic shapes included in art's elements of design.

In our series of symmetrical projects in addition to learning about one of the most important elements of design, shape, we will also learn the significant importance of balance and proportion in the creation of any artwork. Symmetry is one crucial principle of design. Symmetry is evident in everyday life in something as simple and captivating as a butterfly or any leaf on a tree, or as complicated as the science of crystal structure. Although symmetry is all around us, it is difficult to find a definition that most can comprehend. Most definitions of symmetry describe the shape of an object in which there is a pattern repeat, and a balance that is similar in shape around a single point or axis, or along a single line. Several types of symmetry include rotation, square, reflection, translation, and glide-reflection symmetry. It is very possible to have multiple symmetries in one object, and very often this is the case. When multiple symmetries occur in one motif it is referred to as a *motion class* of symmetry.

This unit involves most of these symmetries, and combinations of these symmetries. **Rotation Symmetry** is symmetry where an object can be turned through a specific angle and maintain the same appearance. The turning spokes of a bicycle wheel are a perfect example of rotation symmetry. **Square Symmetry** is a pattern that remains the same after being quarter turned. Tessellations use square symmetry many times. **Reflection Symmetry** is a mirror image of two halves of an object in size, shape and relative position on each side of a centerline. Humans and other vertebrate's external appearances are excellent examples of reflection symmetry. In art, we refer to this form of symmetry as Bilateral symmetry. **Translation symmetry** is a pattern that repeats

itself by an exact movement in a line. The border of a wallcovering pattern is an excellent example of contemporary translation symmetry. **Glide-reflection symmetry** is a glide and a shift in the pattern repeat. Patterned wallcovering is an example of everyday glide-reflection symmetry. A pattern has transitional symmetries if it repeats itself after a translation along a line. The pattern has glide-reflection symmetry if it repeats itself after a translation along a line followed by a reflection in a line. In two-dimensional art, there are several different categories of symmetry. One-dimensional symmetry includes infinite strip and bands of pattern, while two-dimensional symmetry include infinite wallpaper type patterning. These two symmetries are in the motion class of symmetry because they have more than one possible symmetry classification. In addition, three-dimensional symmetry actually refers to the geometric planes, and their interaction.

Sixth grade projects visually define different symmetries. Examining these patterns will set the stage for having each student create their own pattern(s) in several different lessons within this unit. Although the children will see and discuss Islamic art and other symmetrical art forms from around the world, the first lesson in symmetry is entitled **"**Into the Light**".** In this project, each student creates a geometric shaped 12" x 18" faux stained glass window using tissue paper, construction paper, and clear polymer medium finish. Each student selects a pattern from a bank of pattern templates that represent traditional patterns from many cultures. In addition to the Islamic, Mayan, and Greco-Roman patterns, the students will examine the glasswork of Frank Lloyd Wright and Louis Tiffany. We will discuss the geometric shapes included in the patterns, thus introducing the "shape" element of design, and the "symmetry" principle of design.

"What's In a Name" is one of our first projects, and each student will create a pattern using the letters of their name to produce an artwork that has square symmetry with a quarter turn rotation. Using a twelve-inch square piece of paper each student will fold the paper cross center into eight equally sized triangles. With a pencil, the student writes his/her name on one triangle making certain the "bubble" letters touch the top of the triangle at the top and bottom of the triangle. Using either an overhead projector or something as simple as a window, the student will trace the outline of the letters onto the backside of the paper. Once this is accomplished, you can trace five pattern repeats onto the paper. Now trace one additional triangle on the backside so that you are able to get the other three pattern repeats. The alphabetical letters no longer resemble letters as we know them, but rather appear as independent, fresh shapes. Each student selects three colors of marker or colored pencil to complete the project. No two shapes that touch each other can be the same color. Markers require less time and less skill in successfully completing the project.

The next project, "Out of Africa" is a mask-making project designed to celebrate African American heritage, and to display reflection symmetry. Each student receives a basic mask shape. Working independently the student will create a reflection symmetry pattern using all the five basic shapes. They will also create symbolism for the colors

they select and write a one-page narrative telling the history of the mask and its function within the social structure of their imaginary society. In producing this project they will become more familiar with the use of architectural tools, and better understand the symmetry evident in art.

After this, we will explore the world of Brunelleschi and Giotto and the Renaissance beginnings of perspective, "One Point and Two Point Perspective" two-dimensional works of art. Most art has height and width because it has only two dimensions. Depth is the dimension added to make artwork three-dimensional. Perspective is a drawing technique used to give a two-dimensional surface the illusion of depth and many styles of art incorporate perspective in their composition.

Many people mistakenly think that art must be photo realistic to employ perspective, but this is definitely not the case. One well-known style of art that uses perspective effectively is Impressionism. Because of the importance of perspective, several projects are devoted to learning perspective using different subject matter until most are competent in using architectural tools, and are comfortable with the use of perspective. There are numerous excellent sources for information and lesson plans on perspective; however, I have found the following three sources to be excellent in simplifying the subject. These sources are *Hooked on Drawing* by Sandy Brooke and published in 1996 by Prentice Hall, *Hooked on Painting* by Sandy Brooke and published in 1999 by Prentice Hall, and *Hooked on Art* by Jenean Romberg and published in 2000 by Prentice Hall. The sixth grade students will display their understanding of perspective by drawing renderings using specific criteria to draw a one-point perspective piece, and also for a two-point perspective rendering.

There are three one-point perspective lessons. The first one-point perspective lesson is "Your Name in Perspective". Using the letters of their name each student transforms the block letters they draw on 12" x 18" paper with their T-square and triangle from two-dimensional to three-dimensional by extending each letter to a single vanishing point. The student has their own choice to cut the letters short of the vanishing point or continue the lines to the vanishing point, and they may place their letters above or below the horizon line. Each letter is shaded from dark to light using graduated shading. The second one-point perspective project is **"**Landscape in Perspective". This project introduces different subject matter and varied textures while still enhancing the perspective concept. In the third one-point perspective project, the student creates a cityscape. Minimum standards for this project include three buildings with three different textures, two intersections, letters and windows that vanish and remain constant, a six inch wide center street with a centered divided line, and a divided sidewalk to each side of the center road that is two inches in width. Also included in the minimum standards are a recessed door, one door that remains flush with the side of the building, and a porte-cochere. The two-point perspective minimum standards are three houses, each with different textures, multiple openings on one house with one recessed doorway entrance. One house must have a porch, and all with texture appropriate to the setting.

Additionally the rendering must include a walkway to each door of each house. Include one major roadway, and two areas must have picket fences, and one of the houses must include divided pane windows with louvered shutters. One home must have a hipped roof, and one home must have a pitched roof. Vegetation is the final portion of the minimum standards required for the two-point perspective project.

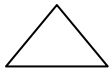
In perspective, we learn creating the illusion of a three-dimensional surface, but actually making a three-dimensional object affords a wide range of different experiences. For our three-dimensional lesson, we will "Create Regular Polyhedras." This year I experimented with this project where the sixth grade students worked in groups of four. We decided our groupings based on the Meyer-Briggs personality study. In this study, they divide every person on earth into four different personality groups. These four groups divide into colors of gold, orange, green, and blue. Ideally, an effective group will have one of each color in their group. Gold represents duty, responsibility, and organization, while Orange represents creativity and little follow through. Green personalities enjoy learning and have the ability to see the steps required seeing a project through to completion, and Blue personality people are the peacemakers. Each person assesses their own personality and determines their dominant color. We all have some of each color in our personalities and our dominant color changes through different stages in our lives, but one clearly defines our spirit at a given time and passage in our life. Once divided into groups, their color determines their primary role in the group.

Although we tried many different polyhedrons this year with the sixth grade students, next year I will limit the choice of polyhedrons and the optimum size. The larger, more intricate shapes met with marginal success with some of the sixth grade students. The group size was too large and difficult to keep organized and on-task, the fine motor skill levels varied greatly, and their exposure to the use of specific tools was a steep learning curve. This project meets cross-curriculum objectives in math, so limiting the scope of the project completes specific objectives and produces a more lasting, positive learning experience. After trying this project with the sixth graders, and some eighth graders, I would limit this project to the eighth grade students if the curriculum permitted. They understand the math concepts better, the use of the protractor, the importance of exact measurement, and have better developed fine motor skills. The sixth grade students are limited to a dodecahedron, snub dodecahedron, a small stellated dodecahedron, octahedron, or icosahedron.

Before beginning the building portion of the project, we will discuss correctly using the architectural scale and the protractor. Vocabulary is also an integral part of this lesson. A polygon is a closed plane figure formed by three or more line segments that do not cross each other. Some polygons are triangles, quadrangles, pentagons, hexagons, heptagons, octagons, etc. Polyhedra are any solid figure composed of these polygon faces in different configurations. The etymology of the vocabulary in this lesson derives from the Greek primarily. Poly means many and "gon" comes from the Greek word "gonu" which means knee, and they referred to knee as "angle". "Hedron" does not

come from Greek, but from the Indo-European word for "seat". Some of the prefixes whose etymology comes from the Greek include:

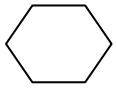
"Tri" meaning three



"Quad" meaning four

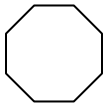
"Penta" meaning five

"Hexa" meaning six



"Hepta" meaning seven

"Octa" meaning eight



"Nonna" meaning nine

"Deca" meaning ten

"Dodeca" meaning twelve

"Icosa" meaning twenty

These are just to name a few of the possibilities of the number of sides possible in creating a polyhedron. Stellated means "star like."

The students create their polyhedrons in tandem. Each couple receives a net to follow, but I want them to measure, cut and tape the figures together individually, not as one single net. Many nets for three-dimensional construction of geometric shapes are found in *Cut and Assemble Three-Dimensional Geometrical Shapes* written by A. G. Smith and published in 1986 by Dover Publications, New York. Students must also decide on a theme for the finished polyhedra, and a pattern for each polygon required to complete their shape. The designs must mirror in color and pattern according to specific shape. We will use rail board, commonly referred to as poster board, for their figures, and they have access to a variety of different colors of tape to use to add to the visual aspect of their creations. Many of my eighth graders chose to make small stellated dodecahedrons and collaged them according to specific themes. The product was outstanding. The eighth grade students will also make a polyhedron on an individual basis. To add to the complexity of the project students must first draw out their patterns for color and pattern unity. If they choose to collage, the collage materials must be in addition to those elements they cut or tear from printed sources. Before beginning this phase of their project, they must first get my approval.

No other art movement better exemplifies symmetry than a movement of the 1960s known as Optical Art. In *Movement in Art Since 1945* by Edward Lucie-Smith (Page 21), the movement is discussed in depth and the significance of the movement explored and correlated with other contemporary movements. This twentieth century art movement affords the opportunity for math-minded students to realize artistic success and art-minded students to achieve mathematic accomplishment. It combines influences of the Bauhaus movement and roots of Russian Constructivists, which are movements

essential to understand the development of twentieth century art. This 1950s – 1960s oriented art movement, as coined by *Life Magazine* in the 1960s, is Op Art. In Op Art geometric shapes of vibrant colors form disorienting patterns that exaggerate the depth of plane and configure the viewer's perception of positive and negative space. Op Art relies heavily on the tendency for the eye to produce an after-image when confronted with very brilliant contrasts of vibrant color or black and white. It is the perfect vehicle to introduce rotation, reflection and transition symmetry, and to further the relationship of this art form in the development s in abstract art. Although Op Art is a contemporary art movement, the Native American Pueblo pottery of Maria and Julian Martinez and traditional Middle Eastern designs in art and textiles displays like patterning. Introducing master artists of the movement like Bridgett Riley, Victor Vasarely, and M. C. Escher reinforce the unit introduction and sparks student direction in beginning their creative process.

We will review the distinctive styles of Bridgett Riley and Victor Vasarely's inventive use of geometric shape to create optical illusions, and work up a preliminary project **"**Repeating Patterns**"** using complementary colors. In this project, each student will fold paper to create squares along the fold lines. From these scored lines each student will draw a grid. Within each grid, they will introduce a repeating pattern in size, shape and position and color in the repeating areas in a complementary color scheme using markers. Using these designs as a nucleus each student will produce a study using one of these two artists, or an approved Op Art artist of their choice. The final project in this genre is for each student to create a 16" x 20" "Design Op Art**"** and paint it on canvas using acrylic paint. Using the style of any approved Op Art artist, as the impetus for their work is acceptable. The Op Art projects are reserved for the eighth grade students who are more familiar with painting and measuring, and have more developed fine motor skills. Throughout the painting process there will be "down time" when the student is waiting for areas of paint to dry. During these times, each student will work on their tessellation, but not before the eighth graders study the distinctive tessellations of M. C. Escher.

So as they are working on their Op Art paintings, the eighth graders will review various square symmetry examples, and simultaneously begin their tessellation study. A "Tessellation" is a repeated design that covers a plane without empty or overlapping spaces. It is essential to let the students see of famous artists who used symmetry in their work. One artist to feature is M.C. Escher. He is intriguing to all the students, and a wonderful way to introduce rotation symmetry. Knowing that he began creating this art after a trip to the Alhambra in Spain reinforces the importance of Islamic tiling in Europe and beyond. M. C. Escher created his graphic work in the early 1900s, but strong symmetry continued with other artists. M. C. Escher thought a plane which should be considered limitless on all sides can be filled with or divided into similar geometric figures that border each other on all sides without leaving any "empty" space. Tessellations reinforce the importance of positive and negative space in a composition, and the interplay between the two composition elements. Each student will produce a tessellation, and paint the projects using complimentary colors.

CONCLUSION

One of my major goals is to interchange the language of the disciplines and enable students who feel less adept in math to be more comfortable in math classes and enrich the student who is a visual learner. By easing math into the curriculum in a less formal setting the reluctant student may better understand concepts and carry them into other disciplines. Art's bilateral symmetry is math's reflection symmetry. Rotation symmetry is either squares symmetry with a quarter or half rotation or radial symmetry in the art world, and so on. If, through their projects in art, they carry over the ability to visualize math concepts then I will enjoy a measure of success, and know that I have contributed to an education more relevant to each student in their further studies. If each student realizes that math is much more important in life than learning to balance your checkbook, and art is much more than an easy class where you learn about paintings to impress a date, or answer the final "Jeopardy" question while sitting in your living room. As a fourteen year old student sitting in geometry class, I had no clear idea how math would affect my art education, my career, and my life. It has taken a long time for me to fully realize the close walk between math and art, and one of my major goals is to shorten the time frame before my students have this epiphany. None of my math teachers ever attempted or implied any correlation between math and art. Since my years of sitting in math class, I have learned much about the marriage of art and math. My sincere desire is to assist my students in appreciating the beauty of calculating and implementing their calculations into a visual representation. I, like you, want them to see the geometry in the world around us.

LESSON PLANS

Lesson Plan One: Into the Light – An Introduction into Shape and Reflection Symmetry

Grade and Subjects
Sixth Grade; Art, Geometry, and Architecture

Art History References
Notre Dame's Rose Window
Frank Lloyd Wright's Stained Glass door panels and *Oak Park Skylight*
Louis Tiffany's *A Wooded Landscape in Three Panels*

Source
Hooked on Art by Jenean Romberg, a Prentice Hall, 2000 Publication

Time Required
Five 45-minute sessions

Materials
Two sheets of 12" x 18" black construction paper

Various colors of tissue paper
Polymer medium
Paint Brush, White Pencil, No. 2 pencil
Scissors
Shape template 6" x 18" overall

Objectives

1. The introduction of the five basic shapes of art
2. The introduction of reflection symmetry
3. The correct use of templates and straight edges and measuring tools
4. The introduction of stained glass as an art form

Learning Experience

1. Fold two pieces of black construction paper in half lengthwise at the same time.
2. Using the white pencil, draw a one-half inch border around the open edges.
3. Place the provided pattern template over the face of the folded paper.
4. Hinge the template to the black construction paper in two places using masking tape.
5. Cut out the shapes around the double lined design.
6. Open the cut out black paper to reveal your reflection symmetry pattern.
7. Looking at the available tissue paper colors, plan your window remembering that the same shape on each side of center must be the same color.
8. Lay a piece of tissue paper over an open space, and draw a line on the tissue paper leaving enough to properly glue the tissue paper onto the black construction paper.
9. Apply tissue paper to all the spaces making certain the shapes that are alike on each side of center are the same color.
10. Glue the second cut sheet of black construction paper to the back side of the project to cover the unfinished edges of the tissue paper.
11. After the glue is dry, paint a coat of polymer medium over the front of the project to give a finished, glossy appearance.

Handout

Definition of reflection symmetry for their art notebooks

Evaluation

Completion of project on time following provided criteria

Lesson Plan Two: What's In a Name? Square Name Pattern Symmetry with a Quarter Turn Project

Grade and Subjects

Sixth grade; Art, Geometry

Time Required

Five 45-minute sessions

Objectives

1. Increase hand-eye coordination in precise folding
2. Create pattern from familiar alphabetic shapes
3. Introduce contrast in color
4. Assist in organization of project thought process
5. Demonstrate art in a more non-representational manner
6. Familiarize students with square symmetry that incorporates balance radiating from a central point

Learning Experience

1. Show the students a finished square name pattern.
2. Ask the students to identify the letters in the pattern. What name does it spell?
3. Demonstrate folding the paper into 8 equal triangular increments, and have the students fold their paper as I fold the example.
4. Carefully show how to position the individual letters with each one touching the top and bottom of the triangle.
5. Take the example to the window and demonstrate a tracing method by using the light through the paper to amplify the lines.
6. Allow the students to see the graphite transfer from one plane to the other after applying pressure to the line…one triangle to the other.
7. After completing all eight triangles have the students select three colors for their projects.
8. Explain that all shapes of that type must be the same color.
9. Different types of shapes that touch each other may not be the same color.
10. Using markers dot each shape from the center shape out to plan your color pattern correctly.
11. Outline each shape with the marker before coloring in all the shape so that the finished project will have a better appearance.
12. Mount the finished project on a white piece of poster board and cut to size.

Materials Needed

(1) 9" x 9" piece of drawing paper, a pencil, markers, poster board

Handouts

Mayan calendar
Glossary of Terms

Evaluation

Project completion following exact instructions.

Lesson Plan Three: Out of Africa, Mask-Making Project, and Reflection Symmetry

Grade and Subjects

Sixth grade; Art, World Culture, English, Geometry

Time Required
Seven 45-minute classes

Objectives
1. Further familiarize skills in using protractor, architectural scale, straightedge, and triangle
2. Demonstrate the effect of shape and color in cultural symbols
3. Introduce narrative writing into the creative process
4. Reiterate the five basic art shapes of triangle, oval, circle, square, and rectangle

Learning Experience
1. Give each student a template of an oval with a fishlike topping drawn on an 11x 14" piece of railboard.
2. Have each student find center using a convenient measure on their architectural scale.
3. Explain that each mask must include each of the five basic shapes. If there is only one of the shape it must be on center, or it will not be reflection symmetry.
4. The shapes on each side of center must be the same in size color and relative position.
5. Draw all lines using the most appropriate architectural tool. Do not draw any lines freehand.
6. You may add of take away a portion of the mask if it is necessary to visualize your narrative better.
7. Write a one-page narrative and include a proper heading. The narrative must include the symbolism of each color, the purpose of the mask, and its importance in your society. Make certain to include the symbolism of the shapes.

Materials Needed
A template of the mask
Colored pencils
Markers
Raffia
Architectural scale
Pencil
Protractor

Handouts
Masks from various part of Africa to show the extremely diverse methods used to make their masks, and the importance in their society
Glossary of Terms

Evaluation
Timely completion of the project following the required criteria

One-Point Perspective Handout for Art Notebooks

Most of the art world proclaims a Renaissance architect and painter named Filippo Brunelleschi as the "Father of Linear Perspective." In 1419 AD he built a colonnade as part of the Foundling Hospital in Florence. The colonnade design is a single repeating unit that creates a long walkway of arches. He realized that each arch, which he knew to be the same size, appeared to get smaller toward the end. He also noticed that the roof-lines above his eye level seemed to angle down and the lines below his eye level seemed to be angling up, converging on the horizon in front of him.

We do see things in perspective but when there is forty feet of real space, it is easier to accept the view than when we translate this view onto the space of twelve inches of flat paper.

Where the earth and sky meet is the horizon, but without that reference, the horizon is at an individual's eye level. Perspective drawing follows a certain number of rules. In perspective, lines vanish to a point on the horizon and objects get smaller the further they are away from us or the closer they are to the horizon. While drawing in perspective, the artist always maintains the same position. To change position is to change the perspective.

Second, as objects appear to get further away from you they become less detailed and objects, with the same lighting, appear lighter and more grayed in color.

With one-point perspective, there is one vanishing point, and this vanishing point is always on the horizon line. All lines above the horizon line vanish down and all lines below the vanishing point vanish up to the vanishing point. All receding lines, or lines that go away from a flat plane, go to the vanishing point located on the horizon line. The point on the horizon to which diagonal lines eventually converge is the vanishing point. All receding lines vanish to that point. The receding lines do not need to end on the vanishing point; they need only to taper in heading eventually to a single point.

In one-point perspective there are only three ways you may draw a line. If a line goes from side to side, it is a horizontal line. All lines that go from side to side, horizontal lines, are parallel one to the other. Vertical lines are the second way lines may be drawn in one-point perspective drawing. All vertical lines are at a 90-degree angle to the horizon. These vertical lines are perpendicular to the horizon. All vertical lines are parallel one to the other. If a line is not horizontal or vertical, it must vanish to the vanishing point. Vanishing lines above the horizon vanish down to the vanishing point, and those vanishing lines below the vanishing point vanish up to the vanishing point. Objects and increments of space also appear to get closer together and smaller.

Perspective drawing, at this point, is a technical way of drawing. Use architectural tools, your architectural scale and T-square, to draw all lines. Draw lightly so that you can easily erase unwanted lines. Drawing in this way is extremely mathematic and fun.

For more information on perspective go to a wonderful website where it is discussed in depth. The website is <http://www.openc.k12.or.us/start/visual/basics/drawing/v-basle.html>.

Lesson Plan Four: Your Name in Perspective – One-Point Perspective from Dark to Light

Grade and Subjects
Sixth grade; Art, Math

Additional Sources on Perspective
Hooked on Drawing by Sandy Brooke, published in 1996 by Prentice Hall

Time Required
Five 45-minute class sessions

Objectives
1. Introduce another approach to one-point perspective
2. Familiarize the students with the use of the T-square and architectural scale
3. Students calculate and measure exact measurements
4. Reacquaint the students with graduated shading
5. Introduce linear perspective and the "father of linear perspective" Filippo Brunelleschi
6. Show process for drawing block letters.
7. Improve hand-eye coordination and technical skill
8. Increase the students' understanding of one-point perspective
9. See a clear example of surfaces as planes

Learning Experiences
1. Using your T-square and your desk edge, make your drawing paper flush.
2. Tape down cross corner.
3. Draw a horizon line across the paper approximately 2" from the top.
4. Put a vanishing point anywhere on the horizon line.
5. Place your T-square approximately 2" from the bottom edge of the paper.
6. Draw a line across your paper using the top of the T-square as the edge.
7. Without moving your T-square, draw a line across your paper using the bottom of your T-square as the bottom edge.
8. The lines drawn in step 5 and 6 will become the top and bottom of your block letters.
9. Draw a vertical line between these two lines.
10. Spell out your name on the paper allowing two inches for each letter and ½" for the space between each letter.
11. Use the ½"/1" side of the architectural scale.
12. Draw all outside vertical letter lines first.
13. Shape the interiors of the letters.

14. Make each cross member and upright portions of the characters ½" in width.
15. On letters that require alternative measurements, find center and then using the ¼"/1/8" side of the architectural scale measure ¼" on center.
16. Using a straightedge, draw lines from each corner point on the letter to the vanishing point.
17. If the line runs into the letter next to it, stop the line. Do not let a vanishing line cross a letter.
18. The vanishing lines may go from all corners on the letter whether the corner is inside or outside.
19. When all the vanishing lines are drawn, the students will have created planes for each side or surface on the letters.
20. They should separate these planes with a value change.
21. They will use color from light to dark indicating the light source to change the color on the plane.
22. Going from light to dark will accentuate the sense of the planes receding and add more weight to the drawing.
23. Students must successfully complete a shading sheet before beginning the shading portion of this project.
24. The students have the option of cutting off the letters so that they seem to be standing up like sculptures. They may choose any length for this sculptural form.

Materials Needed
12" x 18" drawing paper
T-square
Architectural scale
Colored pencils
Pencil
Masking tape
Eraser

Handouts
Shading sheet
Renaissance review
Biographical information sheet (Appendix) on Giotto, Filippo Brunelleschi and Leonardo Da Vinci

Evaluation
Timely completion of the project using the specific criteria for completion

Rules of One-Point Perspective
1. In One-Point Perspective, lines can go one of three ways. They vanish to the vanishing point, are vertical, or are horizontal. If something goes away from you and is above the horizon line, it vanishes DOWN to the vanishing point. If something

goes away from you and is below the horizon line, it vanishes UP to the vanishing point.
2. If a line is vertical it is perpendicular (at a ninety degree) to the horizon. All vertical lines are parallel one to the other, and at a ninety degree to the horizon.
3. If an object is facing you, all the lines are vertical or horizontal.
4. Objects appear to get smaller as they get closer to the horizon line.
5. Objects appear to get closer together as they get closer to the horizon line.
6. Objects appear less detailed as they get closer to the horizon line, and become lighter and less bright in color.

Lesson Plan Five: Landscape Perspective

Grade and Subjects
Sixth grade; Art, Math

Time Required
Five 45-minute class sessions

Additional Sources on Perspective
Hooked on Drawing by Sandy Brooke, published in 1996 by Prentice Hall

Objectives
1. Introduce another approach to one-point perspective
2. Familiarize the students with the use of the T-square and architectural scale
3. Students calculate and measure exact measurements
4. Introduce the students with watercolors
5. Show process for drawing a landscape in perspective, and increase the student's understanding of one-point perspective
6. Improve hand-eye coordination and technical skill

Learning Experiences
1. Using your T-square and your desk edge, make your drawing paper flush, and tape down cross corner.
2. Draw a horizon line across the paper approximately in the middle of your paper.
3. Put a vanishing point in the middle of your paper on the horizon line.
4. Using 12" x 18" drawing paper, mark with a dot 2" in from the two bottom edges and repeat the process on the two top edges.
5. Lightly draw a diagonal line from each dot to the center vanishing point.
6. These diagonal lines form the bottom and the top of your trees.
7. Looking at the provided handout on drawing trees, draw a row of trunks on each side of the center V-shaped space. Begin with the tree closet to the front edge of the paper. The roots of the tree may extend into the center V-shape. Remember the bases of the roots that go to the side are parallel with the horizon. Any roots that

extend toward you are foreshortened, a technique also developed during the Renaissance. There must be a minimum of three trees on each side of the V-shape.
8. In the V-shape draw lines radiating from the vanishing point to the front edge of the paper. Make the lines approximately one-inch apart at the front edge of the paper.
9. In this same V-shape, lightly draw horizontal lines getting closer together as they get closer to the vanishing point.
10. Within the grid you drew in the V-shaped center space, draw irregular lines making radius corners. This will ultimately form a stone roadway.
11. Erase your straight horizon line and give it a bit of a curve to soften the plane.
12. Add some grasses and reeds around the trees and in the grass.
13. Watercolor the piece starting with the background and ending with the foreground.

Materials Needed
12" x 18" drawing paper
Architectural scale
Masking tape
Eraser and pencil
Water colors and water
Paintbrush

Handouts
Rules of One-Point Perspective, Glossary of Terms

Evaluation
Timely completion of the project following the specified criteria

Lesson Plan Six: One-Point Perspective Cityscape

Grade and Subjects
Sixth grade; Art, Architecture, Math

Time Required
Six 45-minute classes

Objectives
1. Further develop an understanding of perspective.
2. Learn to transform a two-dimensional surface into the appearance of a three-dimensional surface.
3. Measure according to required minimum standards.
4. Proper use of architectural tools that include an architectural scale, triangle, and T-square
5. Plan and implement their composition.

Learning Experience

1. Flush and tape the 18" x 24" drawing paper cross corner to the desktop.
2. Use your T-square to verify the paper is truly flush with the reveal of the T-square.
3. Using your T-square, draw a horizon line across the paper approximately in the center of the paper.
4. Dot a vanishing point on the horizon line about in the center of the horizon line.
5. Using your T-square, lightly draw a straight line from the vanishing point to the bottom edge of your paper. This will establish your center point from which you will derive your other measurements to meet your minimum standards requirements.

Minimum Standard Requirements

1. A 6"w road on center with a one-half inch divided line in the middle of the street
2. 2" w sidewalks to each side of the center street divided proportionately as it vanishes to the vanishing point
3. (3) Buildings, each with a different appropriate distinguishable texture.
4. (1) Porte-cochere with columns and a scalloped edged awning
5. (I) Recessed door, and one flush door with handles
6. (2) Intersections
7. (1) Cylindrical object drawn in perspective.
8. Divided pane windows that remain constant and others that vanish.
9. Block letters on the building facades that vanish left and others that vanish right.
10. A walkway at the bottom edge 2" in height. Divide the sidewalk into sections that vanish to the vanishing point.

****Note: These are minimum standards. You may add to these minimum standard requirements, but anything added must also be drawn in perspective. Your city may be located in the real world or in an imaginary world. If you add cars on your street, you are correct in assuming you must draw them in perspective.

Materials Needed

18" x 24" paper
Pencil
Eraser
Architectural scale
T-square
Triangle
Masking tape

Handouts

Minimum Standard Requirements
Glossary of Terms

Evaluation

Timely completion of the project that includes all the minimum standards

Lesson Plan Seven: Two-Point Perspective Suburbanscape

Grade and Subjects
Sixth grade; Art, Architecture, Math

Time Required
Seven 45-minute class periods

Objectives
1. Familiarize the students with a more commonly used form of perspective
2. Increase their ability and comfort level in relying on the architectural tools
3. Correlate the shapes created by intersecting vanishing lines to geometric shapes
4. Plan and execute a successful composition according to state minimum standards

Learning Experience
1. Flush and tape your 18" x 24" drawing paper cross corner.
2. Before completing the taping process and drawing your horizon line, make certain the paper his still flush.
3. Draw a horizon line across the center of your paper. It does not need to be exactly in the center.
4. Dot a vanishing point at each end of the paper on the horizon line.
5. Begin your drawing with a triangular road that runs across your paper most of the way. At the front edge of the paper, the triangle should be approximately 4" in width.

Minimum Standard Requirements
1. A roadway as mentioned above
2. (3) Houses, each with a different distinguishable, appropriate texture
3. (1) House must have multiple doors
4. (1) House must have a hipped roof, and (1) house must have a pitched roof
5. Each dwelling must have windows with divided panes, and one house must have louvered shutters to each side of the windows on the house
6. (1) House must have a front porch with columns.
7. All the houses must have a walkway to the street. Each sidewalk must have a different texture
8. Include vegetation in your suburbanscape
9. (1) Front door must have a transom and sidelights.
10. (1) House must be two-story, (1) must be ranch style, and (1) must be split-level.

****Note: These are minimum standards, and you may add to your rendering. Draw anything you add in proper perspective.

Materials Needed
18" x 24" drawing paper
Pencil

Eraser
T-square
Triangle
Architectural scale
Masking tape

Handouts
Architectural elements handout for their art notebooks
Minimum standard Requirements
Glossary of Terms

Evaluation
Timely completion of their project that meets all the minimum requirements

Lesson Plan Eight: Bridging Perspective and Op Art

Grade and Subjects
Eighth grade; Art, Geometry

Time Required
Two 45-minute classes

Additional Sources for this Project
Hooked on Drawing by Sandy Brooke, published in 1996 by Prentice Hall
Designs for Coloring Geometrics by Ruth Heller, published in 2003 by Grosset & Dunlap, is an excellent overview source.

Objectives
1. Offer a quick exercise that uses precise measurements to create a geometric layout.
2. Demonstrate the ease of creating a three-dimensional optical illusion.
3. Allow the creative process to begin for this project.
4. Create a three-dimensional effect on a two-dimensional surface.

Learning Experience
1. Flush your 12" x 18" paper on your desktop.
2. Using your architectural scale, measure one-half inch increments across the bottom edge of the paper, and repeat the process along one side edge of the project.
3. Using your T-square, draw a one-half inch grid on the paper. Draw lightly.
4. Number each grid line across the top of your paper beginning with zero.
5. Now number down one side so that the horizontal 0 and the vertical 0 are the same.
6. Draw a diagonal line with your straightedge from zero across to two across and one grid down.
7. Draw a diagonal line from #2 across, #1 down across and #0 down.
8. Continue making this zigzag pattern across the top of your paper.

9. On the vertical side go to #2 down and make a zigzag line just as you did before.
10. Repeat the process until the paper is full of zigzag lines.
11. Look at the optical illusion you created.
12. Using a black colored pencil and any two colors of your choice color in like spaces and enjoy the optical illusion you created.
13. Color in all the tops with the black colored pencil and alternate the sides between two colors of your choice.

Materials Needed
12" x 18" paper
Colored pencils
Architectural scale
T-square
Pencil
Erasure
Triangle
Masking tape

Handouts
Biographical sketches on Vasarely and Riley
Glossary of Terms

Evaluation
Timely completion of the project following the given criteria

Lesson Plan Nine: Creating Repeating Patterns, Wallpaper Patterning, and Glide-Reflection Symmetry

Grade and Subjects
Sixth and eighth grades; Art, Geometry, World Culture

Additional Sources
<http://www.iproject.com/>**.**
<http://www.iproject.com/escher/teaching/make_tessel.html**>.**
Symmetries of Culture written by Dorothy K. Washington and Donald W. Crowe, and published in 1988 by the University of Washington Press

Time Required
Five 45-minute classes

Objectives
1. Create a wallpaper type of pattern
2. Prepare for tessellation project
3. Work on painting skills

4. Help to develop style
5. Introduce acrylic paint
6. Time to work on brush technique
7. Organize overall pattern
8. Work with template to position repeating design scheme in each square

Learning Experience

1. Fold a 16" x 16" piece of drawing paper horizontally and vertically until you have sixteen equal increments.
2. Draw a pattern on a four -inch piece of vellum. If you choose, you may draw a second pattern on another four-inch piece of vellum to alternate with your first pattern to create your wallcovering pattern.
3. Trace over the lines of the vellum template on the backside.
4. Transfer your pattern onto each of the squares. If you made two patterns alternate the pattern until you cover the entire paper with your pattern(s).
5. Select two complementary colors and an appropriate size paintbrush and paint each of the squares so that no two shapes that touch are the same color.

Materials Needed

16" x 16" drawing paper
Four inch square Vellum
Pencil and erasure
Straightedge
Protractor
Acrylic paint and paint brushes

Handouts

Various wallcovering patterns from a wallcovering book
Seventeen Islamic Tiling Patterns
Glossary of Terms

Evaluation

Completion of the project in a timely manner following the given criteria

Internet Sources

<http://www.mccallie.org/myates/Symmetry/symmetry.htm>.

Lesson Plan Ten: Tessellations and Rotation or Glide Translation Symmetry

Grade and Subjects

Eighth grade; Art, Art History, Math

Time Required

Ten 45-minute classes

Objectives
1. Create an understanding of both positive and negative space in a composition.
2. Work with complementary colors
3. Hone acrylic painting skills before attempting to paint on canvas
4. Showcase the brilliance of M. C. Escher's tessellations
5. Show the Islamic influence on M. C. Escher's work
6. Increase visualization skills

Learning experience
1. Give each student a 16" x 20" piece of drawing paper.
2. After getting flush and taped down, lightly draw a four-inch grid on your paper. This grid will only be used loosely in the creation of your composition.
3. Take a four-inch square of tagboard.
4. Cut a shape from one side of the square.
5. Tape it onto the opposite side directly across from the cut out.
6. Cut the shape in half.
7. Tape them opposite each other, thus creating your tessellating shape.

Materials Needed
16" x 20" drawing paper
Architectural scale
T-square
Tagboard
Pencil
Tape
Acrylic paint
Paint brush
Scissors

Handouts
Biographical sketch on M. C. Escher
Enlargements of Islamic tiling at the Alhambra
Glossary of Terms

Evaluation
Timely completion of their project working within the provided criteria

Internet Reference
<http://www.iproject.com/escher/teaching/maketessel.html>.

Lesson Plan Eleven: Optical Illusion Study and Op Art Painting

Grade and Subjects
Eighth grade; Art, Math

Time Required
Five 45-minute classes

Objectives
1. Create original designs and get the design perfected for painting.
2. Reinforce basic processes.
3. Understand the difficulty of painting the created design.
4. See linear design from a different perspective.
5. Assist in the student understanding the degree of creativity and work associated with this genre of art.
6. Further develop fine motor skills and use of proper tools.
7. Organize the design and color placement.
8. Experiment with color choices and color placement.

Learning Experience
1. Take a 16" x 20" piece of drawing paper and fold it in half vertically and horizontally creating a quadrant.
2. Using an 8" x 10" piece of vellum, develop a pattern for one quadrant of your drawing paper.
3. Repeat the process again on vellum to see the interaction of the pattern once it duplicated.
4. Once you create a design that you can work with through an entire painting process, draw the pattern in all four quadrants covering the paper entirely.
5. Work with contrasting colors to establish your color palette. Complementary colors are a good place to start, but not always the answer.
6. Make certain there is enough contrast in intensity and value.
7. Work out any "problem areas" on your paper before you begin to paint. It is easier to correct on paper than on canvas.
8. Prime your canvas with two coats of gesso. The first coat covers using horizontal strokes over the entire surface. The second coat covers the entire surface vertically. Once the canvas is dry, trace the pattern on a 16" x 20" primed canvas once you establish pattern and color selection.
9. Be precise in transferring your pattern to your canvas. Keep the lines light. Some paints bleed through some colors of acrylic paint.

Materials Needed
Vellum 8" x 10"
(1) 16" x 20" piece of drawing paper, pencil, erasure
Acrylic paint with paint brushes
(1) 16" x 20" canvas and Gesso

Handouts
Painting technique Sheet

Evaluation
Timely completion of the project following all the criteria

Lesson Plan Twelve: Creating a Three-Dimensional Regular Polyhedron

Grade and Subjects
Sixth and eighth grades; Art, Geometry

Time Required
Fifteen 45-minute classes

Additional Source
Cut & Assemble Three –Dimensional Geometrical Shapes by A.G. Smith and published in 1986 by Dover Publications

Objectives
1. Create a three-dimensional model
2. Learn the importance of precise measurements
3. Gain skill in organization and visualization
4. Compose a polyhedron that defines their personality and life experience
5. Learn more about angles, vertices, and rotations
6. Learn the Greek prefixes for the number of sides of a polyhedra and additional vocabulary words regarding this style of model building
7. Begin the learning process for cutting using a utility blade

Learning Experience
1. Each individual chooses a net of a dodecahedron, snub dodecahedron, a small stellated dodecahedron, octahedron, or icosahedron.
2. The purpose of the net is to show the placement of individual pieces for construction.
3. Using the matte side of white railboard (poster board), or the colored sides of any other railboard begin drawing your template, and then the balance of the shapes.
4. Using your protractor, draw each shape required to build your model. Each side of your model is 3 inches. The exact angle on your protractor is important!
5. Determine the number of shapes required and draw enough of each shape.
6. After drawing the shapes from your templates, cut them out using a utility blade.
7. When cutting line a straightedge up to the cutting line to ensure a straight cut.
8. Put like shapes together to make certain they are all the same. Approximate is not a good thing in building polyhedrons. Make any corrections before you begin the construction process.
9. Using masking tape, tape the inside of the construction first.
10. Now begin taping the sides together on the outside mitering the corners so that there is no tape overlapping. You may use tape that matches the color of your railboard, or you can select a contrasting color.
11. Plan and visualize your conception of the final product.

12. If applying painted designs to the faces of your polyhedron, apply these designs before taping the individual shapes together.
13. If you are using a collage method to complete your project, finish all your taping before applying your collage materials.
14. Apply a finish coat of polymer medium to give a gloss appearance, and secure any embellishments.

Materials Needed
Nets
Railboard
Colored tapes
Masking tapes
Magazines
Sharpie permanent markers
Pencil
Protractor
Straightedge
Utility knife
Pencil
Polymer medium

Handouts
Nets, Glossary of Terms

Evaluation
Timely completion of the project following given criteria

APPENDIX

Artists and Key Innovations of the Italian Renaissance

Historians consider the Italian Renaissance the beginning of the modern age. The name means "rebirth", an accurate description of this period of scientific and artistic innovation. Renaissance thinkers also looked to lost literary texts of the ancient world for new understanding. This renewed interest in history, literature, and the arts was the birth of a whole new way of thinking. This way of thinking centered on the world of mankind as much as on the world of the hereafter. This new way of thinking called *humanism*, which has roots in the Greek concept of "man as the measure of all things." With the invention of movable type during the Renaissance, new ideas and scholarship spread faster than ever before.

The general dates of the Renaissance are 1400 – 1550, and its birthplace is Florence, Italy, a prosperous merchant town. This is an important fact because these great ideas and art required money to cultivate. Florence was a wealthy town and patrons of the arts funded artists and the building of elaborately decorated cathedrals. The greatest family of art patrons was the Medici family, who decorated their city with sculptures bought from Greece and Rome. They commissioned artists and architects to create a city of beauty and culture. They also funded the first universities.

Some of the most obvious changes during the Renaissance are in the paintings and sculptures. They continued with religious subjects, illustrating stories from the Bible, they combined this interest with classical ideals of the human figure and an increased interest in depicting nature. Greek and Roman inspired mythological works were also popular. Artists began to experiment with oil-based paints for the first time. These oil-based paints combined powdered pigments with linseed oil. This gradually replaced the medieval technique of egg tempera. The artists liked the oil-based paint because they dried more slowly and remained workable for a few months. Artists like Michelangelo used the *fresco* technique on plaster walls. Sculptures started working "in the round" rather than relief decorations in cathedrals.

Perspective and light, also introduced into art during the Renaissance, perfected the sense of three-dimensional reality. These artists of the Renaissance made such a dramatic impact in their concept of space and form that they changed the way we look at the world of art for all time.

Giotto

Giotto (1267 – 1337) many call the "Father of the Renaissance." He began using some perspective, gave more volume to the human figure, and gave his characters emotion. In the Medieval times, artists drew the human figure as passive, emotionless icons. The figures were flat looking, and the overlapping planes were crude. Two master works that

demonstrate the early techniques of perspective are *Lamentation of the Death of Christ* and *Cleansing of the Temple.* Giotto is given credit for being the father of linear perspective by some scholars, however; more appear to favor Filippo Brunelleschi for this title. Perspective was a dramatic departure from art of the previous centuries, and the Renaissance artists explores many approaches to this technique and changed the face of art, and still influence art today.

Filippo Brunelleschi

Filippo Brunelleschi (1377 – 1446) was born in Florence, Italy. His father was a lawyer. Filippo began his career as an apprentice for a goldsmith. After six years of apprenticeship (1398) he passed his examination and became a guild master goldsmith.

Later Filippo discovered his passion for mathematics and architecture. He began renovating town homes and small projects. He was the first to carry out a series of optical experiments that led to a mathematical theory of perspective. Brunelleschi devised the method of perspective for architectural purposes. Once Alberti published the method of perspective in 1435, it had a dramatic effect. *The Church of San Lorenzo* reflects the influence of classical architecture in its Corinthian columns and its geometric balance impact on the depiction of three-dimensional space in art. This rendering is an excellent example of linear perspective.

Leonardo Da Vinci

In 1495 he began his best known work, *The Last Supper,* and completed it in 1499. Although this painting still survives today, and is a treasure of Renaissance art, Da Vinci never referred this as one of his better works of art. It is, however, a wonderful example of Renaissance art where he employed atmospheric and linear perspective. He used linear perspective in all his paintings that contained architecture. He was also one of the first artists to make note in his writings about the existence of atmospheric perspective. To give the illusion of receding depth in nature, he painted with warm tones in the foreground, and cool tones in the distance. Another technique he employed, one of the trademarks of his *Mona Lisa (1504),* is sfumato effect. Sfumato is the technique employed by many Renaissance painters, which gives almost a mysterious look to the art. The eyes appear to follow you throughout the room. This is the sfumato, a visual illusion.

Da Vinci also created mathematical formulas for human proportions. *The Vitruvian Man*, the drawing of the human figure inside of a square and a circle, expresses the perfection of the harmony between mathematics and nature. He combined art and science constantly. For example, your foot is the same size as the area between your wrist and your elbow. Your height is the same as your arms outstretched from fingertip to fingertip. Your wrist is the size of your middle finger wrapping around your wrist to

touch your thumb. The human body is nine heads tall. These are just a few of the proportional conclusions by Da Vinci.

Da Vinci died at Cloux and buried in the Church of St. Valentine at Amboise, France, on May 2, 1519. In his will, he left all his drawings, manuscripts, tools and instruments to his favorite pupil, Francesco Melzi. Da Vinci had over 5000 drawings in his notebooks. Before attempting any painting or sculpture Leonardo Da Vinci made numerous sketches of his subject matter until he felt he could portray the likeness from any angle. Many of his drawings still survive while only a few of his paintings still survive. He had many subjects that interested him in his drawings. Among his subjects are men, women, horses, dogs, trees, flowers, fruit, moving water, anatomy, architecture just to name a few. Other relevant information about Renaissance innovations can be found at <http://www.eyeconart.net/history/Renaissance/early_ren.htm>.

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