

### **Spectrum Program Two-Week Session**

#### **Course Title: Illusions & Solutions: The Art of Math**

#### **Course Description**

Some of history's greatest minds have been fascinated by the art/math combination, including Leonardo da Vinci, Fibonacci, Johannes Kepler, and Frank Lloyd Wright. Math is also clearly visible in the work of artists such as M.C. Escher, Piet Mondrian, Georges Seurat, and Pablo Picasso. This course explores the connections between mathematics and art: how artists use math to achieve artistic goals; how art can be used to explain mathematical ideas; and the critical mathematical formulas and principles used by artists and scholars. Students are given opportunities to explore the creative side of mathematics and apply it to various art forms such as linear perspective, tessellations, optical illusions, and fractals. Students will look at the works of famous artists, architects, and inventors, study the math within their work, and apply their learning to their own artwork.

#### **Essential Questions**

- How did historically renowned artists and architects incorporate mathematics in their artwork and architectural designs?
- What makes the golden ratio and its associated properties aesthetically pleasing to the human eye?
- What purposes did the concepts such as perspective, grid, and optical illusion serve in many of the Western works of art?
- How can one demonstrate a harmonious relationship between art and geometry through a mathematically inspired composition?

#### **Outcomes**

Upon successful completion of this course, students will:

- Appreciate the contributions of historically significant artists and mathematicians to the field of fine arts and architecture
- Understand the major mathematical and geometrical concepts such as Fibonacci sequence and golden ratio and how they are calculated
- Apply the geometrical properties of polygons and areas to visually dynamic designs
- Compare and contrast the ways in which mathematical concepts were used in realistic/abstract art or traditional/modern art
- Describe a piece of art using spatial and compositional terminology
- Analyze and critique works of art using the elements and principles of design
- Synthesize the knowledge gained throughout the course and create drawings that demonstrate the relationship between art and mathematics

#### **Instructional Strategies**

Illusions & Solutions will utilize various instructional strategies that are well balanced in lecture, discussion, and hands-on creation. Individual, pair and small group assignments will be assigned appropriately to maximize the

learning experience, and the students will be given an ample autonomy to express their creativity and originality insofar as they follow the criteria for each project. While there will be some measuring exercises and geometry/trigonometry problem solving calculations germane to each lesson, the primary focus of this course is to incorporate the mathematical knowledge gained to create a variety of artwork. The instructor will provide direct instructions via PowerPoint presentation and demonstration and lead class discussion and critique that will broaden their perspective and intrigue their curiosity. Through the field trip to the Art Institute of Chicago, the students will be able to draw a connection between the concepts they learned in the classroom and the actual works of art.

## Resources and Materials

- **Books**
  - a. Course packet/PowerPoint presentation notes
- **Web sites**
  - a. Mr. Narain's Golden Ratio Website <http://cuip.uchicago.edu/~dlnarain/golden/>
  - b. Math Is Fun Website: <http://www.mathsisfun.com/numbers/golden-ratio.html>
  - c. GoldenNumber.net = The PhiSource.com Website: <http://goldennumber.net/>
  - d. The Math Behind the Beauty Website: <http://m.intmath.com/numbers/math-of-beauty.php>
  - e. Arty Factory = [http://www.artyfactory.com/perspective\\_drawing/perspective\\_index.htm](http://www.artyfactory.com/perspective_drawing/perspective_index.htm)
  - f. WebExhibits: Science and Art of Perspective = <http://www.webexhibits.org/sciartperspective/links.html>
  - g. Museum of Science: Exploring Linear Perspective = <http://www.mos.org/sln/Leonardo/ExploringLinearPerspective.html>
  - h. The Renaissance Connection: Discovering Linear Perspective = [http://www.renaissanceconnection.org/lesson\\_art\\_perspective.html](http://www.renaissanceconnection.org/lesson_art_perspective.html)
  - i. Tessellations: Escher and How to Make Your Own = <http://www.tessellations.org>
  - j. Totally Tessellated = <http://library.thinkquest.org/16661/escher/tessellations.1.html>
  - k. Discover, Explore & Create Op-Art = <http://www.op-art.co.uk/>
  - l. ArtLex on Op-Art = <http://www.artlex.com/ArtLex/o/opart.html>
  - m. Fractal Geometry = <http://classes.yale.edu/fractals/>
  - n. Fractals Unleashed = <http://library.thinkquest.org/26242/full/>
- **Materials**
  - a. Calculator
  - b. Writing utensils: pen, pencil, eraser, notebook
  - c. Measuring tools: ruler, compass, protractor, graphing papers
  - d. Drawing materials: white sulfite drawing papers, tag boards, construction papers, markers, colored pencils, scratch papers, stylus, scissors, glue sticks, magazines

## Student Assessment

- **Pre-Assessment**

On the first day of the course a pretest, which consists of both multiple choices and skill demonstration, will be administered to assess the students' prior knowledge of golden ratio, Fibonacci sequence, linear perspective, geometry, and algebraic equations that are germane to the lessons that will be taught.
- **Documentation of Learning**

There will be a combination of small-scale practice exercises and several major projects, which will demonstrate the students' understanding of the concepts introduced in class. Each major project will be assessed by a rubric that clearly stipulates the criteria.
- **Post-Assessment**

The posttest, which is the same as the pretest, will be administered on the last day to measure each student's growth. This can also be considered a final exam. The students will keep a portfolio of their artwork and write

a reflection statement on the art and math connection, their favorite/challenging lessons, and the areas of strength/improvement.

## Schedule

Date	Topic(s)	In-class Activities	Assignments/Assessments
7/18 Mon.	The Golden Ratio and Art & Architecture  Pythagoras, Euclid & Da Vinci	<ul style="list-style-type: none"> <li>• Pretest</li> <li>• PowerPoint presentation and discussion on Golden Ratio and artists, sculptors &amp; architects who have been inspired by it</li> <li>• Draw the golden rectangle using ruler, compass, and protractor</li> <li>• Calculate the golden ratio equation</li> <li>• Start the building façade assignment</li> </ul>	Design a façade of building based on the golden ratio
7/19 Tues.	Fibonacci Sequence and Art, Science & Nature  Order & Beauty	<ul style="list-style-type: none"> <li>• PowerPoint presentation and discussion on Fibonacci numbers and artists who were inspired by it</li> <li>• Construct Fibonacci Spiral</li> <li>• Start a grid enlargement drawing with a focal point</li> </ul>	Grid Enlargement
7/20 Wednes.	Kepler's Triangle & Pascal's Triangle	<ul style="list-style-type: none"> <li>• PowerPoint presentation and discussion on Fibonacci numbers and its relation to the golden triangle (Kepler &amp; Pascal)</li> <li>• Finding the angles in the golden triangle and pentagon</li> <li>• Start face/figure drawing exercises</li> </ul>	Face/figure drawing based on the golden triangle and proportion
7/21 Thurs.	Geometry & in Modern Art  Picasso Seurat Mondrian	<ul style="list-style-type: none"> <li>• Review of elements &amp; principles of design</li> <li>• Analyzing works of art by Picasso and other Cubists</li> <li>• Harmony &amp; Balance exercise based on Mondrian</li> </ul>	Class critique  Midterm assessment
7/22 Fri.	Making a real life connection	<ul style="list-style-type: none"> <li>• Field trip to the Art Institute of Chicago</li> </ul>	Complete any unfinished artwork during the weekend
7/25 Mon.	Linear Perspective  Parallel Lines and Converging Lines	<ul style="list-style-type: none"> <li>• Discussion on the perspective/3D illusion in historical paintings</li> <li>• Demonstration on 1 pt., 2 pt., &amp; 3 pt. linear perspective drawing techniques</li> <li>• Start a linear perspective drawing</li> </ul>	Linear perspective drawing
7/26 Tues.	Circles & ellipse, Geometrical Properties & Optical Illusion	<ul style="list-style-type: none"> <li>• Continue working on the linear perspective drawing</li> <li>• Introduction to Optical Illusion</li> <li>• Start an Op Art design</li> </ul>	Op Art Design

<b>Date</b>	<b>Topic(s)</b>	<b>In-class Activities</b>	<b>Assignments/Assessments</b>
7/27 Wednes.	Polygons & Patterns  M.C. Escher  Tessellations	<ul style="list-style-type: none"> <li>• Continue working on the Op Art</li> <li>• Introduction to tessellation and M.C. Escher</li> <li>• Review the properties of polygons</li> <li>• Start a tessellation project</li> </ul>	Tessellation Project
7/28 Thurs.	Geometry in Modern Architecture  Symmetry/Asymmetry  Frank Lloyd Wright & Le Corbusier	<ul style="list-style-type: none"> <li>• Discussion on geometry and aesthetic revolution in modern architecture</li> <li>• Continue working on the tessellation project</li> <li>• Fractal/Pattern design on a black &amp; multicolor transparency scratch-art</li> </ul>	Finish up any incomplete projects  Class critique
7/29 Fri.	Course Wrap-up	<ul style="list-style-type: none"> <li>• Posttest (Final Exam)</li> <li>• Reflection Statement</li> <li>• Artwork Exhibit</li> </ul>	End of course evaluation

### **CTD Statement on Third-Party Web Sites**

Instructors are required to thoroughly review any third-party web sites they intend to use in their courses for inappropriate content. However, because web content continuously changes, CTD disclaims any responsibility for any of the content contained on third-party web sites used in course materials. If you become aware of anything that may be inappropriate, please notify CTD staff immediately.