Math Powered Art

LEARNING GOALS: After the completion of this workshop, students will understand:

1. Math is an engine empowering the arts.
2. Math and art are intuitive; languages as well as representations.
3. Our perception of beauty is related to our cultural perception of math

CONCEIVE – What do I wish to accomplish through this project?

This stage involves guiding students in defining the goals of the project, then helping them develop conceptual, technical and action plans to meet those goals while considering the technology, knowledge, and skills that apply. This guidance is provided in the form of Essential Questions that use student’s preconceptions, and misperceptions then move them toward a deeper and more realistic understanding of the process and skills needed to complete the project.

ESSENTIAL QUESTIONS:

1. How are mathematics and art related in studio art, crafts, poetry, and music?
2. How can I use the math inside to respond to art, or to create art?
3. If a little math in art is useful, is more math better?

NOTES:

DESIGN - How will I accomplish the project?

This stage focuses on creating the plans, drawings and algorithms that describe the product, process or system that will be implemented.

*Note: the following are a series of concepts and activities that would ideally be used in a multiple exposure learning experience. Generally, any combination of concepts can be selected according to students’ ages/abilities, numbers of example activities used, and time or material restrictions.

BEGIN CLASS

As students enter the class: Have a volunteer snap a digital photo of each student and print the photos.

A/V looping on the screen: http://www.youtube.com/watch?v=V1RxTYRKMIY&feature=related and http://www.youtube.com/watch?v=hhhfqiJ7nU&NR=1

Objects & Space as Numbers

Introduction, warm up: Use a white board and simple geometric shapes to demystify math. The math of art is already inside them even if they haven’t yet learned the methods and vocabulary of math or art.
Shape and Composition as 2 & 3 Dimensional Geometry
Activity: Have students singly and then in pairs manipulate paper and recognize resulting geometric shapes.
Activity: Student small groups collaboratively identify geometric shapes of increasing complexity in studio art. They cut out the shapes from one of several paintings or statues, affix the shapes to a canvas to approximate the selected art, and ask other groups to identify which piece of art the group’s geometric art represents.

Symmetry (Geometry) in the Human Face
Activity: Fold a paper in half. Open it. Cut out a shape that does not cross the center line. Asymmetry. Fold the paper on the fold and use the cut portion as guide. Cut the other half exactly as the first half. Symmetry.

Activity: Introduction: Which do you like better, left, center, or right in this (Lady Gaga) http://www.youtube.com/watch?v=uLYfzS3jRLI&feature=related
  • Explain that the leftmost picture is a photo of Lady Gaga. Have the students pose like the photo.
  • Explain that the center and rightmost pictures are only half of the original photo; mirror image symmetry.
  • Explain that no human face is perfectly symmetrical, that we appreciate some asymmetry.

Activity: Students vote for their favorite image: left, center, or right for the following celebrities. (Johnny Depp) http://www.youtube.com/watch?v=vNIMX_VeLIA&NR=1
(Natalie Portman) http://www.youtube.com/watch?v=pBvpAX-T-PQ&feature=related
(Keira Knightley) http://www.youtube.com/watch?v=JTua5EPWVJs&feature=related

Proportions & Ratios as Hierarchical Importance
Math is a language, as is art. One must learn the terms in order to communicate without frustration.
Activity: Have students puzzle out the meaning of proportion as depicted by size of personages in pre-Renaissance art. (Hierarchical proportion.)

The Math of Distance & Time on a 2 Dimensional Surface
Infinity & the Vanishing Point: The globe, distance, atmospheric interference & Perspective
Activity: Have students puzzle out the differences in hierarchical and perspectival studio art. Create a perspectival representation of a road, train tracks, or stream lined by trees receding into the distance. Have traceable shapes available for students who are reluctant to draw.

Time: Human Proportions & Foreshortening
Activity: Have students measure human proportions as seen in action comics and in representational art to discover foreshortening, the application of a separate vanishing point, and its “meaning.”

Fibonacci Sequence in Nature
Activity: Introduce ratios using a length of colored thread and beads for each student, stringing beads at 0, 1, 1, 2, 3, 5, 8, 13, with 1 being the length of the farthest joint on the longest finger of the student’s hand. (Yeah, I know. Middle school humor with the middle finger. Oh well. Think of it as a finger with more than one use.)

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Activity: Notice the ratios in relationship to the student’s entire longest finger from tip to wrist. Show A/V aid of Fibonacci sequence and the longest finger, http://connect.in.com/fibonacci-series-in-nature/photos-1-1-1-362d704205d1e04b66cc3891ab903e2.html#image_button.


Activity: Identify Fibonacci spirals in various objects such as pinecones, chrysanthemums, etc.

A/V looping slide show using Beethoven music background and images http://connect.in.com/fibonacci-series-in-nature/photo-gallery.html and Billie Ruth Sudduth – basket artist http://americanart.si.edu/collections/search/artwork/?id=35186 and

Activity: Have students assemble proportionally sized rectangles into a Fibonacci number sequent spiral.
Activity: Have student small groups identify Fibonacci spirals in paintings

Golden Ratio
Introduce the Golden Ratio (Phi or Pi)
A/V http://www.youtube.com/watch?v=gGeYr3byGe8&feature=related
(Beginners) Activity: Using calculators and rulers, work with a variety of measurements to find Phi by the long side and by the short side of possible golden rectangles.
(Beginners) Activity: Have students construct a small golden rectangular frame with popsicle sticks and tape, and apply the “frame” to studio art. Did the artist seem to have the golden ratio in mind when creating the art?
(Intermediate) Activity: Have students construct a small rectangular frame and apply the “frame” to their own digital photographs to assess the composition. Experiment, construct other frame shapes within the golden ratio rectangle frame (pentagonal, oval, etc.) and apply these and non-golden ratio frames to group fellow students for photographs. Have assistant take photos & compare the results on the screen. Use the frames to assess studio art and architecture.

Golden Ratio in the Human Face
Introduction:
Activity: Student groups observe one another’s faces and collaboratively list possible golden ratios between elements such as eyes, teeth, mouth, etc.
A/V http://www.youtube.com/watch?v=Wy6cqVUloJQ&feature=related

Activity: Pass out the student’s pictures taken at beginning of class and have them measure different elements of their faces and compute the ratio.
Finding the Golden Ratio

(Advanced) Activity: Consider using software demonstrated here to assess Google Images visual images for relationship to Phi [http://www.youtube.com/watch?v=B2Q2bdUQq3o&feature=player_embedded](http://www.youtube.com/watch?v=B2Q2bdUQq3o&feature=player_embedded) in images of people, art, architecture, nature, etc.

Fractals

Introduction

Define using simplest definition: "a rough or fragmented geometric shape that can be split into parts, each of which is (at least approximately) a reduced-size copy of the whole" (Wikipedia)

Activity: Without revealing the end result, direct students to draw a Sierpinski Triangle using graph paper in successive stages. Do the first two stages on the board. Large equilateral triangle that fills the whole large graph paper canvas first, then elicit from students what must happen next in order to fulfill the definition. Students do successive stages, employing smaller graph paper as necessary.

A/V Play this video silently as a clue and as confirmation as students continue with successive stages on their own, [http://www.youtube.com/watch?v=WRMzglUxmOk](http://www.youtube.com/watch?v=WRMzglUxmOk) then play this video zooming in on the Mandelbrot Set to give a more comprehensive view of possibilities as students finish their Sierpinski Triangles, [http://www.youtube.com/watch?v=G_GBwuYuOOS](http://www.youtube.com/watch?v=G_GBwuYuOOS)

So, what’s so artful about a Sierpinski Triangle?


Advanced Introduction (may follow introduction noted above)

This video may be used to more fully demonstrate the math and art of fractal algorithms [http://www.youtube.com/watch?v=RCFcyia99hHM&feature=related](http://www.youtube.com/watch?v=RCFcyia99hHM&feature=related)

END CLASS

Transition to Audio: Rhythm, From Visual to Audible

As class prepares to leave (clean up) apply visual lessons to audio. Your ears can hear the math your eyes can see. Can you hear the math in this?

A/V Melody, “1.618” [http://www.youtube.com/watch?v=MQoJ8KQOqFA&NR=1](http://www.youtube.com/watch?v=MQoJ8KQOqFA&NR=1)

A/V Rhythm and Melody, [http://www.youtube.com/watch?v=GlilhC5bAX84&NR=1](http://www.youtube.com/watch?v=GlilhC5bAX84&NR=1)

A/V Harmony “The Beauty of Math in Harmony” [http://www.youtube.com/watch?v= s9Ve9g0jPl&NR=1](http://www.youtube.com/watch?v= s9Ve9g0jPl&NR=1)

NOTES:

IMPLEMENT - From an idea to a product!
This stage refers to the transformation of the design into a product. It includes hardware, manufacturing, software coding, testing and validation.

NOTES:

**OPERATE – Does it work the way I planned?**

This stage uses the built product, process or system to satisfy the intended goal.

NOTES:

**RESOURCES NEEDED – What equipment and supplies do I need?**

- Computer with AV connection & internet access
- Calculators & rulers
- Colored & White Paper
- Fibonacci ratio rectangles in different sizes from paper or wood
- Small (<1/4”) medium (1/4”) and large (1/2”) graph paper
- Popsicle sticks and ½” painter’s tape
- Origami boxes (geometry)
- Shells, Pinecones, Flowers, etc (Fibonacci)
- (geometry, golden ratio, Fibonacci)
- Digital camera
- Access to a printer during class
- Assortment of pencils, colored pencils, pens, crayons, magic markers
- Assortment of large format (11 x 17) color printed art works, photographs, pics of teen celebrities & TV cartoon & action comic book art

**SET-UP**
Check computer, projector, and Audio connections and get YouTube intro video started

Test Digital camera and printer

Lay out visuals & instructional supplies