

## **Just Give Me the Facts, Ma'am**

*Cindy Vetter*

### **Rationale**

I love art. I teach it. I also love numbers and math. Math turned out to be one of my academic strengths, though up to a point. I haven't experienced mathematics beyond trigonometry and I can't say that I actually mastered that. As a young student I studied math daily and art monthly, until I reached high school. Art class and math class were part of my daily routine at school. As much as I enjoyed both, I did not think much about the compatibility of the two subjects until I became a school teacher.

Part of learning math concepts involves writing numbers. The process of learning to write number symbols is actually a drawing process of making marks. In their early years, children make random marks on paper. As development progresses, the marks begin to mean something to the child and to the viewer. Straight lines, curved lines and shapes become objects, letters and numbers. Part of the learning process is the ability to record information through writing (drawing). Learning is a balance of seeing, hearing, thinking and recording (writing). This balance of using the senses is critical, in my opinion.

Every year I participate in the administration or proctoring the administration of the North Carolina End of Grade testing. I mostly give the tests to students who need separate setting or read aloud accommodations. Students are tested in mathematics with and without using a calculator. From my experience in these settings, I have several concerns. Many students still count on their fingers. This indicates to me that they have not mastered basic math facts. Some students struggle with fractions and equivalencies. Perhaps there is a weakness in visual thinking and reasoning. I observed students neglecting to use a calculator, rather spending time trying to draw pictures or perform number calculations. The problem solving process breaks down and on a multiple choice exam a student may become frustrated and guess at an answer. Calculators were not a part of my math education, so when I demonstrate a math calculation during an art lesson students marvel at my skill without a calculator. I suppose that as an artist I still enjoy the process of writing out (drawing) the problem and its numbers.

I am a classroom art teacher with over twenty years of experience, seven of those in a middle school classroom and now more than thirteen in an elementary classroom. It is

because I saw eight grade students still counting on their fingers and an overall weakness in problem solving strategies in both elementary and middle school environments that I want to focus on integrating art and math in a way that I hope will benefit math learning skills.

All learning, whether it is math, art or science, relies on cumulative skill building. I realized this in the eighth and ninth grades when I found myself struggling in an advanced math class. Though I was appropriately placed, I was unfocused and easily distracted in my algebra class. As we were building upon skills and concepts that I was not mastering, I found myself in a fog, falling farther behind. Algebra class continued in the ninth grade for a semester, followed by a semester of Plane Geometry. The 'bottom fell out' when I brought home a D on a report card. The very strong reaction by my father convinced me that I needed to take myself out of the advanced math curriculum. I enrolled in a regular Geometry class the next year. Fortunately, this class was a review of the semester of Geometry I took the previous year. The review helped me clarify concepts, restored my confidence and created a new enthusiasm for math. I went on to do very well in Algebra II. When I took the SAT, my math score was ninety-nine points higher than my verbal score.

I was still a committed art student, in spite of my improvement in math. Art is associated with stronger right brain function, whereas math is associated with the left hemisphere of the brain. One might conclude that these two subjects would not be very compatible. I see many connections that I think will help students at my school who are struggling academically.

### **School Information**

I am the art teacher at Rama Road Elementary in Charlotte, North Carolina. The school of seven hundred students, pre-k through grade five, is located among neighborhoods of single-family homes approximately six miles southeast of the city center. Our students come from these neighborhoods, as well as multi-family housing within our attendance area. Rama Road is a Title I school, with eighty percent of our students receiving free or reduced-price lunches, funded by the Federal Government. The cultural make-up of our school includes forty-nine percent African-American, twenty-seven percent Hispanic, seventeen percent Caucasian, three percent Multi-race, and three percent Asian students. We have a faculty of forty-eight certified teachers, all of whom are highly qualified. Seventeen teachers have master's degrees and fourteen teachers are national board certified. Classroom teachers are assisted by nineteen paraprofessionals. Our school is fortunate to have the support of volunteers from a nearby private school who mentor at-

risk students. We also receive financial and volunteer support from area churches that provide tutoring to many of our students during the school day. After school tutoring is provided by another faith-based organization at no cost for students.

### Math Assessment Data

At Rama Road Elementary School, students in grades three through five are tested in Math and Reading near the end of each school year. Students take two tests for Mathematics: Calculator Active and Calculator Inactive. The scores for these tests are combined to show proficiency and growth. The data for the 2010-2011 indicate that over thirty-five percent of third grade students (now fourth graders) are not at grade level. Thirty percent of our current fifth grade students are not on grade level. Proficiency in math for the current fifth grade students improved by twelve percent between the third and fourth grades, however for all students who were tested we did not achieve our goal of 88.6% proficiency as our Annual Yearly Progress for No Child Left Behind.

### Objective

I plan to work with students in grade four and grade five, and I will create lessons and activities that will provide reinforcement of basic math facts. Some students struggle to learn/memorize basic math facts in addition, subtraction and multiplication. I will work with classroom teachers to identify specific needs.

Teachers frequently administer timed tests to assess skills in rapid recall of basic math facts. Fourth grade teachers emphasize multiplication and division. In fifth grade, all math operations are assessed. During the years I have taught art in elementary and middle school, I have noticed that many students still count on their fingers to calculate. Each year during the administration of North Carolina End of Grade testing, I see students struggling with mathematics. Some students use a calculator for math fact based operations that should be committed to memory. Mastering math facts is the foundation on which students build more complex math knowledge. I believe those students who lack mastery of math facts will struggle and find math to be overwhelming and not enjoyable.

The activities in my curriculum will target the math facts that students answer incorrectly on timed tests they take in their classrooms. I will be collaborating with classroom teachers to determine each student's needs. Since I am an art teacher and not a math teacher, I plan to link the activities to the works of selected artists, including Jasper Johns and Charles Demuth.

As an artist and one who loves numbers, I came up with an idea many years ago that I thought might help students memorize basic math facts. I haven't tested my theory until now. Can color play a role in helping students memorize math facts? My first activity will explore this concept. I'll begin by gathering data from timed tests students take during math instruction. I plan to follow up after students complete the activities to determine whether my activities helped students to improve their scores on timed tests of math facts.

## Activities

### Activity 1, Preparation

I will work with fourth grade teachers and our fifth grade math teacher. After those teachers administer timed math fact assessments, students will record those math facts answered incorrectly. Students will bring this information to art class, where each will choose one that will be the focus of the upcoming activities. To get started, each student will color code a number line to use as a reference.

0 1 2 3 4 5 6 7 8 9

Each digit will have a color value:

0= black, 1= red, 2=green, 3= (royal)blue, 4= orange, 5= yellow, 6= purple, 7= pink, 8= (light)blue, 9= brown

After each student completes the colored number line, he or she will create a flash card showing the answer with a colored numeral. Students may make flash cards for any of the math facts they answer incorrectly on their timed tests or for those instances where they are counting on their fingers!

Example: 12 and 7 will be black. Only the answer will be colored, in this example, yellow. Create a flash card for each (timed test) incorrectly answered math fact.

$$\begin{array}{r} 12 \\ -7 \\ \hline 5 \end{array}$$

I will encourage students to study the newly created flash cards. After a follow up timed test in the regular classroom, I will meet with the teachers to compare the results in order to evaluate the effectiveness of this exercise.

## Activity 2

Grid structures are common to both mathematics and art. In the sixteenth century, German artist Albrecht Durer (see Figure #) used a grid to develop linear perspective.<sup>1</sup> During the era of Modernism in art, Jasper Johns used a grid composition and numbers as subject matter. In the Post-Modern era, contemporary artist Chuck Close reinvigorated the use of the grid. The grid will be a common thread in the rest of the activities of this curriculum unit.



Figure 1 Albrecht Durer using a grid to observe his subject for a drawing

Students will choose a math fact that was answered incorrectly on a timed test, or a math fact in which the student uses fingers to calculate the answer. I will consult the classroom teacher, who will assist students in choosing the math fact for reinforcement. Figure 1 below shows a sample layout for this activity. Mark off grid lines that are two inches apart in each direction. The example shown has six cells. A paper measuring twelve inches square may be used for this activity. If a three inch cell is desired, use a paper measuring eighteen inches square. More than one math fact may be included to create a grid with four quadrants, as shown in Figure 3. By using a paper measuring eighteen inches square, students will be able to calculate to find that each cell of the grid will be one and one half inches in size. An example of an art work by Jasper Johns is shown in Figure 5.

To create an artistic aesthetic for the number composition, students will draw “shape” numerals, as opposed to writing them as line symbols. Many students have difficulty seeing letters and numbers as shapes, as they are accustomed to writing them as lines. (The handwriting of letters and numbers is drawing!) There is an easy way to teach

students to draw numbers (or letters) as shapes. I will demonstrate the process and allow students to practice. (Figure 2) Draw the numeral. Draw a new line that surrounds the numeral without touching it, like a fence. Erase the inside line. Some students may be able to draw shape numbers without the step-by-step method, but in my experience most students need to learn and practice this step-by-step approach.



Figure 2: left-- typical line drawn number, middle—a new line surrounds the number, right—the line number is erased, leaving the shape of the number five.

To help reinforce the answer to the math fact the student chooses, the answer number will show the color as defined in the color number line activity. The other numbers used in the project will be black or gray. Below is a sample layout for an art project. In each cell of the grid layout, the student will draw a number or symbol as a shape that will be colored. Each cell will have a background color. A student may choose to make that background a colorful pattern. Figure 3 shows a simple layout. Figure 4 shows a more complex layout. Appropriate art media for this activity are color pencil, marker, crayon and watercolor paint, or tempera paint.

<b>7</b>	<b>+</b>	<b>9</b>	<b>=</b>	<b>1</b>	<b>6</b>
<b>1</b>	<b>6</b>	<b>=</b>	<b>7</b>	<b>+</b>	<b>9</b>
<b>7</b>	<b>+</b>	<b>9</b>	<b>=</b>	<b>1</b>	<b>6</b>
<b>1</b>	<b>6</b>	<b>=</b>	<b>7</b>	<b>+</b>	<b>9</b>
<b>7</b>	<b>+</b>	<b>9</b>	<b>=</b>	<b>1</b>	<b>6</b>
<b>1</b>	<b>6</b>	<b>=</b>	<b>7</b>	<b>+</b>	<b>9</b>

Figure 3 Sample layout

<b>7</b>	<b>X</b>	<b>9</b>	<b>=</b>	<b>6</b>	<b>3</b>	<b>7</b>	<b>+</b>	<b>9</b>	<b>=</b>	<b>1</b>	<b>6</b>
<b>7</b>	<b>X</b>	<b>9</b>	<b>=</b>	<b>6</b>	<b>3</b>	<b>7</b>	<b>+</b>	<b>9</b>	<b>=</b>	<b>1</b>	<b>6</b>
<b>7</b>	<b>X</b>	<b>9</b>	<b>=</b>	<b>6</b>	<b>3</b>	<b>7</b>	<b>+</b>	<b>9</b>	<b>=</b>	<b>1</b>	<b>6</b>
<b>7</b>	<b>X</b>	<b>9</b>	<b>=</b>	<b>6</b>	<b>3</b>	<b>7</b>	<b>+</b>	<b>9</b>	<b>=</b>	<b>1</b>	<b>6</b>
<b>7</b>	<b>X</b>	<b>9</b>	<b>=</b>	<b>6</b>	<b>3</b>	<b>7</b>	<b>+</b>	<b>9</b>	<b>=</b>	<b>1</b>	<b>6</b>
<b>1</b>	<b>6</b>	<b>-</b>	<b>9</b>	<b>=</b>	<b>7</b>	<b>6</b>	<b>3</b>	<b>/</b>	<b>7</b>	<b>=</b>	<b>9</b>
<b>1</b>	<b>6</b>	<b>-</b>	<b>9</b>	<b>=</b>	<b>7</b>	<b>6</b>	<b>3</b>	<b>/</b>	<b>7</b>	<b>=</b>	<b>9</b>
<b>1</b>	<b>6</b>	<b>-</b>	<b>9</b>	<b>=</b>	<b>7</b>	<b>6</b>	<b>3</b>	<b>/</b>	<b>7</b>	<b>=</b>	<b>9</b>
<b>1</b>	<b>6</b>	<b>-</b>	<b>9</b>	<b>=</b>	<b>7</b>	<b>6</b>	<b>3</b>	<b>/</b>	<b>7</b>	<b>=</b>	<b>9</b>
<b>1</b>	<b>6</b>	<b>-</b>	<b>9</b>	<b>=</b>	<b>7</b>	<b>6</b>	<b>3</b>	<b>/</b>	<b>7</b>	<b>=</b>	<b>9</b>
<b>1</b>	<b>6</b>	<b>-</b>	<b>9</b>	<b>=</b>	<b>7</b>	<b>6</b>	<b>3</b>	<b>/</b>	<b>7</b>	<b>=</b>	<b>9</b>

Figure 4 More complex layout



Figure 5 This shows how Jasper Johns organized number shapes in a grid layout.

### Activity 3

“Zentangles” is a term coined by Maria Thomas a graphic designer and friend of Rick Roberts. Maria began doodling patterns on a manuscript and found the experience made her feel calm and relaxed.<sup>ii</sup> Students will use this concept to combine the number sentences and doodle drawing/design to create an art work with a grid composition. I will have students create a zentangle on four separate pieces of paper. Each zentangle design will be unique. Its design will combine drawn lines and pattern plus repetitive writing of a targeted math fact, as shown in Figure 7. Each of the four zentangles the student draws will feature the same or different math facts. Creating a zentangle begins with a blank square paper, for example three inches square, or four inches square. The student will draw a curvy line through the square (lightly) with a pencil.<sup>iii</sup> Using a fine line black pen, the student will begin writing the number sentence in a small size and repeating it to create a pattern (see example). After a number of repetitions, draw a line to close off the patterned area. Make a second line or even a third line as a visual design. Begin another section of doodling, using the number sentence. The number value of the math fact may be interpreted as shapes, for example, sixteen small circles within a linear space. Repetitive doodling of the math fact continues, with the student choosing when and how to draw a boundary line to separate sections, until the square is filled.



Figure 6 (www.zentangle.com)



Figure 7

The finished zentangles will be glued to a color paper, twelve inches square. Color may be added to the zentangles in the areas that are not part of the number pattern. Students will refer to the color-coded number line to choose the accent color, as well as the background paper color.

#### Activity 4

##### *A 'Demath' Painting*

Charles Demuth (1863-1935) was an American painter who gained recognition as a still life painter. Known primarily for his still life paintings, he did not limit himself to that genre. “The Figure 5 in Gold” (Figure 8) “is one of a series of eight abstract portraits of friends inspired by Gertrude Stein's word-portraits that Demuth made between 1924 and 1929.”<sup>iv</sup> Demuth was a college friend of poet William Carlos Williams whose work, “The Great Figure” was the inspiration for this painting.<sup>v</sup>

Charles Demuth wasn't necessarily into mathematics, but his use of the number five as the subject for a painting was unusual for its time. Traditional art subjects did not include the use of numbers. The Pop Art Movement of the nineteen fifties and sixties saw other noted artists, such as Jasper Johns (Figure 5) and Robert Indiana (Figure 9) use numbers as subject matter.





Figure 8



Figure 9

This project will allow the students to use the math fact as the subject of a Charles Demuth inspired painting, to reinforce committing the math fact to memory. At the same time, students will study the art element of space and the design elements of proportion, repetition and emphasis, as well as learn about linear perspective. Students will learn to use vanishing points to create the number sentence on a plane that appears to move away from the viewer. There are options to be explored in creating the illusion of depth, as illustrated in Figure 8 and Figure 9. The answer to the math fact will have the greatest emphasis, for example,  $7+9=16$ . The number 16 will have the greatest emphasis in the picture.

#### Activity 5

##### *A Graphic Mosaic*

Mystery picture worksheets are used to help students practice math operations. I see examples where the shapes of objects are indicated with lines and the interior shape areas will be colored. There is a simple math problem inside the shape, and the worksheet shows a color key. (Figure 10)



Figure 10



Figure 11



A student may simply consult the color key and fill in the shapes with the appropriate color. This type of work sheet could be more challenging if the student had to write a math fact whose answer was the number in the shape. But the picture is obvious. As an art teacher, I don't find this to be very creative or challenging.

For my mystery picture activity, a color image will be scanned and converted into five to eight values that will be assigned to a cell within the grid. (Figure 11) Depending on the logistics of the computer program, I hope to use a photo of the student. If that is not possible, I plan to choose a noted art work portrait. The number of cells in the grid will be determined by the detail desired. The computer programming will be developed at Davidson College by Dr. Tim Chartier. The goal is for the program to be programmed in Java allowing it to run on a PC or Mac. For each cell in the grid, there will be a number value. Students will have to create a math fact whose answer is the value of the cell. The image grid will be recreated with a problem to solve for each cell. Once this step is completed, student pairs will swap grids and solve for the cell values. Each student may now assign a color for each numeric value on the grid. A piece of art work will then be created.

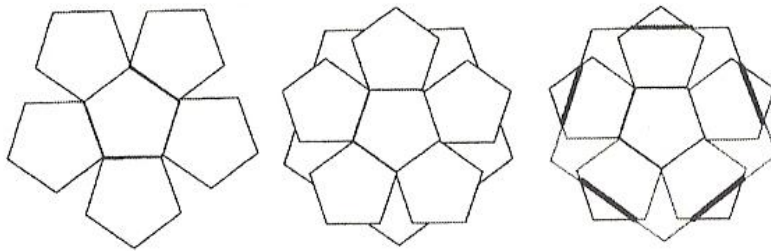
The art project will be created on white railroad board with each cell in the grid measuring one half inch, or one inch, depending on the size of the grid. When we determine whether a half inch cell or an inch cell is best, the board will be measured and lined with a ruler. Each cell will be marked lightly with a pencil to indicate the color to be used. The material chosen will be glued in place on the grid. Students will create a mosaic. Among the possible materials for the mosaic: paper, plastic 'pony' beads, colored plastic buttons, art-foam pieces, M&M candies or Skittles. Dried beans or wadded tissue paper may be considered, as well. Upon completion of the project, the

subject of the image will be revealed to the student. I would love for students to be able to say, “Wow! It’s me!”

### Activity 6

There will be some students who do not need remediation of basic math facts. For those students, a project constructing a pop-up dodecahedron will be an option. Made of twelve pentagons, this relates to the art works of Charles Demuth and Robert Indiana, and their use of the number five (Figures 8 and 9). The students will cut two shapes on heavy paper as illustrated (Figure 12). In an art class, ‘plain white’ isn’t very exciting, so students will choose a math-themed motif for surface decoration of the twelve pentagons. Score the edges of the center pentagon. The six-pentagon shapes are overlapped as indicated in the illustration.<sup>vi</sup> A rubber band weaves in an over-under pattern around the edges of the two shapes. The tension of the band will cause the shape to become the three-dimensional dodecahedron.

An ambitious student (or one not needing math fact remediation) may want to expand this activity by creating multiple dodecahedrons, maintaining the same size or varying the sizes. There are sculptural applications that may be explored, including a freestanding form or the creation of a mobile. A student may research the mobiles of Alexander Calder and his use of Fibonacci numbers.



Three stages in making a pop-up dodecahedron.

Figure 12

The lessons and activities within this curriculum will be aligned with the Common Core standards for Mathematics as defined by the state of North Carolina, as well as the Essential Standards for Visual Art.

### Outcome

At the conclusion of these lessons and activities, I hope students will be able to improve proficiency in recalling math facts. The visual production and the creative process as it relates to math concepts will improve student focus on problem-solving skills. I am optimistic that students will find the combination of math and creative aesthetics will create energy and motivation to learn more about the artistic applications of mathematics.

## **Appendix**

### Materials for the Classroom

#### *Activity 1*

A number line printed on copy paper. Use Microsoft Word Art for the outline numbers. Copy three number lines on a letter size paper. Cut into individual strips. Coloring materials: markers or color pencils. Index cards, 4x6, or tag board cut into pieces.

#### *Activity 2*

For math fact grid: practice paper for shape numerals-- copy paper or newsprint paper. White sulfite paper, 12x12", color construction paper for mounting, 15x15", glue; ruler or straight edge for lining of the white paper, pencil for sketching numbers, color markers.

#### *Activity 3*

For zentangles: 3x3" white paper (smooth copy paper), waterproof fine line black pens, color construction paper for mounting, 12" to 14" square, glue sticks.

#### *Activity 4*

"Demath" painting: white sulfite paper, 12x18", pencils, rulers/straight edge, tempera paint, paint brushes, rinse water in containers, newspapers to cover work area, paint shirts (optional).

#### *Activity 5*

The Mystery Picture: a color photograph of each student, or color photographs of images (famous art, colorful leaves, a classroom still life, a famous portrait, i.e. Mona Lisa), white railroad board, cut into pieces that will allow for a grid of one inch cells, or one-half inch cells, liquid white glue, various tesserae (M&Ms, skittles, color paper squares, plastic beads, buttons), straightedge/ruler, teacher-made grid paper for students to write the math fact for each cell in the grid. The image printed on paper with a number value in each cell.

### *Activity 6*

Pop up dodecahedron: a flat shape template for students to use to trace the six pentagon shape, scissors, rubber bands, drawing materials for surface decoration (pen, pencil, or markers), tag board or railroad board.

## **Appendix: Implementing District Standards**

The Charlotte-Mecklenburg school district uses standards as defined in the North Carolina Essential Standards for Visual Art, slated to be adopted across the state for the 2012-2013 school year. I am citing Visual Arts Essential Standards and Clarifying Objectives for grades four and five. These activities also support the mathematics Common Core standard 4.0A, Use the four operations with whole numbers to solve problems. The Common Core State Standards for Mathematics do not specifically address math facts in grade five, however, based on classroom teacher feedback, some students need additional reinforcement.

### *Activity 1, Activity 2, Activity 3*

The visual art standard 4.V.1, Use the language of visual arts to communicate effectively; 4.V.1.4, Understand how the Elements of Art are used to develop a composition.

Fifth grade Essential Standards include 5.V.1.5, Apply the Principles of Design in creating compositions (demonstrate using line and shape to create repetition.)

### *Activity 4*

The “Demath” painting

The Visual Art standard 5.V.2, Apply creative and critical thinking skills to artistic expression applies the Clarifying Objective 5.V.2.3, Create realistic, imaginative, abstract, and non-objective art. For fourth grade students, the Essential Standard 4.CX.2, Understand the interdisciplinary connections and life applications of the visual arts is addressed. The specific Clarifying Objective 4.CX.2.2, Apply skills and concepts learned in other disciplines, such as math, science, language arts, social studies, and other arts, in the visual arts is applied as students use proportion to show spatial perspective (depth.)

### *Activity 5*

The mystery grid picture addresses the Visual Art Essential Standard 5.V.3, Create art using a variety of tools, media, and processes, safely and appropriately. To further clarify the standard, Objective 5.V.3.2, Use appropriate media for the creation of original art allows students to evaluate a variety of media choices to determine which is appropriate for this project.

### *Activity 6*

Creating a three-dimensional dodecahedron fits within the visual art Essential Standard 5.CX.2, Understand the interdisciplinary connections and life applications of the visual arts.

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<sup>i</sup> "Albrecht Durer - The complete works." Albrecht Durer - The complete works. <http://www.albrecht-durer.org/biography.html>

<sup>ii</sup> "Untitled Document." Untitled Document. <http://zentangle.com>

<sup>iii</sup> "Untitled Document." Untitled Document. <http://zentangle.com>

<sup>iv</sup> "The Metropolitan Museum of Art - I Saw the Figure 5 in Gold." The Metropolitan Museum of Art - Home. <http://www.metmuseum.org/Collections/search-the-collections/210008539>

<sup>v</sup> "Charles Demuth: The Figure 5 in Gold (49.59.1) | Heilbrunn Timeline of Art History | The Metropolitan Museum of Art." The Metropolitan Museum of Art - Home. <http://www.metmuseum.org/toah/works-of-art/49.59.1>

<sup>vi</sup> Stewart, Ian. *Professor Stewart's cabinet of mathematical curiosities*. New York: Basic Books, 2009.

### **Bibliography**

"The Metropolitan Museum of Art - I Saw the Figure 5 in Gold." The Metropolitan Museum of Art - Home. <http://www.metmuseum.org/Collections/search-the-collections/210008539> (accessed November 27, 2011).

Demuth's painting is owned by the Met. The narrative provided with the image explains the inspiration for the painting, as well as analysis of the work.

"Albrecht Durer - The complete works." Albrecht Durer - The complete works.

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<http://www.albrecht-durer.org/biography.html> (accessed November 27, 2011).

The biography section of this web site may be appropriate for a student, grade four and up. It is easily comprehended, compared to some older references I found. There are images of his works which include nudes.

"Charles Demuth: The Figure 5 in Gold (49.59.1) | Heilbrunn Timeline of Art History |

The Metropolitan Museum of Art." The Metropolitan Museum of Art -

Home. <http://www.metmuseum.org/toah/works-of-art/49.59.1> (accessed

November 6, 2011).

This site deals specifically with the painting referenced in my unit, putting it in context of Demuth's body of work as an artist.

Chou, Peter Y.. "The Figure 5 in Gold: Charles Demuth's Art & William Carlos

Williams' Poem." WisdomPortal.com.

<http://www.wisdomportal.com/Christmas/Figure5InGold.html> (accessed

November 5, 2011).

This painting of Demuth's is the inspiration for one of the activities I plan to use to help reinforce math facts for students. Though Demuth was not focused on mathematics, this site provides information about his friendship with the poet William Carlos Williams and his use of the poem as the inspiration for the painting.

"How did it start? - Zentangle." Zentangle - Zentangle.

[http://www.zentangle.com/index.php?option=com\\_content&view=article&id=8](http://www.zentangle.com/index.php?option=com_content&view=article&id=8)

&Itemid=118 (accessed November 27, 2011).

The zentangle web site provides examples, as well as explaining the origin of the concept.

"Jasper Johns - Numbers in Color, 1958-59." Art History Resources for Students,



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Enthusiasts, Artists and Educators - Artist Biographies - Art Timelines - Images and Picture Galleries.

[http://arthistory.about.com/od/from\\_exhibitions/ig/action\\_abstraction/jm-aa\\_08\\_11.htm](http://arthistory.about.com/od/from_exhibitions/ig/action_abstraction/jm-aa_08_11.htm) (accessed November 5, 2011).

There are numerous sources for examples of Jasper Johns' number paintings. This is just one of them. This give students a tie-in for the math-art connection and the basis for the activity.

Milliande. " Zendoodle Sampler Zentangle Pattern Styles Tutorial 1 ." YouTube - Broadcast Yourself. . <http://www.youtube.com> (accessed November 1, 2011).

In a search for Zentangles on YouTube, there are numerous choices for zentangle tutorials. This one was heavily viewed, so that is why I chose to cite this author. She doesn't doodle in math facts, as I plan for my students, but students will be able to use this as a creative resource.

"ROBERT INDIANA . com." ROBERT INDIANA . com. <http://robertindiana.com> (accessed November 5, 2011).

Robert Indiana has contributed to pop culture and I want students to be aware of his work, especially "The Figure 5", another example of an artist turning to numbers as subject matter.

Snyder, Jessica. "Charles Demuth." The Pennsylvania Center for the Book.

[http://pabook.libraries.psu.edu/palitmap/bios/Demuth\\_\\_Charles.html](http://pabook.libraries.psu.edu/palitmap/bios/Demuth__Charles.html) (accessed November 6, 2011).

This provides a quick reference and overview of the life of Charles Demuth. Her sources for the article are listed.

Stewart, Ian. *Professor Stewart's cabinet of mathematical curiosities*. New York: Basic

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Books, 2009.

This book is full of fun math activities that will appeal to students. I marked many items that I considered using, but chose his 'Pop Up Dodecahedron' on page 7. The pentagon fit will with my references to art works by Charles Demuth and Robert Indiana.

"Untitled Document." Untitled Document. <http://zentangle.com> (accessed November 5, 2011).

This is the web site of the creators of Zentangle. It offers background information and galleries of examples that will allow a teacher or student to grasp the concept. For my curriculum unit the Zentangle will use numbers as the primary motif of the designs and I will encourage students to use some non-numeric visual elements in a minor role.