**The Flower Is In Our House!**
**How Art and Math Are Found in the Pre-Columbian World**

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## INTRODUCTION

Long ago, there was a nation in the jungles of Central America called the Maya. Their descendants are still found there today. This nation spread out from countries we know today as Guatemala, Belize, Honduras, El Salvador, Nicaragua, Costa Rica, Panama, and Southern Mexico. Their temple ruins are immense and demonstrate something of the magnificence this civilization must have displayed. Their immense understanding of the area in which they lived, as well as their knowledge of the stars, is just being acknowledged. There have been several documentaries about the subject matter by well-known archeologists and historians. The most amazing of all these topics is that their seemingly simple use of their mathematic system has proven to be the closest to accurate results when charting the sky, creating a working calendar, planting and harvesting, as well as predicting the birth of their children.

> The ancient peoples of Mexico and Central America were deeply interested in the rhythms of the natural world, from the movements of the stars to the length of human pregnancy. The Pre-Columbian peoples found these rhythms to be mathematically knowable, and thus developed one of the ancient world's great mathematical traditions. They independently invented the concept of zero, developed a coherent and rather simple base 20, or vigesimal system, discovered the mathematical rhythms in the movements of stars and planets, used calendrical system of great beauty to count time cycles millions of years into the future and to recount precisely dated histories over a thousand years. While in the hands of the great ancient scribes this system could be extraordinarily complex and subtle, it was based on simple real-world observations that can be learned and taught on any level of mathematical skill. (Koontz, Syllabus)

The Maya developed a complex yet sophisticated math that could chart the stars or count a farmer's parcel. It has beauty in the way it was recorded as well as a spiritual connectiveness to the respect of their person, nature and of their Gods. It certainly went over and beyond the head of Cortez and other Spanish conquistadores, who neglected to see these people as just as intelligent as the Spanish. Did they not see that the Maya counted with base 20, invented the concept of *zero*, were prolific builders of pyramids and temples, and carved sculptures as wonderful as those in Egypt, Rome, or Greece? They recorded their events, their Lord's ancestral lineage, historical moments and much more in books called codices. These codices were burned by the Spanish, considered works of the devil. A few codices were sent to Europe as curiosities and are still kept there today. Much of our understanding of the culture, mathematics, and astronomy of the Maya have been revealed by the existing Dresden Codex as well as many monumental stelas with amazing carvings of mathematical computations.

> Four native books survived the Spanish invasion. Three survive in European libraries and they take the names of the cities where they reside (Dresden, Madrid, and Paris). A fourth, known as the Grolier Codex, apparently came to light in a cave in recent decades

> and is now in Mexico City. All were painted within a hundred years of the Spanish Conquest.
>
> Maya books of the Classic period presumably looked quite a bit like the survivors; taller than they were wide and consisting of folded fig-bark paper laboriously prepared, beaten, and overlaid to create continuous sheets. Maya books of the Classic period usually appear to have been bound between two wooden boards covered in jaguar pelt (Miller 187).

The Maya were the single largest group of American Indians north of Peru and were centered in the Yucatan Peninsula (See Appendix D – Map of Maya Area, HTI Pre-Columbian Math Publication 2007). The Maya spread their concept of mathematics, calendrical systems, architectural tastes, and religious and spiritual disposition, such as seeing nature's bounty and the natural world as Gods. Their main contributions to architecture were the ideas of monumentalized building and stelae, of truncated foundations in which to build their pyramids, of the plaza, and of the ball court.

> Harmony is maintained between the dimensions of buildings and plazas as well as between the different levels of elevation. Geometric volumes are softened, and the resulting assemblage is more dynamic. The architectural plurality of Mesoamerica can be summarized in the following building types; pyramids and platforms… Plazas: open spaces of rectangular plan, residential complexes… the plans are usually rectangular but many may vary considerably… Ball courts: usually consisting of two parallel foundations that delimit the area of the game. (Carrasco 43)

One of the main ideas I leave with after researching the Maya is that everything was sacred to them. Everything was meaningful. Even to this day, we find the descendants of these great people engulfed in ritual and ceremony. Curiously, in modern times, it has been noted that Christian holidays fall on days that the Maya and other Mesoamerican Indians would follow a particular rite or observance. Another Mesoamerican example appears in the more modest Dia de Los Muertos altars and rites. Whether as home altars, cemetery shrines, or public displays in parks, universities, or civic centers, the Day of the Dead sites – a mixture of European and indigenous traditions – depend on religious symbolism. Specially made corn tortillas are staked in thirteen levels and marked with directional symbols. A table is erected with corners carefully oriented to the cardinal directions (Carrasco 167-168). I marvel at their need to have all actions be significant. That leads me to my unit's purpose.

In the learning of art skills and the much needed comprehension of mathematics, my students need to obtain another attitude. They need to see the magic, or shall I say increase their sense of the imagination, by putting themselves inside the Ancient Maya.

Open themselves up to soil, sticks, and nature. Let them see how art and mathematics mesh into beauty and mastery of their pyramids. Approach them with the Maya's harsh surroundings in order to have them see the greatness of their minds and efforts. Create a research base of information for themselves about the Maya. Allow a moment to reflect on what they learn (their codex) and then give them the time to grasp mathematical concepts (that are taught in Math class) in a totally unusual way... All this by looking at natural objects and finding the geometry inside as the Maya did. My curriculum affords this very complete manner of learning – using the senses, being hands-on, using guided study, and not leaving technology alone to do the job. I hope that my students will enrich themselves as I have by getting to know the awesome Mayas!

## OBJECTIVES

### Math and Language Arts Objectives for Practice and Understanding

This unit is customized to correlate to the Texas Essential Knowledge and Skills. These skills are the objectives and standards we expect our students to reach along in the lessons provided. These are the main component objectives listed for 6th, 7th and 8th grades:

Math 6.1, 7.1.01 - number, operation, and quantitative reasoning and practice through the use and practice of base 20. - Compare and order integers and positive rational numbers using concrete or pictorial models, benchmarks and place value. Students will be delving into place value practice with base 20 problems.

MATH 6.1.02 - Use manipulative or pictorial models to represent and generate equivalent forms of rational numbers, including whole numbers, through the use of natural Mayan articles such as shells, sticks, beans or stones.

MATH 6.4.02 - Select and use appropriate units, tools, or formulas to measure and to solve problems involving length (including perimeter), area, time, temperature, volume, and weight; and apply the problem-solving model when doing so.

MATH 6.2.06, 7.2.06 - Formulate equations from problem situations described by linear relationships that are represented in various forms (such as concrete or pictorial models, or as data displayed in a table, chart, or as labels on a graphic). This will be accomplished by the students creating their own problems to solve equations involving rational numbers, use pictures and symbols to record the steps of the solution process, and verify the solutions using substitution.

MATH 7 4.01 - Estimate measurements, solve application problems involving length (including perimeter and circumference) and area of polygons and other shapes, and distinguish between the types of units used. Students will be measuring and estimating perimeter by creating a pyramid temple.

Math 8.4.06 - Model (concretely or pictorially) and describe the resulting effects on perimeter and area when dimensions of a shape are changed proportionally.

***Language Arts Objectives*** are also imbedded into the lessons to assist in the practice and development of understanding for our standard testing called Texas Assessment Knowledge and Skills (TAKS) at the end of each year.

ELA 6.1.02 - Participate actively and confidently in academic discussions by monitoring interaction to maintain topic focus, respond constructively to divergent ideas and opinions, and use higher-level thinking skills and content-specific discourse.

ELA 7.1.02, ELA 8.1.02 - Interact effectively in academic discussions (refine verbal/non-verbal expression, invite others to participate, negotiate roles, acknowledge and respond to divergent thinking, use content-specific/higher-level discourse).

LA 6.1.04, ELA 7.1.04, ELA.8.1.04 - Participate in class study and discussion of conceptually complex and content-specific vocabulary to extend general and academic vocabulary knowledge. Prepare, organize, and deliver a variety of formal individual and group presentations (book/film reviews, dramatic interpretations, panel/group presentations) using visual aids and logical organizational structures.

ELA.6.2.23 ELA.7.2.23 ELA.8.2.23 - Recognize and discuss the influence distinctive cultural mores, values, social conventions, and gender roles have on literary themes using multicultural texts. Recognize and compare the influence distinctive cultural mores, values, social conventions, and gender roles have on literary themes and messages using multicultural texts.

**Fine Arts Objectives**

***Fine Arts Objectives*** are my primary source of initiatives to follow in my Arts curriculum. These objectives are referred to as Texas Essential Knowledge and Skills (TEKS). These TEKS are what a Fine Arts teacher follows and makes sure that they are practicing in any of the year's curriculum. These are the TEKS that will be followed for the seventh and eighth grade levels in this unit.

117.32 (1A, B) Perception. The student develops and organizes ideas from the environment. The student is expected to: (A) illustrate ideas from direct observation, imagination, personal experience, and school and community events; and (B) compare and contrast the use of art elements and principles, using vocabulary accurately.

117.35 (2C) Creative expression/performance. The student expresses ideas through original artworks, using a variety of media with appropriate skill. The student is expected to: (C) produce drawings, and electronic media-generated art, using a variety of art materials and tools in traditional and experimental ways.

117.35 (3A) Historical/cultural heritages. The student demonstrates an understanding of art history and culture as records of human achievement. The student is expected to: (A) analyze ways that international, historical, and political issues influence artworks;

117.35 (4A) Analyze and compare relationships, such as function and meaning, in personal artworks.

117.38 (2A, B) Creative expression/performance. The student expresses ideas through original artworks, using a variety of media with appropriate skill. The student is expected to: (A) create artworks integrating themes found through direct observation, personal experiences, and imagination; (B) apply design skills to communicate effectively ideas and thoughts in everyday life.

117.38 (4B) Response/evaluation. The student makes informed judgments about personal artworks and the artworks of others. The student is expected to: (B) analyze original artworks, portfolios, and exhibitions by peers and others to form conclusions about formal properties, historical and cultural contexts, intents, and meanings.

**RATIONALE: Searching for Effective Learning**

Students in Middle School are at a funny stage in life. They give opinions but can't explain why they feel as they do. You can hear them say, "I hate math!" Are they saying they hate the subject matter? Or are they really saying they do not like the teacher, the way in which the subject matter is being taught, or that they do not understand how to do certain problems in math? I find that my students either have a knack for math or shy away from it because they don't understand it, and do not want the other students to know.

I teach 7$^{th}$ and 8$^{th}$ graders and have found that there are many ways in which a child can be inhibited, develop a bad attitude, and therefore miss out on all the wonderful things about math. Yet they look forward to doing work in the arts, since they feel the curriculum to be less rigid, more diverse, and more fun!

My aim is to introduce students to different and wondrous types of mathematics through studying the Pre-Columbian nations and developing them through art projects. Not only will they realize that the math of the indigenous Indians of America was incredibly advanced, but also they will be able to find out (for many in my class are Latinos and Mexicans) about their heritage in a fun and imaginative way. So when it comes time for them to learn in their math classes (say for example: binary, base 10 or 20 systems) they will be surprised that they understand and grasp it much faster! Close to seventy-five percent of the population in my school has come to the United

States from these countries. I know that most of my students will already be disposed to learn about their ancestors.

In reading what other teachers do and what best practices they follow, I came across a paperback that listed teacher's messages about their thinking and teaching habits. Elvira Bitsoi Largie from New Mexico spoke on the importance of culturally relevant curricula:

> The method I use in teaching mathematics, science and technology can be described as teaching concepts in a bilingual maintenance and immersion program. This involves integration of the content areas into one curriculum using a well-balanced approach among the whole language approach, basic skills development, and real-life applications of mathematics, science and technology. The lessons I teach are relevant and meaningful to the cultures and life of the student population. (Stone 80)

I am always searching for innovative ways in which to introduce art and other subject matter to my students. I'm trying to find out what they can do as a project that will invigorate their art work. I find that creating lessons that invite critical thinking, research, and core curriculum practice, and blending these lessons with artistic expression, brings meaning into the process of creating. In art you must have something to express or say non-verbally through art materials. Unless a child is a genius or has a real command of his/her imagination, he/she does not yet know how to think and express artistically; the child must be encouraged, in some way given vivid information and a good prompt. Prompting, the setting up of criteria, is key to the art experience.

> A quality art program includes the study of art criticism, art history, aesthetics and art production. Anyone teaching art has the responsibility to teach students to think about art and to realize that art involves the mind as well as the hand. (Stone 161)

I hope to have my students' research enough about the Maya to be able to create their own games, stories, and models of temples. With each activity they create, they will learn to be critical, understand and synthesize their ideas, and make playing their games worthwhile. With every story and temple model, I will expect them to take us to another time and place. I would like them to stretch their imaginations and think about what the Maya's life might have been like while appreciating history of this part of the world. In creating these products, they will be advancing into drawing and computer work as well.

**UNIT BACKGROUND: Differentiated and Cool Ideas**

The unit is full of fun activities and discovery. From a Mayan calendar, to understanding base 20 systems, to geometry in buildings, to the golden rectangle, to reading and writing in Mayan hieroglyphics and computer related games…. This unit should fill up all of a *middle schooler's* energy. There are many ways to teach this unit. School fieldtrips, outside activities, creating the very materials with which they are to create art (just like the Maya), interactive-computer games, use of reference books, and individual and group projects will all be included.

The most exciting parts of my unit are the wholly diversified, inter-connective, and multi-sensory lessons. One minute the students will be going outside (just like the Maya) collecting twigs, stones, nuts etc… the next they will be reflective, using their journal like a codex. Then they will practice with natural manipulatives, creating ink from berries, making their own paper, journaling, researching, testing each others' knowledge in a stumping game, then going outside and using geometry with rope creating rectangles for their make-believe buildings. They will be practicing the use of math formulas, such as finding perimeters for pyramid models and discovering nature within geometry and the golden rectangle.

I would like my pupils to feel a real connection with their heritage, a sense of belonging. After all, they live in this region! For the non-Hispanics in the class, I'd like them to be aware

that their ancestry can also be revealed, through literature, the Internet, and documentation. In the process of these lessons, the students will build up a routine to follow and will complete research for themselves. The process involves reading from documentation (reference books, literature, or the Internet), writing in one's own words important information (in their project "codex" journal), compiling work into a PowerPoint presentation, developing practical knowledge of base 20 through the Internet, completing practice sheets and problem-solving activities, and developing new artwork in Maya style.

This unit will require the class to have set enough time aside to compare and contrast student work. In the final project the process of critique will be included. Students will be introduced to this process through group projects, collective studies, and reflective activities in order to respond and show that they have grown in comprehension with their multicultural theme project at the end of the fourth lesson.

Four basic parts will be reviewed as part of the components for their grade, including art history, aesthetics, art production, and art criticism. Students will all grade each other on their progress and production. The rubric chart below will be helpful at any point in the lessons and especially at the end to connect all works in the presentation, and to assist the students in their collective critique:

Student's Name whose work you are critiquing: _____

On each block write how many points you are giving each part, and then add them up for total points. You can assess up to 25 points for each category = equaling 100 maximum pts.

| **Product** | **Description** | **Analyze** | **Interpret or Details** | **Evaluate/Judge** | **Total Points** |
|---|---|---|---|---|---|
| Codex Journal | Did the project have clear and important information about Maya base 20? | Would you be able to do base 20 following the information given? | Did you learn anything new about the Maya or something else just as interesting? | Was this an enjoyable, easy to read and pleasing to look at project? | |
| Power- Point Presentation | Did the project give enough art history information? | Were you able to understand all the slides? Was it read-able? Too much eye-candy? | Did they complete the power-point with a bibliography? | Was the power-point enjoyable to review? Would you want to see it again? | |

| Product | Description | Analyze | Interpret or Details | Evaluate/Judge | Total Points |
|---|---|---|---|---|---|
| Pyramid Temple | Did the model show geometric features as well as symmetry? | Was the structure and steps created in proportioned scale? | Are there any special details added that are Maya? Did it include the math formula and measurements? | Is the project well done and pleasing to the viewer? | |
| Stela or Codex Drawing | Did the work look planned? What do you think of the intention? | Do you think the design was carried out as planned? | Was the scribe careful with their materials and skilled? | Was the drawing or Stela balanced and a good design? | |

**LESSON PLANS**

**Lesson 1: Sticks, Stones and Count to Twenty?**

The Maya as well as other Pre-Columbian Indians came up with their own systems of counting. All people of the world use their surrounding resources for building, clothing, writing, selling, trading – and yes, for counting. The Maya decided that the plentiful cacao bean was a perfect commodity to use as money, and the way to count it was by using beans, stones, shells, and wooden sticks from tree branches. They continued to count in this way for hundreds of years. Their idea of counting came from their use of all the human digits, their hands and feet. Twenty was their base in counting. Our base of counting is ten. This system comes from Arabia. Perhaps the Arabs just felt that counting on our hands was enough?

***Symbols of Maya math and rules for counting and use of place value***

(See Appendices A and B for detailed information and hands-on work sheets)

When counting, the Maya used a dot for a unit by using stones or drawn dots. Once you had 5 units, they would use the stick (or bar) for a 5 and the zero was represented by a shell or shell like drawings. The Maya started with 1st position, *one* -- 1 = ● a dot, (1).

Where in our place value, our 2nd position would be 10,

theirs was *twenty* -- 20 =  a dot over a shell, (1 x 20).

Where our 3rd position would be 100,

theirs would be *four hundred* -- 400 =  a dot over 2 shells, (1 x 20x20).

See Appendices A and B. Read the instructions to learn how to count in Maya.

***Math Objectives*:** Students will practice how to count in values of twenty -- number, operation, and reasoning through the delving into place value practice with base 20 problems. Students will use manipulatives or pictorial models to represent and generate equivalent forms of rational numbers, including whole numbers, through the use of natural Mayan articles such as shells, sticks, beans or stones. They will formulate equations from problem situations described by linear relationships. This will be accomplished by the students creating their own problem-solving equations involving rational numbers, using pictures and symbols to record the steps of the solution process, and verifying the solutions using substitution.

***Language Arts Objectives*:** Students will write and prepare a daily journal for note taking and developing thoughts for their PowerPoint presentation. They will participate in class study and discussion of conceptually complex and content-specific vocabulary to extend general and academic vocabulary knowledge. They will prepare, organize, and deliver a variety of formal individual and group presentations (book/film reviews, dramatic interpretations, panel/group presentations) using visual aids and logical organizational structures.

***Activities***

- Students will go out to collect tree branches, small stones, and/or nuts and fruit from surroundings.
- Instructions (activity sheets – see Appendix 1 and 2) will be given out and the practice begins.
- Composition books will be turned into a "Scribe's Codex Book" (for daily note taking).

***Time Allotment:*** 1- 3 weeks

***Assessment :*** A variety of math worksheets (created by the instructor), demonstration to other classmate that they understand the process of counting in base 20, notes inside the composition book, and creation of their own problems on a work sheet to stump their classmates!

**Lesson II: Scaling up a Temple**

The Maya made immense temples and monuments. They believed in BIG! With very little technology they created their stone monuments, pyramids, and stelae scaled perfectly symmetrically. Smaller and smaller became the steps to their high temples in the sky.

You are about to create your own model of a Mayan pyramid/temple. What is the formula for creating a perimeter that will scale smaller rectangles so that your pyramid steps will fit perfectly one on top of the other? Find this out through the math reference books here, your math teacher, or the Internet. Write it down in your own Codex Journal. Plan your decorative designs in geometric form and show them in your journal. Work up your formula to see if it works. Start with the base being a rectangle the length of 6 inches by a width of 4 inches. Then work up the rest of a 4 stepped rectangular pyramid.

Hint: You will be looking for the math formula that gives you the perimeter of a rectangle or square.

***Project Objective*:** Students will construct a replica of a Mayan pyramid. They will measure and compute the perimeter base of their model base to find the proportioned scaling of the smaller rectangles (to achieve symmetry and balance) and in order to complete the 4 smaller steps that will elevate their pyramid.

***Math Objectives:*** Students will model (concretely or pictorially) and describe the resulting effects on perimeter and area when dimensions of a shape are changed proportionally. They will select and use appropriate units, tools, or formulas to measure and to solve problems involving length (including perimeter) and area, and apply the problem-solving model when doing so.

***Formulas students will be looking for:*** (to start problem solving)

Perimeter of a rectangle/square= two lengths + two widths (2L + 2W)

Area of a rectangle/square = Length X Width (A = L x W) Area of a Rectangle

The area of a rectangle is the product of its width and length.

Example:

What is the area of a rectangle having a length of 6 and a width of 2.2?
The area is the product of these two side-lengths, which is $6 \times 2.2 = 13.2$.

***Art Objectives***: The student will express ideas through original artworks, using a variety of media with appropriate skill. The student is expected to produce drawings, and electronic media-generated art, using a variety of art materials and tools in traditional and experimental ways. The student is expected to create artworks integrating themes found through direct observation.

***Time allotment****:* 2 weeks (**See Appendix H,** in this HTI publication for work sheets.)

***Materials:*** poster board, drawing paper, ruler, t-square, utility knife, Elmer's glue, scissors.

***Vocabulary:*** score, perimeter, area, symmetry, scale, t-square, geometric motif

***Assessment:*** formula practice, perimeter and area quiz.

**Lesson III: The Maya Scribe**

How did the Ancient Maya write? What kind of ink did they have and from what materials did they need to make this from? What did they write on?

Scribes made ink from natural resources also. They wrote on cloth made out of deer first, then started carving their accounts onto large stone structures. These carvings are called stelas.

Don't forget to write in your *Maya Codex* journal what you have researched and learned about how the Ancient Maya recorded their history and mathematics. You will be expected to keep your journal full of information. Keep recording daily things that happen in class as well as information found or given by the instructor. This will help you on your presentation later.

***Language Arts Objectives****:* Students will participate in class study and discussion of conceptually complex and content-specific vocabulary to extend general and academic vocabulary knowledge. Students will prepare, organize, and deliver a variety of formal individual and group presentations (their Maya Codex journal/notes and power-point presentations) using visual aids and logical organizational structures. Students will recognize and discuss the influence distinctive cultural mores, values, social conventions, and gender roles have on literary themes using multicultural texts in their power-point presentations.)

***Fine Arts Objectives****:* Students will develop and organize ideas from the environment. The student is expected to: (A) **illustrate** ideas from direct observation, imagination, personal experience, and school and community events; and (B**) compare** and contrast the use of art elements and principles, using vocabulary accurately. The students (with their hand made paper and ink) will express ideas through original artworks, using media with appropriate skill. The student is expected to: (C) **produce** drawings, and electronic media-generated art, using a variety of art materials and tools in traditional and experimental ways. In the art piece, students will demonstrate an understanding of art history and culture as records of human achievement. The student is expected to: (A**) analyze** ways that international, historical, and political issues influencing their artwork.

***Time allotment***: 1- 4 weeks

***Materials:*** berries, tea bags, vinegar, pot, and heating element, chopped paper, tight-knitted screens, newspaper, empty ink bottles, gum Arabic, salt, old fashioned dipping pen (see hobby stores), toilet tissue, facial tissue, or paper towels, large mixing bowl, wire whisk or hand egg beater, large plastic bin large enough to accommodate the papermaking mold and deckle kitchen towel, newspapers, or paper towels, folded spatula rolling pin, and cookie sheet (or other flat surface)

***Vocabulary:*** Stela, Glyph, carving, mold, deckle, pulp

***Activity:*** Paper Making and Inks

Instructions are found easily on the Internet. Students will research to find best formula.

The information should be written in their Codex book.

Each student should produce a sheet of hand-made paper and their ink to start. (Students may use each other's ink solutions for variance in color.

See (Vivian and Shender) web resource.

Drawn in pencil first, and then inked: Write your name in Maya and your birth date. Maya designs can be added for detail.

***Optional Activity:*** Carving a Stela

Students will research their name and birth date in Maya language and plan a drawing.

Mix plaster-a-Paris and pour it into a milk carton container.

Students will carve and proportion their drawing on to the plaster form (plaster has dried).

***Materials***: plaster-a-Paris, newspaper, milk cartons, water, bucket, gloves, plastic knives for carving

***Assessment:*** Participation and Product Completion

**Lesson IV: The Flowers Are inside our Homes: Pre-Columbian Geometry**

In the journals of the book titled *The Last Lords of Palenque*, Chan K'in de Naha is one of the last descendants of a dying line of kings that knew the old ways and practiced them. One day he was asked: "Why did the Maya use geometric shapes for their homes? Shouldn't they be of more natural shapes, since they are very involved with everything natural, taking their gods from nature, using nature for their medicine, and practicing a natural way of living?" Old Chan answered: "Don't you see? *The flower is inside our houses"* (Perrera and Bruce 89).

So what did Chan K'in mean by saying this? What do you think? Let's look at their architecture and the way they built their homes. Archeologists know, from measuring Mesoamerican architecture, that architects used regular lengths of cord to lay out a building. It seems that the unit measurement varied at each area these buildings are found because it was based on the human body. Perhaps they measured a set distance the way they measured a meter or yard for the size of stones for castles in medieval days, from the length of the current king's body. In any case, their intent was to create certain relationships or ratios between the different parts of the building. The most common geometric shapes used were the square and the rectangle.

This rectangle has a certain proportion of long to short sides that is called the "golden section." Interestingly, this ratio appears in a great many building traditions, including the traditions of Ancient Greece and modern Europe. It is clear, however, that the golden section was independently invented in Ancient Mesoamerica. Maya peoples living today in Mexico and Guatemala also lay out their houses (and often their cornfields) according to the system of cord

measurement described above. They view these proportions as natural and good, comparing them to the ratios found in plants (Koontz, notes)

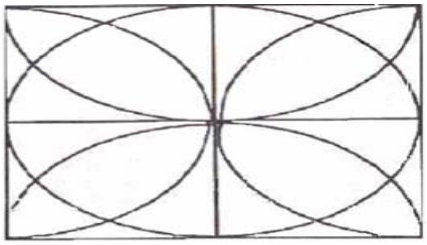
***Math Objectives**:* Students will formulate equations from problem situations described by linear relationships that are represented in various forms (such as concrete or pictorial models, or as data displayed in a table, chart, or as labels on a graphic). This will be accomplished by the students creating their own problems solve equations involving rational numbers, using pictures and symbols to record the steps of the solution process, and verifying the solutions using substitution. After my introduction, students will investigate the Golden Rectangle and Fibonacci number system.

***Language Arts Objectives:*** Students will interact effectively in academic discussions (refine verbal/non-verbal expression, invite others to participate, negotiate roles, acknowledge and respond to divergent thinking, use content-specific/higher-level discourse). They will participate in class study and discussion of conceptually complex and content-specific vocabulary to extend general and academic vocabulary knowledge. They will prepare, organize, and deliver a variety of formal individual and group presentations (Codex Journal/group presentations) using visual aids and logical organizational structures.

***Art Objective:*** Response/evaluation. The student will make informed judgments about personal artworks and the artworks of others through a critique. The student is expected to analyze original artworks and exhibitions by peers and others to form conclusions about formal properties, historical and cultural contexts, intents, and meanings.

***Time allotment:*** 1- 2 weeks

***Materials:*** Graph paper, rope, wood posts, ruler, t-square, colored pencils.



***Activity A***: Measuring like the Maya with sticks and rope cord

Students will be creating a rectangle out of cord, using the 5 points of creating (Maya style) geometric forms, and classmates to hold the cord. Out of this exercise, I expect to have them figure out how nature is inside geometry. (Flower shape).

***Activity B***: Drawing of a Golden Rectangle with a nature piece inside

Students will be drawing a golden rectangle and from their own ideas designing what they can visualize as their own nature (flower or other natural design) inside their God house or home.

***Assessment:*** Critique and Student Assessments Rubric

**ANNOTATED BIBLIOGRAPHY**

**Works Cited**

Carrasco, David, Ed., *Oxford Encyclopedia of Mesoamerican Cultures*. New York: Oxford University Press, 2001.
From A to Z, excellent reference collection of encyclopedia expanding items of interest about the Mesoamerican culture.

Koontz, Rex. Notes Provided. *Pre-Columbian Math Seminar*. Houston Teachers Institute, University of Houston, TX. 20 March 2007.
Notes provided and taken during the HTI seminar in 2007.

---. Syllabus. *Pre-Columbian Math Seminar*. Houston Teachers Institute, University of Houston, TX. 23 January 2007.
Informative introduction essay about Pre-Columbian Math and Peoples.

Miller, Mary Ellen. *Maya Art and Architecture*. New York: Thames and Hudson, 1999.
A clear and beautifully written historical book about the Maya and their Architecture.

Perrera, Victor, and Robert D. Bruce. *Last Lords of Palenque*: *The Lacandon Mayas of The Mexican Rain Forest.* Los Angeles, CA: University of California Press, 1982.
An extraordinary firsthand account of the life of the Lacandon Indians of Naha in southern Mexico.

Stone, Randi. *Best Classroom Practices*. Thousand Oaks, CA: Corwin Press, Inc., 1999.
Collection of Teacher's best habits in the classroom.

Vivian, Miranda, and Benjamin Shender. "Practical Skills: How to Make Ink." *Aftermath.* August 2006. Aftermath. 31 May 2007. <http://aftermathblog.wordpress.com/2006/08/10/practical-skills-the-making-of-ink>.
Recipes and instruction on making natural inks.

**Supplementary Sources**

Childs, Leigh, and Laura Choate. *Nimble with Numbers*. Menlo Park, CA: Dyyle Seymor Publications, 1998.
A teacher's handbook about numbers full with practice sheets and game ideas.

Conklin, Wendy. *Mayas, Aztecs, Incas.* New York: Scholastic Inc., 2005.
A great teacher's reference and activity book

Coe, Michael D. *The Maya.* New York: Thames and Hudson, 1993.
Well versed in Mesoamerican civilization, Coe opens a reader's eyes and places us in a world of the Maya, showing the specific differences and accomplishments of their part of the Mesoamerican equation.

Coe, Michael D. and Rex Koontz. *Mexico, from the Olmecs to the Aztecs.* Fifth Edition. New York: Thames and Hudson, 2002.
This book gives extensive information of the foundation of various Mesoamerican complex societies, culture and daily life rituals from the Olmecs to the Aztecs with information from the archaic period up to the Spanish conquest.

Enloe, Walter, and Simon, Ken Ed., *Linking through Diversity*. Tucson, AZ: Zephyr Press, 1993.
This is a practical classroom manual for teachers to learn how to handle a roomful of multicultural students and how to teach them about their different backgrounds.

Kubler, George. *The Art and Architecture of Ancient America*. Third Edition. New Haven, CN: Yale University Press, 1990.
This book provides a time-line history of the different styles of ancient American architecture, sculpture, painting (codex), ceramics and ornamental art.

Miller, Mary and Simon Martin, *Courtly Art of the Ancient Maya.* New York: Thames and Hudson Inc. 2004.
Life at a Mayan court; its rituals, its practices, and pastimes… A book that is opulent, rich and full of pictures that have included descriptions of the daily lives of the upper class court of these indigenous people. Students can benefit greatly from the written as well as the photographic collection of this volume. The information written encompasses so much detail describing the life of the scribes, through the painting/writings, and all that revolved around the Mayan's universe.

Nuttall, Zelia. *The Codex Nuttall, a Picture Manuscript from Ancient Mexico.* New York: Dover Publications, 1975.
This book is a reproduction of the Ancient Mexican manuscript that provides full color illustrations showing the codices.

**Website Research List for Teachers**

Strom, Karen. "*Mayan Math.*" 1995. Retrieved March 7, 2007. <http://www.hanksville.org/yucatan/mayamath.html>.

<http://www.famsi.org/>.

<http://www.mesoweb.com/welcome.html>.

**Fun and Interactive Website Research Center for Students**

Maya Number Game. <http://www.nga.gov/exhibitions/2004/maya/numbers.htm>.

<http://www.mnsu.edu/emuseum/prehistory/latinamerica/topics/games.html>.

<http://www.ancientmexico.com>.

<http://www.azteccalendar.com/calendar.html>.

<http://www.hanksville.org/yucatan/mayacal.html>.

<http://www.azteccalendar.com/calendar.html>.

<http://www.absoluteastronomy.com/encyclopedia/M/Ma/Maya_civilization.htm>.

**Good Research Books for Students**

Ardaugh, Philip. *History Detectives, Aztecs.* New York: Peter Bederick, 1999.
Appealing in several ways; colorful, interesting information appropriate for children's interests, combines pictures, drawings and cartoons, and interesting Aztec stories to read discoveries and a game of detective, spy and test scores at the end of the game.

Armentrout, David and Patricia, *Treasures from Mexico.* Vero Beach: The Rourke Book Company, Inc., 2001.
A purposeful book laid out for any elementary, middle or high school student to be able to pick up, read, and use. The book is a step by step account of what an archeologist and historian does to uncover ancient civilizations. It speaks about the Mayan, the Aztec people and Mesoamerican past lifetimes.

Fisher, Leonard Everett. *Gods and Goddesses of the Ancient Maya.* New York: Holiday House, 1999.
God by God, a thru z, sampled with instructions on how to pronounce and learn about each Mayan deity. Book created specifically for children.

Pohl, John M.D. *The Legend of Lord Eight Deer: An Epic of Ancient Mexico.* Oxford: Oxford University Press, 2002.
This book was written for students from nine to twelve years of age, retelling the story of the most important of Mexican Lords, perhaps, and the first historical epic of its kind.