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The Beautiful Art of Map Making

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Illustrated maps can summon visions of ancient places, treasure maps and top secret places. The word maps can mean geography to some and driving instructions to others. Since the advent of computers, Mankind have seen a world of new mapping, from the large scale to the tiny—whether seeing mapping through satellites, examinations inside our bodies with MRI machines, or charts underwater with sonar. Stars have been mapped, since the advent of astronomy, now they are charted, displayed, and photographed by the Hubble telescope.

It's common to go to Mapquest or Yahoo maps to get directions. Just think of how many people have recently received an electronic directional computer for their cars as a holiday or birthday gift! Fantasy maps came back into popularity with Tolken's Hobbit map or Captain Jack Sparrow's treasure diagram that charted how to find The Aztec Gold. Maps are everywhere. From guiding yourself around a mall to charting your life goals, you need maps! Indeed, maps have come back into popularity and into common daily life.

The idea of a map or drawing a map is a very special ability that humans have. It is called *spatial reasoning*. How does one develop this? Abstract thinking is involved. Very much like when a child first draws a house that shows flat two dimensional lines and later changes to show the perception of three dimensions, understanding a map has its spatial or visual requirements. It is a cognitive and abstract thought. You see flat yet think in round terms. You see shading with upside-down V-shapes and you visualize height and length in mountains. In a book talking about spatial reasoning, psychologist Rudolf Arnheim calls it Visual Thinking. Rudolf Arnheim asserted that "perceiving and thinking are indivisibly intertwined" and he argues for an "intelligence of visual perception" (Arnheim 2-3). Arnheim also gives us his definition for spatial reasoning:

Specifically, what is visual and spatial thinking and reasoning? By visual and spatial reasoning we mean the ability to:

- Make graphical and three-dimensional representations of problem situations.
- Manipulate these representations (project, rotate, reflect, and invert figures, fold and unfold three dimensional objects and surfaces, etc.).
- Reason about spatial properties and relations within these representations (identify relative positions, shapes, fill in missing information that can be logically derived) (Arnheim 2-3).

Spatial reasoning is not a common topic yet it is included in most math, science, geography and art curriculums. It's an objective that is commonly combined with some objective goal that involves working with patterns, shapes, lines, and geometric forms, algebraic or symbolic formats. The deeper that scientist and

behaviorists study the brain and its functions, the more they need to confront and understand spatial relationships.

Recently, researchers in psychology, artificial intelligence, and design have begun to seriously explore the role of diagrams in representation and reasoning. The goal of research in this area is to examine whether diagrams support thinking, and if so how and under what circumstances. Methods of inquiry range from protocol analysis of people solving problems with diagrams to computational modeling of diagram based reasoning; the task domains range from mathematics and physics to design (Arnheim 2-3).

The ability to think and reason visually and spatially plays an important role in Fine Arts. For an artist, the use of spatial reasoning becomes a game as well as a challenge to create a sense of space within a 2 dimensional plane. The process of using Art's element *Space* to create the illusion of room or space within a painting or drawing is quite an amazing feat that also involves skills of perspective, mathematics, scale and visualization. To generate a facsimile of reality on a paper or painting, one must use spatial reasoning in order to make it convincing.

> We are called on constantly throughout our intellectual life to exercise spatial and visual reasoning. As children we play with shape and color blocks and intelligence tests ask us to see spatial analogies among configurations of geometric shapes (figure A is to figure B as figure C is to?). Then there are the visual brain challenges to solve spatial configurations or the impossible spatial drawings of M.C. Escher's famous woodcuts which work only on paper and make perfect sense in that space and scale. It is the play with conventions of projecting three dimensions into the only plane that challenges our visual imagination (Schattschneider 66-71).

Middle school children are at the point of expanding his visual sense of spatial reasoning. To think of angles, transparency, parallels, and the like makes their introduction to abstract thought, geometry, algebra, and other concepts easier to grasp. That also leads to being able to display understanding of patterns, relationships and use problem solving with more of a systemic ease when needing to use measurement and formulas. So what does that have to do with making and learning about maps? Map-making is one of the oldest and least talked about skills, historically. Additionally, the beauty of mapmaking hasn't been presented as an art skill, at least to the majority of the public.

At the Yale National Institute this summer, I chose the seminar *Maps and Mapmaking*. It intrigued me and my sense of always seeking another connection to Art and the World. Students of middle school years have often taken geography in a repetitive manner by coloring their world maps and memorizing names of places that mean little to them. I find myself thinking about old maps that I've seen in Spain. These ancient maps were intricate, impeccably drawn, beautifully illustrated and incredibly comprehensible. What these people had to go through to create these charts I can only imagine! My recollection of paper making, creating the inks, and gold laminates with egg yolk are some of the memories of past classes in Art history that I have experienced would work into the understanding of creating these beauties. It would be interesting to see a class that would go to such lengths in middle school to make their own maps, yet it would be a way to have them realize and envision the hardships of making a map. . ..not to mention the adventures in going to sea and land in order to chart these places for the cartographer. I hope my students can learn to admire maps and get beyond the rote memorization they associate with the subject.

What types of maps could we investigate? What skills could we learn?

Cartography is the skill of map making. The knowledge of using the compass, charting, measuring and all

other tools of the trade must be understood by the map-maker. My unit will provide discussion, research, writing, science, geography, history and art to surround the students with ways in which to enrich their spatial relationship skills. Another consideration for spatial knowledge would be the knowledge of the concept of "north." The concept of "true north" has many references. It is a direction to keep track of when traveling, camping, driving, hiking, or looking at the stars. It is also a reference to staying true to one's self, following your goals, staying centered:

> A value-based map may provide some useful description, but the principle-centered compass provides invaluable vision and direction. An accurate map is a good management tool, but a compass set on "true north" principles is a leadership and empowerment tool. When pointing true north, the needle reflects alignment with natural laws. . . (Covey 20)

Children of middle school age are very idealistic and start thinking about what they'd like to do in life. They reject goal setting and are irreverent with regard to rules, especially when they don't see these as logical. Middle school children are very opinionated and want to grow up fast. Curiously, without knowledge of Man's own history, or know any laws of nature, these students can often sense what is a good direction for someone's life or not, but they cannot tell you how to get home or tell much about their surroundings or city they live in. It would be advantageous to expose my students to discover what types of mapping are available, and to gain the skills to read them. What would they be able to do if they had experience in making them?

Geographic space is large-scale space. Spatial reasoning is what is beyond the human body and that may be represented by many different geometries at many different scales. (Kuipers and Levitt 25-47)

I can imagine my pupils creating maps that are developed by their new found interest. From factual to fantasy and from historical to current, there is much to research and present. My students can gain appreciation for the finer skills of drawing, mapping skills, and technology. While practicing spatial reasoning activities, my students can increase their math knowledge and vocabulary as well.

Map Beginnings

Since the Iron Age, the oldest recorded maps that have been discovered demonstrate a purpose in their society. These maps were made by drawing or engraving lines into baked clay, stone or metal. Some of the earliest maps were found in Mesopotamia, in the area now known as Iraq. These maps were made in about 2400 B.C. showing property boundaries and were made for the purpose of land taxation. A Roman map dating from about 335-366 A.D. showed such topographical features as roads, cities, rivers, and mountains (Cavette). Another much earlier contender as one of the earliest maps found has been found on a wall in Ankara, Turkey, of an ancient city called Catal Hyük. This map-form is a wall painting that is approximately nine feet long depicting a town plan with a live volcano behind it. It has been determined from radiocarbon dating as early as 6,200 B.C. James Mellaart[1] , the archeologist who excavated and discovered the artifact, speculated thatthese local volcanic mountains were important to the inhabitants of *Catal Hyük* as a source of obsidian used in the making of tools, weapons, jewelry, mirrors and other objects. Further, from graphic embellishments around the mountain, Mellaart has considered that the depiction of the volcano in an active state is accurate since volcanism in this area continued for some 4,000 years later. This early version of a map may not be what we would consider in today's description of a map, but it does have the beginnings of

pictograms that show symbolic use or cartouche-like markings to represent the village with the volcano in action. Descriptions in Mellaart's notes regarding this early rendering mentions that the (map-form) wall painting appears to have purpose and land mark positioning that without a written language (timed in the Neolithic era) is quite remarkable (Mellaart 17-177).

> Clearly, the *Catal Hyük* "map" is still not the beginning of cartographic history. Investigation into the earliest beginnings of cartography will continue with a fair probability of further successes. This optimism is warranted by the fact the materials used during these periods to record such geographical spatial concepts were more durable elements such as stone, clay, metal, earthenware, etc., unlike later cartographic artifacts made of more fragile materials such as paper and wood (Henry-Davis 100).

Mappae Mundi

Moving into the more interesting and commonly known as "ancient maps" are the Medieval Maps from the 1100's on known as Mappae Mundi. Mappae mundi link mapmaking to the art of illumination created in books of that time. Many of the features such as having painted decorative corners, calligraphic style lettering, and use of black and red color to refer to important emphasis were all transferred to early map making from the making of bibles and other religious books. The use of red was given an important emphasis like that of red letters signifying the spoken words of Jesus. One can see the same use of gold leaf and crushed precious stone to create blue or green for river or seas, while still being applied to vellum with egg as its bonding material. These maps were created by monks working under a master. In this fashion they would be able to make numerous copies just as books were copied over and over in medieval times.

Another element recognizable in Mappae Mundi[2] is their circular form with Jerusalem at the center. Its purpose was intended to explain and teach about the history of the world, relying on the Bible and Pliny, a Roman historian. Some of these maps show the origins of Paradise, include the center of the Christian world, Jerusalem, and feature the three continents, Africa, Asia and Europe. To compare them with contemporary maps, the Mappae Mundi looks primitive, inaccurate and very superficial. They convey more of an idea rather to render information. These illustrations were never meant for navigation rather they were a graphic representation to teach concepts, Bible stories, history, mythology and cardinal direction. You could say that it was used to diagram like an encyclopedia would for medieval knowledge.

Ptolemy

Claudius Ptolemy[3] was a mathematician, astronomer and early geographer around the second century. His works had been overlooked for several centuries and rediscovered in the 13th century. His work was embraced by Italian Renaissance mapmakers and mathematicians. As a result, his maps became widely published, and his mapping principals remained in use until the time of Columbus. He is known for his work called

Geographia. There is little known of his life but it is speculated that he lived in Alexandria where so many great ideas were exchanged in that day. Ptolemy was very important in the history of geography and the beginnings of cartography. Ptolemy knew that our planet is a sphere, but believed that the sun and other planets revolved around the Earth. Ptolemy's is the first known projection of the sphere onto a plane. He improved on projection formulas giving better definition to the Earth's surface. Latitude was measured from the equator (as maps do today) and he articulated longitude as time (by 12 to 24 hours). He added a meridian of zero and chose the Canary Islands to be his point of origin. Today the meridian is positioned in Greenwich, England.

Ptolemy was probably the first to use captions and legends on his maps. His geographic works compiled all that was known in his times, including information on how to make maps. He assigned coordinates and geographic features; he knew the world was round and added the grid to his globe drawings.

> Now the main part of *Geographia* consisted of maps but Ptolemy knew that although a scribe could copy a text fairly accurately, there was little chance that maps could be successfully copied. He therefore ensured that the work contained the data and the information necessary for someone to redraw the maps. He followed previous cartographers in dividing the circle of the equator into 360 and took the equator as the basis for the north-south coordinate system. Thus the line of latitude through Rhodes and the Pillars of Hercules (present day Gibraltar) was 36 and this line divided the world as Ptolemy knew it fairly equally into two. The problem of defining lines of longitude is more difficult. It required the choice of an arbitrary zero but it also required knowledge of the circumference of the Earth in order to have degrees correspond correctly to distance. Ptolemy chose the Fortune Islands (which we believe are the Canary Islands) as longitude zero since it was the most western point known to him (Royster 3).

Between the existing medieval maps of Mappae Mundi and the resurgence of lost ideas from Ptolemy, mapping would take a turn in evolving. The Crusades and Marco Polo's discovery of China brought the need to make improved maps. Trade and religious wars brought back the interest of mapping skills. By the Renaissance, European nations and traders needed to chart better passages to the East. The need to develop accurate maps was unmistakable.

Portolan Maps

When one mentions "ancient maps," I know that these Renaissance beauties come to our minds. The magnificent Portolano maps4 of Angelino Dulcert (he has been credited as the original designer) spread popularity and preference for his particular style. His maps filled the need and wants of the knowledge hungry while they had the finesse and beautiful embellishments that any art lover of the Renaissance demanded. Portolano map-making shops developed around 1250 along the Mediterranean. Not only mariner charts or maps were created but also the idea of the atlas book gained popularity with this style of drawing maps. The goal of the map maker was to have alignment to the coast on their maps. Angelino Dulcert devised a map projection system that took advantage of the ability to use a compass and to keep a straight patterned vogage. He did this with creating patterns of straight lines spreading or radiating from various central points. These were called rhumb lines. These radiating lines and the fleurette shaped compass or rosette shapes (showing north, south, east, west) imprinted on each map are the distinctive identifying features.

> At a time when Christian Europe was producing religious representations of the world rather than scientific maps, another type of map, or perhaps more accurately chart, for the use of sailors began to appear. These were called *portolan* maps (from the Italian word for a sailing manual) and were produced by sailors using a magnetic compass. The earliest examples we know about date from the beginning of the 14th century, and were Italian or Catalan portolan maps. The earliest portolan maps covered the Mediterranean and Black Sea and showed wind directions and such information useful to sailors. The coast lines shown on these maps are by far the most accurate to have been produced up to that time (Royster 4).

During the fifteenth century, at a time that the portolan style map was preferred by mariners, the exploration fever of the Renaissance took root; to find a better route to the Orient was the goal of every major trader. The world powers of the day such as England, Spain, Italy, Holland and France were interested in expansion of their own realms as well as trading with the Orient and other lands. It is portolan charting techniques that made these maps popular. Descriptive detail of boundaries, the crisscrossing rhumb lines, meticulous writing of each port's name and accurate detail of coast line that made these maps most valuable to any sailing nation or trading company. They were also popular with the aristocracy as they were beautiful to look at as well as useful to have.

Portolan maps were informative and their purpose was directly targeted to the success of voyaging to distant lands, but specifically to have in the hands of the ship captain or pilot. As new discoveries became known, a more distinctive fixation becomes more apparent: the idea of the map as ego-centric or politically powerful display. Map-making became a way to express colonization, growth in land, riches, and conquering might. In later centuries (especially prominent in the 19th century) maps portray these recordings of grandeur or display of intimidating power. Unlike the portolan map, the new maps of nation-states and colonialism were designed for many people to see.

With the expansion and conquering of new lands, good, reliable maps became essential. Attractive maps were in high demand! People used framed maps to put on their walls. Cartographers learned the art of engraving, and much later, lithography. This allowed maps to be made in greater quantities, and thus made all good cartographers artisans in their practice of fine arts in order to become successful.

Terra Incognita, Sea Monsters and Mythical Symbolism

The Latin term *Terra Incognita* 5 means unknown lands. The term *Mare Incognita* means unknown seas. From ancient times of the early cartographer, additional embellishments such as mythical and monster-like sea creatures, mythical figures or impressive animals were added to emphasize the impending dangers that these adventures could bring or perhaps just to embellish and to refer to mythical folklore and traditions. Cartographers in Medieval ages up to the l7th century (and even later) have used fantastic beasts, serpents and sea monsters to decorate their oceans and seas. Whether it was to depict the contemporary sea-faring legends of the day, or to exaggerate the exploration of the unknown, this mapping technique (used as a visual aid or filler) was always a favorite among cartographers and their patrons.

There are so many variations of these sea creatures and mythological connections that they have not been found specifically with any particular style of map. The two concepts, the unknown and medieval myths

(1200-1600's "urban legends") particularly fit many of the maps because truly, these discovery assignments were the first of their kind as recorded explorations. Many of these creature and animal renderings go back as far as early Roman and Greek eras. This tradition of adding creatures continued even up to the 16th century as decorative embellishments on globes. The oldest existing globe ca.1503 can be seen at the collection of artifacts and maps in the New York public library. The globe shows dragon-like beasts and actually has the words inscribed "*Here be dragons*" (using the Latin "*hic sunt dracones*") (Da Costa 529-540). By the 19th century, the unknown, mythical embellishments and sea creatures lost their popularity along with the inscriptions of *Terra Incognita* disappeared from maps once both the coastlines and inner parts of the continents had been fully explored.

Mapping the Course

My position serves two functions. One is to teach Fine Arts classes to regular students as an elective and second, to teach a more rigorous curriculum of graphic design to the Magnet student program. The magnet students study both graphic design and architecture for three years (as possible careers) receiving an in-depth program of study. This middle school is called Sharpstown Middle as is located in the south-west part of Houston in the suburb called Sharpstown. These students are all in 6th, 7th, or 8th grade ages ranging anywhere from 11 to 14 years.

My expectations and wishes for my students from these lessons are to foster in them an appreciation for the talent and initiative of past efforts in drawn works, and handcrafted items such as hand-made paper and hand made inks, as well as to recognize the mapmaker's skills that lie behind the map. Mapmaking involves art, history, geography and mathematics. Art lends itself well in mixing these subject matters. Given the rich background of historical, artistic, and majestic map samples that can be used to demonstrate the skill and beauty of maps, I hope to reach my elective students in several ways: the student that was just put into my class (no interest in art), the student that feels inhibited but does well in math and other core subjects, and the student that needs a bit of assistance in that area. The lover of art will just enjoy most of the unit due to its variety.

The idea of mapping can mean many things to different students, so they will get a chance to investigate a reasonable amount of mapping concepts. Centered on the enrichment benefit of incorporating the idea of mapping, skills in orientation (use of compass, etc.) art and mathematics, this topic will include their relationship, and the way in which they have been used together throughout history. Teaching this unit from year to year can be fun for the teacher because of the variety of forms this subject matter can take. The concept of mapping has taken off into many directions in the twentieth century. For example, the concept of a map can mean mapping of life goals, an atom, DNA, the cell, a hand (fortune-telling), the body, roads, towns, cities, countries, continents, oceans, the world and beyond! I see the versatility of these lessons as very inviting and flexible material-base for a student's interest and research capability. Since there are many alternatives to current use and concepts of mapping, these instructions can serve as one of the more interesting units that a teacher from other curriculums can adapt and add to their particular needs.

As a starting point, the unit will go through the steps and process of learning to work with a compass, while relying on mathematical measurements and use of symbols and numbers to achieve map reading and map making skills of their own. The background work will require that students research through books, internet

and power-point presentations by the teacher to get them acquainted with the many types of maps that there are. The students will have fun creating handmade ink or preparing handmade paper. They will be able to practice with pens and draw sea creatures, add keys or legends to their maps, and learn add color. In later lessons they will be able to create a reflective piece to include with their presentation about their mapping discoveries.

Rationale

The reason for this unit on cartography with a strong geographical and mathematical focus is to help my students become aware of and critically think about the efforts of others in our past. Their dedication, aesthetics and the nature of work ethics, their struggles against nature and lack of technology, which caused them to constantly use critical thinking to solve problems. And yet, after all the trouble that it was to make a good map, they believed in creating a beautiful one for the "eye to behold."

Another expectation will be that students connect the past with the present in mapping. I expect them to develop a sense of comfort in giving directions. I hope that they will become more aware of their surroundings through the practice of observation to detail. Discovering history and important connections between the functional and decorative elements of mapmaking can be an essential part of the study and exploration of drawing skills. I hope my students learn that they must have many practice trials to gain spatial, observational and rendering skills.

> The specific skills involved in the manifestation of the spatial visualization ability improve with practice. Given the opportunity to develop spatial visualization skills, both sexes have equal potential for acquiring significant gain from the training. When these spatial visualization skills have been attained, they last and even continue to develop overtime. (Chiam, Lappan, and Houang 68)

I'd like my students to realize art elements and principles of design can be identified in early portolan maps. I'd like them to use their imaginations as they experience the primary materials for artist and artisan of those times; hand-made paper, pen and ink. To realize that both artist and mapmaker used math equations to create their work and that both artist and cartographer's work ethics were to *stay relentless* in creating a thing of beauty. As these objectives are met, I will look ahead to observing my students (a)Realize that they too can create a beautiful map, compose, and gain art drawing skills; (b) Present a researched theme on mapping; (c) Understand the important role that maps had historically for mankind; (d) Gain a better comprehension of math skills; (e) Expand their comfort level with art elements, principles of design, composition, scale, and critique (critical thinking - discussions).

I will use the history and the art of cartography, especially with Portolan maps as a starting point, to promote higher order thinking on behalf of the students, as it relates to keen observations of the world and the way the mapmakers viewed and used mathematics. Students will learn to stride and count with a compass, use math to perform problem- solving formulas, achieve their scale conversions of distance:(here we can talk about inches and centimeters), and to be able to draw their map's key or legend. They will have different types of practice activities prior to drawing their map. Some activities may include creating their own paper or ink.

Some activities may require using a protractor, tape, and compass. Others may include drawing maps and research on computers. The beauty of this unit is that all or any combination of lesson activities can be tried or skipped depending on what the student's needs are. Are they low in math skills? Can the students be challenged and do something more complex? With the knowledge of the versatility that this unit possesses, the students will be able to develop an understanding of the importance for learning how to work with the concepts of art elements and principles as they develop their higher order - critical thinking skills, and create works of their own. With regards to having students practice higher order thinking, I will also develop for them discussion questions, critiques, and observation times that will initiate the process in which my classroom functions; idea introduced by teacher, samples shown, demonstration of skill (by teacher or student), student practice time, discussion, samples of practice shown , create planned project, critique/or assessment.

In observing my student's participation, discussions, practices and works, I look for certain participation as indicators. Are they analyzing and evaluating? Do they show reflective thinking, showing reasoning techniques in the critiques? Are they using reasoning in math activities? Are they displaying attentive concentration while practicing with drawing tools? In discussions, do they mention anything of relevance to the learning experience? Is the vocabulary being used? All of these informal observations are part of what an art teacher is trying to develop in their students; educators call it critical thinking skills. In an article called "What to Think about Critical Thinking" from the Illinois Center for Education Reform there is an excerpt that states much of my intent for this unit's rationale.

> "Understandably, modern educators want to impart the same skills to our children. However, many educators misunderstand the terms 'critical thinking' or 'higher order thinking skills.' One of the most common mistakes teachers make is to view critical thinking as the opposite of rote learning or memorization. In reality, the learning of facts is the essential first step to thinking critically. ... If we want our children to make wise decisions, we must also provide in-depth knowledge about the humanities and sciences. ... To give a child a story and ask 'how do you feel about this?' accomplishes very little. ... The more a child knows about history, literature, math and science, the better equipped he will be to construct his own judgments." (Illinois Loop 1)

While working with map making, my lessons will still include all seven *Elements of Art*. Through **Color, Value, Texture, Shape, Form, Space** and **Line** students will study Western style rules that will force students to decide and problem solve the projects provided. In addition to the *Elements of Art,* the *Principles of Design*, Contrast, **Emphasis, Balance, Unity, Pattern, >Movement,** and most importantly **Rhythm** are all found in nature and rendered skillfully in many ancient maps. From the use of math, history and critique/discussions, the students will have practiced skills such as measuring, detail observation, reflection and solve compositional design problems with the principles of design.

Houston District School Objectives

Number operations and quantitative reasoning. Using base 10, by normal functions such as; adding, subtracting, multiplying, and dividing. Decimals, inches, metric, and earlier forms of measuring will be included.

Communicate mathematical ideas using language. Efficient tools, appropriate units, and graphical,

numerical, physical, or algebraic mathematical models.

Select and use appropriate units, tools, orformulas. To measure and to solve problems involving length including perimeter.

Geometry and spatial reasoning. The student uses coordinate geometry to identify location in two dimensions. The student uses coordinate geometry to describe location on a plane.

Measurement. The student solves application problems involving estimation and measurement of length, area, time, and angles.

Patterns, relationships, and algebraic thinking. The student represents a relationship in numerical, geometric, verbal, and symbolic form.

Understand the purposes of all art elements and design principles involved in the creation of artistic maps of medieval times, and how specific principles are used to organize art elements. As an example, critically thinking of how Mapmakers and Artisans would have viewed their work, and what they would consider such as; symmetry, balance, unity, color, line, texture, values, contrast, emphasis, proportion, scale etc.

Understand the expressive qualities of specific art elements and design principles in examples of Portolan Maps

Strategies Interactive participation will be found in lessons involving outside use of simple surveying practice with compass and tape measuring. It will also be found in some of the internet lab activities.

Journaling opportunities will take place along with notes taken, reflections, internet lab and library research, sketching and planning for mapmaking projects.

Math activities will be found in lessons that practice the compass and use math manipulatives such as protractor, using graph renderings, tape, and the compass.

Fine Arts practice will comprise of sketching, making paper, ink, designing maps, practicing the use of art elements and principles of design, perspective, proportion and scale, using creative ideas of their own.

Critical Thinking skills will encompass all the information learned through these strategies along with practice, discussion and problem solving to generate sophisticated

products from the lesson experience.

Preliminary Vocabulary

Map, common daily maps; cartography; political maps; physical maps; relief maps; climate; energy; economics; vegetation; land use; defence; industry; population density; regional maps; Africa; North America; South America; Central America; Caribbean; Asia; South-east Asia; Central Asia; Indian sub-continent; Middle East; Australia; Oceania; Western Pacific; Europe; Eastern Europe; Central Europe; Polar regions; Russia;

historical atlases, MRI, legend, scale, compass, topographical, birds-eye, magnetic, declination, true north, magnetic north, compass, azimuth ring, graduation, compensate, scale, protractor, striding, compilation, needle, rudimentary, legend, key, cartography

Lesson 1: Learning the Basics

Time allotment: 3-4 weeks (activities flexible)

Objectives: While gaining a better comprehension of math skills, Students will understand the important role that maps had historically for mankind, expand their comfort level with drawing and learning the elements and principles of design

Activities: Introduction to Maps (power-point), Journaling mapmaking notes, Compass and Pacing, Math Formulas, Mapping the school, drawing birds-eye, Creating Symbols or icons for legends, designing a key or legend. Researching vocabulary, online inquiries to see how many kinds of mapping there is, preparing research on Microsoft word for presentation, study, fill out, Quiz and review forms for lesson one (See Appendix I II & III).

Materials: composition books, compass, long tape measure, drawing paper, protractor, pencils, computer, rulers, prepared-info sheets, tape.

Lesson 2: History of Maps and Mapping

Time allotment 3-4 weeks

Objectives: Understand the important role that maps had historically for mankind, research and present a researched theme on mapping through group or individual presentations, expand their comfort level with drawing, and learning the art elements and principles of design. Students will see that they too can create beautiful maps, compose complicated frames, and gain art drawing skills.

Activities: Learning about Portolan Maps and other styles, Reasons for Maps - A group presentation, Preparing paper and/or ink, planning and designing your map (fantasy, scavenger, treasure, etc) making paper look aged, marbling the paper. Present information on Mapping, research in the school's library or use the computer lab to research on chosen map theme, work in teams (cartographer's shop) or individually.

Materials: paper (all kinds), collected foliage, pot and heating element, quill pens, India ink (option), water. wooden frame, sieve with holes of about 1 mm (available in a hardware store), Formica sheets, rectangular bowl/container large enough to fit the frame, mortar with pestle, jug, hairdryer, newspaper, green and dried grass (optional) flowers (optional), flat sponge and water

Nut-Gall Ink- Iron gall ink (sometimes iron gall nut ink) is a purple-black ink made from iron salts and tannin (TANIC ACID) from vegetable sources. It was the standard writing and drawing ink in Europe, from about Iron

Gall Inks the 12th century to the 19th century, and remained in use well into the 20th century This recipe is taken from Household Cyclopaedia of General Information, published in 1881 (found in Wiki-pedia). It is not in common use now, though the preparation of inks with similar methods was common at one time. Recipe for 1 gallon of ink:

Twelve oz. nut-galls, 8 oz each, sulphate of indigo and copperas, a few cloves, 4 or 6oz of gum arabic

The permanence and water-resistance of the iron and gall-nut formula made it the standard writing ink in Europe for over 700 years. Its use only started to decline in the 20th century, when other water-proof formulas (better suited for writing on paper) became available. Nowadays, iron gall ink is manufactured chiefly by artists enthusiastic about reviving old methods.

What is an Oak Apple? An **oak apple** is a mutation of an oak leaf caused by chemicals injected by the larvae of certain kinds of gall wasp. They are so called because the gall, which can measure up to 5cm in diameter but is normally only around 2cm, looks a little like an apple. European oak apples are caused by the *Biorhiza pallida* gall wasp and American oak apples by *Amphibolips confluenta*. Oak apples may be brownish or reddish. **Other recipes can be found on line. Have students research these!**
http://www.funsci.com/fun3_en/paper/paper.htm#3>

> Hand-Made Paper Procedure: - soak some of the newspaper in water (it's better if you let it to set for a day or two) - squeeze out the excess water with the mortar and pestle, crush a little bit of paper at a time until you get a homogeneous paste, consisting of fibers isolated from each other - repeat this until you have enough paste, fill the bowl halfway with water - put the paper paste in the bowl and stir it to separate the fibers - remove any resulting clumps (a dense suspension of fibers must remain in the water) - immerse frame in the watery suspension in the bowl (the sieve should be facing bottom bowl) slowly remove the frame from the suspension keeping it steadily horizontal; eventually move the frame to even out the layer of fibers - wait for the water to drain; place the smooth side of a sheet of Formica on top of the sheet of paper still soaked with water. Press on the Formica a little to drain the water, taking care not to deform the sieve - with a sponge, collect water from underneath and squeeze it away every so often - carefully remove the sheet of Formica so that the sheet of paper remains attached to it - let the sheet of paper dry. To do this more quickly, you can dry it with a hairdryer

Lesson 3: Creating a map from a Painting

Time Allotment 1-2 weeks

Objectives: Understand the important role that art elements and principles of design can be identified and applied to their mapmaking composition, using proportion and scale. Present a researched theme on mapping to the class as a group or individual presentation; expand their critical thinking skills through the last drawing project and discussion critique feature.

Activities: Imaginative mapmaking project- Students choose a postcard landscape painting and convert it to a birds-eye topographic map (from their minds-eye and all the experience they've had). Critiques of all works and presentation (group assessment and discussion)

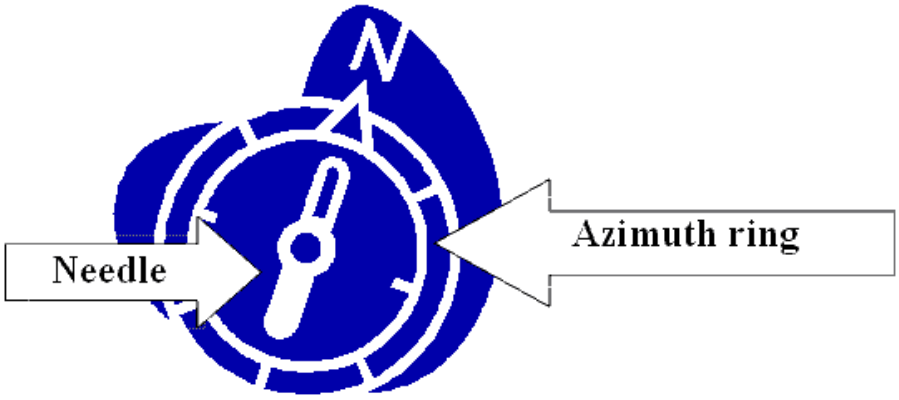
Optional Activity: Fieldtrip to Downtown. The Downtown District has underground streets and tunnels, a great place to do striding with compass and mapping while using the tunnel map. www.houstondowntown.com

Materials: 30 artist landscape samples (found in art museum gift shops), paper, rulers, pencils, computer (if power point presentation), watercolors.

Appendix I: Worksheets

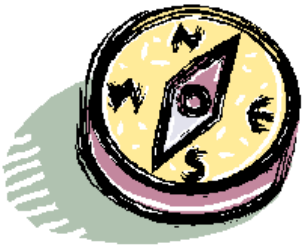
Rudimentary Information for Mapping Lesson 1

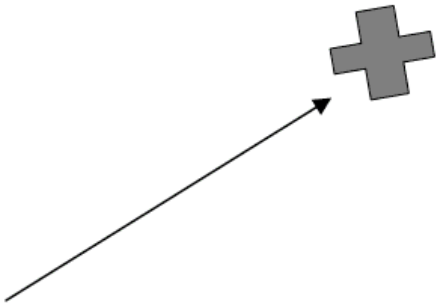
The Compass



A device for finding directions, usually with a magnetized needle that automatically swings to magnetic north.

MAGNETIC DECLINATION the angular deviation of a compass needle from true north.





STRIDING **any various standard linear measures, representing the space naturally measured by the movement of the feet in walking.**

How to measure strides: Right-handed people (start with your left foot) Left-handed people (start with your right foot) hold the compass steadily in the palm of your hand and then start walking towards your point of reference. Count a pace only when you use the pacing foot. Count only those paces **to and from** your desired

place of reference.

Appendix II Lesson 1 - Instructions for mapping land: check-off list for each step

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Holding the Compass

__Place the compass in the middle of your hand and hold it steady

You will see that in the center of the compass there is an arrow that points red and the arrow continues to the opposite side (white). The red confirms magnetic north.

__Let the arrow become stable in your hand (arrow length doesn't move)

Focus on the (red) part of the arrow and move the **azimuth ring** to N (for north) to place it to directly fitting along with the red arrow. Now you are ready to stride

Striding

__Decide what your landmark will be (where you will stop and return)

__Holding your compass (watching that you are keeping the needle north at all times)

Start your stride counting all the way to the landmark, turn around and stride count

all the way back to the start of your first stride

__Report to the person recording the strides how many strides did it take total to and

from the landmark

__Someone in the group record; the others help measure with a long tape measure

the length of your paced area.

Math time!

__Collect (from your teammates) all the totals strides and add them.

__Divide strides into the amount of teammate's strides to get the average.

__Divide the average into the length of the set area measured (by measuring tape)

to get how many feet per stride.

__ Multiply feet per stride by 12 (12"= 1 foot) to get inches per stride.

__Now you have how long each inch in your map will equal to

Graphing the strides (Mapping)

__You and your team are given a place to map (from your instructor)

__Have 2 team members measure each length with measuring tape

__Start at place that looks like the straightest length (to start) and then look for true

North from it, (Write down the variance of degrees difference from north each time)

__Start striding and collecting the information from your team, and average it,

divide it by the measured tape information and multiply it by 12.

The answer that you get will be the number of inches per stride

__Collect the average from each team, add them and get the overall average of the teams

__Now you have the scale for your map (sample answer: 4 graph squares = every 10 feet)

__Designate 1 or 2 people to draw the information on graph paper

Appendix III

Lesson I

Name_____ Period_____

Vocabulary: In full sentences, find the definition of these words in regards to mapping.

magnetic-

declination-

true north-

magnetic north-

compass-

azimuth ring-

compensate-

scale-

protractor-

striding-

compilation-

needle-

rudimentary-

legend-

key-

cartography-

Appendix IV

Lesson II

Name_____ Period _____ Date _____

Quick Quiz: Tell me about these maps: Use these words to explain what you know.

hand-written, dated, notations, bird's-eye view, compass, satellite photograph, weather map, scale, key, signed by mapmaker, contour-line map, political, pictograph, stride, topographic, symmetrical, legend, portolan, treasure, ancient, natural resource, anatomical, celestial, precise, mythical

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_____ _____ _____

_____ _____ _____

[image is not available] [image is not available] [image is not available]

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[image is not available] [image is not available] [image is not available]

_____ _____ _____

_____ _____ _____

Notes

(1) James Mellaart, "Excavations of Catal Hyük, 1963, Anatolian Studies", Journal of the British Institute at Ankara, vol. XIX, 1964. - "Catal Hyük: A Neolithic Town in Anatolia", pp. 17-177. Sample and information found:

Neolithic Town Map in Anatolia, wall painting found July 26, 2007 http://www.atamanhotel.com/catalhoyuk/oldest-map.html

Slide #100, Catal Hyuk: Neolithic Town http://www.henry-davis.com/MAPS/carto.html

(2) Mappae Mundi samples found:

http://www.henry-davis.com/MAPS/EMwebpages/EML.html

[image is not available] [image is not available]

(3) Ptolemy's works were rediscovered in the middle ages, and the first printed Ptolemaic map was the Ulm map of 1482- no earlier maps are known to survive. A printed Ptolemaic map from the 14th (a) and 16th (b) century samples found:

Ptolemaic map was the Ulm map of 1482 http://eaudrey.com/myth/Places/styles_of_old_maps.htm

[image is not available] (a) [image is not available] (b)

(4) Portolan map samples found: July 26, 2007

http://bell.lib.umn.edu/map/PORTO/CAN/center.html and

http://www.antique-map.net, http://eaudrey.com/myth/serpents+dragons.htm

More samples of portolan style close-ups

[image is not available] a [image is not available] b [image is not available] c [image is not available] d

a. "Rosette" compass within a floral type design.

b. Rhumb lines

c. Portolan map

d. The first known portolan map, the *Carte Pisano*, was made about 1275.

(5) Mare Incognito and Terra - map drawn in 1566 showing the new world and references to unknown land and seas. Sample found: http://en.wikipedia.org/wiki/Image:Map_North_America_1566.jpg and http://eaudrey.com/myth/serpents+dragons.htm

[image is not available]

[image is not available]

(6) The Lenox Globe (ca. 1503-07), copper, 13cm in diameter (in the collection of the New York Public Library): "HC SVNT DRACONES" (i.e. "*hic sunt dracones*", "here are dragons") appears on the eastern coast of Asia

http://www.maphist.nl/extra/herebedragons.html

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