The History of Visual Technology

4th Edition

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Rev 2

Expectations Joanne Paris, 2014 used by permission

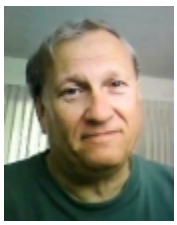
The History of Visual Technology

Fourth Edition, *by James Janossy*

ad maiorem Dei gloriam inque hominum salutem

This publication contains readings useful as a supplement to ***The Story of Art*** by Sir Ernst Gombrich for course *GPH-205 Historical Foundations of Visual Technology* offered by the College of Computing and Digital Media (CDM) of DePaul University, Chicago. The classic text by Gombrich provides an excellent introduction to art of the Western world since the cave art of Lascaux and Altamira, with minor excursions into the art of the Middle East and China. The readings and web resources in these materials are designed to provide similar exploration of the highlights of the technologies employed from prehistoric times to the present by craftsmen and artists in support of the design intent of the course. Web resources cited in these materials are accessible via **http://bit.ly/gph205-info**.

Unit 1
Prehistory, the Ancients, Rome (to AD 600)



Introduction to Unit 1

Goals and Objectives of GPH-205

Integration of homework, reflective essay, and conclusions work

Introduction

Hi—my name is Jim Janossy. I'm your mentor as we explore art and the technologies used to create it by reading ***The Story of Art*** by Sir Ernst Gombrich, a classic art history text. We begin hundreds of feet underground in Lascaux, France where thousands of amazing, remarkably sophisticated drawings were discovered in the 1930s. These drawings were made by peoples about whom we know very little—people who lived an estimated 30,000 years ago. We'll then trace some elements of civilization through northern Africa about 7,000 BC, the Sumerians, Egyptian civilization, the Assyrians, Persians, and Greeks. We'll end up with Rome, "world conquerors." That's quite an expanse of time and history! You'll learn about the colorants and some of the techniques used by these civilizations to create art and architecture and the ideas that they had about it.

Goals and Objectives

This course aims to **acquaint you with the wide range of technologies used to create art**. In order to do this it's inescapable that we consider what these technologies were used to create: the art and architecture itself. A further goal is to **help you understand how the orientation, perspectives, and philosophies—the "world view"—of each of several civilizations shaped their use of technology and the development of visual objects**. Lastly, our goal is to help you **form your own perspective to be able to articulate trends in these areas so and see a "big picture" of art, its creators, its purposes and evolution**. The objectives for each unit are the same: to develop in each learner the knowledge of facts concerning these topics, the skill to express them in an articulate and cogent manner, and to be able to see trends leading to the modern world. The coursework for each of the four learning units" of this workbook is a physical implementation of the objectives of the unit in the form of an information-recording document for note-taking.

Integration of homework, reflective essay, and conclusions work

This course is designed to make the most productive use of your time. To accomplish this the homework is closely integrated with the end-of term "take home" final exam:

- Each of the four learning units has written homework that is designed to help you identify and document the important facts of the subject matter. This is the Unit Summary Form.
- Each unit provides an interesting multi-part hands-on project to help you understand how the technology you have studied was actually used.
- All during the course you develop the first part of the final exam, in the form of a first-person reflective essay "story" that provides the framework for facts you have gathered.
- In the last two weeks of the term the conclusions work is posted; you complete this by proving or disproving the posted statements using facts drawn only from your own essay.

This workbook, and how the course works

This workbook is designed to accompany ***The Story of Art*** by Sir Ernst Gombrich, a classic introductory art history text. That text is rather unique in that unlike most college textbooks it was not written with the intent of being revised frequently to create new, incompatible editions (which, it's no secret in the publishing world, is done primarily to make used textbooks unusable). Instead, Ernst Gombrich and the publisher, Phaidon Press, have maintained the same content throughout all editions of ***The Story of Art***. They could do this because historical events don't change with the passage of time and an introductory text deals primarily with the presentation of facts. They could also do this because Phaidon is interested in distributing knowledge rather than artificially inflating sales, and because Gombrich himself saw no need to indulge in the specious process of moving chapters around simply to change things. And quite as a public service, the cost of even the newest edition of ***The Story of Art*** (the 16th edition) has been held to the economical range of $25-30.

This workbook was created to supplement ***The Story of Art*** with readings and web resources providing historical background and coverage of the technologies used by craftsmen and artists to create images, sculpture, and architecture from prehistoric times to AD 1900. What you will find here parallels the preface, introduction, and chapters 1-25 of Gombrich's book. I have broken the text reading down into four sections I call "units" but which some may call "chapters" and other may refer to as "modules." Each unit starts with pages called a "Unit Summary Form" which is intended to be useful, in printed form, to students as a note-taking device. These pages are available as a separate 8-page .pdf download at the course web site (see the footer below). I suggest that you download and print those pages and use them as intended. You will be gathering up facts on the purpose of art for each historical era we study, the rules for the formation of what the civilization in that era deemed to be "valid" art, the technologies they used, and the modern impact, if any, of their art and technologies they developed. Your sources for these facts are ***The Story of Art*** chapters assigned for reading in the unit, the workbook pages assigned for reading, and the required video viewings for which web links are provided at the course web site unit web page. When you have completed gathering the facts for the USF and jotted notes on a printed copy of it you download the USF form in .docx or .rtf form at the unit web page. You then your choice of word processor to type up your notes and submit them electronically as a .docx, .rtf, or .pdf file.

Each of the four units in this workbook ends with instructions for a project. The projects are designed to help you "get the feel" of some of the technologies covered in the unit. In creating the projects I purposely kept them simple; they require only commonly available inexpensive items. Most students find the projects fun! All products of the projects are designed to be submitted electronically, most as pictures of your work, with you in the image, taken with a cell phone camera. Each unit also contains an optional extra credit project that's available for possible credit.

The course this workbook supports requires that students develop a first-person story all during the term as they imagine themselves living through each of 12 specified eras. Detailed instructions for this story are contained in the pages labeled "GPH-205 Essay Guide" at the end of Unit 1. This essay becomes a form of "oral history" that each student uses to support the Conclusions Work posted near the end of the term as a take-home final exam. A draft of the first page of the essay is due in Unit 1 simply so that I can confirm that each student understands the intended nature of this story-writing assignment.

The following page provides a checklist of the assignments (USFs, projects, and essay work) on which your course grade is based. Your grades will come to you on a consolidated score and feedback form that includes comments on all of your work; the most recent copy will contain everything that preceded it as well as new scores and feedback. I teach this course with a "mentoring" pedagogy by which I mean that I help you "perfect" your work. Every assignment is repeatable; you can revise it based on my feedback and resubmit it for re-grading. The USFs are your source of facts for your essay and the Conclusions Work. In this way all of the work of the course is integrated to make your study time most productive. I think you will enjoy this approach to learning! -- Jim Janossy

ASSIGNMENT CHECKLIST

Unit Summary Forms are provided at the start of each unit, and the unit project is at the end of the unit.

UNIT 1 – Prehistory, Ancients, Rome *Story of Art chapters 1-5, workbook pages 1-54*	**Points**	**% of course grade**
Unit Summary Form 1 (USF1)	**100**	**10**
Project 1 – Perfect solids, golden rectangle, Fibonacci series	50	5
Draft of the first essay page, on Lascaux; start of your story	**25**	**2.5**

UNIT 2 – The Middle Ages *Story of Art chapters 6-11, workbook pages 55-86*		
Unit Summary Form 2 (USF2)	**100**	**10**
Project 2 – Historiated initials, 12-segment (petal) rose window, drawing Celtic knots	50	5

UNIT 3 – Renaissance, Reformation *Story of Art chapters 12-18, workbook pages 87-124*		
Unit Summary Form 3 (USF3)	**100**	**10**
Project 3 – Egg tempera experimentation, typography, and color theory and use	50	5

UNIT 4 – Baroque and Beyond *Story of Art chapters 19-25, workbook pages 125-170*		
Unit Summary Form 4 (USF4)	**100**	**10**
Project 4 – Identifying symmetry and perspective use in Renaissance and Baroque art	50	5

Reflective essay *See the essay instructions on workbook pages 50-54*		
Remainder of essay body ***(due near the end of the course)***	**175**	**17.5**
Conclusions Work ***(take-home final; instructions will be posted 10 days before end of term)***	**200**	**20**
Total	1000	100

You can see from the bolded point/percentage values that the USFs and essay/conclusions work counts for 80% of your course grade. Place the greatest emphasis on completing those well! The USFs are where you gather the facts that you need to write into your reflective essay!

GPH-205 Unit 1 Summary Form (USF1) Page 1

THIS IS BOTH A STUDY AID AND HOMEWORK ASSIGNMENT. Use a printed copy of this page for hand-written notes that you prepare as you accomplish the required reading and viewing. Put concise phrases in the boxes, not sentences! *Then download the editable .docx or .rtf copy of this form from the link on the course Unit 2 web page and type in your responses.* ***DO NOT COPY AND PASTE FROM TEXT OR WEB SOURCES.*** *The boxes for your responses on this form will automatically expand as necessary.* ***Submit your word-processed document NOT a scanned copy of your hand-written responses!*** *This work is integrated with your reflective essay and take-home final exam. The facts you gather form the basis for your essay and the Conclusions Work.*

Civilization/Art movement	Art purpose(s)	Art formation rules	Art technologies	Their art's impact on our modern life
Ancient Lascaux peoples *(this row is already filled in for you as an example and for use in forming reflective essay page 1)*	Honor animals, Work magic, Rites of passage rituals, Gain control over animals	Look lifelike, draw accurately with colors they really had (as much as possible with the limited technology!)	Natural earth colorants, not combined, no binder, colors rubbed on walls, or water or animal fat binder.	Not much. Surprised that prehistoric people could create such graceful looking pictures.
African civilization 7000 BC				
Egyptians				
Sumerians				

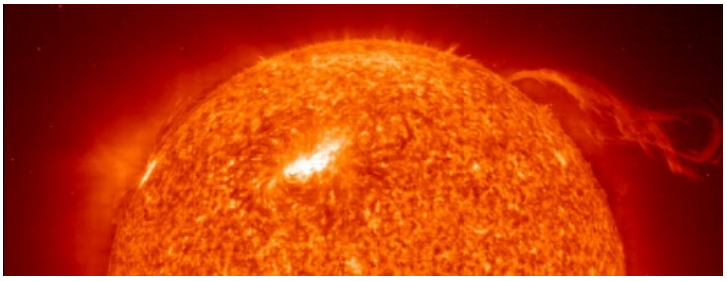
GPH-205 Unit 1 Summary Form (USF1) Page 2

THIS IS BOTH A STUDY AID AND HOMEWORK ASSIGNMENT. Use a printed copy of this page for hand-written notes that you prepare as you accomplish the required reading and viewing. Put concise phrases in the boxes, not sentences! *Then download the editable .docx or .rtf copy of this form from the link on the course Unit 2 web page and type in your responses.* ***DO NOT COPY AND PASTE FROM TEXT OR WEB SOURCES.*** *The boxes for your responses on this form will automatically expand as necessary.* ***Submit your word-processed document NOT a scanned copy of your hand-written responses!*** *This work is integrated with your reflective essay and take-home final exam. The facts you gather form the basis for your essay and the Conclusions Work.*

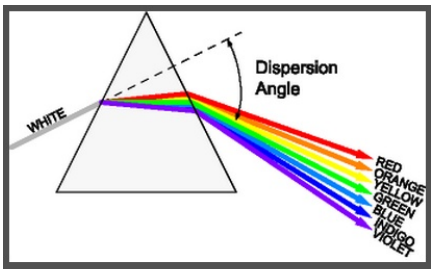
Civilization/Art movement	Art purpose(s)	Art formation rules	Art technologies	Their art's impact on our modern life
Assyrians				
Persians				
Greeks				
Romans				

Strange Beginnings: it all begins with the sun

We live on a planet that orbits around a star. We can live at all because of that star, which we call the "sun". The sun is responsible for coal, oil, gas, and the plants that lived eons ago from which these sources of energy were formed. The sun continues to supply us with energy without which no living thing on earth could survive. Because of this, and the sun's impact on past and present civilizations and the way we humans visually perceive things, our quest to understand the historical foundations of visual technologies starts with the sun.



The sun is actually an ordinary star, much like the other billions of stars we can see on a clear night. We see the sun differently than we see other stars because it is, relatively speaking, so close to us. Science tells us that the sun is a giant ongoing nuclear fusion reaction running on hydrogen. Each second about 700,000,000 tons of hydrogen are converted to about 695,000,000 tons of helium at the sun's core. The remaining 5,000,000 tons of mass are given off as energy. (The mass of a helium atom is slightly less than the mass of two hydrogen atoms, and that small excess of mass is liberated directly as energy. Einstein's famous equation $e=mc^2$ tells the amount of energy: about 386 billion billion megawatts per second!).[1] A tiny portion of the energy sent forth from the sun falls on the surface of the earth after travelling 93,000,000 miles through space. That energy gives plants—the bottom of the food chain—the ability to perform photosynthesis to create what they need to live and grow. That energy also warms the land and oceans, creating our weather.



A prism splits light into its individual colors.
(Image Credit: NASA)

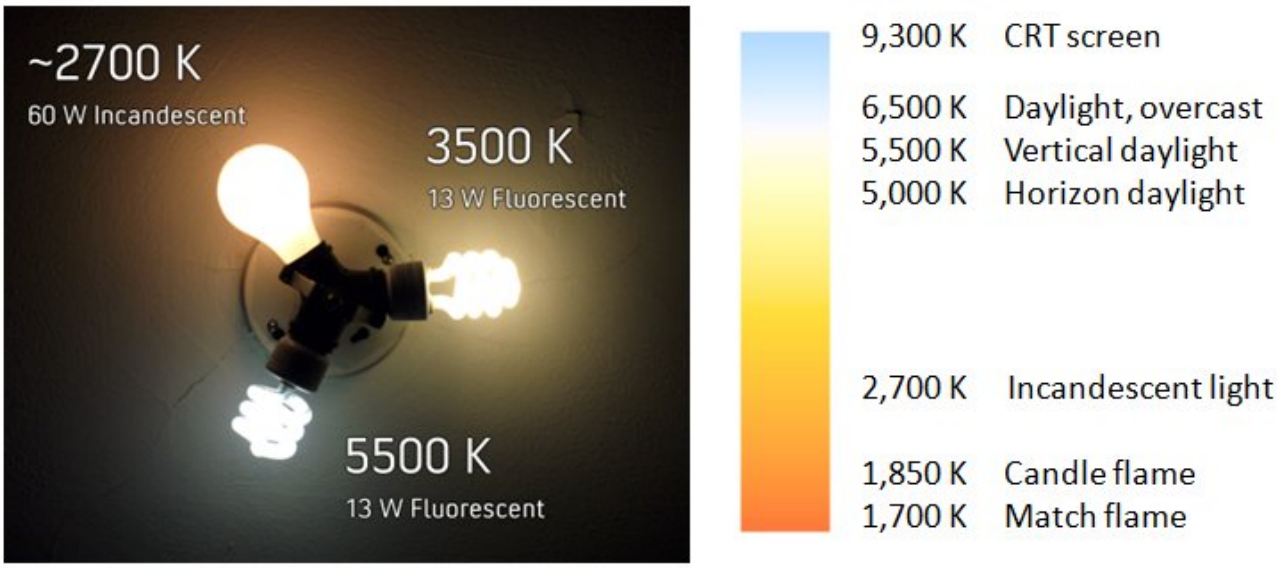
The sun has had its direct effect on what prior civilizations created that we now call "art." It was personified as a god by many civilizations; the Greeks called it ***Helios*** and the Romans called it ***Sol***, and before both of them the sun was the ancient Egyptian god ***Ra***. So in addition to powering human societies the sun has been the focus of much of human life.

The light from the sun makes it possible for us to see objects. Light we see with our human eyes is a small special part of the energy that the sun sends us. Although sunlight looks dazzling white at noon on a clear day it's actually composed of what humans perceive as many colors. A prism forces these different colors to separate as do the droplets of water lingering in the air that produce a rainbow. Sunlight is what gives things color; objects appear to be the color or colors they **do not** absorb! *For example, a red apple absorbs the light energy of all colors except red, and reflects the light energy that our eyes detect as red.*

[1] This information is from a marvelous web site named ***The Nine Planets*** created by Bill Arnett and located at the Lunar and Planetary Laboratory, University of Arizona, Tucson, Arizona, USA.

Light's "color temperature" and art

For things that don't create light on their own, the color we see them is whatever they reflect of the light that is falling on them. It's important to understand this because things will look different under different lighting conditions. That's why stores where house paint is sold usually have a small enclosure where you can view paint samples under incandescent lighting. Stores are usually illuminated with fluorescent lights, which provide a bluer light than light bulbs. Various kind of light sources are rated with a measurement called the **color temperature**. This has a basis in physics and is expressed in a scale as in this illustration:



Color temperature is expressed in degrees in the absolute temperature scale, Kelvin, which starts at absolute zero, -459.67 degrees Fahrenheit (-273.15 degrees Celsius). You don't need to remember what the actual values are, just realize that there's quite a difference in the yellow or bluish content of common light sources. The incandescent light bulb, inefficient as it is (it generates a lot more heat than light!) produces a cozy warm glow while the newer energy-efficient fluorescent equivalents usually produce a "colder" white or bluish-white light. A given colored object will look different—in some cases radically different—under each type of light, and may look different in sunlight depending on the time of day. As the sun crosses the sky it may appear to be red, orange, yellow or white depending on its position. The changing color of the sun during the day is mainly a result of scattering of light. The blue color of the sky is caused by scattering of sunlight by particles in the atmosphere.

This background on light is important as we consider visual objects because **we need to think about what type of illumination was available to and was used by people creating art, to view the art as they saw it.** As we'll see, the very first "artists" from whom we have any legacy of "art" worked 30,000 years ago and placed their images in caves far beneath the surface of the earth. How the colorants they used appeared in daylight and how they appeared underground where they worked was different—in sunlight, or by the light of flickering torches—a factor that very likely contributed to magical qualities they may have associated with the place where they created and left their art.

Colorants, pigments, binders and paint

Dark objects, and black objects in particular, absorb more of the sun's light and convert it to heat; lighter ones reflect more, and objects that we see as white reflect all of the visible light frequencies. The "color temperature" of a source of illumination (the frequencies of visible light it contains) can certainly affect the light an object can reflect. Now the question: how do artists obtain and apply substances of desired colors to form images?

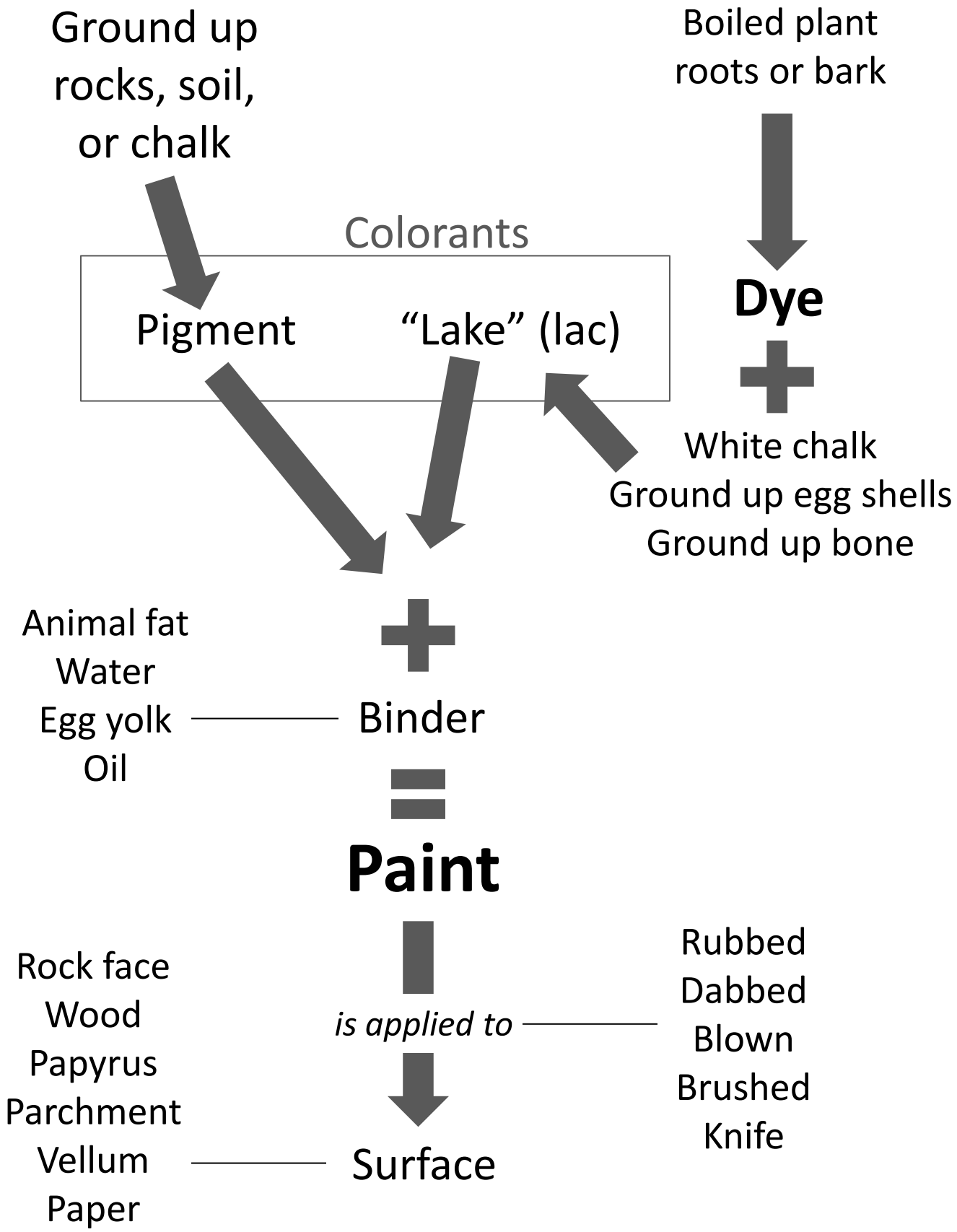
The substances people used earliest to create images were naturally occurring in the form of different colors of soil (earth) and rocks and the very black carbon formed when wood or bones are burned. Different soils and rocks have different colors depending on the minerals and chemical compounds in them, such as iron oxide (rust). These colors range from shades of gray to light yellows, reds, oranges and browns, sometimes call "ochre". These are the colors the Lascaux peoples had to work with. Let's assume that each of these was worked into a powder by grinding them with stones. We call these **pigments**.

To apply a pigment to a surface such as a cave wall you need to make paint out of it so you can apply it using something like a stick, a bit of moss or cloth, or by blowing it on. **Paint** is a pigment mixed with a binder. A **binder** is some substance or fluid that accomplishes two things: it sticks the pigment particles together, and it sticks them to the surface on which the image is to be created. The Lascaux peoples may have experimented with **animal fat** as a binder, or any liquid such as **water** or blood. Most pigments won't mix well with water but if a little plant sugar is added to the water from plant sap the powder will mix adequately well and the binder will dry with adhesive qualities. A better binder is **egg yolk** but it wasn't until the Egyptians and later that people discovered this. And it wasn't until the early Renaissance about 1400 AD that the Dutch artist Van Eyck tried using various kinds of plant-derived **oil** as a binder, which has turned out to be one of the best substances for this purpose.

There's another way to produce a **colorant**, the general name for a coloring material such as a pigment. Some types of plant, such as the madder plant, the woad plant, indigo, and some types of wood from trees can produce a strongly colored liquid called a **dye** when the roots are dried, ground up, and boiled in water. In civilizations later than the Lascaux, people also learned to use some types of insects, such as the kermes or cochineal beetle to produce a red dye, or a small shellfish to produce a deep purple dye, or even the dark ink produced by the octopus. Dyes can be used to color cloth produced from plants or animals such as sheep, but dye is too thin to use as paint (try painting with coffee and you'll see this firsthand!). A form of colorant called a **lake** can be made from a dye by using the dye to color a receptive white powder such as chalk, ground up egg shells, or ground up bone. The powder absorbs some of the coloring. When it's dried, it can be made into paint in the same way a pigment is made into paint.

If a colorant is **colorfast** it will retain its color even after exposure to the sun. Natural earth pigments are usually colorfast. But lakes unfortunately tend to fade or change color when exposed to light, as do clothes colored with the dyes the lakes are made from. This is not a problem for clothes, which wear out, but a colorant that's not colorfast is disastrous for any image intended to last a long time! Colorants that are not colorfast are known as **fugitive**.

Ways paint was formed and used



Lascaux, Chauvet, and Altamira cave art

Quite amazingly, humans who lived as much as 15,000 to 30,000 years ago in western Europe created and left behind huge amounts of art on the walls of natural subterranean caverns. These caves, in southern France and Spain, were discovered and explored only within the last century. Because the art in these caves dates from before the time of recorded history (history for which we have written records) they are called "prehistoric" art.

What did their art mean to these peoples—why did they create it—what purpose did it serve in their lives? And further, what was the status or role of the person who created the art? Were they artists as we would imagine them, creating something that expressed some aspect of their view of the world, or simply workmen regarded as would be a carpenter or shoemaker who practiced a trade according to accepted practice?

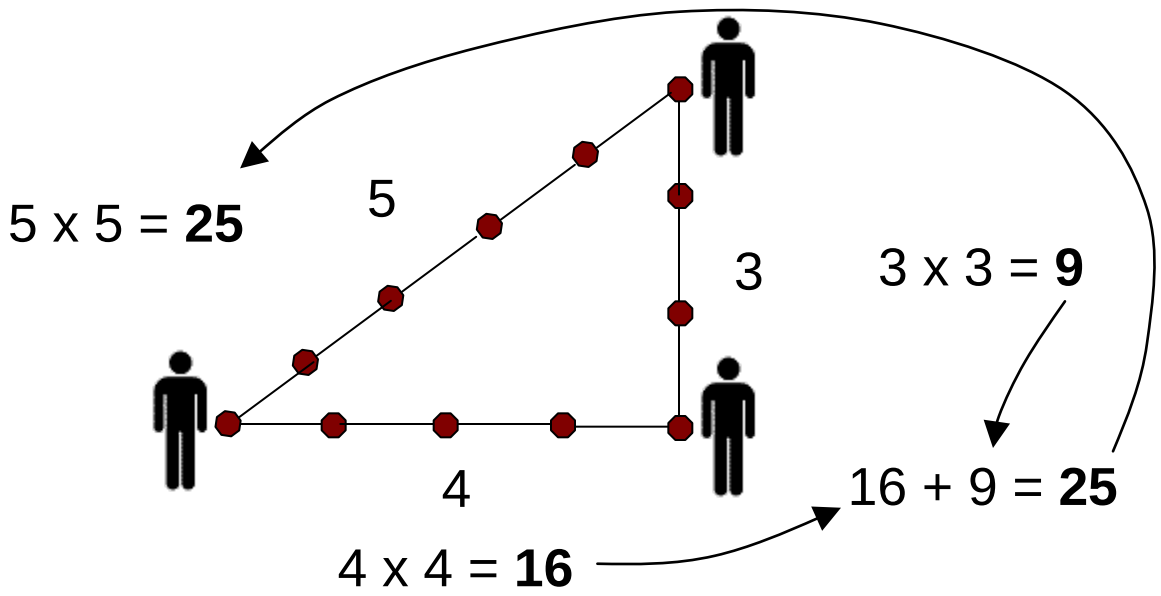
Because no written records exist we can only try to make an intelligent guess why these people created this art and how they used it. We can base this guess on some facts we do know and can appreciate. The caves are deep underground, places where most people would have to muster quite a bit of courage to explore, especially by just the light of flickering torches. So the reason for the creation of this art was not trivial; this wasn't a bored sailor carving at scrimshaw for recreation. The art may have served a magical purpose, capturing the essence of an animal to be hunted, with mastery of the picture giving the hunter mastery of the beast—with the depiction in the cave preserved to honor the beast after it was killed.

These decorated underground places may have served as places for sacred rituals, such as coming-of-age ceremonies surrounded by the animals that a young hunter was now able to stalk on his own. These places were something special.

The fact that these places were special doesn't necessarily mean that the people who created the images on the walls were regarded with an exalted status. They may well have been, but as we'll see with many of the civilizations that arose later, people creating images were often regarded as skilled craftsmen, not creative artists. They followed rules dictated by the society for the intended purpose of the images and their work was judged on how well they followed those rules. In ***The Story of Art*** Sir Ernest Gombrich consistently points out the status within their societies of the people creating art and the rules they followed. To this we add in this workbook an emphasis on the tools and techniques at their disposal and which they used, including some of the mathematical and scientific discoveries that underlay the art and architecture they created.

Rope Pullers as ancient surveyors

Ancient peoples were much more sophisticated than many modern people imagine. A type of worker known as a "rope puller" could accurately and quickly accomplish a lot of what modern surveyors do, using only stakes and knotted ropes. A very useful knotted rope was a cord with a knot at each end and 11 equally spaced knots on its length, as you see here:



Using such a rope, a small group of people could stake a point in the ground and quickly pull the rope taught, putting the knots at the corners of a right triangle as shown. The angle at the lower right corner is a perfect 90 degrees, such as would be needed for the corner of a building foundation or even for the corners of a pyramid! This is a clever use of the Pythagorean theorem.

Pythagoras, an ancient Greek, figured out that the sum of the squares of the sides of a right triangle is equal to the square of the hypotenuse (the longest side). In other words, sides of a length of 3 and 4 produce a hypotenuse with length 5 as shown above, and you could calculate that length of that longest side with simple arithmetic.

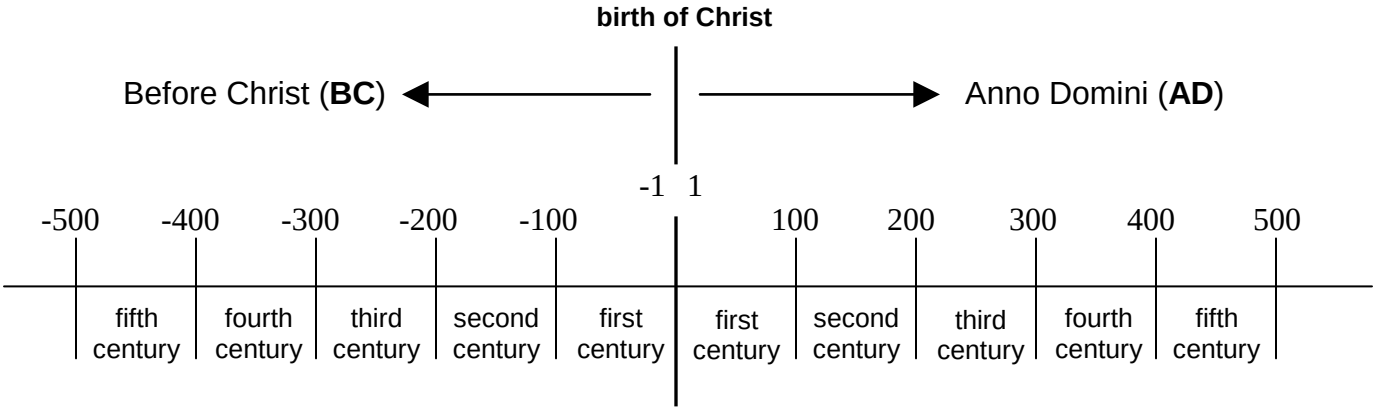
You might think that the theorem is useful if you know the short sides of the triangle and want to determine the length of the hypotenuse—since that's how this is often demonstrated in geometry and algebra classes. But that's kind of a lame! How useful is that, really? You have probably had to find the length of a hypotenuse about as often as you've been called upon to find the length of a hippopotamus!

But ancient engineers realized that when you need to lay out a perfect corner, constructing a right triangle like this could give you the angle you needed just by using a rope knotted as shown. This may be the way that the base of a pyramid was laid out on the desert sand or the walls of a building were made vertical or the mast of a ship made square with the deck.

In addition to laying out a perfect 90 degree angle, ropes can be used to develop circular shapes (as you might do with a compass) and polygons within circles, or to bisect angles or to arrange widely separated lines in parallel. The ancients had rope and made use of it; we use a compass.

BC, AD, BCE, CE, and BP dates explained

The terminology associated with dates that cross over the "0" year dividing line can be confusing. The birth of Jesus Christ has long figured as a pivot point in the way dates are expressed in Western societies. Many other calendars—ways to count the years—do indeed exist. Another well known one is the Jewish calendar, in which 2016 is actually expressed as year 5776 (the Jewish calendar begins with 0 at the creation of Adam and Eve). The Hijri date is the Islamic calendar. It started in the year in which the prophet Muhammad immigrated from Makkah (Mecca) to Madinah: 579 AD. Year 2016 in the western calendar is year 1437 in the Hijri calendar. The French Republican calendar (French revolutionary calendar) was proposed during the French Revolution and used in France. It designated 1789—the year of the French revolution—as year I with years numbered in Roman numerals. It was abandoned by Napoleon in 1806 (year XVIII). The easiest way to picture the BC/AD calendar is with a number line:



Now for the fine print: In this line zero is the point at which Christ was born and is not a number associated with a year—**there is no year 0**. It would be easiest to think of the year as a signed number in which years after this point were positive and years before this point were negative. Here you see the 1,000 years between 500 BC and 500 AD measured out in centuries that way. But negative numbers had not been conceptualized when the Anno Domini dating system was devised in 525 by the monk Dionysius Exiguus. Years after Christ's birth were given the name "anno domini" which means "in the year of our Lord." The AD is placed before the year. For example, the year that Columbus landed in America would be stated as AD 1492, reading as "in the year of our Lord 1492." Dates before the birth of Christ were stated as "BC" for "before Christ." By convention the "BC" was placed after the date, so for example the defeat of the Persians by Alexander the Great 336 years before Christ's birth would be stated as 336 BC. ***Needless to say, the ancients had no idea of "BC" dating, it's a much later invention!***

Confusion enters the scene when scholars refer to a range of years with a term like "the fifth century." "Century" means 100. Count the centuries forward from the zero point and you'll see that **the first century spanned years 1 through 100**. The second century spanned years 101 through 200. The fifth century AD is 401 through 499. The 20th century was 1901-2000. We're now in the 21st century.

The potential for more confusion exists when scholars refer to centuries BC **without saying BC** as in "fifth century Greece." To know what this means you have to know that ancient Greece existed only in the BC era! So "fifth century Greece" refers to the years -500 through -401, that is, 500 BC through 401 BC. And since the years count backwards in BC, it is harder still to form an accurate conception! AD is now often stated as CE (Common Era) and BC is stated as BCE (Before Common Era) to avoid reference to any specific religion. "BP" is sometimes used as "Before Present." It's poor form to omit the "BC" or similar reference when referring to BC dates but scholars do it all the time in referring to "century!"

The Persian Empire (550 BC – AD 651)

A documentary on the Persian Empire is contained in the video playlist for chapter 3 and 4 of ***The Story of Art***. The Persian Empire receives scant coverage in the textbook but it is well for you to understand more about the history of the region, this once-vast empire and its effect on western civilization and art. The actions and accomplishments of Cyrus the Great, one of the most famous rulers of antiquity, extend down to the present day.

Persian is the ancient name for the region now known as Iran. There is a tendency for Americans to stereotype all Muslims as "Arabs" but this is not an accurate portrayal. Present-day Iranians are descendants of the Persians, not the nomadic tribes from which many other Muslim peoples are descended. Even the "denomination" of Islam of the Iranians is different from that of the majority of Muslims. Iranians are Shiite Muslims and comprise about 15% of the Muslim world while Sunni Muslims form the vast majority. The significant differences between these sects are rooted in different beliefs concerning the rightful successors to the prophet Muhammad which are beyond the scope of our consideration. But this difference is what makes the present situation in Iraq, immediately west of Iran, confusing to many Americans. The rulers of the area that forms Iraq were for hundreds of years Sunni Muslims while the majority of the population of Iraq was and continues to be Shiite Muslims, as are almost all Iranians.[1]

As you watch the playlist focus your attention on the types of art and architecture developed by the Persians, the engineering work that they accomplished, and the differences between their art and the art of the Greeks. I have annotated the map below to help you visualize the areas we study in this unit and the references to geography in the video segments.

See this map in a larger form at the web link for this page at the course web site.

[1] By invading Iraq to ostensibly bring democracy to it, America empowered the previously long-suppressed Shiite majority to assert control. This introduced a dynamic into the region with far-reaching consequences. It is therefore not surprising that Iran took great interest in supporting the Shiite majority in Iraq during recent and continuing hostilities. Given the past glories of the Persian Empire it's also not surprising that present day Iran has a tendency to assert itself in the region; the longevity of its culture and illustrious history naturally foster nationalistic fervor even apart from its religiously conservative leaders. Sadly, it appears that much of the American populace as well as some of their elected leaders are ignorant of this history or choose to ignore it.

Ancient Greek, Persian and Roman history

Archaic Greek Period (750-500 BC) – This period saw advancements in political theory, especially the beginnings of democracy, as well as in culture and art. The style of pottery and sculpture show the beginnings of the more naturalistic style of the Classical period.

Classical (Hellenic) Period and conflict with Persia (500-336 BC) – The Greeks came into conflict with the Persian Empire to the east. This conflict began with the defeat of the Persians by the Greeks at the Battle of Marathon in 490 BC after which the Greeks assumed greater prominence in the ancient world. This included the full development of the democratic system of government under the Athenian statesman Pericles, the building of the Parthenon on the Acropolis, the creation of the tragedies of Sophocles, Aeschylus and Euripides, and the founding of the philosophical schools of Socrates and Plato.

Hellenistic Period after defeat of Persia (336-146 BC) – This is the period between the conquest of the Persian Empire and the point at which the Rome took control of the area. It's called "Hellenistic" to distinguish it from the Hellenic culture of the classical period. Alexander the Great, a king of Macedon, a state in northern ancient Greece, was born in 356 BC. He was tutored by Aristotle until the age of 16 and became king in 336 BC. He used his experienced army to invade Persia and overthrow the Persian King Darius III in 336 BC. During these 200 years Greece enjoyed the greatest height of its power and its culture spread in the region.

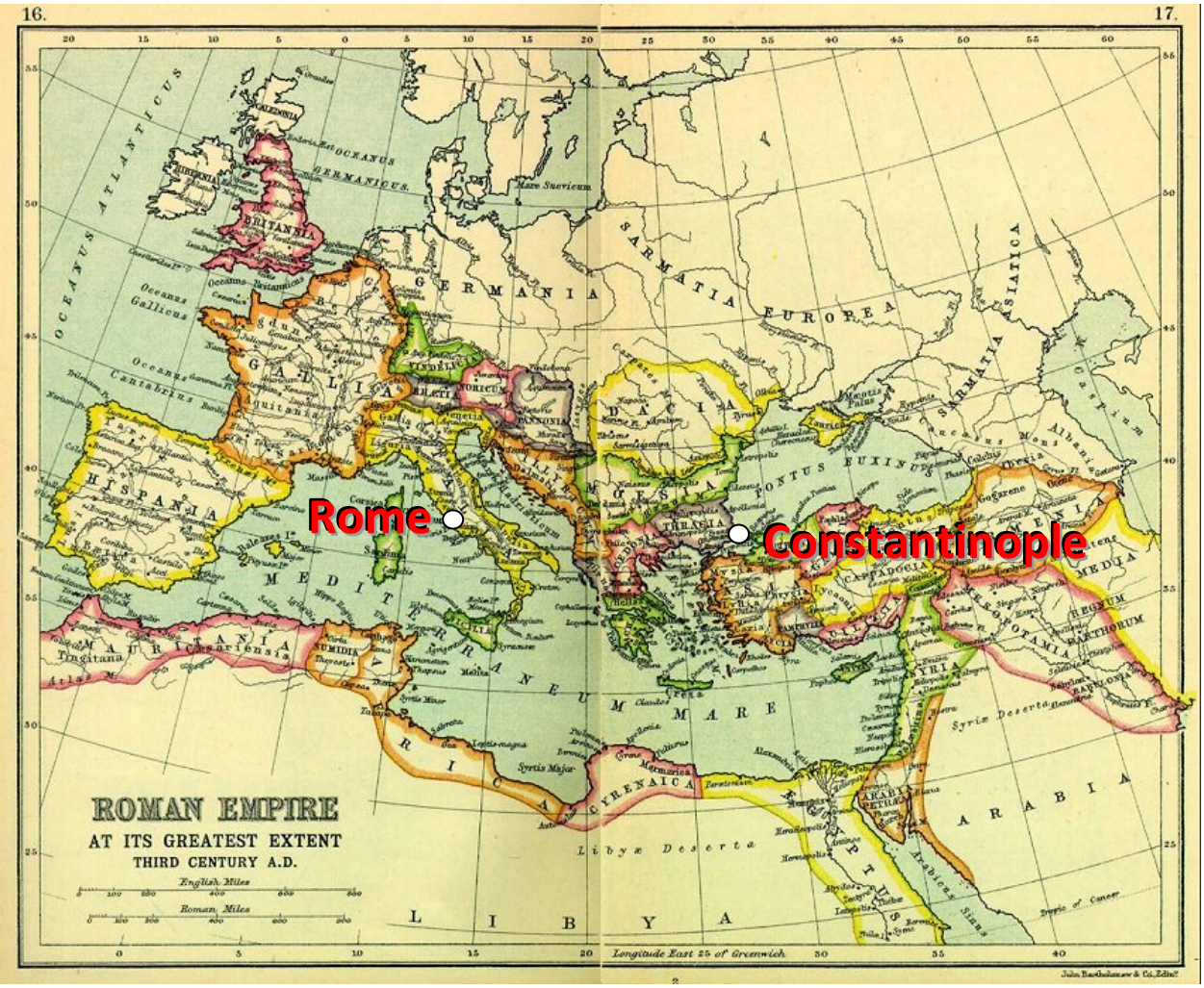
Roman Era (145 BC-476 AD) – While it is impossible (and a bit silly) to be so precise the generally agreed-upon date for the founding of Rome is April 21, 753 BC. According to legend it was founded by the brothers Remus and Romulus, who had been raised by a wolf after being abandoned. Romulus eventually killed Remus in a fit of anger.

From the time of its founding Rome gained strength and frequently started wars to gain new territory and safeguard its security. From the fourth century BC (399-300 BC) onward Rome steadily expanded its political and military influence through central Italy through an astute combination of diplomacy and warfare. In 340-338 BC the Romans gained mastery of Latium and fought and won wars with the Samnites to the east in 327-304 BC and 298-290 BC. This extended Rome's power to the Adriatic and southwards to the Bay of Naples. Their next major war was against Pyrrhus, King of Epirus in northwest Greece, who landed in southern Italy in 280 BC to invade Rome with an army of 25,000 men and 20 elephants. Epirus was stopped and eventually gave up trying to conquer Rome; the Romans were able to hold on to southern Italy.[1]

The continued expansion of Rome put an end to the empire created by Alexander the Great: Macedonia was conquered by Rome in 167 BC and Greece in 145 BC. Seleucid Asia was conquered by 65 BC. Cleopatra VII, the last Macedonian descendent of the pharaoh Ptolemy to rule Egypt, committed suicide in 30 BC after which Egypt was also added to the Roman Empire. Rome's government changed from a republic governed by a senate to an empire governed by a dictator when Octavian took the name Augustus in 27 BC. From that point until Rome gradually

[1] Much of the detail here is extracted from http://www.classicsunveiled.com/romeh/html/unifyitaly.html and edited to provide an appropriately brief summary. Additional information was extracted from WikiPedia.

fell apart and was conquered in the fifth century AD, by peoples from northern and Eastern Europe, it was ruled by a series of emperors who gained power by inheritance or intrigue.
The Christian church, which grew out of the Jewish religion, eventually established a governing structure of bishops; the bishop of Rome gradually was acknowledged as first among equals and eventually the position of this bishop became known as the Pope. When the Roman civil government fell, the church, under the Pope, became a bridge of continuity between the culture of the ancient and modern world and provided some semblance of a unifying structure in the absence of the Roman government. The time from the fall of Rome (about AD 500) until the Renaissance (about AD 1500) is often referred to as the Middle Ages or the "Dark Ages."



The Roman emperor Constantine (reigned AD 306-337) moved the capital of the Roman Empire eastward from Rome to Byzantium, which was renamed Constantinople and rebuilt from AD 324-330. The eastern part of the church (the Byzantine church) was much more heavily influenced by Greek artistic forms than the church in Rome in the west.

The eastern church and the western church formally separated in AD 1054 over theological issues including celibacy for priests. The Eastern Church is known as the Eastern Orthodox Church led by the Patriarch in Constantinople. The western part is the Roman Catholic Church led by the bishop of Rome, the Pope. The Eastern Church has about 300 million adherents and the western church about 1.2 billion members.

Ancient colors, pigments, and painting techniques[1]

Prehistory: Lascaux, Chauvet, Altamira, North Africa, India

The colors available to prehistoric people were those naturally occurring minerals at or near the surface of the earth, and from accessible substances that could be crushed to a powder, including these dull colors:

- Carbon black, from charred bones, wood, or charcoal
- Yellow and red earths, from iron oxides ("rust")
- Brown earth, a mixture of iron and manganese oxides; the colors ranging from red brown to almost purple
- Green earth, from clay minerals containing aluminum, iron, magnesium and potassium; these are less common that other types of naturally-occurring materials
- White pigments, from chalk and crushing animal bones.

Prehistoric peoples probably mixed pigments with animal fat to form a greasy paint, which they applied to cave walls with sticks, fibrous plant stems, or brushes made of tufts of animal fur. Explore these pigments and many more that we'll discuss below by visiting the web site at the QR code and URL at the right! This informative web resource shows you the colors of pigments and the time periods each was originated and used. (The link isn't a typical lecture on this page.)

Egypt

Ancient peoples of the Sahara, which in prehistory had been a moist and lush land, developed from hunters into a settled people by about 4000 BC. Nomadic tribes began to unite and by about 3000 BC Egypt was unified by the first pharaoh. Our earliest legacy of Egyptian pottery and hieroglyphics date from about then. The pharaoh was believed to be divine and would have an afterlife. His body

Mineral	Color	Composition and nature
Azurite, Malachite	Green and blue	Ground up copper compounds
Cinnabar	Red, tends to get darker as affected by light	Compounds of mercury, poisonous, but used of necessity by Egyptians, Greeks, and Romans in spite of its toxicity
Orpiment	Bright golden yellow	Arsenic sulphide, toxic, gives off poisonous fumes and a bad smell
Lapis lazuli	Deep blue	Durable, crushed to a powder, not toxic and no odor; but expensive since it was also used as gems in jewelry. One of the most expensive pigments.

[1] This writing draws much information from multiple web-accessible references; see the index for attributions.

had to be preserved so that his "ka," his soul, could live forever. Painting and art followed strict rules because picturing the environment of the dead pharoah accurately was necessary for his afterlife. Significant events and surroundings of the pharoah's life were recreated inside his tomb. The natural pigments used by the Egyptians to form these depictions included the minerals illustrated in the pictures here. Egyptian craftsmen also developed new pigments to serve the needs of their art. They learned how to make natural pigments brighter by heating or refining them and experimented with and perfected ways to make new pigments by mixing and heating natural substances. By about 2500 BC they developed a blue pigment in the form of a glass that could be ground up to form a powder. To make this, which is called “smalt,” they mixed sand, copper metal, copper ore, alkali, and mineral containing cobalt, then heated the mixture. This is an early form of chemistry and was probably done by a process of trial and error to see what different mixtures produced.

The Egyptians developed pottery **glazes** in a similar trial and error way. Glazes invariably require much experimentation to create. A glaze is a thick liquid slurry of materials applied to once-fired pottery. The glaze changes to a different color when the pottery is fired a second time, to melt the glaze and adhere it to the pottery. “Firing” is the heating of the pottery in a covered pit or oven to a temperature of 600 to 900 hundred degrees. The resulting color of the glaze depends not only on its chemical composition but on the nature of the clay forming the pottery and the temperature of the second firing. Achieving a specific desired result meant keeping accurate records and developing ways to perform consistent mixing and firing.

The Egyptians discovered dyes that could be used not only to color cloth but to make pigments in the form of lakes. The **woad** plant, **indigo**, and **madder** plant are among those they used. Woad and indigo produce a blue color. These were boiled in water and the foam produced on the boiling water mixed with ground chalk, which was then dried and used as pigment. Red dye was produced from dried madder roots, boiled with water mixed with alkali. This dye could be converted into a lake. Carmine, a deep red color mentioned in the Old Testament, was also used by the Egyptians. They discovered that the kermes beetle, when killed, dried, ground up and boiled in water, could produce a deep red carmine dye that could be used to make a lake pigment red in color. (Thousands of years later the Spanish conquerors of Mexico discovered that the native Aztecs used the cochineal beetle in the same way, and this produced an even richer red than the kermes beetle.)

Fresco as a painting method was probably invented either by the Egyptians or Babylonians. With fresco, paint is applied to lime plaster while it is still wet. A sketch is drawn onto the second to the last layer of plaster, and design outlines are marked. Then a fresh layer of plaster is put on the surface in small sections which are then painted. The plaster dries in a reaction between the lime and air to form a transparent calcium carbonate film. Fresco is very durable and was later used by the Greeks, Romans, and even Renaissance artists.

Encaustic is another medium used in Egypt. This term comes from the Greek word *enkaustikos* meaning "to burn in." Pigments are mixed with beeswax and a resin and then softened by heating the mixture. A heated knife in then used to forced the soft warm "goo" onto a wooden panel. Encaustic gives a brilliantly colored, hard, long-lasting surface. Used for funerary images such as the Fayum mummies, encaustic was later adopted in the Byzantine era as a medium to create sacred icons.

Tempera is another ancient binder technique probably developed in Babylon and later learned by the Egyptians. Here, pigment is mixed with egg yolk and possibly a little vinegar. This is applied with a brush working quickly on a small area, since this dries quickly. The yellow color of the egg yolk does not affect the color of the paint because the yellow color is fugitive and bleaches out quickly as light falls on it. Despite its organic nature, and contrary to casual thought, tempera paints can produce images that age well over hundreds or thousands of years with no odor.

Greece

The Greeks learned lessons of art from Egypt and then built on them. But unlike the Egyptians, who built a single pyramid for each pharoah because they had just one divine ruler, the Greeks built many smaller temples structures reflecting their polytheistic beliefs. A revolution in art took place in Athens where philosophy, politics, and drama developed. As Gombrich notes in ***The Story of Art***, the Greeks began to use their eyes rather than just following a formula to create an image or sculpture. They departed from the mechanistic method to prepare art, and began to represent things as they actually saw them.

Greek art flourished but very few original examples of their works survive. The sculptures we do have are lifeless, cold copies made by Roman art collectors. The original statues were often 30 feet tall or taller, made in bronze or wood, painted with bright colors and decorated with gold. The eyes of sculptures were created from gemstones to produce lifelike faces. Greek sculpture depicts "perfect" human bodies created from their knowledge of anatomy. You might say that while they used their eyes and tried to represent things as they saw them, they also idealized the human form to create sculpture that was more perfect in all its elements than any individual human could be.

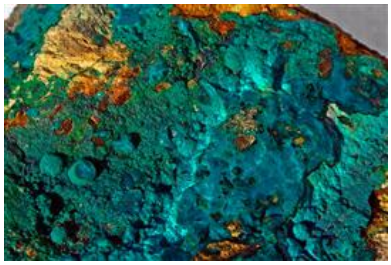
The Greeks inherited the range of colorants from the Egyptians but soon started to explore natural substances not known to or used by the Egyptians. To the natural pigments they learned from the Egyptians the Greeks added sepia, gold and crysocolla.

Sepia is a transparent dark brown colorant. It was obtained from the octopus found in the Adriatic and Mediterranean seas. The octopus squirts dark ink as a defensive measure. The ink sacs were removed from these creatures after they had been caught by fishermen and this ink could be used directly as a watercolor or fresco paint. If the ink sacs were dried and ground up they could be used as a pigment to make paint.

Gold was used by the Greeks to adorn their statues and temples but was also ground up and used as a pigment—a very precious one!

Crysocolla is a natural green copper mineral found in Syria and Israel. It was used by the Greeks as an adhesive for gold as well as

functioning as a pigment. The name crysocolla literally means "gold glue" in Greek. Like green earth, it's a mixture of iron, magnesium, aluminum and potassium salts.



In addition to these new natural pigments the Greeks introduced white lead, red lead, yellow lead, verdigris and red vermilion pigments, all of which they manufactured. How they developed some of the preparation processes is not known, but given the complexity of these processes it must have taken quite a bit of trial and error to come up with them.

White lead is lead carbonate and works much better as a white pigment than chalk or crushed bones; it's still used in oil painting. It's made by putting strips of lead in clay pots hanging above vinegar. The pots are sealed up in a small enclosure packed with animal dung between them. After about three months the acetic acid, oxygen and carbon dioxide ferment the dung and form white lead carbonate on the surface of the lead strips. The white lead is scraped off and the pigment then ground to a powder. White lead is a popular pigment even today.

Red lead (lead tetroxide, also called *minium*) and yellow lead (also called *massicot* or *litharge*), were produced by stirring molten lead for several hours so a yellowish-grey powder formed on the surface. This was ground up and washed in water to separate the yellow massicot from metallic lead. Massicot is not a very good pigment and is best used as an intermediate product to manufacture red lead. A second stage of work similar to the first is used to create red lead, except that temperature control is more critical. The pigment red lead can be a darkish, dull red or a brighter red orange. It is a very durable colorant and was long used as a protective coating for exposed iron and steel.

Verdigris ("green of Greece") is a transparent blue-green pigment prepared by the Greeks from copper and wine vinegar. It was manufactured by pouring sour red wine into a pot and placing copper plates onto a grill above the wine, then sealing up the pot for a week. When the copper plates were removed they were sprinkled with wine vinegar and pressed under weights for several weeks. Green matter formed on the surface of the copper; this was scraped off, dried, and used as pigment. Verdigris gets its color from copper acetate, which is highly toxic. Verdigris is also highly reactive in air and ages to dark brown or black.

Vermilion is the naturally occurring mineral cinnabar ground into a fine powder. It's a bright red color. It could also be manufactured by heating liquid mercury and sulfur to form mercury sulfide, which was then ground up. Vermilion made in this way was initially black but turned red as it was ground. Because of its mercury content, cinnabar can be toxic. It was dangerous to those who mined cinnabar; mercury poisoning caused shaking, loss of balance, dementia, and ultimately death.

Rome

The great achievements of the Romans are in the fields of civil engineering and architecture, such as the use of the arch to construct monumental aqueducts and structures like the coliseum. The Romans were not particularly noted for their artistic achievements but were fond of Greek art and frequently commissioned copies of Greek sculptures.

Art was used in a decorative manner in Roman times as archaeological evidence from Pompeii attests. Many of the wall decorations in homes and buildings in Pompei were preserved for almost 2,000 years by the accumulations of ash that rained on the city from Mt. Vesuvius in 79 AD. These reflect the use of the types of pigments used by the Greeks, from whom the Romans borrowed heavily. Here too, even toxic pigments such as cinnabar and orpiment were used since they were the only colorants available to produce brilliant reds and yellows, still vibrant after two thousand years on the interior walls of structures excavated in Pompeii.

Much Roman art was focused on propaganda. The military campaigns and conquests of the emperors were recorded in carvings to serve as "broadcast" mechanisms of the day. Roman commemorative arches were decorated with carved images of victories, the parading of captured enemies as slaves, and bringing home the booty of victorious campaigns.

Roman sculptures and coins show the actual appearance the emperors. These portray real people rather than images of anatomical perfection, for a very practical reason: Roman emperors wanted to be recognized by the people they ruled!

Two busts and a coin of emperor Claudius (AD 41-54)

Coins of three different emperors

The Pitsa panels: early Greek painting[1]

Very few ancient Greek paintings survive since the paints have deteriorated and the wood on which the paint was applied has decayed. The four painted panels here are a group of painted wooden tablets found near Pitsa, Corinthia in the 1930s. They can be dated to about 540-530 BC. They were probably preserved due to the unusually dry conditions inside the cave in which they were found. Read pages 626-37 of ***The Story of Art*** for an update on art of this era.

The Pitsa panels are thin wooden boards covered with stucco (plaster) to form a surface on which to paint. Since the plaster was allowed to dry before paints were applied these are not frescos but actual paintings. The artists used pigments made from naturally occurring minerals and most likely a binder made egg yolk to form the paint. Only eight colors (black, white, blue, red, green, yellow, purple and brown) are used; they are bright with no shading or gradation.

Most ancient paintings that survived from this early a time are either frescoes (pigment applied to wet plaster) or vase paintings (painted in glaze on pottery and fired). According to ancient Greek authors panels such as this were the most respected form of Greek art. The subjects were often portraits and still-lifes (inanimate objects arranged specifically so that an image of them could be painted). These types of paintings were collected and often displayed in public spaces. The ancient author Pausanias describes such exhibitions at Athens and Delphi. From ancient literature we know the names of many famous painters but not one example of this type of high-quality panel painting has survived. Unfortunately the Pitsa panels are not good examples—they are thought to be low-quality renditions of this form of Greek art.

These tablets are connected with the rural cult of the nymphs (Greek goddesses). This is a religious scene: a sacrifice. Two women are approaching an altar accompanied by musicians playing the lyra and aulos (flute). The woman nearest the altar is pouring a liquid offering. A small figure behind her is most likely a slave leading an animal to be sacrificed. The ancient inscription names two woman, Euthydika and Eucholis, the people who paid to have it created.

[1] From `http://en.wikipedia.org/wiki/Pitsa_panels` and heavily edited by Jim Janossy

On constructing an ancient personality

An extract from a writing by Ben Witherington III[1]

…our own modern way of thinking about the relationship of the body and the mind, or the body and the spirit/soul, have largely arisen out of Cartestian ways of thinking.[2] Rene Descartes distinguished pointedly between mind, the nonphysical realm and the supernatural on the one hand and body, material existence and the natural on the other.[3] For Descartes the "I," or the sense of human identity, could be identified with the mind or soul: "I think, therefore I am."

In such a worldview the body can neatly be distinguished from the mind as simply a physical nature, a house of the soul. There is no essential connection or relationship of substance between body and mind, or body and soul, or body and spirit. "On the one side were body, matter, nature, and the physical; on the other were soul or mind, non-matter, the supernatural, and the spirit or the psychological.[4] **Whatever we may think or say about this dichotomy, such a dichotomized approach has affected and continues to affect modern ways of thinking about human life and personality, and also about the way God works in a mechanistic natural universe.**[5] To be sure, there has been some quite proper reaction to this mode of thinking in modern medical discussions of humans as psychosomatic wholes and in explorations of holistic medicine. But we still remain deeply influenced by the Cartesian model and it prevents us from hearing ancient texts and ideas about the body and the human person as we should—for Cartesian ways of thinking would have been quite foreign to the ancients.

Martin suggests that the ancients saw the human body as **hierarchically** arranged, in a sense a microcosm of the hierarchically arranged society of the times. In fact, he says, "the hierarchical concept of the body… supports and maintains the power structure of Greco-Roman society."[6] Within the bodily hierarchy there were various dimensions or parts.

The Greeks and Romans did make a distinction between body and soul, but there was considerable discussion about the nature of "soul." Aristotle, like many others, assumed that the soul was a part of nature. From his point of view nature included everything, from the mind or soul to what we would call biology and physics.[7] Aristotle quotes a number of other authors on the nature of the soul. Democritus says it is fire and heat, Pythagoreans that it is identical with the particles of the air, Leucippus that it is constructed of highly mobile spherical atoms. In other words, while the soul might not have a form and might not be visible it did have substance and so was a part of nature. Earth, air, fire and water were assumed to be the elements of which all nature was composed. … Matter and spirit were not seen as opposites.

Furthermore, it was widely believed that the human body is a microcosm of the universe itself. Remember, it was assumed that the human body was made up of the same

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1 Ben Witherington III, ***The Paul Quest: The Renewed Search for the Jew of Tarsus***, p.p. 35-38.
2 Dale B. Martin, ***The Corinthian Body***, pp. 4-20.
3 Descartes: French philosopher, 1596-1650. A generally well-known version of dualism is attributed to René Descartes (1641), which holds that the mind is a nonphysical substance. Descartes was the first to clearly identify the mind with consciousness and self-awareness and to distinguish this from the brain, which was the seat of intelligence.
4 Martin, p. 6.
5 Consider Webster's dictionary definition of a miracle as "something that violates or interrupts nature or known natural laws."
6 Martin, p. xviii.
7 Aristotle, ***On the Soul***, 1.1. 402a

elements or materials as the universe itself—earth, air, fire, and water. It was assumed that conditions in the macrocosm (the environment) affect conditions in the microcosm (the body). The same violent wind that uproots trees could also cause apoplexy if it occurred within an individual.[8] The boundaries between individual and world became rather blurred, such that "the workings of the internal body are not just an imitation of the mechanics of the universe; rather they are a part of it, constantly influenced by it."[9]

The state of the soul was believed to be affected by the condition of one's blood, and both were linked to the appearance of the body. Blood was thought to be either hot or cold, thick or thin, moist or dry, swift or slow, and these characteristics affected not only the physiology of the soul but also a person's behavior and appearance. If a person was hot-blooded he might be quick to anger. The ancient physician Galen put it this way: "For if very much heat dominates, straightaway there is bitter anger and madness and rashness."[10] In this view "the faculties of the mind follow the mixtures of the body".[11]

From such reasoning we can easily see why ancient persons might believe that one's outward appearance mirrors one's soul. The modern clear boundary between the psychological and the physiological, the inner and outer person, was by no means so clear-cut in antiquity. The boundary was thought to be quite porous, if it existed at all, with influence going in both directions, from inner to outer and outer to inner.[12] The isolated individual did not really exist because of the ongoing interchange between an individual's body and soul with the outside forces and world. The self was shaped by outside forces, material as well as social. People were thought to take in "spirit" (*pneuma*) when inhaling; they needed air for nourishment.[13] "The outside air (which either is or contains pneuma) sustains the inner pneuma by inhalation… The body is a refinery for processing, among other things, pneuma.[14] This inhaled pneuma was considered by Galen as the basic stuff from which came thought, rationality and sensation.[15] It was believed to be susceptible to pollution and corruption, as we speak of air being polluted.

Not only was there an interaction between the inner and outer person, the inner and outer world, but a hierarchical ordering was assumed to exist in the universe, in society, and in the human body. God ruled the universe as the emperor ruled society and the mind or soul ruled the body.

An important thought to gain from this discussion is that in ancient times people did not think in the same way that we as modern people do. Their conception of how people related to their environment and how the environment affected people was far different from ours. This affected the way they looked at everything, including the art that they created. "Artists" as we know them today did not exist; art was not created to "express" the view of the person creating it, or for aesthetic enjoyment, but to serve a specific purpose in the hierarchical ordering of society and the universe. Think about who defined the purpose of art in a given society…

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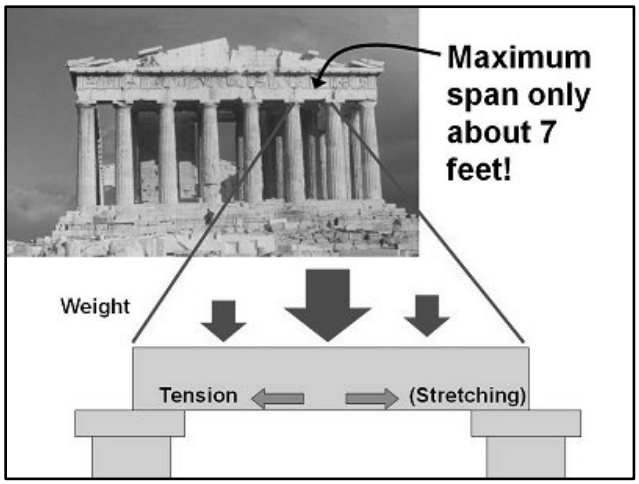
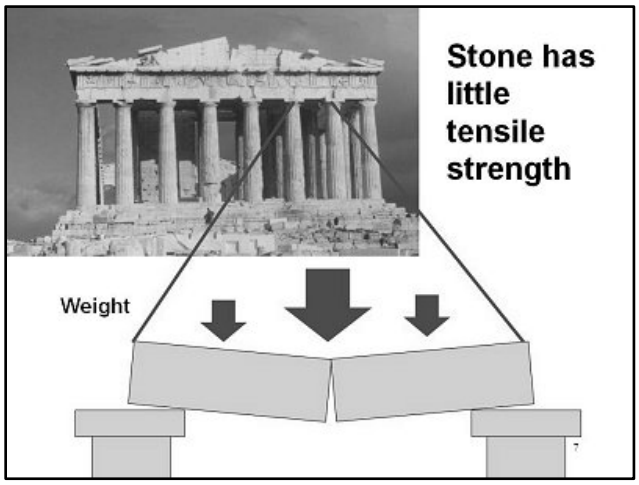
[8] Hippocrates, ***The Nature of Humankind, Breaths,*** 3, p. 13.
[9] Martin, p. 17.
[10] Galen, ***Ars Medica*** 10.
[11] Ibid., 4.767-822.
[12] Martin., p. 20.
[13] Dio Chrysostom, ***Discourse***, 12.30.
[14] Martin, p. 22.
[15] Galen, ***Hygiene***, 1.4, 11.

Building with stone: problem and solution

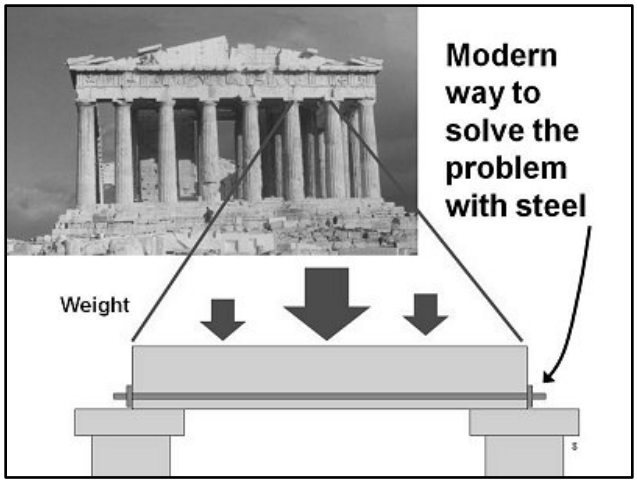
The most common material for building important structures in ancient times was stone, quarried from natural deposits such as outcroppings of rock in Egypt, Europe, and other places in the world. Stone was used by Egyptians to construct the pyramids by piling up blocks into a mountain shape. It was cut into interlocking parts by the Greeks to build their temples, such as the Parthenon on the hill named the Acropolis.



But there was a problem using stone. It's not possible to span a large distance with a stone beam. Stone has great "compressive" strength but it does not have great "tensile" strength. You can try to compress it and it won't crush, but you can't try to stretch it much or it breaks. This limited the span between the columns of a Greek temple to about 7 feet. Making the stone beam wider and thicker doesn't help much because the added weight of the stone still puts too great a tension on the bottom of the beam, cracking it as you see in the second illustration.



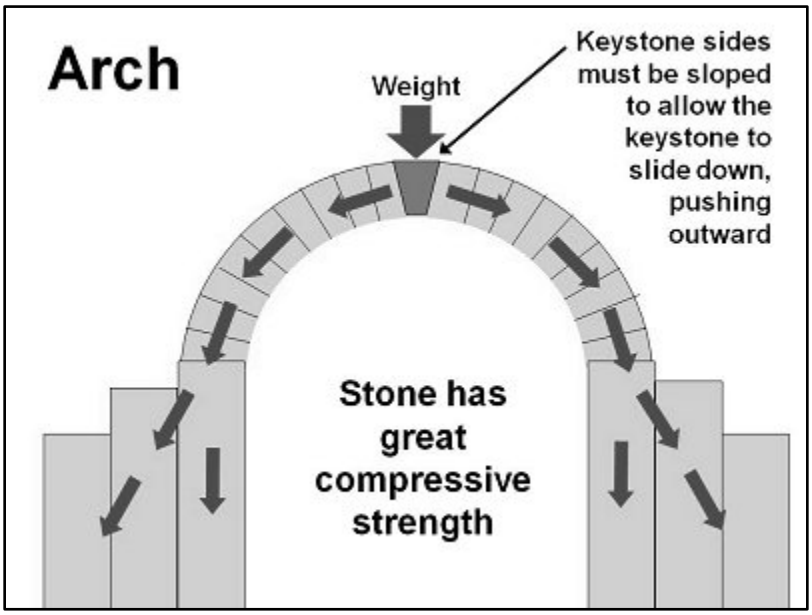
In modern construction concrete is used much like stone. It can be molded in the form of long beams and it "sets" to stone as a result of a chemical reaction. Beams of 50 or more feet in length can be constructed because we now have the technology to make large quantities of steel reinforcing rods or cables. Steel does have great tensile strength and is used to overcome the weakness of stone in regard to tension.



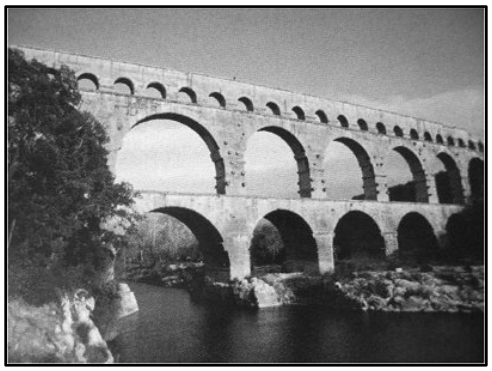
Steel reinforcing is included in the lower part of the concrete beam to resist the stretching forces that the slight"flexing" of the beam causes. In the case of "pre-stressed" concrete beams often used in modern parking garage construction, the concrete is formed with hollow conduits along the bottom edge in which steel cables are strung. The cables are tightened to give the concrete beam a slightly arched shape that flexes down into a level surface under the weight of the load. The modern solution for an ancient problem!

The ancient solution for the problem of stone

The Sumerians invented the arch and used it to span openings in brick and stone walls. The Greeks knew about the arch but did not make much use of it. Neither the Greeks (or the Romans) had the technology to make large amounts of steel of consistent quality—this takes iron, carbon, and continuous high heat and the ability to control the carbon content of the result. The Greeks therefore exploited the temple architectural form and refined it. The Romans, however, were preeminent civil engineers. They constructed massive public works projects such as aqueducts to bring water to Rome and other cities and massive structures like the coliseum. The Romans perfected the use of the arch for these purposes.



The arch cleverly exploits the compressive strength of stone. Individual stones are cut in the form of trapezoids. A temporary support called “falsework” is constructed from wood in the shape of the intended circular opening. Masses of weight are placed on each site of the intended opening, and the stones are built up on the falsework on both side of the arch. The last step is to set in place the keystone, the stone at the top of the arch. When this stone is in place, gravity pulls it down, which exerts force on the stones on each side. The weight of the keystone, and the weight of any wall built above the arch, is channeled to the side masses and the ground.

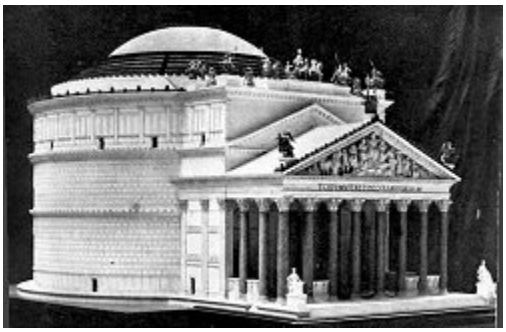


The Romans realized that the role of the side masses could be assumed by another arch since the weight it was channeling around the opening acted in opposition to the forces on the first arch. Arches could be repeated as much as was necessary to go any require distance. They used this technology to build aqueducts many miles long. While a solid wall could have been used in many places, the arch also reduced the amount of stone needed.

Once you understand how an aqueduct built with arches works, it’s easy to understand how the coliseum works. It’s really the very same arch wall, wrapped around in a large circle! Here is what the coliseum in Rome looked like about AD 100. Roman arches are round, they are half-circles. The Romans refined their use of the arch to create large, structurally complex domed buildings.

The Pantheon in Rome: dome construction

The Pantheon is one of the oldest buildings of the Roman Empire still standing and in use; anyone can walk in to it free of charge. Constructed at the height of Roman power about AD 126, it was intended to be a monument to all the Roman gods, including the emperors. In 609, the Byzantine emperor Phocas gave the building to Pope Boniface IV, who converted it into a Christian church and consecrated it to Sancta Maria ad Martyres, now known as ***Santa Maria dei Martiri***, Saint Mary and the Martyrs. The building's consecration as a church saved it from the abandonment and the worst of the spoliation that befell the majority of ancient Rome's buildings during the early medieval period. Even so, parts were removed since ancient time for use elsewhere. The original bronze tiles were removed and sent to decorate buildings in Constantinople, much fine external marble has been removed over the centuries, and Pope Urban tore away the bronze ceiling of the portico in about 1640, to be melted down into defensive cannon for the nearby Fort San Angelo. Since the Renaissance the Pantheon has been used as a tomb. The artist Rafael is entombed there.

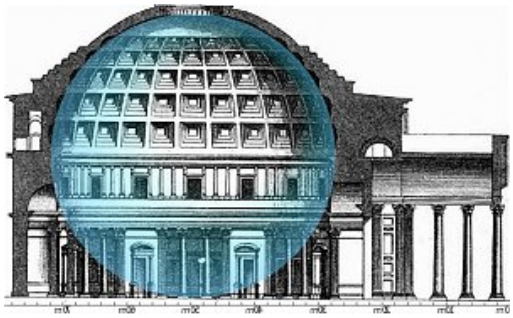


Construction

It took 732 construction workers over 3 years to construct the Pantheon. The grey granite columns that were used in the Pantheon's porch were quarried in Egypt. Each is 39 feet tall, five feet in diameter, and 60 tons in weight. These were dragged more than 100 km from the quarry to the river on wooden sledges. They were floated by barge down the Nile River and then transferred to vessels to cross the Mediterranean Sea to the Roman port of Ostia. There, they were transferred back onto barges and pulled up the Tiber River to Rome.

The recessed shapes for the concrete dome were poured in molds, probably on the temporary scaffolding. The concrete dome of the Pantheon weighs over 4500 tons! The thickness of the dome varies from 21 feet at the base of the dome to 3.9 feet around the oculus.

The height to the oculus and the diameter of the interior circle are the same, 142 feet, so the whole interior could house a sphere 142 feet in diameter. These dimensions make more sense when expressed in ancient Roman units of measurement: The dome spans 150 Roman feet; the oculus is 30 Roman feet in diameter; the doorway is 40 Roman feet high. The Pantheon is still the world's largest unreinforced concrete dome.



Simple geometry, perfect solids, Golden Mean

Why take a look at geometry in considering the technology of art? Much of the art that we study in the ancient world, the Middle Ages, and even into later periods relies on the use of geometric forms and operations. The Greeks made much use of complicated geometry in constructing temple, and very simple tools were fashioned from material as basic as rope to aid in building.

Basic definitions

A **point** is a place in space. It is an imaginary construct that has no dimensions. You can think of it more as a location than a physical thing.

A **line** is a connection between two different points. A line has only one dimension, its length. A line has no width or height. One way to think about a line is to imagine it as a rope connecting two points, except that in this case the rope has no "thickness." Another way to think about a line is to picture it as what you would see if a luminous point moved between two other fixed points.

A **plane** is what you get if you "sweep" a line through space. If you do this in such as way as to use only two dimensions, you define a flat surface. A plane has only two dimensions: length and width. A plane has no thickness any more than a line has thickness. You can think about it as a flat sheet of paper, but as a theoretical concept a plane has no bound like a cut sheet of paper does—the plane extends outward in its two dimensions as far as the universe goes.

We live in a world in which we experience **three dimensions**, commonly thought of as **length**, **width**, and **depth**. As humans we are biologically and neurologically "wired" to sense our surroundings in these terms. We have two eyes and a brain that "triangulates" the observations of our two eyes. The brain integrates the slightly differing observations of the two eyes into a visualization of three-dimension space. This lets us move through three-space with a visual sense of distance, or **depth perception**.

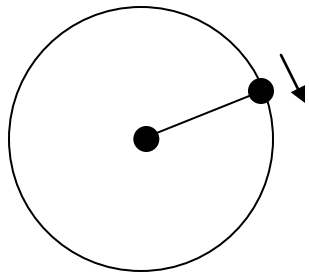
A **shape** is a collection of points connected with lines. For example, three points not on the same line can be connected with three lines, forming a triangle. One point swept around another point so as to remain in the same plane and always the same distance from the other point maps our a circle. Four equally space points on a circle when connected map out a square.

A **solid** is mapped if you move a two-dimension shape through three-dimension space. If the shape was a square, the movement of it in a third dimension for a distance equal to the length of a side of the square can define a cube. There are other ways to construct solids. For example, if a point exists above a circle and a line is drawn from that point to the circle and then rotated following the circle, the moving line maps out a cone. Solids are also known as **polyhedra**. There is a set of five solids that were long ago discovered to be the most basic solids possible, named **Platonic Solids**, also called the **Perfect Solids**.

The perfect solids raised a lot of questions in the minds of the ancients. Why were there only 5? Did this imply that the gods had some special favor or give significance to this number? Were the shapes of the triangle and the pentagon of some special significance? Since the ancients thought that everything was made of four elements: air, earth, water, fire, and the heavens was the number 5 a guide to that "truth?" These questions became even more interesting when connections were established between the pentagon and the golden section (golden mean) which we'll consider a bit later.

The circle

A **circle** is defined by rotating one point about another point, keeping the moving point in the same plane and the same distance from the other point as it is rotated:



This is exactly what you do when you use a drawing compass with a point on one end and a pencil on the other to draw a circle. You can create a circle using any type of material for the line connecting the fixed point (the point at the center of the circle) to the point you are sweeping around the center. In ancient times, people used rope for this line, attached to a stake at the center. The monuments and stones at Stonehenge were most likely laid out in this way.

The **radius** of a circle is the length of the line from its center to the curved line forming the circle itself. The **diameter** is twice the radius, that is, the line continued to the opposite side of the circle. The **circumference** of the circle is the length of line that forms the circle (the curved line). The length of the circumference in relationship to the radius has often been regarded as mysterious, especially by ancient peoples. The circumference is related to the length of the radius by this formula ("x" here is the multiplication sign):

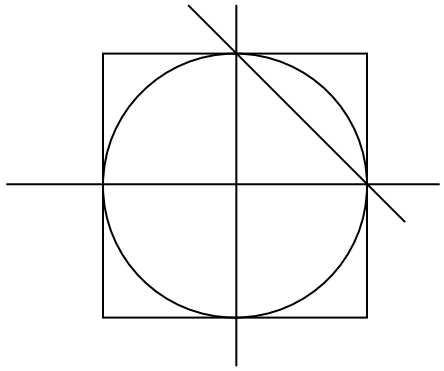
circumference = 2 x radius x pi

Pi is a number that can be computed in a variety of ways, but can only be represented (in base 10 numbers) by a series of digits that begin with 3.14 and go on forever. For example, here is pi to 50 decimal places:

3141592653589793238462643383279502884197169399375 10…

Pi is roughly approximated by the fraction 22/7, a fact some ancient people determined and used to lay out and construct circular structures. 256/81 is another approximation of ancient Egypt.

The area of a circle is also related to pi. Suppose you drew four squares to cover the circle, each with a side the same length as the radius:



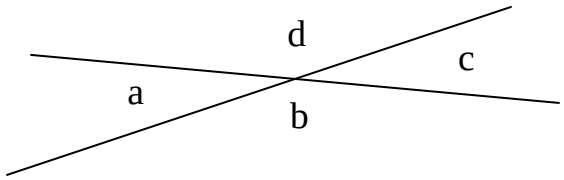
The area of each of these four squares would be:

radius x radius

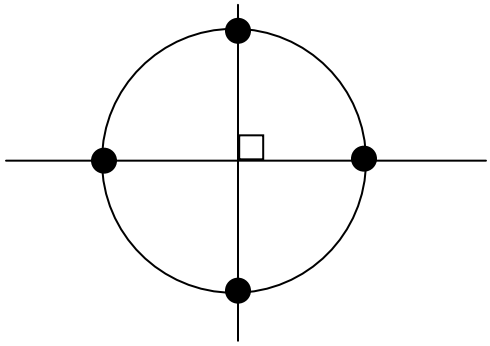
and since we have four squares the area of the square surrounding the circle would be 4 x radius x radius, which we could also write as 4 x radius^2 since the superscript 2 means "squared" (that is, multiplied by itself). The area of the circle is clearly less than this area. In looking at the area of just one-quarter of the circle, you can see that this area is more than half the area of the square with length radius, and less than whole area of the square's area, which is radius x radius. This is especially clear if you cut one of the radius x radius squares in half diagonally. It turns out that the area of the circle is pi x radius x radius, that is, pi x radius^2. The mystery deepens…

Angles

Four **angles** are formed when two lines intersect:



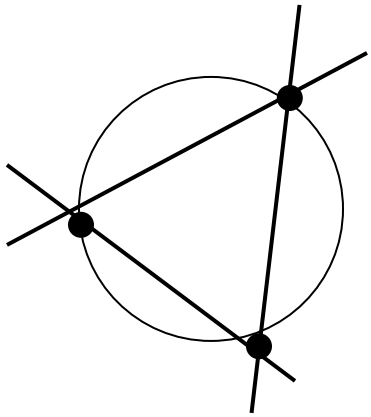
In this example two lines intersect; in doing so they have exactly one point in common. The four angles a, b, c, and d are formed. Angles a and c are equal, and angles b and d are equal. Angles are commonly measured in degrees. The sum of the angles a, b, c, and d is 360 degrees. This is an important definition, because it tells us that all of the angles surrounding a point (or a circle) add up to 360 degrees. If we have a circle and place four points on its circumference as far apart as they can be from each other, they will space out evenly around the circle:



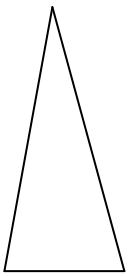
Now if we join the opposite points together, we have split the circle into four equal parts, and we have split the 360 degrees around the point at the center of the circle into four equal parts. 360 divided by 4 is 90 degrees. 90 degrees is called a **right angle,** which is usually denoted with a small box at the angle. A right angle is one corner of a square; a square encloses four of them.

Geometric shapes

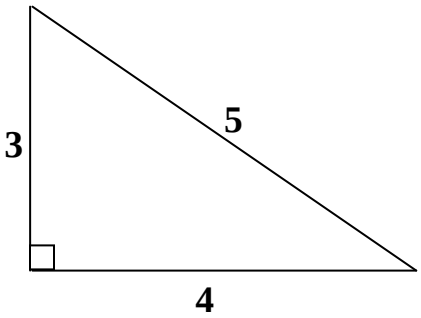
Plane (flat) shapes can be defined using a circle with points on the circumference. For example, if we place three points on the circumference of a circle, such that they are each as far apart from each other as possible, we can then connect the points to form an equilateral triangle:



All sides of the **equilateral triangle** are of equal length. It's possible to construct triangles in which the sides of not of equal length. If only two sides are of equal length, the shape is called an isosceles triangle:



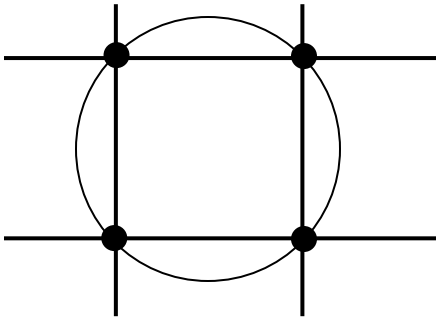
A **right triangle** has the property of having one of two of its sides forming a 90 degree angle. While an infinite number configurations of right triangles exist, a special relationship documented on a Babylonian tablet dated to 1900-1600 BCE, and described by Pythagoras (560-480 BCE) lets us construct a right triangle very easily. If we use lines of length 3, 4, and 5 to form a triangle, the angle between the sides of length 3 and 4 will be a right angle. The Egyptians used this to construct a tool named a "square" to aid in constructing things precisely vertical:



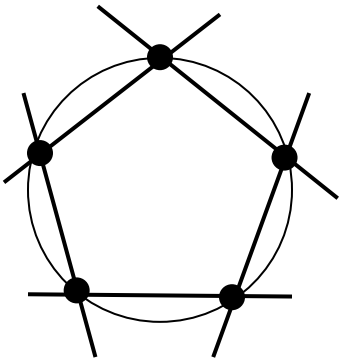
Why is this important? If you want to construct something that is square, you need to be able to compare what you are building to a right angle—hence the name of this masonry tool, the square. Similarly, unless you want a structure (like a wall or tower) to lean and become unstable,

you need to construct it precisely vertical in relationship to the center of the earth. To do this you need to know what 90 degrees is, and you need to know what “level” is. But level that isn’t hard to figure out. The surface of any still pond of water or bowl of water is level.

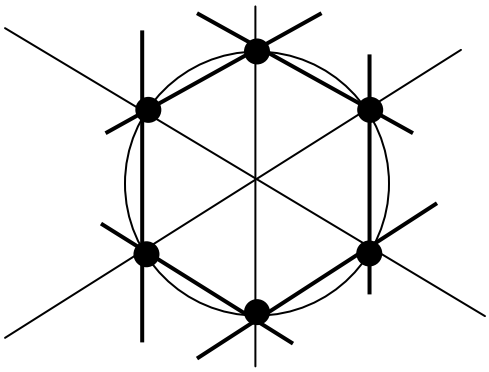
If we have a circle and place four points on its circumference as far apart as they can be from each other, they will space out evenly around the circle. If we connect the four points with straight lines the result will form a **square**. Each side of the square will be of the same length, and each corner of the square will have a 90 degree angle:



If we have a circle and place five points on its circumference as far apart as they can be from each other, they will space out evenly around the circle. If we connect the points we will form a **pentagon**:



If we have a circle and place six points on its circumference as far apart as they can be from each other, they will space out evenly around the circle. If we connect the points we will form a **hexagon**:



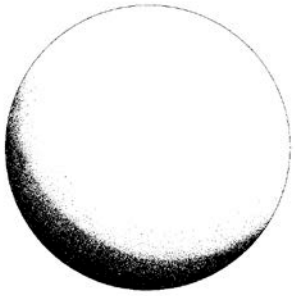
The perfect (Platonic) solids

Solids are three dimensional objects. It was discovered in ancient times that only a small set of "perfect" solids exists. These are named the **Platonic solids** so named because they were first documented by Plato in his work *Timeaus* between 427 BCE and 347 BCE. Euclid documented a proof for their uniqueness between 325 BCE and 265 BCE. Ancient peoples thought these solids had a sacred significance. **Only five exist or can exist!**

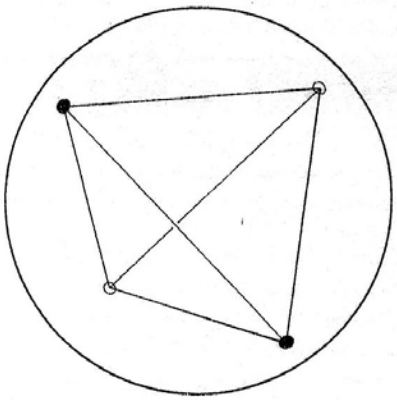
The five Platonic solids (and only these) meet these rules, which make them "perfect"—and which seemed to give the number “5” special significance:

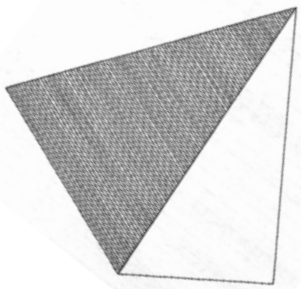
1. They look the same from any corner point.
2. For a given solid, each face is of the same shape and size.
3. Every edge and every angle is identical.
4. Their corner points are the most symmetrical distributions of 4, 6, 8, 12 and 20 points on a sphere.

Just as the basic shapes are derived from a circle, we start with a 3D circle to form the solids, that is, we start with a sphere. This is a circle that has been completely rotated about an axis, just like a globe of the earth. A sphere is "perfect." Every point on it lies exactly the same distance from the center. It's surface is the smallest area that can be formed to enclose a given volume. This is why a droplet of liquid released in outer space naturally forms a sphere; the surface tension forces the most compact enclosure for a given volume.



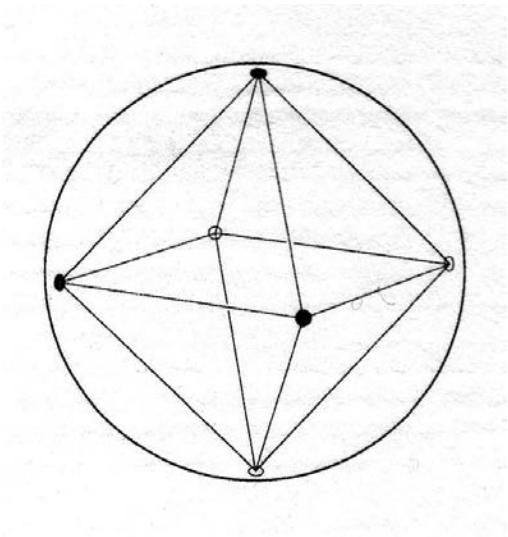
If we put 4 points on the surface of sphere, each as far apart from each other as possible, we get a **tetrahedron**:

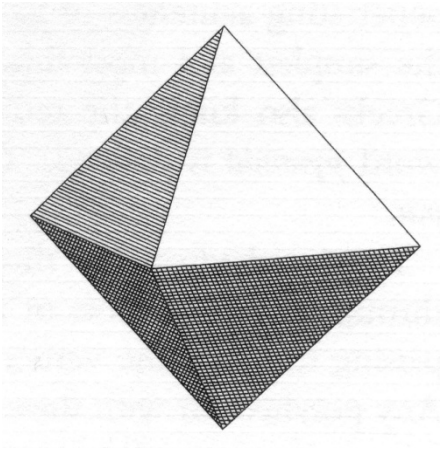




The ancients thought that four elements made up world: fire, earth, air, and water. They associated each with one of the perfect solids. Plato associated the tetrahedron with fire. While a tetrahedron resembles a pyramid (Greek *pur* means fire, and the Greeks also call the tetrahedron *puramis*, from which we get the word pyramid), an Egyptian pyramid has a base that is square. All faces of a tetrahedron are equilateral triangles, even the “bottom” so it is **not** a pyramid!

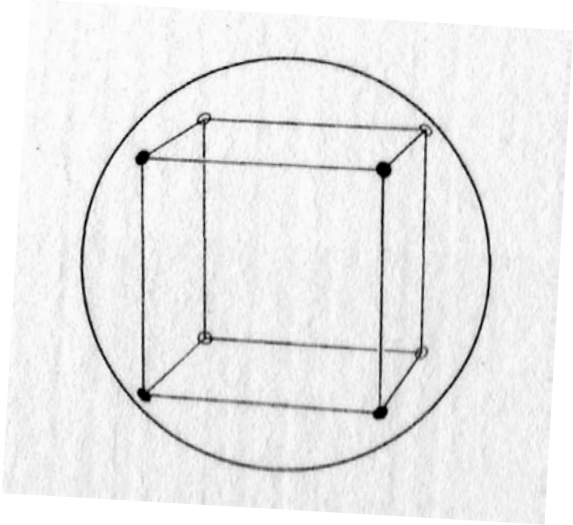
If we put 6 points on the surface of sphere, each as far apart from each other as possible, we get an **octahedron**:

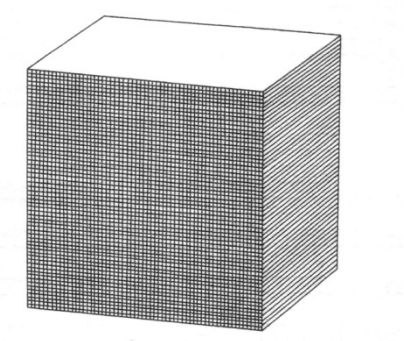




An octahedron has 8 faces. The top half of it is a pyramid. Octahedrons, like the other perfect solids, are found in minerals. Diamonds, for example, are often in this shape. Plato associated the octahedron with air.

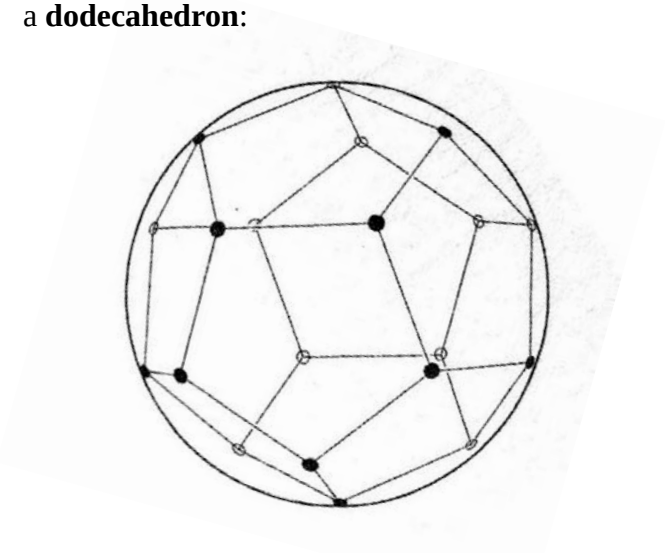
If we put 8 points on the surface of sphere, each as far apart from each other as possible, we get a **cube**:

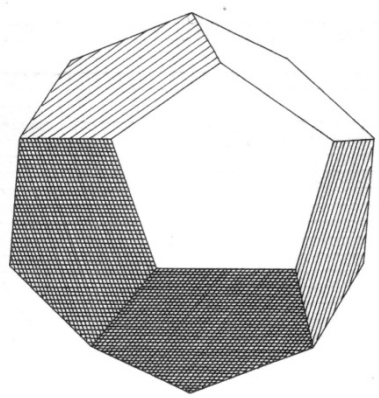




The cube was associated by Plato with earth, since its square base represents ultimate stability. But the cube has several qualities that the ancients regarded as indicative of a special significance. It has six "directions": north, south, east, west, up, and down. Numerology (attributing significance to various numbers) was important in the lives of some ancients, and 6 is the first "perfect" number since its factors 1, 2, and 3 all add up to the number itself. If you add up the number of the cube's edges (12), face diagonals (12), and internal diagonals (4) you get 28, which is the second perfect number (1 + 2 + 4 + 7 + 14 = 28). Various biblical and religious references to cubes are perhaps based on this special significance. Many molecular structures such as salt crystals and the arrangement of molecules follow a cube structure.

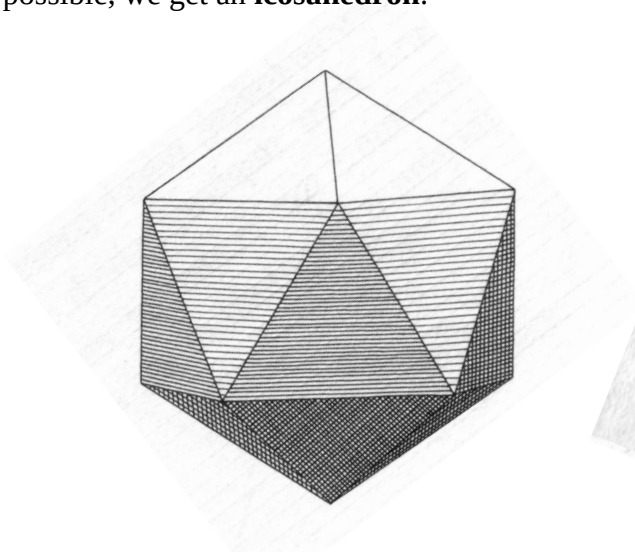
If we put 20 points on the surface of sphere, each as far apart from each other as possible, we get a **dodecahedron**:

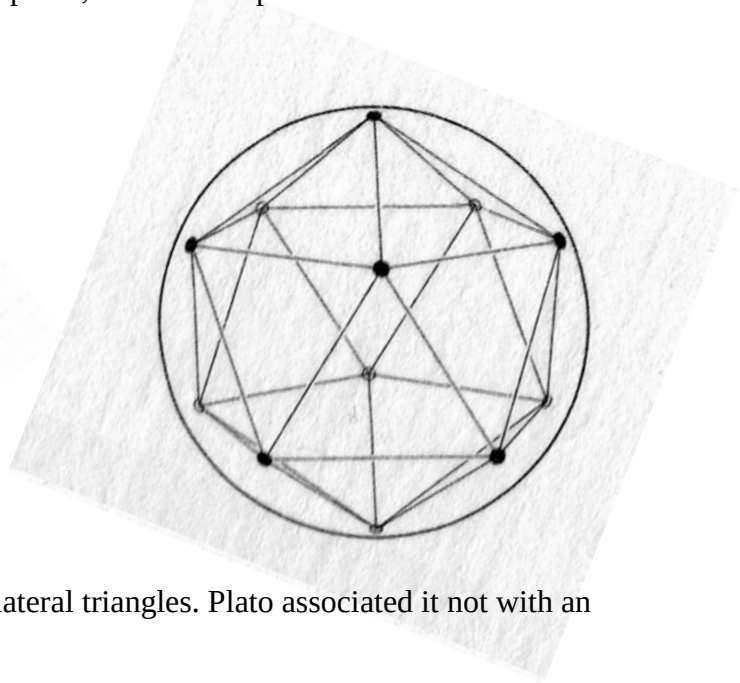




The dodecahedron has 12 faces which are pentagons, five-sided shapes. It was known as "the sphere of twelve pentagons." Three of the four elements recognized by the ancients were fluid: fire, air, and water. Water is the densest of the fluid elements, and Plato associated the dodecahedron with water. If you join the two ends of any edge of the dodecahedron to the center you form an isosceles triangle. As Daud Sutton notes in ***Platonic & Archimedean Solids*** (from which much of this discussion of the perfect solids is drawn) this isosceles triangle has the same proportions as the four faces of the Great Pyramid of Eqypt. Is this mysterious? Probably not. The Egyptians, as did many other ancient peoples, knew about these solids and attributed significance to many aspects of them. Since they felt that God (or the Gods) had created these solids, the solids could be use for guidance on how to conduct life and build structures that honored their deities.

Finally, if we put 12 points on the surface of sphere, each as far apart from each other as possible, we get an **icosahedron**:





The icosahedron has 20 faces which are equilateral triangles. Plato associated it not with an earthly element but with the stars.

Exploring the perfect solids

Tetrahedron
4 sides
*Is **not** a pyramid!*

Hexahedron
6 sides
A "cube"

Octahedron
8 sides
half is a pyramid

Dodecahedron
12 sides

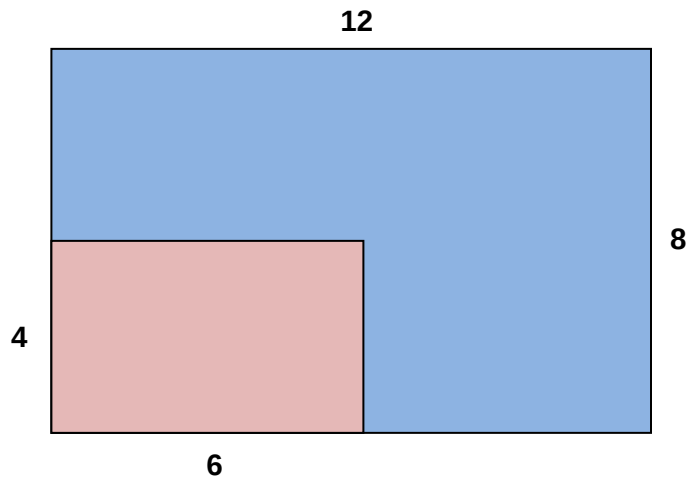
Icosahedron
20 sides

Visualizing the perfect solids is easier if you can play with a 3-dimensional representation. Before doing part 1 of Project 1, visit the link for this page at the course web site where you can rotate and play with these sophisticated graphic representations!

The Golden Mean and the Golden Rectangle

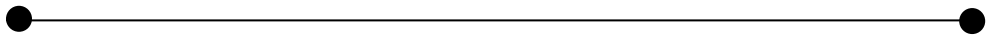
A proportion is the relationship of two things with each other. For example, in a 4" x 6" photograph, the height is 4 inches and the length 6 inches (for a "landscape" orientation). The proportion is 4/6. If we enlarge the photo to an 8" x 12" size, the height and length are still in the same proportion.

These are NOT Golden Rectangles! Why? Their width and height are not in the ratio of the Golden Mean. 12/8 = 1.5, as does 6/4. For the larger of these rectangles to be a Golden Rectangle, with a width of 12 the height would have to be .618 x 12 = 7.4 inches (approximately). Why? ***See below!***

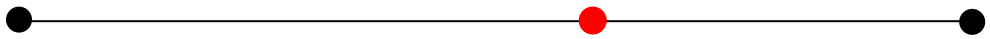


On the other hand, we can't enlarge a 4" x 6" to an 8" x 10" photo because they are not in the same proportion. The dashed line above shows you what would happen if you did this. Simply put, the "shape" of an 8 x 10 is not the same shape as a 4 x 6. (This is currently causing a lot of dismay as people fond of 4 x 6 snapshot prints make enlargements in the common 8 x 10 size!)

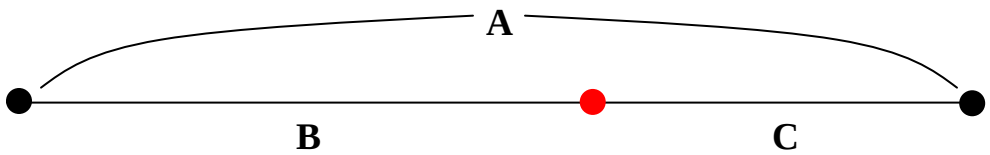
Now here is a puzzle the ancients were fond of: "Take a line. Divide it into two unequal parts such that the longer of the two segments is to the shorter as the whole line is to the longer segment." Whoa! How about saying that in plain words? Let's do it graphically. Here is a line:



Cut it into two by putting a red dividing point somewhere on it:



Now let's label the whole line and each segment so we can talk about these easily:

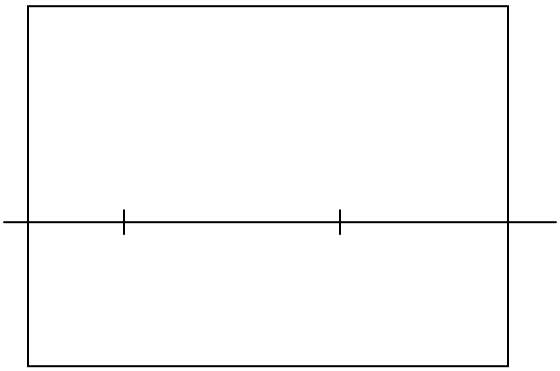


Place the dividing point so that A is B equals B to C, that is A/B = B/C. This can be done only in one way: where the length of C is .618 (approximately) that of B. To put it another way, if the line as a whole (A) is 1.618 inches long, the red dividing point is where B is one inch long, and C is .618 inches long. **Does 1.618/1 = 1/.618 (very nearly)? Not exactly, because the Golden Mean is an irrational number, a never-ending decimal number. But it defines a very pleasing shape!**

Creating a Golden Rectangle with geometry

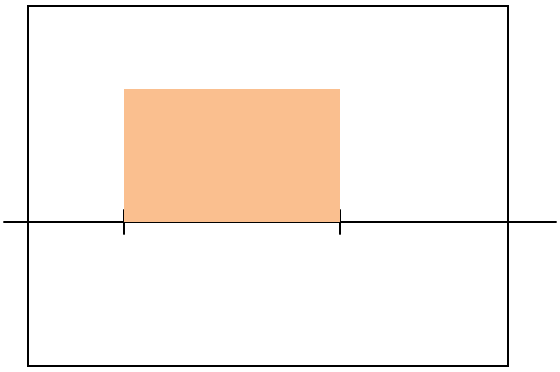
The golden rectangle involves the use of the golden mean. In such a rectangle the long side is divided into segments with the golden mean dividing them. Then the longer of the two segments is used as the width of the rectangle. By following these steps you'll construct a golden rectangle using only a compass and a straightedge—you cannot measure things because the ancients would not have had used measurements for this process. This construction is covered in one of the videos associated with this unit. That video implements the following sequence of actions:

1. Using a straightedge draw a line on a piece of manila folder similar in orientation to this illustration:



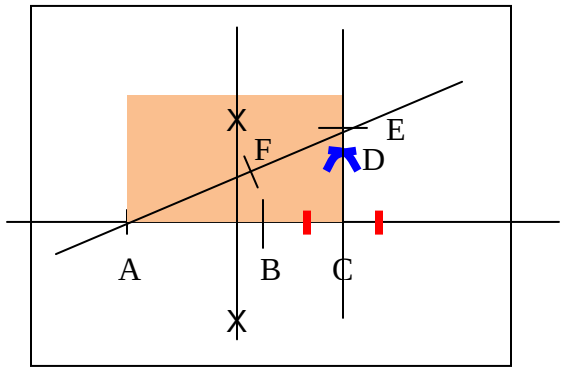
2. Carefully mark off a 16.2 cm. section of the line putting two marks separated by this distance on the line as shown.

3. Your goal is to construct a golden rectangle like the shaded area in this illustration. How do you accomplish this? You need to follow the instructions below. This is not intended to be a sketch! It is intended to be a very precisely detailed and accurately constructed golden rectangle, developed using your compass and straight edge.



4. Using the straightedge, mark points an equal distance from point C on the horizontal line. Construct a perpendicular line at C by striking arcs with a compass so that they intersect

at point D. Finally, draw a line passing through D and C; this line will be perpendicular to line AC.



5. Bisect line AC, that is, divide it in half by striking arcs above and below from its end points and connecting the points where the arcs cross with a line.
6. Transfer for the measurement of half of line AC to the vertical line running through points C and D. This is point E.
7. Draw a sloping line from point A to point E.
8. Transfer the measurement of half of line AC leftward from point E down the slope on line EA to establish the location of point F.
9. Transfer for the measurement of the segment AF to line AC. This will establish the location of point B. **Point B establishes the golden mean of line AC.**
10. Form a square with side of length AB, with its lower left corner at point A. You do this by forming perpendiculars at points A and B, and measuring up on them length AB.
11. Extend the top side of the square to meet line CD. If you have done this correctly, your golden rectangle will outline an area similar in proportion to the shaded area in the above illustration.
12. Slightly darken the lines of your golden rectangle. Do not erase all of your arcs and the working lines and marks by which you constructed the golden rectangle.

Check your work: if you established the location of point B correctly, the distance from point A to point B will be exactly 10 cm long. Why? Because the definition of the golden mean is that BC is to AB as AB is to AC:

$$\frac{BC}{AB} = \frac{AB}{AC}$$

This can happen only when BC is equal to .618 the length of AB. So if AB is 10 and BC is 6.18, the sum (which is line AC) is 16.18, which is the length you marked off as line AC (close; it's 16.2 cm.). This value is named **phi**, pronounced as in "fee **fi** fo fum". Its value is irrational; it is a never-ending decimal number that starts as

1.618033988749895...

and goes on forever. **The golden mean establishes the golden rectangle, which is a significant shape in the design of many visual objects.**

Project 1

Introduction

The Greeks and other ancient people thought about the world and god(s) differently than many people living today. In civilizations like ancient Greece the ability to produce a surplus of food made it possible for some members of society to not have to work at that. They had time to think about the nature of things—with much less distraction than we have today. Philosophers such as Plato, Aristotle, Pythagoras and many others thought a lot about geometry and the relationships between things such as how the circumference of a circle relates to its diameter, how lines could be divided in ways that produced a special effect, and how to "communicate" with their gods by recognizing some of these relationship as "riddles" that the gods designed for people to solve. If you solve a riddle someone has left for you they might think more favorably about you—and having a god feel favorably about you or your city would be a good thing if a war arose, you needed rain, or your city was sick. In the **three parts** of this project you'll explore the perfect solids, the Golden Rectangle, and the Fibonacci Series with some surprising results!

Project 1 Part 1 of 3: Constructing the five Perfect Solids

Review the material on the perfect solids and "rope pullers" in the course e-book. Then print the next several pages on which you will find fold-up patterns for the five perfect solids. Cut out the flat patterns for the perfect solids and fold them up to make them. Since these are physical object how you submit them for grading electronically? Very simply! When you have created them put them on a table, crouch behind them so that both they and your face are visible and have someone take a picture of you and the solids. E-mail the picture to the dedicated course e-mail address. The picture doesn't have to be high resolution, you and the shapes just need to be recognizable.

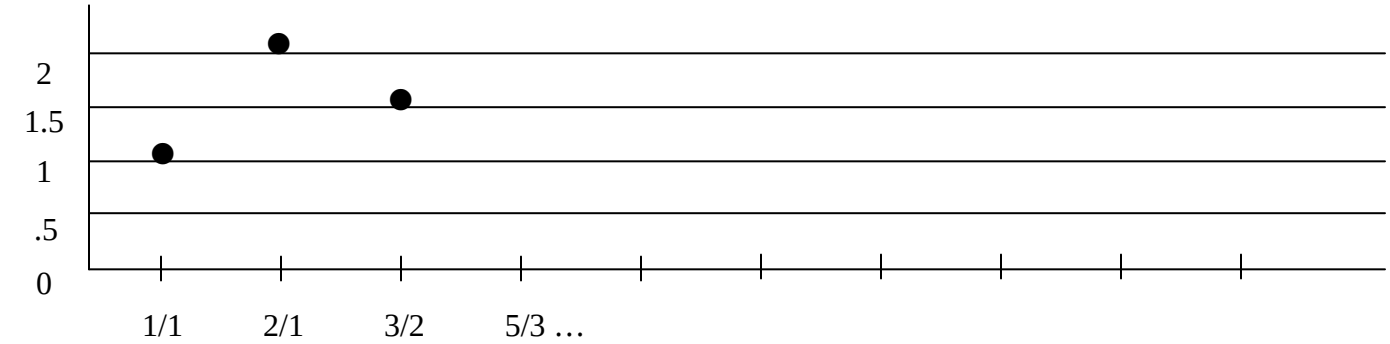
Project 1 Part 2 of 3: Constructing a Golden Rectangle

The Golden Rectangle is a fantastically interesting shape with many unique properties. View the video playlist for this page (the link is at the class web site page for Unit 1). In the first of three videos Donald Duck will explore the relationship of the Golden Rectangle to the pentagram and the many uses the Greeks made of this rectangle shape. In the second and third videos I show you how to do the geometric operations you need to use to form a golden rectangle. Use only geometric operations, a straightedge, and a compass; no ruler or protractor, and no measuring! Take a picture of yourself holding up your work and submit the picture for grading.

Project 1 Part 3 of 3: Exploring the Fibonacci Series

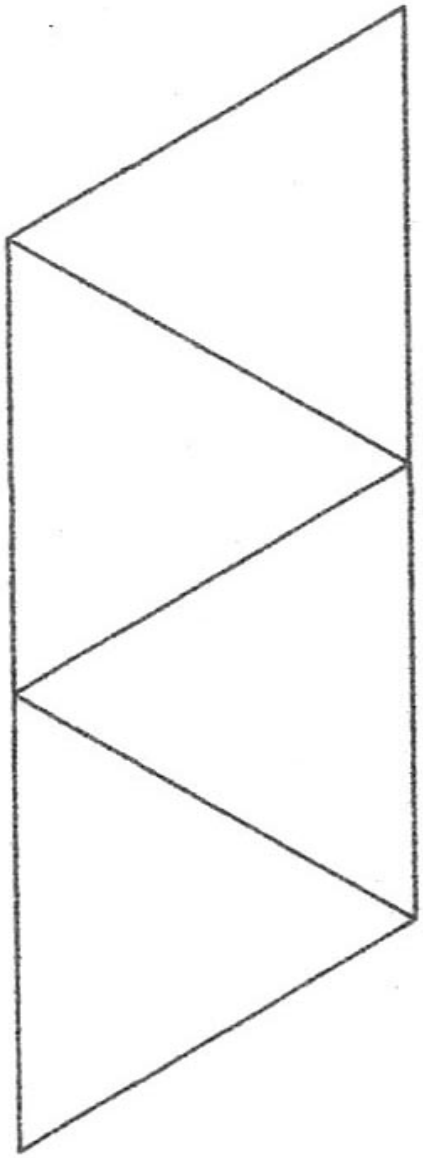
The Fibonacci Series is a simple sequence of arithmetic operations that produces a series of numbers. In this part of Project 1 you'll produce 11 numbers in this series and do a simple calculation on each pair of numbers. You'll then plot the values that you compute, which will help you see a trend. Finally, you'll be asked to think about what the result means; that is, what you think is happening with your plotted values, which seems more than coincidental… Follow these steps using a separate sheet of paper:

1. Develop the Fibonacci Series of numbers by starting with 0 and 1. Write down 0+1=1 to compute the third number in the series. The series is now 0, 1, 1.
2. Write down 1+1=2 to compute the next number in the series. The series is now 0, 1, 1, 2.
3. Write down 1+2=3 to compute the next number in the series. The series is now 0, 1, 1, 2, 3.
4. Write down 2+3=5 to compute the next number in the series. The series is now 0, 1, 1, 2, 3, 5.
5. Continue computing the series until you have 11 numbers in the series. In each case the next number is computed by just adding the prior numbers.
6. Now start with the two 1's in the series. Divide the second 1 by the first 1 and write down the result at the bottom of this page (it's 1).
7. Now move forward one position, and divide the 2 by the 1 before it (the result is 2; write it down below).
8. Now move forward one position and divide the 3 by the 2 just before it (the result is 1.5).
9. Continue doing this to the end of your 11-number series keeping three decimal places of precision and writing the division and its result below.
10. **Now plot the your computed values on this graph**, one result per horizontal mark, and **explain what's happening and how it relates to the Golden Rectangle**! Write your name below, scan or photograph this work, and e-mail the image with your paragraph to the dedicated course e-mail address. The paragraph you write can be the actual e-mail message to which you attached the picture or scan of your plotted values.

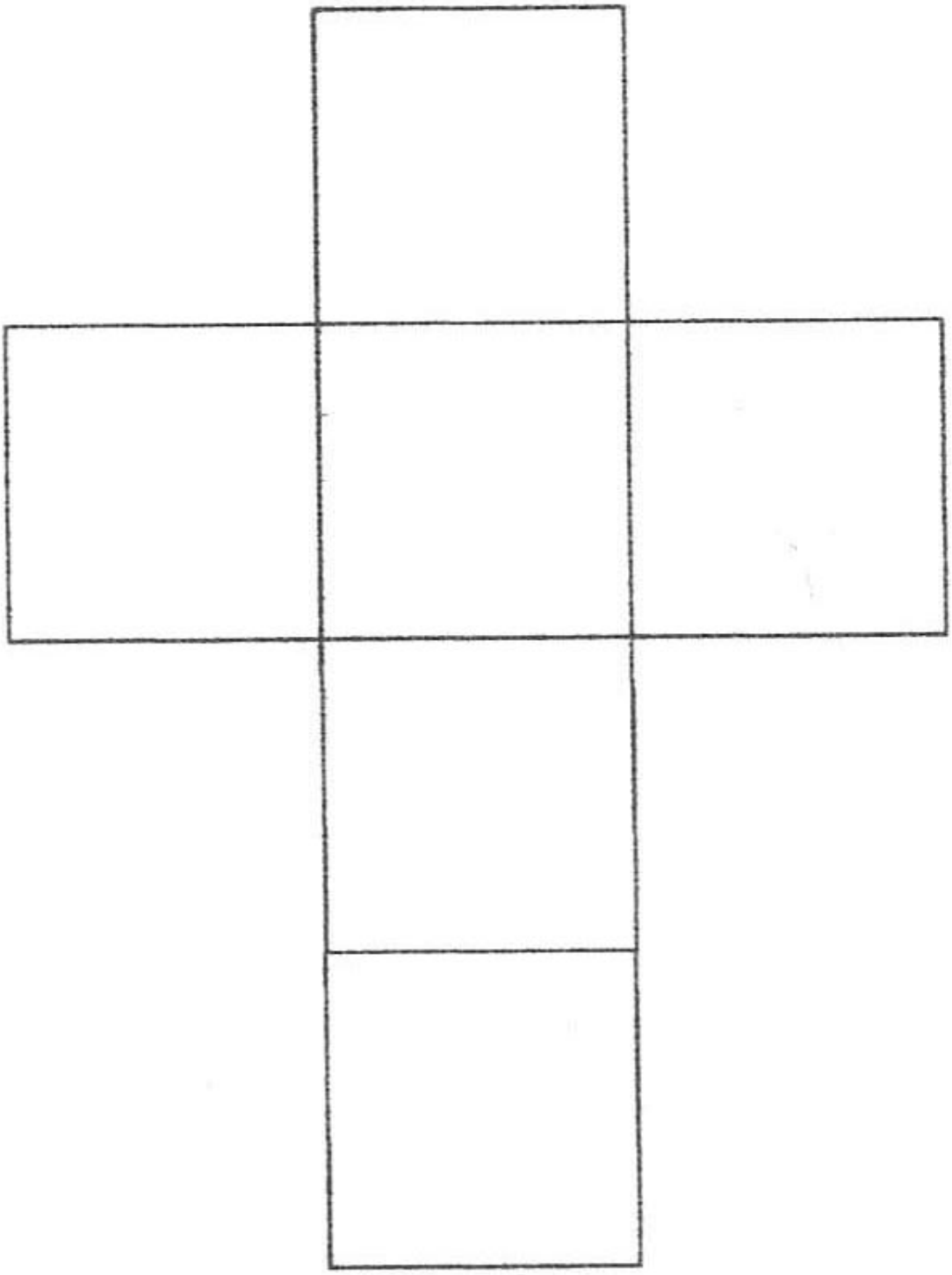


Result: 1 2 1.5 …

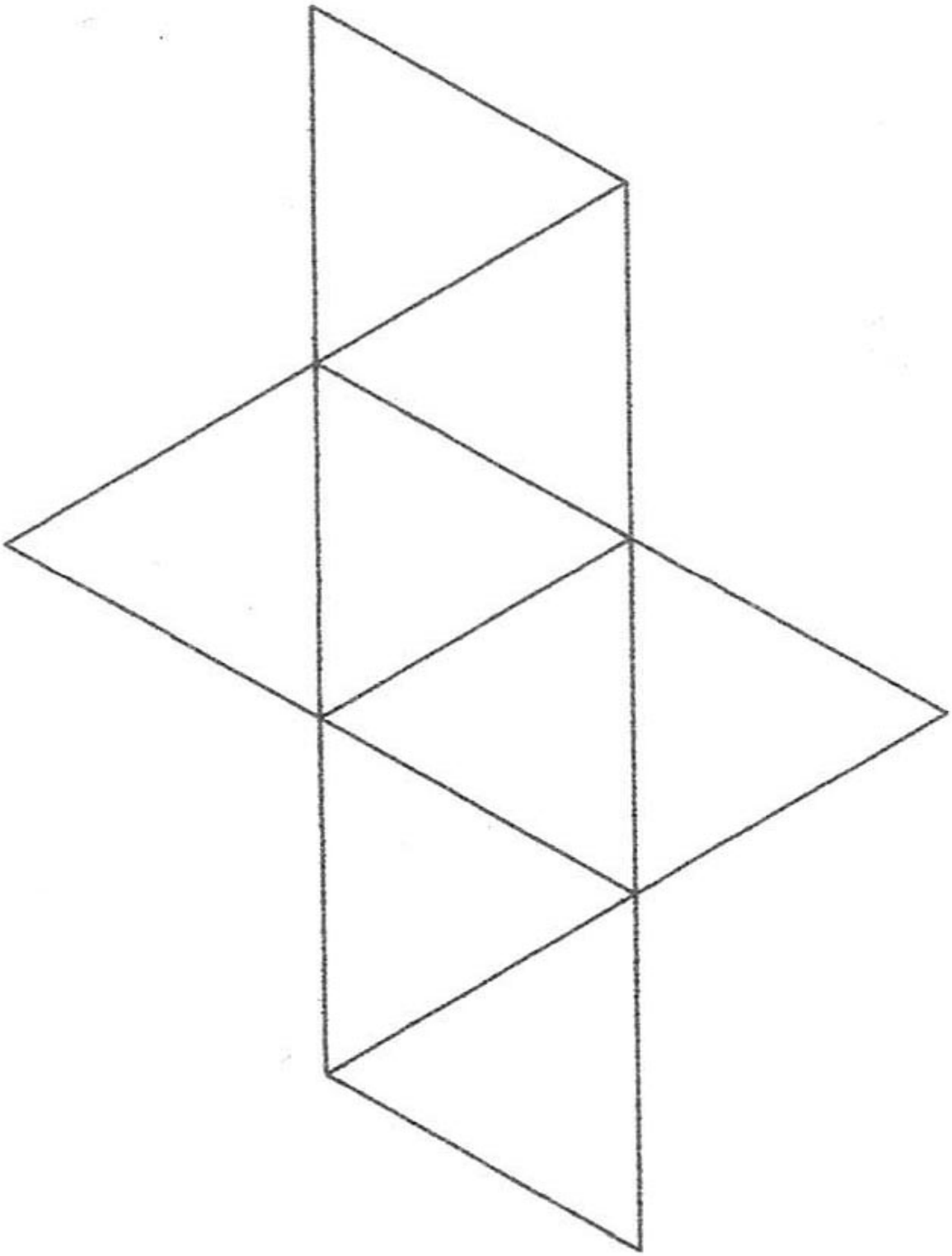
Tetrahedron



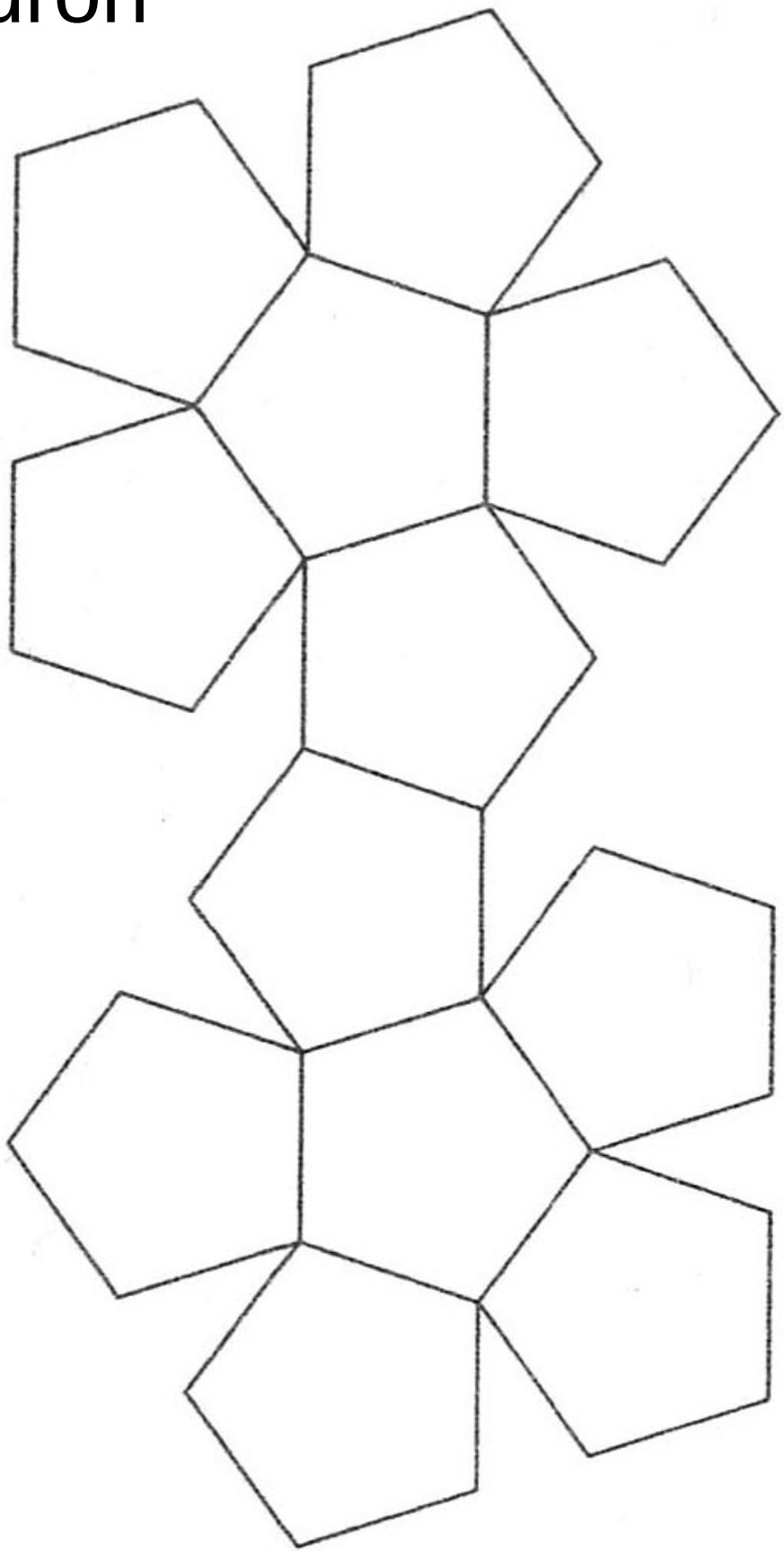
Hexahedron (cube)



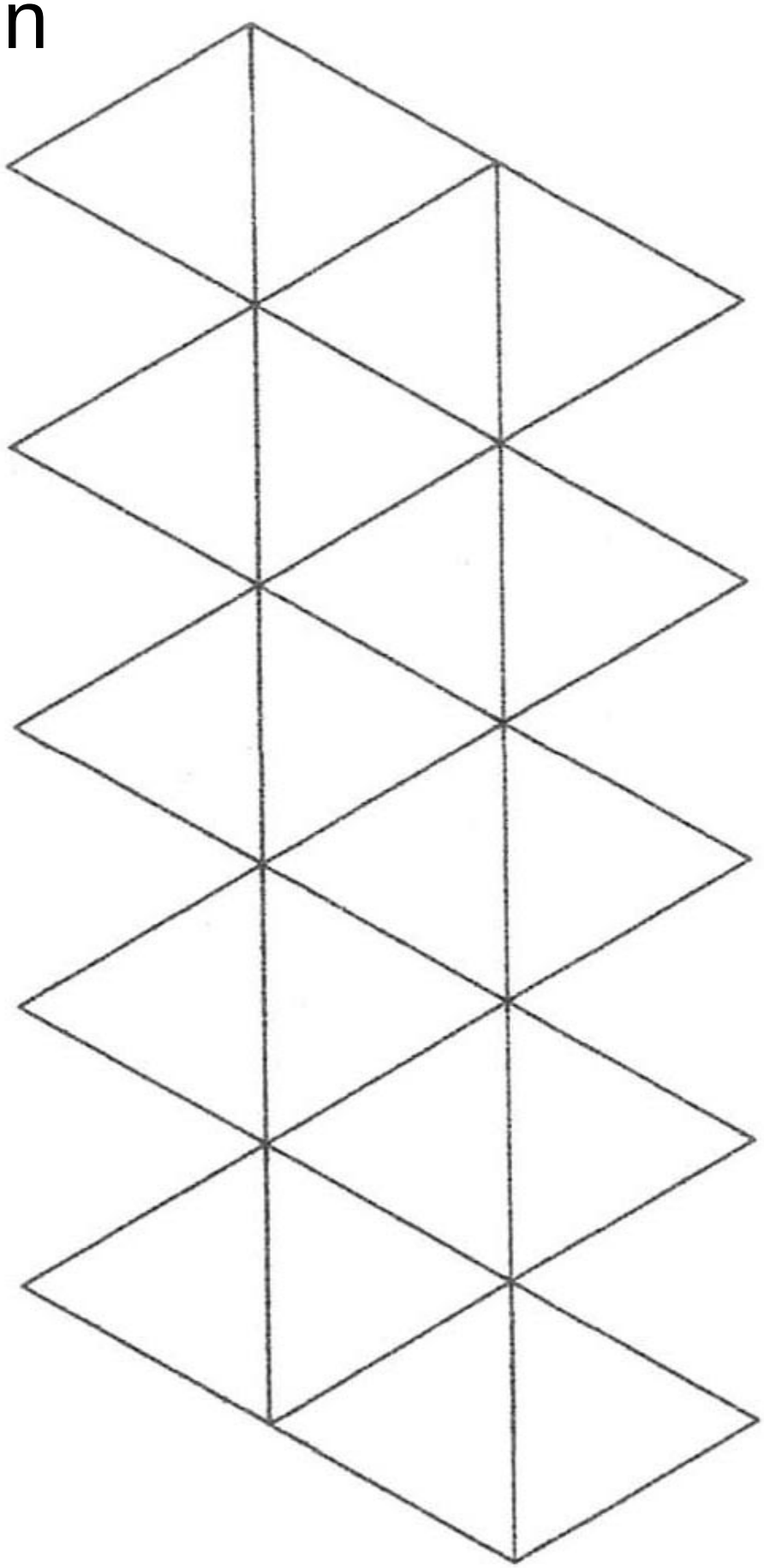
Octahedron



Dodecahedron



Icosahedron



Extra credit: Laying out a pyramid foundation

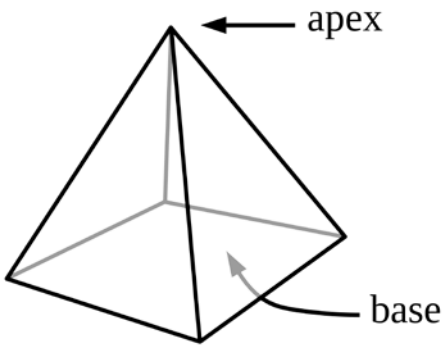
As of 2008 about 140 pyramids have been discovered in Egypt, constructed from 2630 BC onward. The pyramids are the world's oldest monumental structures. The Pyramid of Khufu at Giza is the largest Egyptian pyramid and is the only one of the seven wonders of the ancient world still in existence.

In this extra credit project you'll construct a rope similar to the ones used by ancient Egyptian rope pullers to define perfect right angles and you'll actually lay out the foundation for a small pyramid!

You do this project in two sessions. In the first session you prepare a special Pythagorean rope, which will take about an hour and then several more hours for glue to dry. In the second session, also about an hour long, you'll use your Pythagorean rope to lay out the pyramid base as a perfect square.

To do this project you'll need these things:

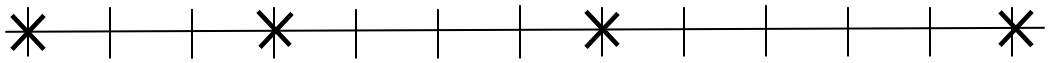
- 150 feet of twine (package tying twine or garden twine is fine; make sure it is heavy enough not to stretch very much when pulled taut)
- Household glue such as Elmer's glue or wood glue
- 4 wooden stakes or sticks each about one foot long that can be pushed into the ground
- A hammer or mallet to pound stakes
- Access to a large open area such as a lakefront park or beach at which you can see the sunrise
- Two friends to help you
- A digital camera to record your work.



Session 1 – Making your Pythagorean rope

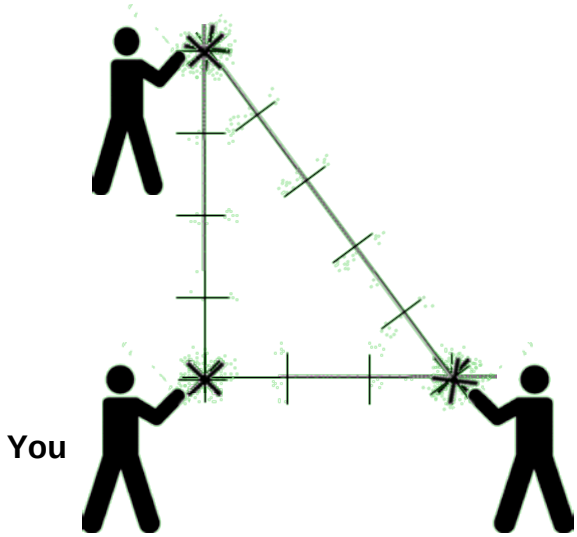
A cubit is an ancient unit of measure; it's approximately 20 inches in length. Just for fun we'll use that as a measure for an element of your Pythagorean rope. Do this to prepare your Pythagorean rope:

1. Cut off a piece of twine about 22 feet long.
2. Cut another 13 pieces of twine each three inches long.
3. Tie a three inch piece of twine around the twenty foot twine every 20 inches. This will look something like the sketch below, where the long line represents the 22-foot length of twine and the short straight lines crossing it are the three-in ties:



4. Put a drop of glue on each knot so the tied string knot won't move. Let the glue dry.
5. Tie a second string at the four places shown with an "X". Glue these in place and let the glue dry. This is your **Pythagorean rope**. This complete the first session.

You will probably recognize how this string will work. You hold the end "X" ties together, and another person holds the second "X" tie, and a third person holds the third "X" tie. If the second and third person move so that all parts of the string become taut, you will be standing at a right angle form by the string, since it defines a triangle with sides of length 3 cubits, 4 cubits, and 5 cubits:

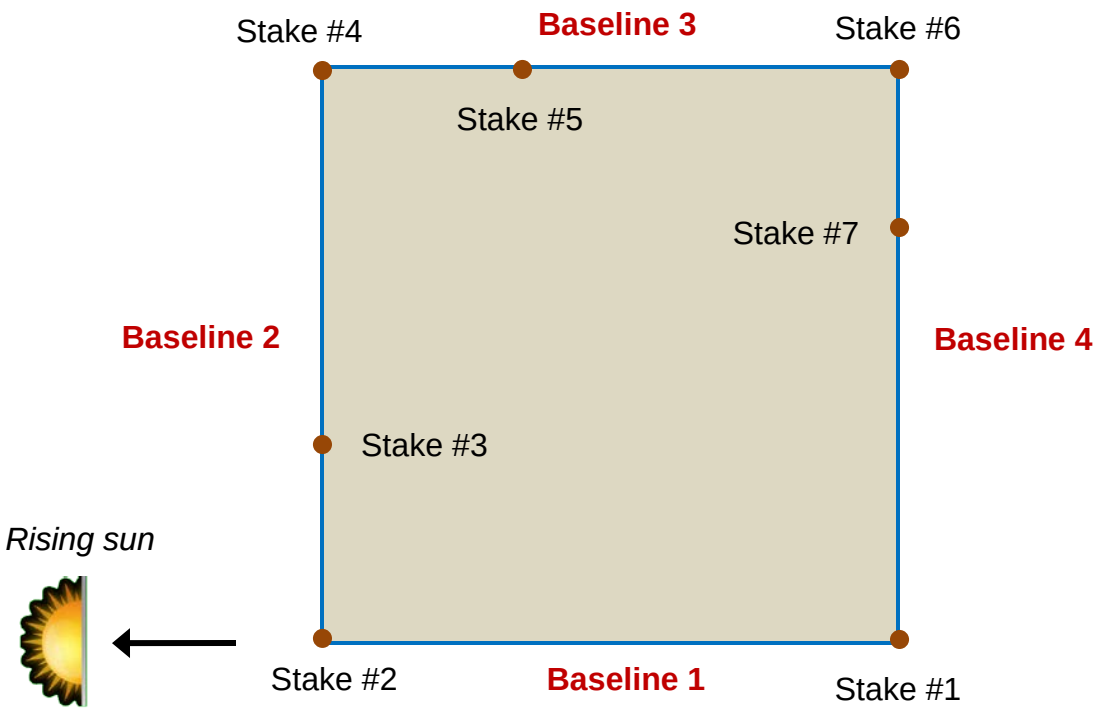


Session 2: Laying out the base of the pyramid

Find a please in a lakefront park or open area where you have at least 20 feet to work with in each direction and you can see the sunrise. Then take these actions:

6. Face the sun and place a stake in the ground. This is stake #1.
7. Then walk directly towards the sun for 12 cubits (use your Pythagorean rope as a measuring device) and place another stake in the ground. This is stake #2.
8. Run a piece of fresh twine from stake #1 to stake #2 and tie the twine to each stake.
9. Stand near stake #1 and make sure that the twine stretched and tied between it and stake #2 points toward the sun at sunrise. If it doesn't, start the process all over again with new stake locations so the holes you made in the ground don't affect the process. If the twine between the two stakes points directly toward the sun at sunrise, proceed with the next step. **This tied line is named baseline #1.**

Ultimately, you will lay out a square to form the base of the pyramid. The stake numbers and elements of the base will be labeled in this way:



10. You and your two friends stretch the Pythagorean rope taut as shown in the sketch above. You move to stake #2. Have the person three ties from you stand so as to align the twine with baseline #1.
11. When all sides of the triangle now formed by the Pythagorean rope are taut, the side leading to the person holding the twine four ties from you is forming a perfect right angle to baseline #1. Place a stake along that edge of the triangle. Call that stake #3.
12. Again using your Pythagorean rope as a measure, stretch the rope between stake #2 and stake #3 *and beyond it.* Measure 12 cubits along that line and put a stake at that location. This is stake #4.
13. Tie a length of twine between stakes #2 and #4. This twine defines **baseline #2.**
14. You and your two friends stretch the Pythagorean rope taut as shown in the sketch above. You move to stake #4. Have the person three ties from you stand so as to align the twine with baseline #2.
15. When all sides of the triangle now formed by the Pythagorean rope are taut, the side leading to the person holding the twine four ties from you is forming a perfect right angle to baseline #2. Place a stake along that edge of the triangle. Call that stake #5.
16. Again using your Pythagorean rope as a measure, stretch the rope between stake #4 and stake #5 *and beyond it.* Measure 12 cubits along that line and put a stake at that location. This is stake #6.
17. Tie a length of twine between stakes #4 and #6. This twine defines **baseline #3.**

18. Now comes an interesting part! You and your two friends stretch the Pythagorean rope taut as shown in the sketch above. You move to stake #6. Have the person three ties from you stand so as to align the twine with baseline #3.
19. When all sides of the triangle now formed by the Pythagorean rope are taut, the side leading to the person holding the twine four ties from you is forming a perfect right angle to baseline #3. Place a stake along that edge of the triangle. Call that stake #7.
20. Again using your Pythagorean rope as a measure, stretch the rope between stake #6 and stake #7 *and beyond it.* Measure 12 cubits along that line. Have you arrived back at the precise location of stake #1? If so, tie a length of twine between stake #6 and stake #1; this is **baseline #4**. You have laid out a perfect square for the base of a pyramid that is aligned with the rising sun! ***But if your last measure of 12 cubits along baseline #4 doesn't arrive exactly at stake #1 you have made an error.*** *The Pharaoh's chief architect will deem that you are unfit for this critical work and you will be reassigned to chip out stone blocks in the quarry for the rest of your life!*
21. Take a picture of your layout of the pyramid base with you and one of your friends (both, if possible!) included in the picture.
22. Write a short narrative of your experience in performing this work; describe if your work with the Pythagorean rope was successful or not, and if it wasn't entirely accurate on your first attempt try to identify the factors that resulted in errors.
23. Submit your picture of the work and your narrative for grading.
24. Don't forget to remove your stakes and twine from the ground and take them away; you don't want other people tripping over these things and hurting themselves!

Scholars are pretty certain that this is the way the Egyptian builders actually laid out the foundation for their pyramids, using just the same kind of simple tools. Now for the hard part… how are you going to quarry a million stone blocks and get them in place on the site of the base? We'll work on that for a while yet…

GPH-205 ESSAY GUIDE
Your Reflective Essay and Conclusions Work

An assignment with two parts (Revision 7, May 22, 2016)

Introduction

There is no midterm exam in GPH-205 and the course has no scheduled final exam. *It has no midterm because the amount of feedback you receive on every assignment—all of which can be revised based on feedback provided to you and re-submitted for re-grading—is much greater than the one-time "how am I doing?" feedback that you might receive from a rote-memorization midterm test. The course has no schedule "test" type of final exam because the degree of your learning is assessed much more comprehensively with a first-person reflective essay you can work on all during the term, and by "conclusions work" based on your essay. This assesses your ability to think critically employing what you have learned. All of the work of the course is designed to help you learn what you need to understand to develop the essay and to do the conclusions work. ☺ Jim*

The first part of the assignment: your reflective essay body

The first part of this assignment is writing the body of the essay, which is imaginative and creative writing. In this part you put yourself in the shoes (sandals?) of a person who was born into the Lascaux civilization and who for some reason doesn't age, grow old, or die. You live on and experience 22,000 years of existence and wind up in 1900, with a memory of it all. **You are NOT a modern person who has gone back in time; you are a truly prehistoric person who has lived from the time of Lascaux to the present.** Part of the work here is developing the character of this person, how they come to realize that they live on, and how they experience life and art in the eras in which they keep a journal (or "diary").

Your reflective essay does not have a "thesis statement." In the essay you are not trying to "prove" anything. *You are recording your (imagined) life experiences in living through the ages we study, especially those experiences in which you interact with the art, and possibly artists of that era or civilization, in the way the art affects you, and the way the people creating the art are treated by others, and the technologies used to create it. This is akin to what is sometimes called an "oral history."*

Your essay provides the basis for the conclusions work that you do at the end of the term. But the basis it provides is as a source of facts to prove or disprove conclusions I give to you; you don't develop your own conclusions. So as you begin this writing don't worry about the conclusions. I will be giving you separate instructions for the conclusions work 10 days before the end of the term. Focus now on your life and live going forward in time as we progress through the material, and have fun doing this creative but factual (in the sense of art) writing!

Your first page: where you start

You are approximately 20 years old and living in the Lascaux cave civilization. You give yourself a name that might have been appropriate to that civilization—probably a short one or two syllable name. The point of this scenario is for you to weave into your story the facts that you know about the civilization—the facts you learn from the first part of Unit 1 of the workbook, chapter 1 of ***The Story of Art,*** and the related videos. Those facts are collected by you from these sources on the first row of the Unit Summary Form (USF) for Unit 1. In order to get you started and to provide an example of the format and content intended for you USF entries I have given you the facts you need on workbook page 57; there's nothing keeping you from beginning your essay in the first unit of the course. **The first page of your reflective essay is a required work item you must submit in Unit 1!**

Your first page draft needs to be at least one double-spaced page with one inch margins in 12 point Times New Roman font. It can be longer than one page if you wish.[1] You develop it early in Unit 1 and you submit it to the dedicated course email address by the end of Unit 1. It's one of three items of work in Unit 1, the others being USF1 and the Project 1

What eras or civilizations do you write about?

Your USFs will take you through a total of 27 eras or civilizations you are required to learn about. However your reflective essay body only documents your life experiences in less than half of these—specifically, these 12:

	Civilization/era	Studied in Unit…
1	Lascaux about 20,000 BC	1
2	Egypt about 2400 BC	1
3	The Persian Empire under Cyrus the Great	1
4	Greece about 300 BC	1
5	Rome about AD 400	1
6	The Middle Ages in Europe about AD 1000	2
7	China in about AD 1000	2
8	The Gothic Era in Europe about AD 1200	2
9	The Renaissance about AD 1550	3
10	The Baroque in Italy about AD 1700	4
11	The Enlightenment about AD 1800	4
12	Impressionist era about AD 1890	4

Your essay simply ends about 1895. You don't die, we just don't hear from you anymore. **Your writing simply stops with no conclusions at its end; you'll do the conclusions work separately as later instructions will indicate.**

[1] The entire essay, due at the end of the term, must be at least 2,500 words minimum. *But there is no maximum length limitation, write as much as you like if you are thusly inspired!*

Making the body of your paper interesting

Developing your character takes imagination. But fleshing out your story line can be fun! Here are some ideas that can help you add interest to your story:

- **Interact with noted people in history.** In at least one era have your character meet some person who we now recognize as very famous although he or she wouldn't necessarily be in their own time. One student has herself being pushed into a crypt by none other than King Tutankhamen himself and the sarcophagus lid being slid shut! That was a transition for her to the next era since she just slept (she's immortal, remember?) and when she woke up she was in Greece. The tomb Tut pushed her into had been pilfered by grave robbers who took the sarcophagus to Greece where it was opened and she escaped (the slaves who opened that mummy case for the Greek person who bought it from the thieves really got a surprise!).
- **Express some astonishment early on that you are alive when people you knew have died off,** and how you don't seem to age although the people you meet in your life do age and eventually die. Wonder about this and decide eventually that something must have happened to you in that first event that gives you this immortal "life force." Maybe some mist or strange-smelling water you fell into? Or some of those weird berries you ate? That glowing rock you picked up in a nearly hidden recess of a cave?
- **Introduce some tension.** Some people around your character will notice that he/she isn't aging like they are. In earlier days this could make some locals suspicious that your character is a witch, or whatever the male counterpart is to a witch, and consorting with Satan! Or they may just be jealous and send some ill will your way. Whatever, it gets tense for your character to be there and maybe this is a good time to make an exit that happens to lead to the next era you'll document living through. Account for time and geographical distance somehow in the transition.
- **Get to know some noted person really well and have a "flashback" later to that memory long after that person is gone** (you are still very alive and well!). One student in her paper happened upon a young "Leo" in the Renaissance and lived with him for a year and described what he was doing with art—she later in another era learned from an old man tending a church that Leonardo da Vinci painted the art on the wall. She remembered then that Leo had been sketching it out when she knew him 300 years before! Things like this can fascinate readers and make your writing very interesting as you describe simple details of a person's life that you can only know by having been there.
- **Describe some features of noted people you observe**—for example, the student who Tut pushed into a crypt saw his face and described it. That puts you right there, in his presence. If you really want to be bold, put yourself in the Roman Middle East about the time of Jesus and get a glimpse of him and mention it matter of factly—remember, things that are held in esteem in modern times were ordinary day-to-day experiences in ancient times to a person living then.

- **Correct a person who doesn't know as much as you do because you were there and they weren't.** At the end of your creative writing (at which point you have arrived in about AD 1900), let's say you are talking with friends in an art class; have another person say something about some historical art that is not correct, and correct them in a way that reveals that you were actually there seeing it being created. For example, someone asks you how come you know so much about it, were you there in Rome when the Coliseum was being constructed? You can respond in a coy way since you know they would never believe that you actually HAD been there 1800 years ago and were still around! One little episode that suggests itself is that hand print in a Lascaux cave where the artist put his hand on the wall and must have spit paint out to form a silhouette of it. Let's say someone says the artist painted dots around his fingers like a pointillist painter would later do. You can blurt out something like "No, Nhut did that by taking a mouthful of the gooey beast-fat paint and spitting it out" and then you realize that you just said the name of a person who had been dead 22,000 years and no one else knows anything about him. So you have to backtrack a bit about how you knew this—but you know you really were there and saw it, which brings a wry smile to your face.
- **Put yourself in some noted art.** Looking at paintings in prep for an art history final, someone you are studying with remarks that you look a lot like the woman in Manet's ***A Bar at the Folies-Bergere***. You remember that it really was YOU who posed for that picture that rainy Thursday night in August 1881 when Manet hobbled in on a cane, asked for absinthe, and sketched you on the back of an old calendar page. But you don't mention it because you know people will think you're crazy! A twist like these little reminiscences can add a lot of human interest. They are easy and fun to cook up if you think about this technique.
- **Add some detail.** One thing that can make writing more interesting is detail. Don't just say "flowers near the door" say "scarlet red geraniums overflowing the broken rim of the old clay pot rightward of the door." Don't say the man looks old, say "he had creases on his face around his eyes and lines caked with paint around a nose that had for many years been pointed at frescoed ceilings." Remember, you were there. You saw all of this. Your reader didn't and needs the word picture to visualize it.
- **Use appropriate-period names for people and places.** Don't use modern names. Make up short names that sound primitive like "Oog"or "Ahya." Drop in a variation of the name in the era such as "Lash Koa" for the first era. It's reasonable to think that the modern name derives from some much earlier words for a place. This helps anchor the character in the location and time without using a modern name. The web site at this link `http://bit.ly/namehints` can help you come up with all sorts of names.
- **Don't use numbers** like "100" in prehistoric or ancient times because although we take a capable numbering system for granted, numbers for counting large quantities and Arabic numerals weren't invented until thousands of years later. Use the word "many" and repeat it for emphasis to describe very long periods of time, like "many, many". Repetition is still a part of some modern cultures as a

means of emphasis. Express things like your age in term like "four hands cold cold times" (ie., 4 x 5 fingers = 20).

- **Don't use the word "year"** because this is a modern idea and term for time. Instead, use "moons" or "warm times" or "cold times" which imply recognition of an annual cycle.
- **Have other characters do some of the explaining.** Don't always have your character tell the facts, have other characters that you talk to in eras explain things. Have your character meet people who provide some of the information. Variety is good as you progress through the eras.

This assignment is intended to be more fun than composing a typical dry academic paper. It can be, if you start early enough and you work on it all during the term as you study each era. It gets tougher and tougher to do if left to the last part of the term. That's why I demand that you compose the first page early in the term and let me review it. I can help you take your writing in the intended direction!

The second part of the assignment: your conclusions work

The GPH-205 reflective essay body is not traditional academic essay writing as you now know from reading the above.

The conclusions work is not traditional either, because YOU don't form conclusions. Instead, I will give them to you; they are different every term!

Near the end of the term it will be your job to judge whether each of the three conclusions I give you at that time is true or false, and then to draw facts from your reflective essay body and cite them to substantiate your determination. You'll do this conclusions work in a very streamlined, structured way that's time-efficient and focuses your attention on critical thinking, not on the arcane minutia of typical academic paper-writing. Because your own reflective essay is the ONLY allowed source of facts for your substantiating argument, there's no outside research involved (and other resources can't be cited!). Also because of this there is no need for a bibliography. And I provide a very simple citation format and form that you use instead of writing free-form.

Your Unit Summary Form (USF) written homework for each unit is integrated with your reflective essay/diary and conclusions work. On the USFs you gather the facts on art purpose, rules for formation, and technology that you need to weave into your essay. I help you "perfect" the USFs with my feedback. Keep up with the USF work and you already make progress on your essay!

But enough for now on that conclusions work—it's not your concern at the start of the term! Your immediate job as GPH-205 begins is to develop the first page of your reflective essay body and submit it on or before your Unit 1 due date! This is so that I can confirm the kind of writing that's intended—so you don't waste time developing a "traditional" kind of academic essay!

Unit 2 - The Middle Ages, AD 600 to 1300

We now consider Europe in the centuries after the fall of Rome, about AD 600, through the Middle Ages, Post-Roman Europe, the International Style and the Gothic Eras. This period was marked by turmoil as invaders from the east and north ravaged Europe. The church became the only unifying influence tying together various areas that had formerly been united under Rome. The church grew rich during this time as the wealthy often bequeathed their lands to it.

We also examine developments in the lands east and south of the Mediterranean Ocean, which was soon dominated by Islam. Islam originated in the early seventh century (AD 622-30) and spread by conquest throughout much of northern Africa and the Middle East within 100 years. The conquest of Hispania (Spain) between AD 711 and 718 brought this European territory under Muslim control. Known to Muslims by the Arabic name al-Andalus, the territory became the Caliphate of Córdoba. Muslim conquest of Europe continued with the Battle of Toulouse (France) in AD 721. Charles Martel defeated the Muslims at the Battle of Tours (Poitiers) in AD 732 and Muslim control in what was to become France ended in AD 759; were it not for this defeat, Europe would probably have come under Muslim control and the history of western civilization been written much differently.

We take a brief look at how the art of India was influenced by Rome at the height of Roman power, which stretched for a time that eastward to that extent. Roman trade with India began with overland caravans and later by direct maritime trade following the conquest of Egypt by Augustus in 30 BCE. Not long after, up to 120 ships were setting sail every year from Egypt to India. Multiple stashes of Roman coins used in trade have been found in southern India in archeological explorations. Roman influence can be seen in some of the early art of India.

Finally, we take a brief look at the unique aspects of Chinese art of the period known in the west as the "Dark Ages." We see that not only were methods of creation and the rules for art different in China, but the status by which society regarded the creators of art was also vastly different.

What to read, view, and do

Assigned reading and viewing

1. ***The Story of Art*, *any edition*** (Gombrich), chapters 6 through 11
2. ***History of Visual Technology, 4th edition*** (Janossy) Unit 2 (this material)
3. **Web lectures and supplementary videos**; links provided on the Unit 2 web page

Work due

1. **Unit Summary Form 2**
2. **Project 2** Historiated Initials, rose window, Celtic knots
3. *Extra credit:* 32-petal rose window design

GPH-205 Unit 2 Summary Form (USF2) Page 1

THIS IS BOTH A STUDY AID AND HOMEWORK ASSIGNMENT. Use a printed copy of this page for hand-written notes that you prepare as you accomplish the required reading and viewing. Put concise phrases in the boxes, not sentences! *Then download the editable .docx or .rtf copy of this form from the link on the course Unit 2 web page and type in your responses.* ***DO NOT COPY AND PASTE FROM TEXT OR WEB SOURCES.*** *The boxes for your responses on this form will automatically expand as necessary.* ***Submit your word-processed document NOT a scanned copy of your hand-written responses!*** *This work is integrated with your reflective essay and take-home final exam. The facts you gather form the basis for your essay and the Conclusions Work.*

Civilization/Art movement	Art purpose(s)	Art formation rules	Art technologies	Their art's impact on our modern life
Byzantium				
Islam (decoration of the mosque)				
China				

GPH-205 Unit 2 Summary Form (USF2) Page 2

THIS IS BOTH A STUDY AID AND HOMEWORK ASSIGNMENT. Use a printed copy of this page for hand-written notes that you prepare as you accomplish the required reading and viewing. Put concise phrases in the boxes, not sentences! *Then download the editable .docx or .rtf copy of this form from the link on the course Unit 2 web page and type in your responses.* ***DO NOT COPY AND PASTE FROM TEXT OR WEB SOURCES.*** *The boxes for your responses on this form will automatically expand as necessary.* ***Submit your word-processed document NOT a scanned copy of your hand-written responses!*** *This work is integrated with your reflective essay and take-home final exam. The facts you gather form the basis for your essay and the Conclusions Work.*

Civilization/Art movement	Art purpose(s)	Art formation rules	Art technologies	Their art's impact on our modern life
Middle Ages: Post-Roman Europe				
Gothic era				
International Style				

Icons and the Byzantine Church

Chapter 6 of ***The Story of Art***, entitled "A Parting of Ways," relates the controversy that arose in the seventh and eighth centuries about the role of images—paintings, mosaics, and statuary—in the Christian church. At that time "the church" was one church: there was no separation, as there is today, between the Roman Catholic (western) and Eastern Orthodox Christian churches, nor were there any significant non-Catholic denominations which arose only with the Protestant Reformation of the sixteenth century. But even in AD 600 there were definitely different ideas in different parts of the church about the role images should be allowed to play in church.

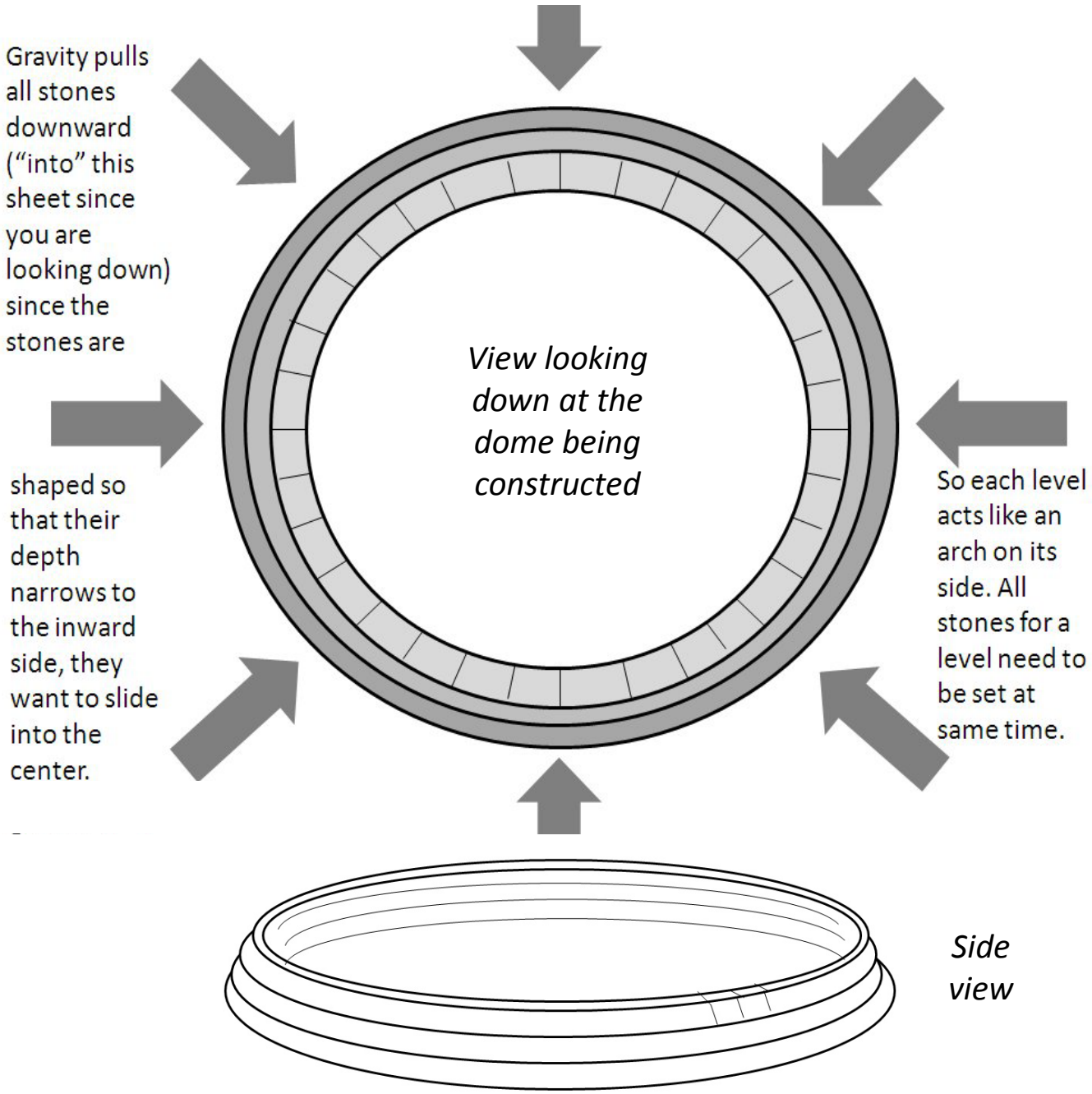
Pope Gregory the Great, who was the Bishop of Rome from AD 590 to 604 is quoted as having said,

> *"Illiterate men can contemplate in the lines of a picture what they cannot learn by means of the written word."*

This was taken to mean that images of Jesus, Mary, the apostles and later saints and depictions of biblical stories and events could be used to decorate churches. But their aim had to be communicating church history and doctrine without being overly artful—that is, the artistry of the image was not the point and should not distract the viewer.

Some prominent people in the church disagreed with Pope Gregory based on the commandment "thou shalt not worship graven image". They feared that recently-converted pagans would do precisely that since they were accustomed to worshipping idols. The people against the use of images were known as ***iconoclasts***. This same sentiment has also arisen at other later times, such as in the Protestant Reformation in which various denominations broke away from Roman Catholicism and formed separate Christian denominations. In the iconoclasm of the seventh century images in churches were often painted over as shown in this manuscript illumination.

Against the charge of idolatry the Orthodox Church tells the faithful not to worship the wood and paint but to deeply respect and venerate the person depicted. It distinguishes between adoration (worship, due to God alone) and veneration (deep respect). Pagans worshiped idols because they believed that the deity was present in the idol. The Orthodox make no such claim concerning icons; they are only images of the person depicted. By the end of the eighth century icons were restored in the Orthodox Church. Notice the icon images on the wall decoration in the background in this picture from an Eastern Orthodox household. Revered icons are often formed using encaustic techniques where pigment is mixed with hot wax and the mixture applied to a wooden panel using a small knife.



How a dome can be built without falsework

Domes like that of the Pantheon in Rome, Hagia Sophia in Istanbul, and the Duomo of the cathedral of Florence are too large to be supported with a temporary wooden structure known as "falsework" as they rise. The Romans figured out how to raise a dome **without** falsework and the architects who built Hagia Sophia probably inherited the knowledge from them. But that knowledge was lost in the Middle Ages. When Filippo Brunelleschi designed and constructed the dome in Florence he had to rediscover how to accomplish it. A dome constructed in this way will need some form of circular banding around some of the courses (layers) of stone to keep the downward pressure from pushing one or more rings of stone out in a direction from the center.

Hagia Sophia History

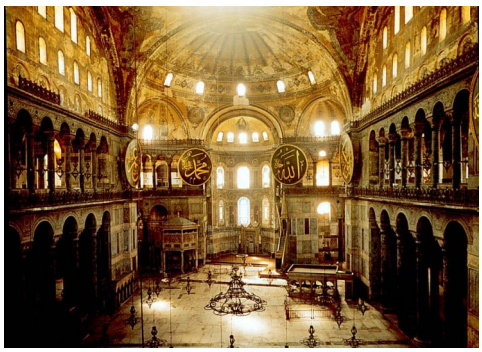
Extracted from Al Altan's Hagia Sophia at www.focusmm.com on April 25, 2010 and edited to include additional illustrations

Hagia Sophia is a magnificent domed church constructed in the early Middle Ages in Constantinople (Istanbul) and converted to a mosque when the Turkish forces conquered the city nearly a thousand years later in 1453. Although there are no artifacts confirming it, it is said that Hagia Sophia was built on the site of an ancient pagan temple. Hagia Sophia underwent two phases of construction before attaining its present state.

Documents indicate that the first Hagia Sophia was built by Emperor Constantius, son of Emperor Constantinos I, and was opened for services in 360 AD. Although very little is known about this Church it's assumed that it was a basilica-type structure with a rectangular floor plan, circular apse and timbered roof. It was similar to St. Studios, a basilica in Istanbul, the ruins of which still exist. Ancient sources emphasize that the eastern wall was circular. Constantius donated gold and silver as well as religious objects to his church but these were vandalized by Arians during the Council of 381 AD.

Hagia Sophia was first named "Megale Ekklesia" (the Great Church) as it was the largest Church in Constantinople, and was later renamed Sophia. The name given to the church symbolized the second divine attribute of the Holy Trinity. Originally, Sophia, which means "Holy Wisdom", was a name given to Christ by 4th century theologians. Both names, Megale Ekklesia and Hagia Sophia are used today.

The original Church was destroyed in 404 AD by mobs during the riots when Emperor Arcadius sent the Patriarch of Constantinople, John Chrysostom, into exile for his open criticism of the Empress. Emperor Theodosius II built a new Church which was completed in 415 AD. The architect of this second church was Ruffinos. This church was constructed in basilica style and had five naves. In common with other basilicas of that age it had a covered roof. The remains of this Church, excavated in 1935, show that a staircase of five steps led to a columned propylaeum in front of the entrance of the building. Including the imperial entrance, there were three doorways in the facade. The results of excavations indicate that this Hagia Sophia was 60 metres wide. The length is unknown since further excavations inside the present-day building are not permitted.



During the rebellion of Monophysites in 532 the second Hagia Sophia was destroyed along with many other important buildings, among which were the church of St. Eirene, Zorzip Bath and Samsun Hospital. After resorting to bloodshed, Emperor Justinian succeeded in saving his throne. This revolt is known as the "Nike Revolt" in Byzantine history, since the rebels repeatedly shouted "Nike", the name of the goddess of victory.

Following these events, Emperor Justinian ordered the construction of a new church which was to surpass in magnificence all earlier churches. His ambition to make this new church unique spurred him on to unremitting effort. Historians write that he personally supervised the construction and made full use of all the resources his empire could offer. The two most famous architects of the age, Anthemius of Tralles (Aydin) and Isidorus of Miletus, were entrusted with the construction of the building. They supervised one hundred master builders and ten thousand laborers.

The finest and rarest materials from the four corners of the empire were brought to Constantinople to be used in the construction of the new Hagia Sophia. The prophyry columns previously taken to Rome from an Egyptian temple in Heliopolis, ivory and gold icons and ornaments from ancient temples in Ephesus, Kizikos and Baalbek were among them. The construction was completed in a very short time: less than 6 years, from February 23rd 532 AD to December 27th 537 AD. During the dedication ceremony Emperor Justinian put aside formalities of state and entered the Church excitedly to say a prayer of thanks to God for allowing him to fulfill his dearest wish. He cried with pride, remembering the temple in Jerusalem "Oh, Solomon, I have surpassed thee!" Later, the Church was damaged many times by earthquakes and fires, and had to be repaired and reinforced:

- On August 15th 553, January 14th 557 and May 7th 559, earthquakes destroyed the eastern side of the dome. The damage was repaired by

the nephew of the original architect, Isidorus. He increased the height of the dome by 2.65 metres and built buttresses in the form of towers to support the dome.

- On February 9th 869, during the reign of Emperor Basil I (867-886), an earthquake damaged the western side of the building. It was repaired in 870.
- On October 25th 986, a violent earthquake resulted in the collapse of the western apse and caused partial damage to the dome. The church had to be closed until the architect Tridat finished repairing it in 994.
- In 1204, the church was sacked by the Fourth Crusaders. Later in that century Emperor Michael VIII (1261-1282) had Hagia Sophia repaired by the architect Ruchas and the buttresses in the south-west were added at that time.
- In 1317, during the reign of Emperor Andronicus II, the north-eastern and south-western walls were reinforced on the exterior by pyramid-shaped buttresses.
- In 1348, the eastern half of the dome collapsed and was afterwards repaired.

In the first half of the 15th century, travelers described Hagia Sophia as being in a state of disrepair. When the Turks conquered Constantinople in 1453, the church was converted into a mosque as a place of Islamic worship. Initially the Turks preserved the frescoes and mosaic figures of Christian saints which decorated the walls. However, in the 16th century, these were completely covered by plaster since the Islamic code forbids the use of human figures in mosques. After it became a mosque, the following changes, necessitated by Islamic architectural standards, were made:

Sultan Mehmed II "the Conqueror" built an altar (mihrap) in the east, since the apse should be in the direction of Mecca and the brick minaret on the south-east corner of the edifice.

Sultan Bayezid (1484-1512) added a minaret on the north-east corner.

The Turkish architect Sinan, built the two minarets in front of the Church during the reign of Sultan Murad III (1574-1535). Murad III also had water urns of the Hellenistic period (300 BC) brought to the mosque from Bergama. The pulpit (minber) and preacher's pew (muezzin mahfili) were added to the interior during the reign of Murad IV.

In 1739, Sultan Mahmud I built a library and a primary school (mekteh-i sibyan) in the south.

In 1850, Sultan Abdulmecit added the present day Imperial Pew. During his reign (1833-1861), important repairs were entrusted to the Swiss architect Gaspare Fossati. He removed the plaster covering the mosaics and then replastered them. He decorated these newly plastered areas with frescoes. The building was completely renovated inside and out.

In 1926, the government of the new Republic of Turkey, appointed a technical commission to investigate the architectural and static state of the building thoroughly. According to the commission's report the foundation of the structure rested solidly on a bed of rock. Following Kemal Ataturk's orders Hagia Sophia was converted into a museum on February 1st 1935 in keeping with the secularization of Turkish society that was a hallmark of the new republic.

The Muslim World, Islam and Islamic art

The term "Muslim world" or the Ummah has several meanings. In a religious sense it refers to those who adhere to the teachings of Islam, referred to as Muslims. In a cultural sense it refers to Islamic civilization, including non-Muslims living in that civilization. In a modern geopolitical sense it refers to Muslim-majority countries or towns. As of 2009 about 23% (1.6 billion) of the world's population are Muslims. Of these 62% live in Asia, 20% in the Middle East-North Africa, 5% in Sub-Saharan Africa, 3% in Europe and 0.3% in the Americas.[1] About 85% are Sunni Muslims while 15% are Shiite, concentrated mostly in Iran (Persia) and Iraq.

Islam was founded in AD 622 by revelations of the Prophet Mohammad. By AD 750 it had been spread to many areas of the southern Mediterranean. This map shows current political boundaries and countries but the dark shading shows the area of Muslim control in AD 750:

Islam holds five things roughly equivalent to the "sacraments" of the Roman Catholic faith. The first two of these are prevalent in much of the calligraphy decorating mosques.

1. The Shahadah

This basic creed of Islam must be recited under oath as the following statement: "I testify that there is none worthy of worship except God and I testify that Muhammad is the Messenger of God." This testament is the foundation for all other beliefs and practices in Islam. Muslims must repeat the shahadah in prayer. Non-Muslims converting to Islam must recite it; when they do in good faith, they become Muslim, which is held to be a one-way conversion from which a person cannot later revert or recant.

2. Salah

Ritual prayer that must be performed five times a day. Each salah is performed facing towards the Kaaba, an ancient sacred square building in Mecca, Saudi Arabia. Salah is intended to focus the mind on God and gives gratitude and worship. In many Muslim countries reminders called

[1] This is an extract developed from several WikiPedia sources, here `en.wikipedia.org/wiki/Muslim_world`

"Adhan" (call to prayer) are broadcast publicly from local mosques at the appropriate times or the call is given by a muezzin from a tower (minaret) on a mosque. The prayers are recited in Arabic and are verses from the Qur'an.

3. Zakat

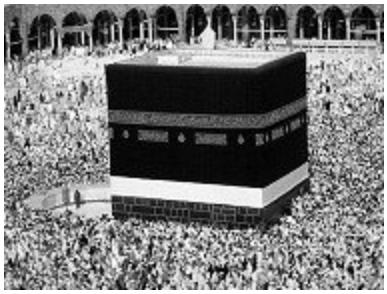
One of the most important principles of Islam is that all things belong to God and that wealth is therefore held by human beings in trust. Alms-giving is a practice of giving based on accumulated wealth. In general it is obligatory to give away 2.5% of one's savings and business revenue as well as 5-10% of one's harvest to the poor. The intended recipients include the destitute, the working poor, those who are unable to pay off their own debts, stranded travelers, and others who need assistance, under the principle that the rich should pay it to the poor. The Prophet Mohammad said "Charity is a necessity for every Muslim." When asked: "What if a person has nothing?'" He replied: "He should work with his own hands for his benefit and then give something out of such earnings in charity."

4. Sawm

Fasting during the month of Ramadan. Muslims must not eat or drink from dawn to dusk during this month and must be mindful of other sins. The fast is to encourage a feeling of nearness to God. During it Muslims express their gratitude for and dependence on Him, atone for their past sins, and think of the needy. Sawm is not obligatory for people for whom it would constitute an undue burden. For others flexibility is allowed depending on circumstances, but missed fasts usually must be made up quickly.

5. The Hajj

Every able-bodied Muslim who can afford it must make a pilgrimage during the Islamic month of Dhu al-Hijjah to the Masjid al-Haram mosque in Mecca, Saudi Arabia at least once in their lifetime. Rituals of the Hajj include walking seven times around the Kaaba, touching the black stone that fell from heaven to show Adam and Eve where to build an altar, walking or running seven times between Mount Safa and Mount Marwah, and symbolically stoning the Devil in Mina. More than 1.6 million people journey to Mecca every year to make this pilgrimage. The mosque area can hold 300,000 people.



The Kaaba and pilgrims circling it

Islamic art [2]

No Islamic visual images or depictions of God are meant to exist because it is believed that such artistic depictions may lead to idolatry. Muslims believe that God is incorporeal, making any two- or three- dimensional depictions of God impossible. Instead, Muslims describe God by the names and attributes that, according to Islam, he revealed to his creation. All but one sura (verse) of the Qu'ran begins with the phrase "In the name of God, the Beneficent, the Merciful". Images of Mohammed's face are likewise prohibited.

Islamic art is difficult to define because it covers many lands and various peoples over some 1400 years; it is not art specifically of a religion, or of a time, or of a place, or of a single medium like painting. It includes the huge field of Islamic architecture as well as calligraphy, painting, glass, ceramics, and textiles. Islamic art is not restricted to religious art but includes all the art of the rich and varied cultures of Islamic societies. The calligraphy and decoration of

[2] This is an extract and heavy editing of `en.wikipedia.org/wiki/Islamic_art`

manuscript Qu'rans is an important aspect of Islamic art. Human representation for the purpose of worship is considered idolatry and is forbidden in Islamic law, known as Sharia law. Many examples exist of depictions of Muhammad in historical Islamic art but always with veiled face. Human figures, while never present in the decoration of the mosque, occur in secular works on the walls of palaces or illuminated books of poetry—things seen only by the small wealthy elite. Small decorative figures of humans and animals , especially if they are hunting the animals, are found on secular pieces in many media from many periods, but actual human portraits were slow to develop.

Islamic art was influenced by Roman art, early Christian art, and Byzantine styles. The art of pre-Islamic Persia, Central Asian styles, and Chinese influences also had a formative effect on Islamic painting, pottery, and textiles. Repeating elements exist in Islamic art such as the use of geometrical floral designs in a repetition known as the **arabesque**. The arabesque in Islamic art is often used to symbolize the transcendent, indivisible and infinite nature of God. Mistakes in repetitions may be intentionally introduced as a show of humility by artists who believes that only God can produce perfection. Calligraphy of many forms is very frequently used to form the Shahadah in decorations of gold leaf, tiles, or wood.

Going further with Islamic art

The curiosity of students is often piqued by the brief exposure to Islamic art provided by ***The Story of Art*** and this workbook. I've included these suggestions for students who would like to learn more about Islamic art and the peoples who produced it:

Strange as it may seem, start with the excellent entry on Islamic art in Wikipedia from which I extracted elements of this short summary (see the earlier footnote reference). This article provides a good high level summary to begin with.

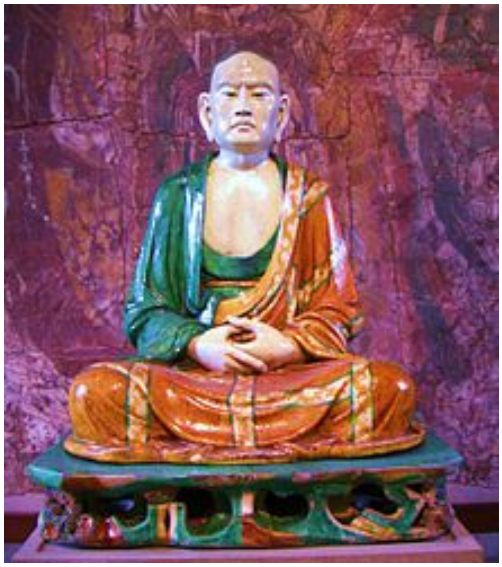
Then I'd suggest you look at ***The Illustrated Encyclopedia of Islamic Art and Architecture: An Essential Introduction*** by Moya Carey. This contains over 500 color pictures and costs less than $30 online. It comes closest to what Ernst Gombrich did for art in general in ***The Story of Art***.

The quintessential reference work on Islamic art is ***The Grove Encyclopedia of Islamic Art & Architecture (3 volumes)***, Bloom and Blair editors. This is a classic, but huge and expensive at over $400! This is massive overkill for a beginner but essential for a researcher or grad student for reference purposes. The following book, however, by the same scholars, is a great second book on the subject: ***The Art and Architecture of Islam, 1250-1800*** by Blair and Bloom. This covers later art from several areas of the Islamic world and it's a paperback typically costing less than $30!

Since Islamic art is so intertwined with the religion of Islam, you might also find ***The Illustrated Encyclopedia of Islam: A Comprehensive Guide*** by Mohammed Seddon useful. This is well illustrated and priced under $30. It focuses on the prophet Muhammad and aspects of the religion of Islam rather than its art per se, but it can help a student of Islamic art see the intimate connections between much of the art of Islamic peoples and their faith.

The Eighteen Arhats (Lohans)[1]

Ten disciples of Gautama Buddha are identified in the earliest Buddhist literature where they are referred to as **Arhats**. When Buddhism reached China they were called **Luohans** or **Lohans**. Four of these Lohans, named Pindola, Kundadhana, Panthaka and Nakula, were believed to have been instructed to carry the message of Buddha to the world and to await the coming of Maitreya. Maitreya is foretold as a future Buddha of this world; he or she is to appear on Earth, achieve complete enlightenment, and teach the pure dharma. According to Buddhist scriptures, Maitreya will be a successor of the historic Buddha, "the enlightened one."



Chinese representations of the Lohans can be traced back to as early as the fourth century and mainly focused on Pindola who was popularized in art by the book ***Method for Inviting Pindola***. A cult built around the Lohans as guardians of Buddhism arose among Chinese Buddhists at the end of the ninth century for they had just been through a period a great religious persecution under the reign of Taoist Emperor Tang Wuzong. The number of Lohans was increased in China to 16 and then to 18 to include patriarchs and other spiritual leaders. The last two additions to this roster, Taming Dragon and Taming Tiger, are directed against persecution by Taoists.

No historical records exist showing how the Lohans looked. The first portraits of the Lohans were painted by the monk Guan Xiu in 891 AD. Legend has it that the 18 Lohans knew of Guan Xiu's expert calligraphy and painting skills and they appeared to the monk in a dream to make a request that he paint their portraits. The paintings depicted them as foreigners having bushy eyebrows, large eyes, hanging cheeks and high noses. They were seated in landscapes, leaning against pine trees and stones. In these paintings they were portrayed as unkempt and "eccentric" which emphasize that they were vagabonds and beggars who have left all worldly desires behind. When Guan Xiu was asked how he came up with the depictions, he answered: "It was in a dream that I saw these Gods and Buddhas. After I woke up, I painted what I saw in the dream." The paintings were donated by Guan Xiu to the Shengyin Temple in Qiantang where they were preserved with great care and ceremonious respect. The portraits by Guan Xiu have become the definitive images for the Lohans in Chinese Buddhist iconography, although in modern depiction they are given more typically Chinese facial features.

[1] Adapted from WikiPedia at http://en.wikipedia.org/wiki/Eighteen_Arhats

Insular Art of the Middle Ages[1]

Insular art is the style of art produced in the Middle Ages in the British Isles. “Insular” comes from *insula*, the Latin term for "island". Britain and Ireland shared a common style different from that of the rest of Europe. Although mostly thought of as a term describing ornate manuscripts, Insular art also includes metalwork and other objects. The Insular style is most famous for its highly dense, intricate and imaginative geometric decoration. There is no attempt to represent depth, all emphasis is on a brilliantly patterned surfaces.

Most Insular art originates from the Irish monasticism of Celtic Christianity or metalwork for the secular elite. Across all the British Isles society was entirely rural, buildings were rudimentary, and architecture has no distinctive “Insular style.” Both religious and secular buyers of Insular art expected individual objects of dazzling virtuosity that were all the more brilliant **because of the lack of visual intensity in the world in which they lived** (the same reason that stained glass windows of the later Gothic era were as fascinating to people then as they were). The Celtic and Anglo-Saxon elites had long traditions of metalwork of the finest quality used for their personal adornment.

The Insular period begins around 600 AD with the combining of “Celtic” styles and Anglo-Saxon (English) styles. The highpoint of the Insular period was brought to an end by the disruption of life of the Viking raids which began in the late 8th century. These raids may have interrupted work on the ***Book of Kells***; no later Gospel books are as heavily or finely illuminated as the masterpieces of the 700’s. In England the style merged into Anglo-Saxon art around 900 AD, while in Ireland the style continued until the 1100’s when it merged into Romanesque art. Insular art influenced all subsequent European medieval art especially in the decorative elements of Romanesque and Gothic manuscripts.

Surviving examples of Insular art are mainly illuminated manuscripts, metalwork and carvings in stone, especially stone crosses. The best examples include the ***Book of Kells***, ***Lindisfarne Gospels***, ***Book of Durrow***, brooches such as the ***Tara Brooch*** and the ***Ruthwell Cross***.

Carpet pages are a characteristic feature of Insular manuscripts. These are pages of mainly geometrical ornamentation often placed at the beginning of each of the four Gospels in Gospel Books. These pages contain little or no text **but they are not the same as highly decorated historiated initials.** Carpet pages are wholly devoted to ornamentation with brilliant colors, active lines, and complex patterns of interlace such as the Celtic knot. Some art historians see their origin in Coptic decorative book pages, oriental carpets, or other textiles. Roman floor mosaics seen in post-Roman Britain are also cited as a possible source. There are notable carpet pages in the ***Book of Kells***, ***Lindisfarne Gospels***, and ***Book of Durrow***. Pages such as these also exist in Islamic and Jewish illuminated manuscripts.

[1] Extracted from http://en.wikipedia.org/wiki/Insular_art and edited by Jim Janossy

Illuminated manuscript decorations[1]

During the Middle Ages books were expensive and rare because each book was a hand-made creation. Every page had to be lettered manually usually by a monk in a monastery. The books most often considered worthwhile to be copied were the bible (in Latin), "books of hours" used to guide personal devotions, and missals used to guide worship services. It became a common practice to include decorations in such hand-copied text, which often used expensive vellum produced from animal skin, creating what are known as **illuminated manuscripts**.

The first letter of each paragraph or page is commonly given special treatment in illuminated manuscripts. This decoration takes the form of a historiated initial or, less commonly in copies of sacred text, an inhabited initial. A **historiated initial** is an enlarged letter at the beginning of a paragraph or other section of text which contains a picture that is in some way related to the text on the page and illustrates it. An **inhabited initial** contains figures (human or animal) that are decorative only, without forming a subject related to the text. In modern typography the kind of letter you see at the start of this paragraph resembles a historiated initial but it's called a "dropped capital" and is supported by some word processors!

Both historiated and inhabited initials became common and elaborate in illuminated manuscripts during the Middle Ages. These initials were first seen in the Insular art of the early 700's. The earliest known example is in the Saint Petersburg Bede, an Insular manuscript of AD 731-46. Red and blue were the colors most frequently used, with small amounts of green, brown or black, and sometimes gold or gold leaf. Letters that began a new section of a text or a particularly noteworthy section might receive more flourishes and space. In luxury manuscripts an entire page might be devoted to a historiated initial. Both the size and elaboration of such initials reflect the status of the manuscript and on its owner. Manuscripts meant for everyday use or use by friars or university students often possessed hardly any elaborate historiated initials or flourishes. By contrast, manuscripts commissioned by wealthy patrons or for a wealthy monastery often possessed gold or silver illuminations. This may be seen in the simplicity of the materials used to create the manuscript; those colored mainly in red, black, and blue ink were intended everyday purpose. Those decorated with gold and more rare colors, such as gold, lapis lazuli blue or purple, often ended up in the hands of wealthy collectors or nobles.

The Hill Museum and Manuscript Library, which you can reach at `www.hmml.org`, provides online access to thousands of examples of historiated initials.

[1] This material was gathered from, among other places, `http://en.wikipedia.org/wiki/Historiated_initial`

The Crusades: 1095-1272 AD

(adapted by Jim Janossy from various sources in Wikipedia)

Overview

The Crusades were a series of religiously-sanctioned military campaigns waged by much of Christian Weater Europe. These campaigns, to restore Christian control of the Holy Land, were fought over a period of nearly 200 years between 1095 and 1291:

First Crusade 1095-1099
Second Crusade 1147–1149
Third Crusade 1187–1192
Fourth Crusade 1202–1204
Children's Crusade
Fifth Crusade 1217–1221
Sixth Crusade 1228–1229
Seventh Crusade 1248–1254
Eighth Crusade 1270
Ninth Crusade 1271–1272

The Crusades were fought mainly by Roman Catholic forces against Muslims who had occupied the near east since 638 AD. Orthodox Christians also took part in fighting against Islamic forces in some crusades. Crusaders took vows and were granted penance for past sins, often called an indulgence. The crusades originally had the goal of recapturing Jerusalem and the Holy Land from Muslim rule and were launched in response to a call from the Christian Byzantine Empire for help against the expansion of the Muslim Seljuk Turks into Anatolia (Turkey).

The crusades had far-reaching political, economic, and social impacts, some of which have lasted into contemporary times. Because of internal conflicts among Christian kingdoms and political powers, some of the crusade expeditions were diverted from their original aim, such as the Fourth Crusade, which resulted in the sack of Christian Constantinople and the partition of the Byzantine Empire between Venice and the crusaders. The Sixth Crusade was the first crusade to set sail without the official blessing of the Pope, The Seventh, Eighth and Ninth Crusades resulted in Muslim victories which marked the end of the crusades.

The crusades were never referred to as such by their participants. The original crusaders were known by various terms, including *fideles Sancti Petri* (the faithful of Saint Peter) or *milites Christi* (knights of Christ). They saw themselves as undertaking an *"iter,"* a journey, or a *peregrinatio*, a pilgrimage (although pilgrims were usually forbidden to carry arms, which the crusaders did indeed carry).

Like pilgrims, each crusader swore a vow to be fulfilled on successfully reaching Jerusalem, and they were granted a cloth cross (crux) to be sewn into their clothes. This "taking of the cross," the crux, eventually became associated with the entire journey; the word "crusade" coming into English from the Medieval French *croisade* and Spanish *cruzada*.

The Holy Land

The Holy Land, on the eastern shore of the Mediterranean Sea—also known as The Levant—is significant in Christianity as the place of nativity, ministry, crucifixion and resurrection of Jesus of Nazareth, whom Christians regard as the Savior, the Messiah. By the end of the 4th century, following the Roman Emperor Constantine's conversion to Christianity in AD 313 and later the founding of the Byzantine Empire after the partition of the Roman Empire, the Holy Land had become a predominantly Christian region. The Muslim presence in the Holy Land began with their conquest of Syria in the 7th century. The Muslim armies' successes put increasing pressure on the Eastern Orthodox Byzantine Empire which had originally claimed the region, part of the Eastern Roman Empire.

Churches commemorating various events in the life of Jesus had been erected at key sites in Jerusalem when the Christians held the territory before the coming of the Muslims. Jerusalem also holds historical and religious importance for Jews as the site of the Second Temple (Herod's Temple) and the First Temple (Solomon's Temple). Jews consider Israel as their ancestral homeland and had been visiting the city since its capture and destruction by the Romans in AD 66-73. After 632, Jerusalem began to hold significance in Islam as the site of the ascension into heaven of the prophet Muhammad whom Muslims believe to be the foremost prophet of God; Jerusalem is regarded as the third most sacred site in Islam. Christians and Jews continued to have a presence in the Holy Land and coexisted with the Muslims as "people of the book" (the bible).

In AD 1009 the ruling Caliph of Jerusalem al-Hakim bi-Amr Allah ordered the destruction of the Church of the Holy Sepulchre, built on the supposed site of the

crucifixion. In 1039 his successor, after requiring large sums be paid for the right, permitted the Byzantine Empire to rebuild it. Pilgrimages were allowed to the Holy Lands before and after the church was rebuilt but for a time pilgrims were captured and some of the clergy were killed. The Muslims eventually realized that much of the wealth of Jerusalem came from the pilgrims; for this reason and others, the persecution of pilgrims eventually stopped. However, the damage was already done and the violence of the Seljuk Turks became part of the concern that spread support for the crusades across the Christian world.

Factors Leading to the Crusades

The origins of the crusades also lay in other developments. The breakdown of the Carolingian Empire in the late 9th century, combined with the relative stabilization of local European borders after the Christianization of the Vikings, Slavs, and Magyars, had produced a large class of armed warriors whose energies were misplaced fighting one another and terrorizing the local populace. The Church tried to stem this violence with the Peace and Truce of God movements, which was somewhat successful, but trained warriors always sought an outlet for their skills. Opportunities for territorial expansion were becoming less attractive for large segments of the nobility.

The crusades were an outlet for an intense religious piety which rose up in the late 11th century among the lay public. A crusader would, after pronouncing a solemn vow, receive a cross from the hands of the pope or his legates, and was thenceforth considered a "soldier of the Church". This fervor was further strengthened by religious propaganda that advocated “just war” to retake the Holy Land from the Muslims. The remission of sin was a driving factor and provided any God-fearing man who had committed sins with an appealing way to avoid eternal damnation in Hell. It was a hotly debated issue throughout the Crusades as what exactly "remission of sin" meant. Most believed that by retaking Jerusalem they would go straight to heaven after death. All of these factors were manifested in the overwhelming popular support for the First Crusade and the religious vitality of the 12th century.

First Crusade

In 1063 Pope Alexander II had given his blessing to Iberian Christians in their wars against the Muslims, granting both a papal standard (the *vexillum sancti Petri*) and an indulgence to those who were killed in battle. Pleas from the Byzantine Emperors, now threatened by the Seljuks, thus fell on ready ears. These pleas were made in 1074, from Emperor Michael VII to Pope Gregory VII and in 1095, from Emperor Alexios I Komnenos to Pope Urban II. Later that year, at the Council of Clermont, the pope called upon all Christians to join a war against the Turks, promising those who died in the endeavor would receive immediate remission of their sins.

The official crusader armies set off from France and Italy on the papally-ordained date of 15 August 1096. The armies journeyed eastward by land toward Constantinople, where they received a wary welcome from the Byzantine Emperor. Pledging to restore lost territories to the empire, the Crusaders were supplied and transported to Anatolia where they laid siege to Seljuk-occupied Nicaea. The city fell on 19 June 1097. The Crusader armies fought further battles against the Turks, facing grave deprivation of both food and water in their summer crossing of Anatolia. The lengthy Siege of Antioch began in October 1097 and endured until June of 1098. The ruler of Antioch was not sure how the Christians living within his city would react, so he forced them to live outside the citadel. The siege only ended when one of the gates to the city was betrayed by an Armenian dissident. Once inside the city the crusaders massacred the Muslim inhabitants, destroyed mosques and pillaged the city. A large Muslim relief army immediately besieged the victorious crusaders within Antioch, but this was defeated on June 28, 1098. The starving crusader army marched south, moving from town to town along the coast, finally reaching the walls of Jerusalem on June7, 1099 with only a fraction of their original forces.

The Jews and Muslims of Jerusalem fought together to defend Jerusalem against the invading crusaders. They were unsuccessful and on July 15, 1099 the crusaders entered the city. They proceeded to massacre the remaining Jewish and Muslim civilians and pillaged or destroyed mosques and the city itself. One historian has written that the "isolation, alienation and fear" felt by the crusaders so far from home helps to explain the atrocities they committed; perhaps that is so but the atrocities bear no rationalization as acts of true Christians. As a result of the First Crusade, four small Crusader states were created: the Kingdom of Jerusalem, the County of Edessa, the Principality of Antioch, and the County of Tripoli. In the Kingdom of Jerusalem at most 120,000 crusaders (predominantly French-speaking Western Christians)

ruled over 350,000 Muslims, Jews, and native Eastern Christians who had remained in the area since the Arab occupation had begun in 638 AD. The crusaders also tried to gain control of the city of Tyre but were defeated by the Muslims.

Second Crusade 1147–1149

After a period of relative peace in which Christians and Muslims co-existed in the Holy Land, Muslims recaptured the town of Edessa in 1044. A new crusade was called for by various preachers, most notably by Bernard of Clairvaux. French and South German armies marched to Jerusalem in 1147 but failed to win any major victories. By 1150 both the kings of France and Germany had returned to their countries without any success in regaining cities that had been recaptured by Muslims in the Holy Land. St. Bernard of Clairvaux, who had encouraged the Second Crusade, was upset with the amount of misdirected violence and slaughter of the Jewish population of the Rhineland that took place as the crusaders journeyed east through Europe toward the Holy Land. On the western side of the Mediterranean the Second Crusade met with success as a group of Northern European crusaders stopped in Portugal, allied with the Portuguese King, Alfonso I of Portugal, and retook Lisbon from the Muslims in 1147. A detachment from this group of crusaders helped Count Raymond Berenguer IV of Barcelona conquer the city of Tortosa the following year.

Third Crusade 1187–1192

In 1187, Saladin, Sultan of Egypt, recaptured Jerusalem after 89 years under Christian rule. After the Christians surrendered the city Saladin for the most part left churches and shrines untouched and spared the civilians to be able to collect ransom money for them, but several thousand apparently were not redeemed and were sold into slavery. The reports of Saladin's victories shocked Europe. Pope Gregory VIII called for another crusade, which is sometimes referred to as the Kings' Crusade. It was led by several of Europe's most important leaders: Philip II of France, Richard I of England ("Richard the Lionheart"), and Frederick I, Holy Roman Emperor. Before his arrival in the Holy Land, Richard captured the island of Cyprus from the Byzantines in 1191. Cyprus would serve as a crusader base for centuries to come, and would remain in Western European hands until the Ottoman Empire took the island from Venice in 1571. After a long siege Richard recaptured the city of Acre and took the entire Muslim soldier garrison under captivity; it was executed after a series of failed negotiations. The crusader army headed south along the coast of the Mediterranean Sea. They defeated the Muslims near Arsuf, recaptured the port city of Jaffa, and were in sight of Jerusalem. However, Richard did not believe he would be able to hold Jerusalem once it was captured, as the majority of crusaders would then return to Europe, and the crusade ended without the taking of Jerusalem. Richard left the following year after negotiating a treaty with Saladin. The treaty allowed unarmed Christian pilgrims to make pilgrimages to Jerusalem while it remained under Muslim control.

After the First Three Crusades…

On a popular level the first crusades unleashed a wave of impassioned, personally-felt pious Christian fury that was expressed in the massacres of Jews that accompanied the movement of the crusader mobs through Europe as well as the violent treatment of "schismatic" Orthodox Christians of the east. During many of the attacks on Jews, local Bishops and Christians made attempts to protect Jews from the mobs that were passing through. Jews were often offered sanctuary in churches and other Christian buildings.

Fourth Crusade 1202–1204

The Fourth Crusade was initiated in 1202 by Pope Innocent III with the intention of invading the Holy Land through Egypt. Because the crusaders lacked the funds to pay for the fleet and provisions that they had contracted from the Venetians, Doge Enrico Dandolo enlisted the crusaders to restore the Christian city of Zara (Zadar) to obedience. Because they subsequently lacked provisions and time on their vessel lease the leaders decided to go to Constantinople where they attempted to place a Byzantine exile on the throne. After a series of misunderstandings and outbreaks of violence, the crusaders sacked the city in 1204 and established the so-called Latin Empire and a series of other crusader states throughout the territories of the Greek Byzantine Empire. This is often seen as the final breaking point of the Great Schism between the Eastern Orthodox Church and (Western) Roman Catholic Church.

Children's Crusade

The Children's Crusade is a series of possibly fictitious or misinterpreted events of 1212. The story is that an outburst of popular enthusiasm led to a gathering of children in France and Germany, which Pope Innocent III interpreted as a reproof from heaven to their unworthy elders. The leader of the French army, Stephen, led 30,000 children. The leader of the German army, Nicholas, led 7,000 children. None of the children actually reached the Holy Land: those who did not return home or settle along the route to Jerusalem either died from shipwreck or hunger, or were sold into slavery in Egypt or North Africa.

Fifth Crusade 1217–1221

By processions, prayers, and preaching, the Church attempted to set another crusade afoot, and the Fourth Council of the Lateran (1215) formulated a plan for the recovery of the Holy Land. In the first phase, a crusading force from Austria and Hungary joined the forces of the deposed Christian king of Jerusalem and the Christian prince of Antioch to take back Jerusalem. In the second

phase, crusader forces achieved a remarkable feat in the capture of Damietta in Egypt in 1219, but under the urgent insistence of the papal legate, Pelagius, they then launched a foolhardy attack on Cairo in July of 1221. The crusaders were turned back after their dwindling supplies led to a forced retreat. A night-time attack by the ruler of Egypt resulted in a great number of crusader losses and eventually in the surrender of the army.

The Egyptian ruler, Sultan Al-Kamil had put a bounty of a Byzantine gold piece for every Christian head brought to him during the war. During 1219, St. Francis of Assisi crossed the battle lines at Damietta in order to speak with the Sultan. He and his companion Illuminatus were captured and beaten and brought before the Sultan. St. Bonaventure, in his *Major Life of St. Francis*, says that the Sultan was impressed by St. Francis and spent some time with him. St. Francis was given safe passage and although he was offered many gifts, all he accepted was a horn for calling the faithful to prayer. This act eventually led to the establishment of the Franciscan Custody of the Holy Land.

Sixth Crusade 1228–1229

Emperor Frederick II had repeatedly vowed a crusade but failed to live up to his words, for which he was excommunicated by Pope Gregory IX in 1228. He nonetheless set sail from Brindisi, landed in Saint-Jean d'Acre, and through diplomacy he achieved unexpected success: Jerusalem, Nazareth, and Bethlehem were delivered to the crusaders for a period of ten years.

Seventh Crusade 1248–1254

A Muslim force recaptured Jerusalem in 1248. The crusader army and its Bedouin mercenaries were completely defeated within forty-eight hours. This battle is considered by many historians to have been the death knell to the crusader states. Although this defeat provoked no widespread outrage in Europe as the fall of Jerusalem in 1187 had done, Louis IX of France organized a crusade against Egypt from 1248 to 1254, leaving from the newly constructed port of Aigues-Mortes in southern France. It was a failure and Louis spent much of the crusade living at the court of the crusader kingdom in Acre.

Eighth Crusade 1270

The eighth Crusade was organized by Louis IX in 1270 to come to the aid of the remnants of the crusader states in Syria. But the crusade was diverted to Tunis where Louis spent only two months before dying. For his efforts, Louis was later canonized. The crusade failed.

Ninth Crusade 1271–1272

The future Edward I of England undertook another crusading expedition in 1271, after having accompanied Louis IX on the Eighth Crusade. The Ninth Crusade was deemed a failure and ended the crusades in the Middle East. With the fall of Antioch (1268), Tripoli (1289), and Acre (1291), those Christians unable to leave the cities were massacred or enslaved and the last traces of Christian rule in the Levant disappeared.

Criticisms

Western and Eastern historiography present variously different views on the crusades, in large part because "crusade" invokes dramatically opposed sets of associations—"crusade" as a valiant struggle for a supreme cause, and "crusade" as a byword for barbarism and aggression. The First Crusade ignited a long tradition of organized violence against Jews in European culture. Elements of the crusades were criticized by some from the time of their inception in 1095. For example, Roger Bacon felt the crusades were not effective because, "those who survive, together with their children, are more and more embittered against the Christian faith." In spite of such criticism the movement was widely supported in Europe long after the fall of Acre in 1291. Later, 18th century Enlightenment thinkers judged the crusaders harshly. Likewise, some modern historians in the West express moral outrage at this series of bloody campaigns.

The Legacy of the Crusades

The crusades had an enormous influence on the European Middle Ages. At times much of the continent was united under a powerful Papacy. But by the 14th century the development of centralized bureaucracies (the foundation of the modern nation-state) was well on its way in France, England, Spain, Burgundy, and Portugal. This occurred partly in reaction to the dominance of the church at the beginning of the crusading era.

Although Europe had been exposed to Islamic culture for centuries through contacts in the Iberian Peninsula and Sicily, much knowledge in areas such as science, medicine, and architecture was transferred from the Islamic to the western world during the crusade era. The crusades are seen as having opened up European culture to the world, especially Asia:

The New Catholic Encyclopedia states that:

> "The crusades brought about results of which the popes had never dreamed and which were perhaps the most important of all. They re-established traffic between the East and West, which, after having been suspended for several centuries, was then resumed with even greater energy; they were the means of introducing westerners into the most civilized Asiatic countries. A new world was thus revealed, and crusaders who returned to their native land carried back novel ideas..."

Along with trade, new scientific discoveries and inventions made their way east or west. Arab advances, including the development of algebra, optics, and refinement of engineering, made their way west and sped the course of advancement in European universities that led to the Renaissance.

The need to raise, transport and supply large armies led to a flourishing of trade throughout Europe. Roads largely unused since the days of Rome saw significant increases in traffic as local merchants began to expand their horizons. This was not only because the crusades prepared Europe for travel, but also because many wanted to travel after being reacquainted with the products of the Middle East. This also aided in the beginning of the Renaissance in Italy since various Italian city-states from the very beginning had important and profitable trading colonies in the crusader states, both in the Holy Land and later in captured Byzantine territory.

Increased trade brought many things to Europeans that were once unknown or extremely rare and costly. These goods included a variety of spices, ivory, jade, diamonds, improved glass-manufacturing techniques, early forms of gun powder, oranges, apples, and other Asian crops.

From a larger perspective, and certainly from that of noted naval/maritime historian Archibald Lewis, the crusades must be viewed as part of a massive macro historical event during which Western Europe, primarily by its ability in naval warfare, amphibious siege, and maritime trade, was able to advance in all spheres of its civilization. Recovering from the Dark Ages of AD 700-1000, throughout the 11th century Western Europe began to push the boundaries of its civilization. Prior to the First Crusade the Italian city-state of Venice, along with the Byzantine Empire, had cleared the Adriatic Sea of Islamic pirates and loosened the Islamic hold on the Mediterranean Sea. The Normans, with the assistance of the Italian city-states of Genoa and Pisa, had retaken Sicily from the Muslims from 1061-1091. These conflicts prior to the First Crusade had weakened the Islamic hold on the Mediterranean allowing for the rise of Western European Mediterranean trading and naval powers such as the Sicilian Normans and the Italian city-states of Venice, Genoa, and Pisa.

The pre-First Crusade actions, along with the crusades themselves, allowed Western Europe to contest and gain control of the trade of the Mediterranean Sea and Black Sea. This allowed the economy of Western Europe to advance to previously unknown degrees, most obviously as regards the Maritime Republics of Venice, Genoa, and Pisa. It is no coincidence that the Renaissance began in Italy, as the Maritime Republics, through their control of the Eastern Mediterranean and Black Seas, were able to return to Italy the ancient knowledge of the Greeks and Romans as well as the products of the Orient. As a result Western Europe began to trade extensively with the Orient, allowing the products of Asia to be brought to such ports as Acre, Antioch, Kaffa and even, for a time, Constantinople itself. The Fifth Crusade of 1217-1221 and the Seventh Crusade of 1248-1254 were largely attempts to secure Western European control of the Red Sea trade region, as both of these crusades were directed against Egypt. It was only in the 1300s, as the stability of trade with Asia collapsed, the Middle Eastern crusader states were lost, and the rising Ottoman Empire impeded further Western European trade with Asia that Western Europeans sought alternate trade routes to Asia, ultimately leading to Columbus's voyage of 1492 and the Age of Discovery.

Silverpoint: a unique art medium[1]

A silverpoint drawing is made by dragging a metal rod or wire across a surface often prepared with gesso or primer. The initial marks of silverpoint (when made using actual silver metal) appear gray but exposure to air tarnishes the lines to a warm brown tone. The oxidation becomes perceptible over a period of several months.

Silverpoint is one of several types of metalpoint used by craftsmen and artists since ancient times and by medieval scribes on manuscripts. Metalpoint styli were used for writing on soft surfaces (wax or bark), ruling and for underdrawing on parchment and drawing on prepared paper. The metals first used were lead and tin, and then in later times, silver. The softness of these metals made them effective drawing instruments. Goldsmiths also used metalpoint drawings to prepare their detailed, meticulous designs. Albrecht Dürer's father was one such craftsman who later taught his young son to draw in metalpoint. Durer's 1484 self-portrait at age 13 is still considered a masterpiece. Old Master silverpoints are typically intimate in scale recalling roots in manuscript illumination.

Metalpoint was used in the Middle Ages directly on parchment for the underdrawing of illuminated manuscripts or model books. On uncoated parchment and paper silverpoint is particularly light in appearance. Since the silverpoint of the 1300's was used more successfully on prepared supports. A traditional ground can be prepared with a rabbit skin glue solution pigmented with bone ash, chalk and/or lead white. Contemporary grounds include acrylic gesso, gouache and commercially prepared claycoat papers. The slight tooth of the ground preparation scrapes off a little of the silver from the tool as it is drawn across the surface, resulting in a darker line than is apparent on an unprepared surface.

In the late Gothic/early Renaissance era silverpoint using actual silver metal emerged as a fine line drawing technique. Not blunting as easily as lead or tin, and rendering precise detail, silver was especially favored in Florentine and Flemish workshops. Silverpoint drawings of this era include model books and preparatory sheets for paintings. Artists who worked in silverpoint include Jan van Eyck, Leonardo da Vinci, Albrecht Dürer and Raphael. Cennino Cennini's book ***Il Libro dell'Arte*** of the late 1300's provides a window on the practice of silver and leadpoint drawing, as well as preparing metalpoint grounds. Susan Dorothea White's recent book ***Draw Like Da Vinci*** (2006) describes the silverpoint technique of Leonardo da Vinci.

Drawing styles changed at the end of the 1500's resulting in a decline of metalpoint. The discovery of graphite in Cumbria, England in the early 1500s and its increasing availability to artists in a pure, soft and erasable form hastened silverpoint's eclipse. Artists sought more gestural qualities, for which graphite and red and black chalk were better suited. Ink and wash drawings are also prevalent in the period (a wash is a brushing of mostly solvent with a little paint and covers a broad area without apparent brush strokes). These other drawing techniques required less effort and were more forgiving than silver, which resists erasure and leaves a fainter line.

[1] Extracted from WikiPedia at `http://en.wikipedia.org/wiki/Silverpoint` and edited by Jim Janossy

Medieval stained glass[1]

Stained glass windows of ever larger size became a widely used artistic medium in the late Middle Ages and into the Gothic Era as new architectural techniques made it possible for cathedral walls to be constructed thinner, and larger and larger areas used for window space. Images are formed in stained class cut into pieces and fit together with a flexible lead strip having an "H" shaped cross section, called "lead came". Each of the channels is fit around the cut glass to hold it together and sections of the panels formed in this way are fitted into iron frames to form a large window.

Medieval colored glass is composed of silica, soda or potash, and lime. Glass factories were set up where there was a ready supply of silica sand, the essential material for glass manufacture. Silica requires very high heat to become molten, something furnaces of the Middle Ages were unable to achieve. So materials such as soda or potash were added to allow the silica to melt at a lower temperature, and then lime was added to make the glass more stable.

Sources of silica were often impure, with iron oxide being one of the most common impurities, producing a greenish or blue color without the addition of any other minerals. From ancient times craftsmen had learned that glass can intentionally be colored by adding metallic oxide powders or finely divided metals while it is in a molten state. In modern times these substances can be manufactured, but in medieval times it was more common to use Beech wood ash or other plant matter to supply iron and manganese oxides. Since the content of these minerals in plants varied with the soil conditions in which trees and plants grew it was difficult to predict what color of glass would be produced in a given batch. The way the glass was heated also affected its color, which could range from yellow to flesh colored to light purple or even reddish.

Some of the stronger reds, blues and greens that are a feature of medieval stained glass rely on the addition of copper oxides. The production of bright reds and blues in particular was straightforward. The addition of copper to the mix resulted in the reliable creation of the red, blue and green glasses widely used in Romanesque and Gothic stained glass windows. Depending on how it was handled and other impurities present in the glass, copper oxides could also produce green or bluish green. Adding cobalt mineral ores makes deep blue, and gold produces wine red and violet glass. The experimental manufacture of glass resulted in colors ranging from colorless to yellow, amber, brown, green, blue, pink and purple.

[1] Much of the information on this topic comes from Wikipedia pages on stained glass, with additional material on silver stain from entries on Islamic glass; see http://en.wikipedia.org/wiki/Stained_glass and http://en.wikipedia.org/wiki/Islamic_glass

An author named Theophilus[2] documented in the 1100's that Roman tesserae (mosaic glass cubes) were also melted into new glass batches to produce colored glass. He writes that "little square stones" from "ancient pagan buildings" could be used to produce glass; "they even melt the blue in their furnaces, adding a little of the clear white to it, and they make from it blue glass sheets which are costly and very useful in windows."

Some glasses were produced by "flashing", which means that a thin layer of colored glass was bonded to clear glass to form two or more layers. Flashing could be done by dipping a small sphere of molten glass into a molten uncolored glass and blowing this into a cylinder form (the cylinder blown sheet process) which was then cut into sections and flattened in an annealing oven. Red copper-based glass was usually flashed with clear glass since the color is too dark in a layer thick enough to be self-supporting.

Producing a strong clear yellow could be difficult in early stained glass since it required more careful control of furnace conditions than was possible. In the 1300's silver stain was developed to produce yellows. It's quite possible that the technique was picked up from increased contact with Islamic civilizations during the Crusades, where staining glass with copper and silver pigments was known from around the AD 200's AD and is called "luster painting". Silver stain was a combination of silver nitrate or silver sulfide blended with clay and applied to clear glass, which is then heated to chemically cause the stain to bond with the class. This technique enabled the use of more detail in stained glass windows than could be achieved with pieces of cut glass. Silver stain was sometimes applied over the surface of colored glass to create a wide range of glass hues, combining yellow with the underlying color of the glass.

Painton Cowen, in conjunction with the Centre For Medieval Studies at York University (England) has digitized more than 19,000 photographs of medieval and ancient stained glass panels at over 500 locations and made these accessible on the web. You will access this web site at the Unit 2 web page of the class web site as a part of Project 2. The stained class examples here are from that site.

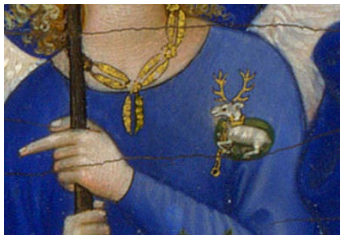
[2] Theophilus Presbyter (c. AD 1070-1125) is the pen name of an anonymous author, perhaps Benedictine monk Roger of Helmarshausen, who compiled a Latin text with detailed descriptions of various medieval applied arts between AD 1100 and 1120. The three parts of his writing cover painting techniques, paints and painting walls, ink for manuscript illumination of texts, stained glass and techniques of glass painting, and goldsmithing, metalwork and even and introduction to organ building. Interestingly, his writing gives clear instructions for oil-based painting, but at that point it was probably used for painting sculptures, carvings and wood fittings, perhaps especially for outdoor use. Jan van Eyck is credited with demonstrating oil as a superior binder for art painting in about AD 1425-35.

Gothic “International” Style: The Wilton Diptych

(circa 1395-99 AD; egg tempera medium)

English King Richard II presented to the Virgin and Child by his Patron Saint John the Baptist and Saints Edward and Edmund (approx. 19” x 24”)

The “Wilton Diptych"”was painted as a portable altarpiece for the private devotion of King Richard II, who ruled England from 1377 to 1399. The diptych is thought to have been made in the last five years of Richard's reign although its artist remains unknown. It is called The Wilton Diptych because it came from Wilton House in Wiltshire, the seat of the Earls of Pembroke.



A diptych is a painting, carving or piece of metalwork on two panels usually hinged like a book. The panels of the Wilton Diptych are made of north European oak but have been transformed by immaculate painting and gilding into a heavenly vision. King Richard II kneels at the feet of the Virgin and Child and 11 angels. Behind him is Saint John the Baptist, Saint Edward the Confessor and Saint Edmund. The saints are recognizable by their attributes: the lamb of Saint John, the ring of Edward the Confessor and the arrow of Saint Edmund (Edward and Edmund are earlier English kings who came to be venerated as saints.) The outside surface of the diptych, illustrated on the next page, bears Richard's arms and his personal emblem of a white hart chained with a crown around its neck. The hart is a stag, an animal much like a reindeer and is shown as an emblem on the shoulder of each angel.

Outside surface of the diptych

It is not known who painted the Wilton Diptych; artists from England, France, Italy and Bohemia have been suggested. Many of the earliest paintings of this type cannot be linked with a specific artist. The practice of signing a finished painting was not widespread before the late 1400's. It would probably not have occurred to the majority of earlier artists to put such a personal stamp on the object that they had created particularly if it was be used in religious devotions.

The status of the person creating a work such as this was that of highly skilled craftsmen who usually worked collaboratively with others. All painters trained as part of a studio run by a master artist who was registered with the local trade guild. Master artists might also work with associates of similar status as an efficient way to pool different talents. Paintings were rarely therefore the result of one "hand" alone. Their makers did not see themselves as unique individuals in the way that artists have done in later years especially since the 19th century. Where one artist or studio seems to have been responsible for a group of pictures the maker is often referred to as 'Master', followed by either the subject or location of their most notable work, for example the Master of St Giles .

The Wilton Diptych is a work in the "international" style that developed at the end of the Gothic era—the end of the Middle Ages. It is an outstanding example of egg tempera painting in which pigments were mixed with egg yolk or egg white as a binder. As this work shows skilled hands could depict extreme detail and subtle shading and coloration with this medium even though it can be difficult to work with since it dries very quickly.

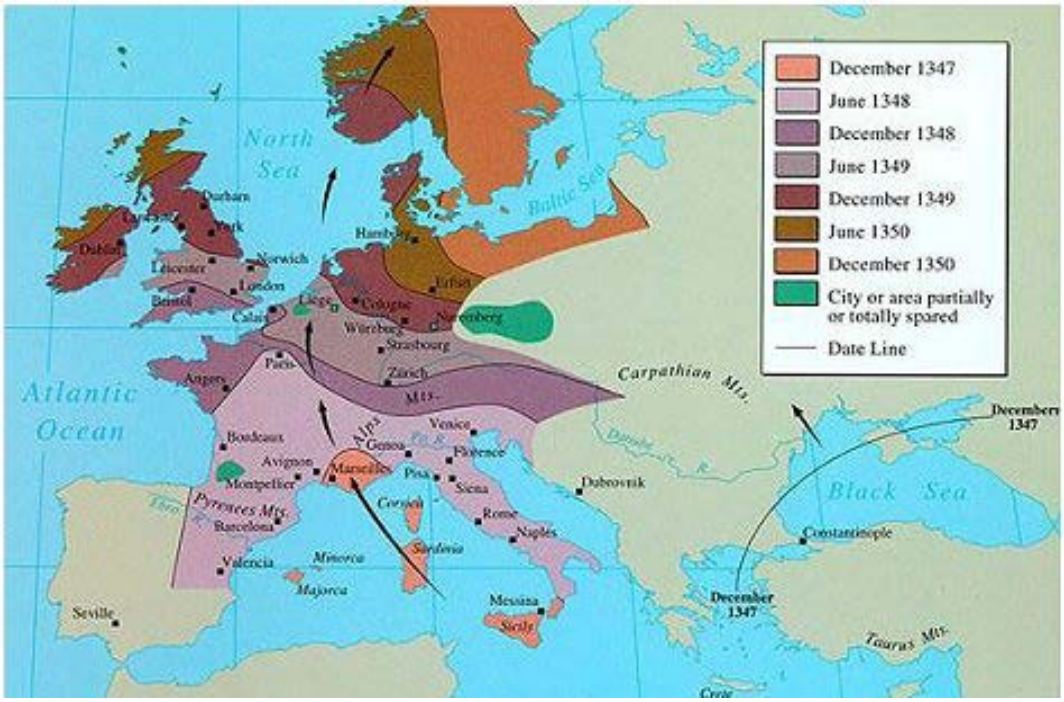
This elaboration of the Wilton Diptych was drawn from several web resources including the web site of the National Gallery of England in Trafalgar Square, London, the entire collection of which is viewable online. Tempera painting is still actively pursued by the Society of Tempera Painters which also provides a web site exploring this medium. Explore these links:

The European Black Plague of the 1300's

The Black Death was one of the worst natural disasters in all of history. In AD 1347 a great plague swept over Europe and ravaged cities causing widespread hysteria and death. One third of the population of Europe died, over 25 million people. The primary culprits in transmitting this disease were fleas carried on the back of black rats brought into the Italian ports of Europe on trade ships from the east. But people did not know that cause and assumed that somehow God was sending punishment—but why?

The "danse macabre" (the dance of death) became a common theme in Europe in illustrations like this example during the late 1300's and onward for a century or more. Because the plague affected everyone it was a great equalizer. As images of these type show, the rich as well as the poor, royalty and high church officials as well as peasants, all were taken in agony by death, depicted here as skeletons dancing happily as they lead their suffering victims to the grave.

The plague was carried to Europe by rats and fleas on trading ships from Asia, entering in Sicily and Marseilles in 1347. It progressed between 1347 and 1350 to Northern Europe:



Here is what some writers of that era said:

> *Neither physicians nor medicines were effective. Whether because these illnesses were previously unknown or because physicians had not previously studied them, there seemed to be no cure. There was such a fear that no one seemed to know what to do. When it took hold in a house it often happened that no one remained who had not died. And it was not just that men and women died, but even sentient animals died. Dogs, cats, chickens, oxen, donkeys sheep showed the same symptoms of the same disease and died. And almost none, or very few, who showed these symptoms were cured.*
>
> -Marchione di Coppo Stefani

> *It struck me very deep this afternoon going with a hackney coach from my Lord Treasurer's down Holborne, the coachman I found to drive slower and slower, at last stood still, and came down hardly able to stand, and told me that he was suddenly stuck very sick, and almost blind, he could not see. So I left him and went into another coach with a sad heart for the poor man and trouble for myself lest he should have been struck with the plague, being at the end of town that I took him up; But god have mercy upon us all! It was dark before I could get home at Churchyard, where to my great trouble I met a dead corps of the plague in the narrow ally just down a little pair of stairs.*
>
> -S. Pepys

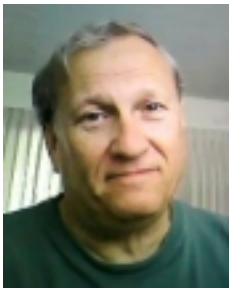
> *Realizing what a deadly disaster had come to them the people quickly drove the Italians from their city. However, the disease remained, and soon death was everywhere. Fathers abandoned their sick sons. Lawyers refused to come and make out wills for the dying. Friars and nuns were left to care for the sick, and monasteries and convents were soon deserted, as they were stricken, too. Bodies were left in empty houses, and there was no one to give them a Christian burial.*
>
> -Unknown

> *How many valiant men, how many fair ladies, breakfast with their kinfolk and the same night supped with their ancestors in the next world! The condition of the people was pitiable to behold. They sickened by the thousands daily, and died unattended and without help. Many died in the open street, others dying in their houses, making it known by the stench of their rotting bodies. Consecrated churchyards did not suffice for the burial of the vast multitude of bodies which were heaped by the hundreds in vast trenches like goods in a ships hold and covered with a little earth.*
>
> -Giovanni Boccaccio

People's attitudes towards music and art changed as they began to see the depressing situation surrounding them. The horrible nature of the Black Death was reflected in realistic depictions of human suffering and carnage and the symbolic use of the skeleton. During the Black Death music was played very grimly or never played at all. The change in art and music demonstrated the grim reality of the world.

(Much of the information here was extracted from a web site focused on the insect that carried the plague, http://www.insecta-inspecta.com/fleas/bdeath/Black.html. This web page now no longer exists, at least at the original web location.)

Project 2



A multi-part, hands-on project designed to make many of the highlights of art technology of the Middle Ages **REAL** to you!

This project has **three required parts**:

1. Exploring historiated initials
2. Designing and coloring a 12-petal rose window
3. Creating two Celtic knots

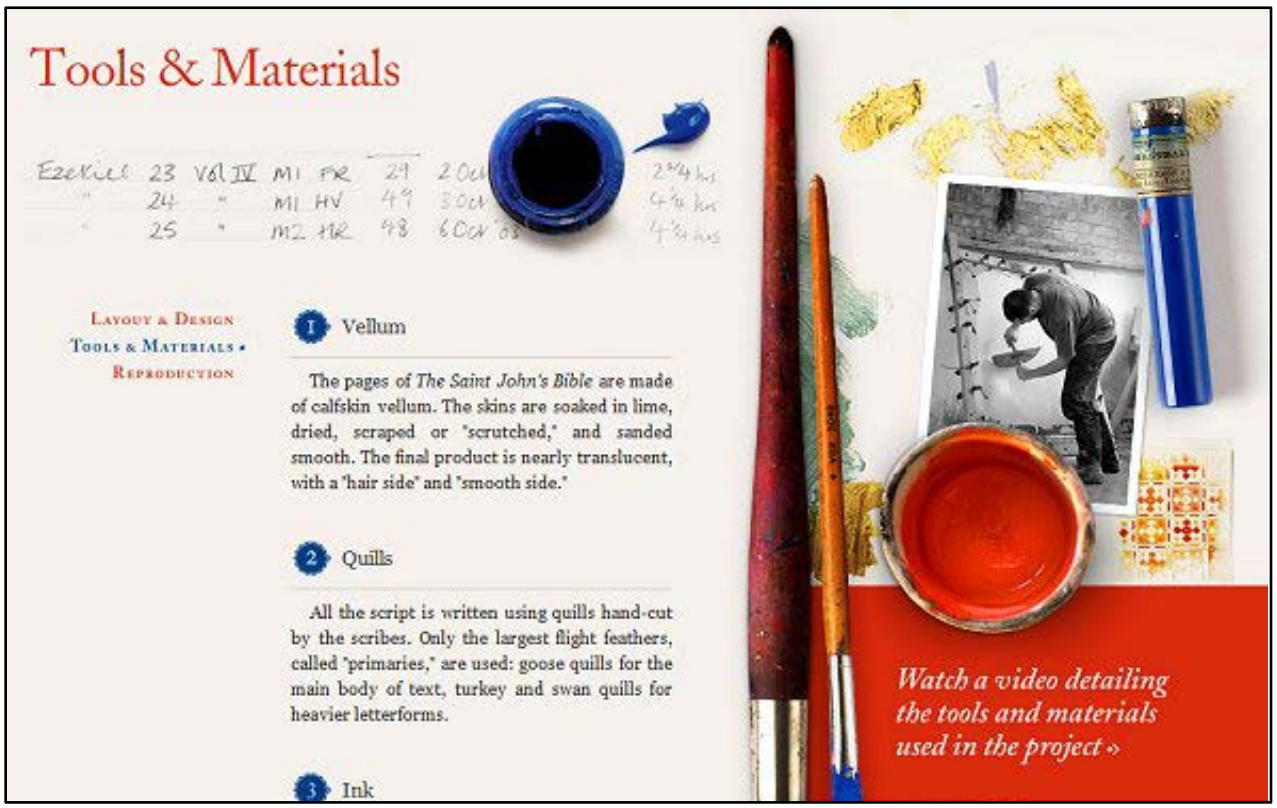
In addition, an optional extra credit item is available to you: creating a 32-petal rose window design.

I have carefully designed and documented the parts of this project so that each part should be easy to follow. Each of the parts is equipped with one or more web resources such as brief readings or tutorial videos. You can submit the different parts of this project separately; there's no need to hold onto the separate parts to submit them all at once. Contact me if you have any questions or problems! ☺ Jim

Project 2 Part 1: Exploring historiated initials

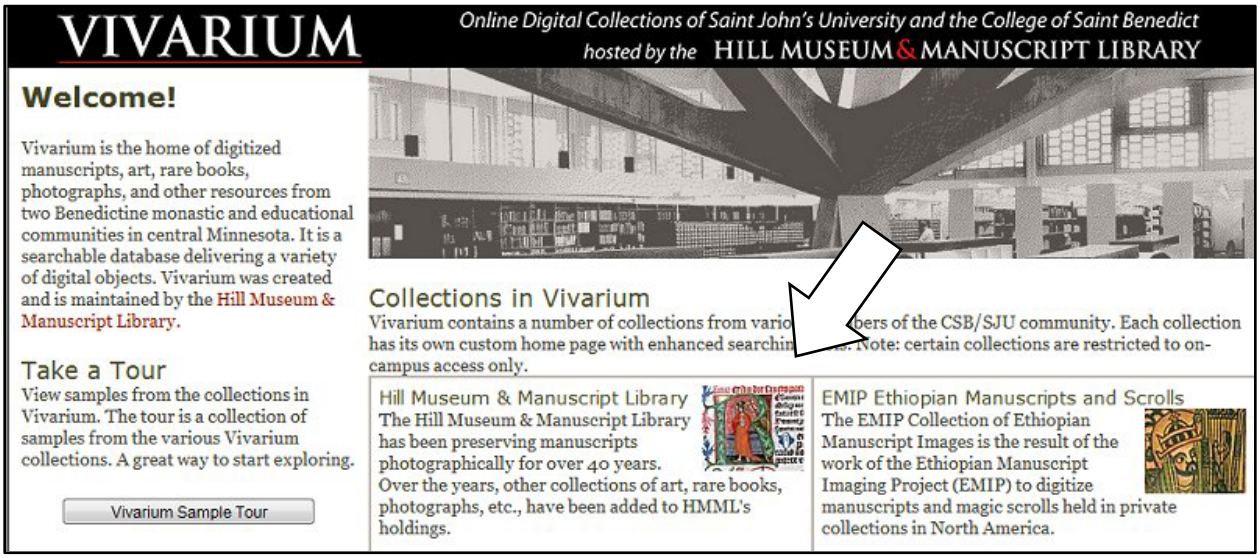
One of the primary tasks of many monasteries in the Middle Ages was the hand-writing of the bible to create additional copies and to replace copies as they deteriorated and became unusable. Since the movable-type printed press was not invented until centuries later, hand-copying was the only way to create these kinds of "manuscripts." You see here a small part of a manuscript, decorated or "illuminated" with the first letter of the first word of a new paragraph. The colors are vibrant even after several hundred years because, as Ernst Gombrich points out, they are protected from light and air simply because when a book is closed it naturally protects the pages. In addition, illuminated manuscripts were usually written on parchment or vellum, which is calf's skin that has been soaked in lime, stretched, dried, scraped, then sanded smooth (vellum is an especially fine quality grade of parchment). These pages don't deteriorate as would paper.

Start this project by visiting the web site pictured at the left, which is a part of the site of the St. John's Bible Project. This is a major effort to create a modern hand-copied and illuminated bible. The link for this site is located on the Unit 2 web page, via **`http://bit.ly/gph205-info`**.

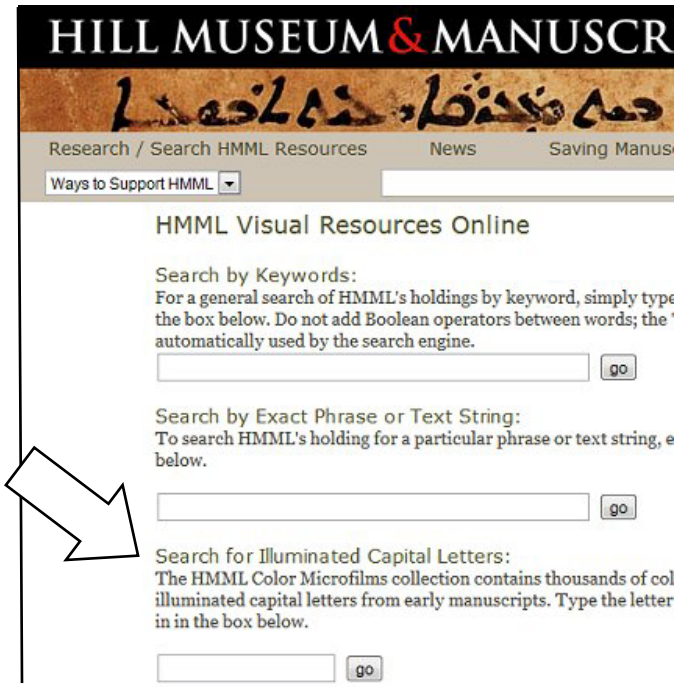


What to do for Project 2 Part 1

In this part of the assignment you'll visit an archive of tens of thousands of digital images of historiated initials of St. John's University and the College of St. Benedict, maintained by the Hill Manuscript Museum and Library. This online archive is accessible at `www.hmml.org` for which a QR code is located below. At this site you want to search for the "vivarium" (Latin, "place of life"; an area, usually enclosed, for observation). At the vivarium page, which appears as below, you click on the historiated initial near the center where I have pointed an arrow:



This will take you to a page where you can search for illuminated capital letters. Find five examples of illuminated initials for the first letter of your last name. Copy each to a separate page or PowerPoint slide, and also copy the title, description, and date (century). Include that information on the page with the image of the historiated initial. Label these five pages (or slides) with your name and submit them for grading as a part of Project 2. Then make sure you go on to parts 2 and 3 of this project!



Project 2 Part 2: Design a 12-petal rose window

As cathedral building progressed in the Middle Ages, bulky, thick-walled Romanesque cathedrals with rounded arches and small windows gave way to Gothic designs. In the design of a Gothic cathedral, thinner walls became possible as architects learned how to support a structure with external "flying buttresses" to withstand the forces otherwise handled by the wall. This made it possible to open up more of the wall for windows to let in light, which led to the refinement of two technologies: stained glass and rose windows. Colored glasses had been made even as early as a thousand years before Christ by the Egyptians, who had discovered that minerals added to molten glass could color it blue. By the Middle Ages craftsmen had learned to add minerals to molten glass to color it various shades of red, blue, green, yellow, amber, brown, blue, pink and purple. Images and designs were formed from pieces of colored glass held in place by lead channels and iron frame, to be fitted into wall openings.

Here you will create your own design for a **12-petal rose window** similar to this rose window from Lyon Cathedral in France, built in AD 1240-50. You'll use just a compass and straightedge to lay this out. View my tutorial video showing you step-by-step how to create a rose window design at the Unit 2 web page:

1. Create a circle 6 inches in diameter
2. Using only geometric operations, divide it into 12 equal segments. Leave all your working lines and marks in place, don't erase them!
3. Insert one or two concentric inner circles.
4. Insert "petals" or interior circles as I indicated in my video tutorial.
5. Use the link at the Unit 2 web page to view several actual stained glass rose windows in French cathedrals. After this exploration color your completed rose window in a way that emulates the coloration and color scheme of a typical rose window.
6. Submit a photo of you holding your finished rose window for grading.

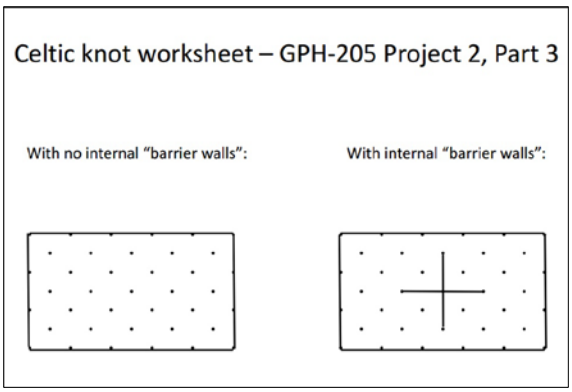
Project 2 Part 3: Creating Celtic knots

Celtic knots are a variety of stylized graphical representations of knots forming decoration, used extensively in the Celtic style of insular art. These knots are most known for their adaptation for use in the ornamentation of Christian monuments and manuscripts, such as the 8th-century ***St. Teilo Gospels***, the ***Book of Kells*** and the ***Lindisfarne Gospels***. The vertical part of this Celtic cross is decorated with Celtic Knots. Most Celtic knots are endless and many are varieties of basket weave knots.

In this part of Project 2 you'll explore the background of this decorative form and will create two hand-drawn Celtic knots of your own design. Follow these steps:

1. Access the short web site reading and three short videos at the web link for this page on the course web site Unit 2 page. The reading gives you background on Celtic knots and the first video is a tutorial on how to create a simple Celtic knot. The additional videos show you a more complex Celtic knot with internal "walls" some of the work of a Celtic knot "addict" including a time lapse (sped-up motion) video of the creation of a large knot and demonstrates how it really is continuous.
2. Download the worksheet from the link for this work at the Unit 2 course web page.
3. Using the first dot pattern on the worksheet create a simple Celtic knot with no internal "walls" (the term is defined in the first video mentioned in Step 1).
4. Color the band in your simple Celtic knot with a light color such as yellow or green or pale blue (not a vivid color such as the red in the video in the third video, which is such an intense color it obscures the knot pattern).
5. Using the second dot pattern on the downloaded worksheet create a second Celtic knot using your dot pattern with internal walls. When you have done that color it with a different color from your first Celtic knot.
6. Photograph both of your Celtic knots with your face visible in the picture and submit it to the dedicated course e-mail address for grading.

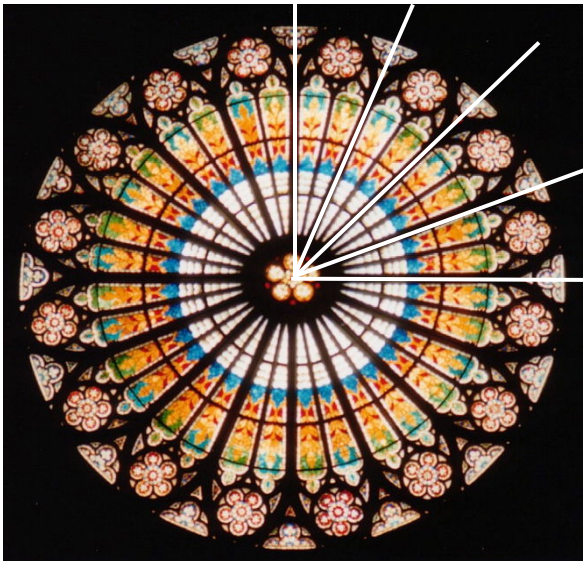
Here is a miniature illustration of the worksheet you download for this part of Project 2. Download the full sized worksheet from the link at the Unit 2 web page



Extra credit 2: A 32-segment rose window!

Dividing a circle into six equal segments using a compass is easy; you just draw the circle and then strike arcs with the compass (at the same setting) starting at any point on its circumference and continuing to strike arcs around the circle using each strike point for the center of the next arc. You then connect opposite points and you have six equal segments. You can repeat the process for any multiple of six segments.

Now examine this picture of a rose window at Strasbourg Cathedral in France. Notice that it contains 16 major segments. This is not a multiple of 6. Dividing a circle into 16 segments requires using more and different geometric manipulations.



To complete this extra credit, do this:

1. Use a compass to draw a circle about 6 inches in diameter on a sheet of paper.
2. Think through the geometric operations you can perform to divide this circle into exactly 16 perfectly equal pie-slice shaped sectors. Then use those operations to divide the circle into 16 segments **and leave all of your working lines visible.** Some of the same geometric operations you did in forming the Golden Rectangle in Unit 1 will be helpful to you but the Golden Rectangle itself has no relationship to a rose window.
3. Once you have completed the development of your circle divided into 16 equal segments, take a digital picture of it **with working lines visible. Keep this image because you'll do more with this rose window but I need to see the working lines at this stage!**
4. Write a set of step-by-step instructions that can be used by another person to do the same thing you did to divide the circle into 16 equal segments. This should be a simple list of actions entitled "How to divide a circle into 16 parts using geometry."
5. After taking a picture of your circle divided into 16 segments, continue working with it to divide it into 32 equal segments.
6. Insert three large inner circles centered on the center of the original circle as you see in the window illustrated on this page, proportioned in a similar way.
7. Insert a ring of 16 smaller circles between segments around the outer edge, as you see in the window pictured here.
8. Using colored pencil, crayons, or water colors recreate the coloring of your window in a similar way to the Strasbourg Cathedral window pictured here.
9. Take a digital picture of your completed 32-segment colored rose window.
10. Submit the digital image from step 3, your instructions from step 4, and the digital image from step 9 for grading.

Unit 3 – Renaissance and Reformation

Renaissance means "rebirth." What was reborn, starting in northern Italy about AD 1300, and lasting until about AD 1550? During this time Europe emerged from the "Dark Ages" in which much of the knowledge and artistic skill of the ancient world was rediscovered and extended. Artistry turned from telling religious stories in the simplest possible way to developing the tools and techniques to portray three dimensional things in the two dimensions of the painter's canvas. As Gombrich says at the start of chapter 17 of ***The Story of Art,*** the great Renaissance masters—Donatello, Da Vinci, Michaelangelo, and Raphael—produced three major accomplishments:

- the development of five scientific perspectives
- knowledge of human anatomy rivaling the knowledge of the ancient Greeks
- the rediscovery and resurrection of Greek and Roman architectural forms.

Coupled with the invention of oil as a binder for artistic paints, the accomplishments of the Renaissance set the stage for the art and philosophical thought for western civilization down to the present day.

The revolution in Western religious thought, the Reformation, was a rebirth of an earlier development. In the 1200 years since the adoption of Christianity by the Roman Empire under Emperor Constantine in AD 312, the church had grown into a large organization with massive wealth (much of it by donation of lands and money as legacies) with a vast hierarchy of officials leading up to the pope, the bishop of Rome. The church regarded itself as the interpreter of Christianity for its members. The bishops of the church, with the bishop of Rome as its head, was known as the ***majesterium***, claiming investiture by Christ through the apostle Peter as the gateway for man to God. This was challenged in the early 1500's in a revolt that had both religious and political dimensions. The result was that some areas of Europe broke away from the Church of Rome as protesters—"protestants." Protestants looked to the bible and Christ as the human connection with God. As we'll see, this split had consequences for art because the church had for over a thousand years been the largest commissioner of the creation of art.

Assigned reading and viewing

1. ***The Story of Art***, chapters 12 through 18
2. ***History of Visual Technology, 4th edition,*** Unit 3 (this chapter)
3. **Lecture and supplementary videos**; links provided on the unit web

Work due

1. **Unit Summary Form 3**
2. **Project 3** Exploring egg tempera, font and color use
3. *Extra credit:* Typography

GPH-205 Unit 3 Summary Form (USF3) Page 1

THIS IS BOTH A STUDY AID AND HOMEWORK ASSIGNMENT. Use a printed copy of this page for hand-written notes that you prepare as you accomplish the required reading and viewing. Put concise phrases in the boxes, not sentences! *Then download the editable .docx or .rtf copy of this form from the link on the course Unit 2 web page and type in your responses.* ***DO NOT COPY AND PASTE FROM TEXT OR WEB SOURCES.*** *The boxes for your responses on this form will automatically expand as necessary.* ***Submit your word-processed document NOT a scanned copy of your hand-written responses!*** *This work is integrated with your reflective essay and take-home final exam. The facts you gather form the basis for your essay and the Conclusions Work.*

Civilization/Art movement	Art purpose(s)	Art formation rules	Art technologies	Their art's impact on our modern life
Early Renaissance (up to 1400)				
Northern European Renaissance in the 1400's				
Tuscany and Rome in the 1500's				

GPH-205 Unit 3 Summary Form (USF3) Page 2

THIS IS BOTH A STUDY AID AND HOMEWORK ASSIGNMENT. Use a printed copy of this page for hand-written notes that you prepare as you accomplish the required reading and viewing. Put concise phrases in the boxes, not sentences! *Then download the editable .docx or .rtf copy of this form from the link on the course Unit 2 web page and type in your responses.* ***DO NOT COPY AND PASTE FROM TEXT OR WEB SOURCES.*** *The boxes for your responses on this form will automatically expand as necessary.* ***Submit your word-processed document NOT a scanned copy of your hand-written responses!*** *This work is integrated with your reflective essay and take-home final exam. The facts you gather form the basis for your essay and the Conclusions Work.*

Civilization/Art movement	Art purpose(s)	Art formation rules	Art technologies	Their art's impact on our modern life
Late Renaissance in Venice in the 1500's				
Northern Europe in the 1500's				
The Mannerist era				

A summary of perspective techniques

In art, ***perspective*** is synonymous with depicting depth. Paintings, sketches, printed illustrations and photographs are all two-dimensional objects. They have width and height but are essentially flat surfaces with no appreciable third "receding" dimension. Yet many artists want to depict things in such as way as to have our eyes "see" the third dimension. To accomplish this artists of the period immediately preceding the Renaissance, and during the Renaissance itself, began to experiment with techniques that would make it appear to the eye as if a two-dimensional depiction really did have the third dimension of depth. Here is summary of these techniques; ***you will find this summary very handy for Project 4 in the next unit!***

Positional perspective

Positional perspective is the simplest perspective technique but it's easy to overlook. It was the first technique of perspective that artists such as Giotto di Bondone (1267-1337) pioneered. This consists simply of conveying a sense of depth by placing some objects in front of others, allowing some parts of the object behind to be obscured by the object in front.

Light perspective

The technique of light perspective is also known as ***chiaroscuro***, the gradual shading of a circular or spherical surface when it is illuminated on one side by a light source. For example, the shading on a tennis ball in bright sunlight reveals its three dimensional shape to the eye: the sunlit side is brilliant and the ball shades gradually to the dark side. Artists of the Middle Ages had a idea of this, as seen in the shading of faces or objects in manuscript illuminations.

Linear perspective

The technique most commonly associated with producing the illusion of depth, an understanding of linear perspective was pioneered by Filippo Brunelleschi (1377- 1446) in the 1400s. Once you understand how linear perspective works, to prepare a drawing you draw lines receding to a point first, and then use them to map out the way that objects appear to gradually grow smaller in size in an orderly way as they become more distant. This seems simple to us now but it was revolutionary to artists of the Renaissance. See the next page for much more on this topic!

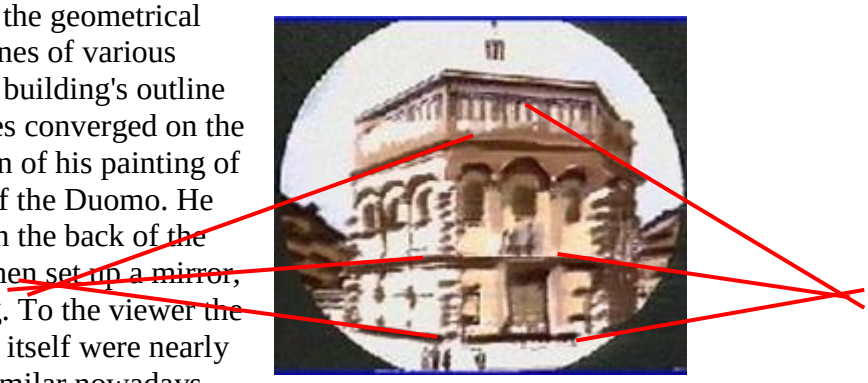
Atmospheric perspective

In outdoor scenes things in the distance appear to take on a bluish cast. The farther away they are the bluer they appear. This is due to the way the molecules and particles in the earth's atmosphere scatter the shorter (blue) wavelengths of light. This is also why the sky appears blue both on the surface of the Earth and when Earth is viewed from space. Technically this is known as Rayleigh scattering. An outdoor scene seems to have depth if the distant parts of the scene are pictured with a bluish cast since our eyes and minds are conditioned to this effect.

Focus perspective

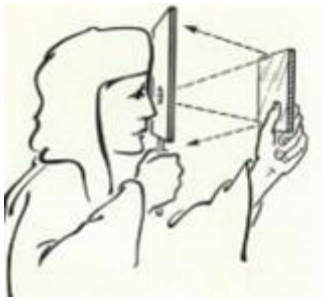
Objects closer to us appear with more detail than objects that are far away. If all parts of a scene are painted with a high degree of detail the painting looks "phony." To give a scene the illusion of depth a skillful artist will make objects in the distance a bit fuzzier. Don't confuse this though with ***sfumato***, and intentional bluring of some facial features close up, which is done for an entirely different purpose (to introduce uncertainty of emotion into a portrait).

Linear Perspective History and Use



In 1415 Filippo Brunelleschi demonstrated the geometrical method of perspective by painting the outlines of various Florentine buildings onto a mirror. When a building's outline was continued he noticed that all of the lines converged on the horizon line. He then set up a demonstration of his painting of the Baptistery in the incomplete doorway of the Duomo. He had the viewer look through a small hole on the back of the painting, facing the Baptistery. He would then set up a mirror, facing the viewer that reflected his painting. To the viewer the painting of the Baptistry and the Baptistery itself were nearly indistinguishable.[1] We can do something similar nowadays using a photograph of a scene.

Soon thereafter nearly every artist in Florence used geometrical (linear) perspective in their paintings. Donatello started sculpting elaborate checkerboard floors into the simple manger portrayed in the birth of Christ. Although hardly historically accurate these checkerboard floors obeyed the primary laws of linear perspective: all lines converged to a vanishing point and the rate at which the horizontal lines receded into the distance was graphically determined. This became an integral part of Quattrocento (1400's) Renaissance art. Not only was linear perspective a way of showing depth it was also a new method of composing a painting. Paintings began to show a <u>single unified scene</u> rather than a combination of several scenes.



To sum up: before this understanding of linear perspective artists simply did the best they could in picturing a scene in which distance was involved, such as a landscape. They composed their paintings according to rules of symmetry, rules dictating that the most important object be placed in the center or closer to the viewer than any other, and in "stock" ways with traditional poses more or less going by guesswork on how objects in the distance looked smaller. When linear perspective began to be understood an artist would first sketch a horizon line and vanishing point and lines converging to it and would then sketch in the placement of figures and objects sizing them according to the lines to the vanishing point. This would produce a more realistic-appearing composition. Quite often the effect was made explicit by including a floor composed of square tiles, a ceiling composed of tiles, or the rather artificial placement of long objects such as swords or spears pointing toward the vanishing point. Look at the fast-moving 2 minute animated video and you will see exactly how an artist who knows about linear perspective uses it to create an accurate sketch before applying paint to the scene.

[1] Images here are from: http://www.kap.pdx.edu/trow/winter01/perspective/ (accessed 2/1/2008)

Trompe l'oeil: illusions with linear perspective[1]

Trompe l'oeil (French for “trick the eye”) is an art technique involving extremely realistic imagery in order to create the optical illusion that the depicted objects appear in three dimensions instead of actually being a two-dimensional painting. Here are some examples of trompe l'oeil artworks. At right is the oculus (hole in the center of a dome) on the ceiling of the Spouses Chamber in the castle of San Giorgio in Mantua, Italy, painted by Andrea Mantegna before AD 1500. It looks as if there actually is a hole here looking out to the sky and people looking in but it is really just painted on the center of the dome.

Here’s another example, a before and after view of the Saint-Georges Theatre in Paris. You can see that the building has a bland wall with a few odd windows openings. The same building is pictured at the right with various architectural features just painted on. Yet especially at a glance the building looks as if those painted features are real! Trompe l'oeil type is always something of a practical joke.

A dramatic example of Baroque trompe l'oeil art at the lower right is a portion of the ceiling of Rome's Jesuit church of Sant'Ignazio painted by Andrea Pozzo between 1685–1694. This is Pozzo’s masterpiece, with hundreds of figures that seem to be suspended in space in various poses of activity. A person sitting in this church is completely fooled by the expert use of linear, atmospheric and light perspective and the sense of depth is acute.

[1] This material was extracted from Wikipedia at http://en.wikipedia.org/wiki/Trompe-loeil. Find more information about the trompe l'oeil art of Andrea Pozzo at http://en.wikipedia.org/wiki/Andrea_Pozzo.

Julian Beever is an English artist famous for his trompe l'oeil sidewalk art created in chalk on pavements in England and around the world. Using chalk and a creative imagination Beever creates works that looks 3D only from the **correct position** using a projection called **anamorphism** that creates the illusion. Many people have speculated that his work as pictured on the internet is a result of digital photo editing but the images really are authentic street art. He projects an image onto the surface of the pavement at an oblique angle as a guide to drawing. Notice that phrase "correct position" in the paragraph above. As with a photograph, linear perspective can replicate what the eye sees. But unlike the real three dimensional world, a painting composed using linear perspective techniques (or a photograph) is locked into one perspective position. You can move around the painting or photograph and the view doesn't change as it would if you moved around a real three-dimensional object or scene. This doesn't matter much for a painting on a museum or church wall, but it does for a painting on a sidewalk where you can stand in front of, on the side, or behind it! The Beever flat pavement drawings here must be viewed from the position in which the linear perspective was composed or else the image is complete distortion.

The drawing of a globe at left looks fine from the correct position. But seen from the side, which is not the position from which the linear perspective was developed, the globe looks like it was made of dough and run over by a rolling pin! Beever also makes excellent use of light perspective (chiraroscuro) on the globe by making the top bright and the lower part shade off to darkness, enhancing the perception that the shape is round, and he puts a shadow under it.

Similarly, the picture below seems to look real as viewed in the photo on the left, but when you walk around it to view it from behind it makes no sense whatever—you can see that the pool has no depth and that the raised leg is really about 20 feet long. It is stretched out to give the same information to your eyes that a real leg would give if it were present and being viewed in front! See more of Beever's unique art at his web site, the link is on the unit web page for this page.

Who is watching and what does He see?

Examine the images and read the text above. Give it some thought. Are you "intimidated" or affected by someone looking at you? For myself, I have to say that it creeps me out to look at those eyeballs staring at me. These days the effect might even be heightened because we all know that video surveillance cameras are present in many stores and public locations so we may think that a picture with eyes like that is just a visual warning about the cameras—"someone is watching." But isn't that exactly the same as with many of the religious artworks and church decorations we have seen leading up to the Renaissance?

The next page is entitled "A thinking and discussion reading on perspective." You should become familiar with the notions expressed on that page, which is an extract from a writing by Christopher Small. That brief extract also deals with the way people look at things and how they think things should be observed.

In his writing Small gives a lucid description of several differences in orientation and outlook of people before and after the Renaissance and the effect of these differences on art. He proposes an explanation for the differences and how and why the thinking of artists changed. These are interesting and important ideas. You should be familiar with them and should consider drawing on these ideas as a resource in your reflective essay.

Why didn't perspective develop earlier?

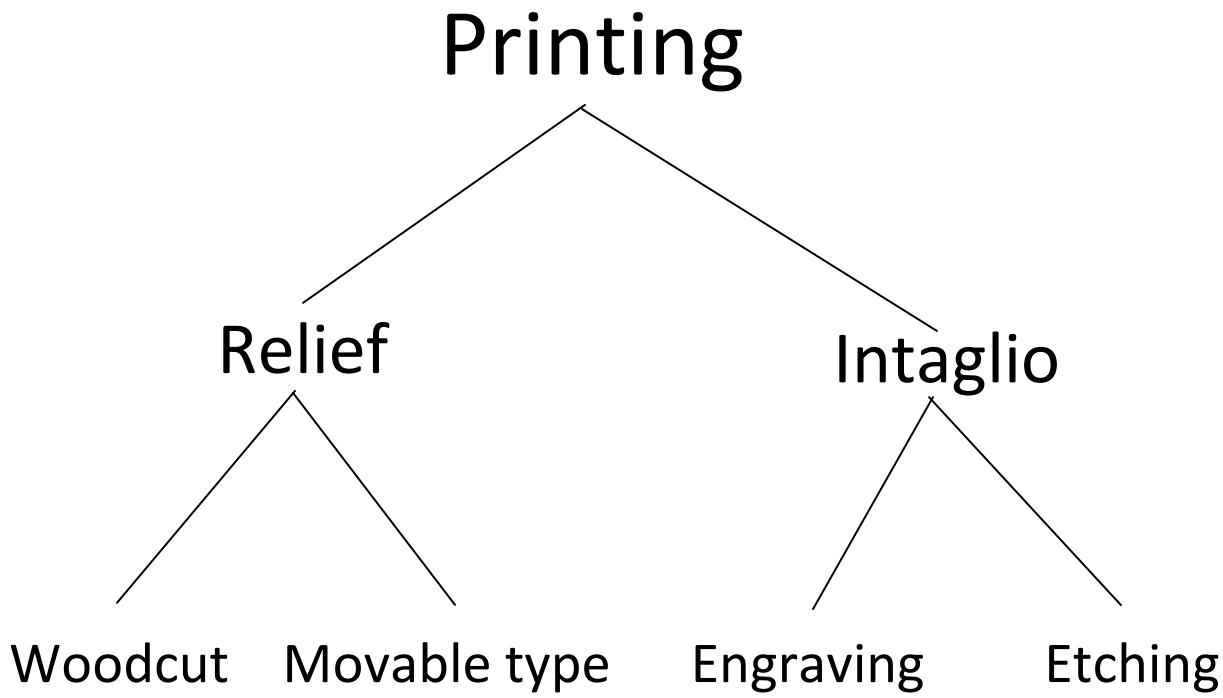
This reading is an excerpt from a book entitled ***Music, Society, Education*** by Christopher Small.[1] His book is a study of music as a social force; he reexamines assumptions about western classical music often taken for gradnted by people in modern society. In this excerpt from chapter 1 Small theorizes why the development of perspective did not occur earlier than the Renaissance. He summarizes his point of view about the differences in orientation between the medieval and Renaissance mind. Read this excerpt and see if Small's contentions parallel or differ from those of Gombrich in ***The Story of Art***.

> Europe in the centuries before the Renaissance was an oral, mainly non-literate communal culture, not so very different in style from the rest of the world. It was around the middle of the fifteenth century [1400s] that our culture began to reveal those new attitudes and concepts, ways of feeling, seeing and hearing, that were to cut Europe off from the rest of mankind and make her culture, including her music, unique.
>
> The changes are a familiar matter of history: the growth of humanism and individualism, the questioning of the theocentric world, and the desacralization of nature which gave rise to the scientific worldview, the "invention" of man as a private individual—the last possibly associated with the contemporary development of printing and the rise of the printed book. These changes became visible in painting as far back as Giotto in the thirteenth century [1200s], long before they became audible in music.
>
> **The medieval painter had seen his subject matter as it were under the eyes of God, who sees everything, to whom all events are simultaneous, and he gave expression to a communal, rather than a personal, consciousness.** Thus we might have a painting of a city in which all its features are depicted in a way which would be impossible for an individual standing in a single spot to see, but which might be said to represent God's view, as well as the whole community's experience, of the city. As long as painters took such an attitude perspective did not develop, not because painters were not capable of it but because it was of no use or interest to them as a technique. Similarly, we might see the representation of the life of a saint, in which his birth, several miracles, his martyrdom and his apotheosis are all contained within the single visual field. This can be taken as representing not only the combined vision of all who knew the saint, the communal experience, but also the divine, timeless, god's-eye-view of his life, in which all events are, not foreordained, but simply simultaneous. (The painter was so little concerned with the individual experience that the picture was usually unsigned.)
>
> **The post-Renaissance artist, on the other hand, saw his subject as if through the eye of a single spectator, in a particular spot at a particular instant.** Perspective, the placing of all the elements of a picture in logical relation to one another and to a "vanishing point", assumes that we look through the eyes of man rather than of God, the individual rather than the community, while **the instantaneousness of the painter's vision speaks of a concept of time very different from the medieval**. Man the individual, living in time, has displaced God, living in eternity, from the center of the universe.

[1] Small, Christopher (2011-02-15). Music, Society, Education (Music Culture) (Kindle Locations 351-354). Wesleyan University Press. Kindle Edition.

The four printing processes of the Renaissance

Two major types of printing were available to artists of the Renaissance period. Only the woodblock and intaglio processes were useful for the production of art. Here is how these processes naturally group according to the way they work.



Relief printing means that the surface is cut away for areas that are not intended to pick up ink and transfer it to paper—those areas are "relieved." The woodcut is prepared by an artist as a left-to-right reverse image by carving out the relief areas, inking the surface, and then pressing the block to paper. Movable type is usually cast in soft metal with the letter shapes raised.

Intaglio printing involves the relieved area carrying the ink to the paper. With engraving, score lines are scratched by hand in the flat surface of a metal plate. With etching, the metal is coated with wax and the wax scratched away so that acid can be used to eat away exposed metal forming ink-carrying lines. The ink in the score lines transfers to the paper when paper is pressing on the plate.

Fonts: different appearances for same letters

As Bruce Jones has written, *"In 1452, Johannes Gutenberg conceives of the idea of movable type. In his workshop, he brings together the technologies of paper, oil-based ink and the wine-making press to print books. The printing press is not a single invention. It is the aggregation in one place of technologies known for centuries before Gutenberg"*. Gutenberg's invention led to the possibility of standardization in the way the letters of the alphabet are formed. Prior to this time the style of script of manuscripts depended a great deal on the skill and hand of individual scribes or calligraphers. Letters themselves could be and often were regarded as artwork! The first "fonts" (families of letters in the same style) used by Gutenberg are now called "Blackletter" and look like the first line below:

Blackletter:

Old English:

Trajan:

Garamond:

Line 1 may seem hard to read! Font styles were progressively streamlined; the second line above shows an "old English" style and the third is a style derived from Latin inscriptions like those on Trajan's Column. The fourth line is close to the modern "Times Roman" font you are now reading. Arial, a sans-serif (without little "feet") font, looks like this with normal intensity or **like this** if "bold". Font size is measured in "points," with each point being 1/72 of an inch (in other words, 72 point type is one inch high).

The number of different fonts now numbers in the tens of thousands and new typefaces are still being designed. As Carlos Segura and others have pointed out, the appearance of a font can alter the intent of a message, and some fonts can in themselves represent works of art. Fonts available in modern word processing software on computers making fonts as varied as these and many others readily accessible:

Comic Sans Baskerville Old Face French Script **Bauhaus**

Printing processes used to produce artworks

Relief and intaglio printing processes flourished in parallel from the Renaissance onward. Let's consider some of the details and capabilities of each process.

Relief printing (block printing and movable wooden type)

Starting with a flat block of material, usually wood an inch thick, an artist carves away material to leave at the original surface level only the areas that are intended to print. A greasy oil-based ink is then rolled onto the raised surfaces then paper is pressed flat against the block with moderate pressure. The ink is thus transferred to the paper only where the block material was left uncarved. The image transferred to the paper is reversed from left to right from the original carving. Moderate detail is possible as in this German woodcut from the 1400s but not very fine lines because carving away as much material as is required for a fine line leaves the raised area too weak to survive much printing pressure. The woodblock can last for several hundred impressions but eventually begins to wear out at the finer (narrower) raised areas are crushed by the repeated printing pressure.

Intaglio printing (engraving and etching)

Intaglio printing processes include engraving and etching. In both of these processes grooves are formed in the surface of a flat metal plate. With engraving the lines are scored by an artist using a hand tool called a burin, a pointed rod of hard metal. With etching, the metal plate is first coated with wax and the artist scores lines in the wax, opening grooves that expose the surface of the metal. After all lines representing the image are scratched in the wax acid is poured onto the plate and eats away some of the metal exposed by the grooves (the wax is not affected by the acid). After the acid bath the plate is removed, washed and dried, and the wax is melted away. The effect of both engraving and etching is to produce a metal plate with lines that can "catch" and hold ink. To print, oil-based ink is rolled onto the plate then the plate is wiped with a flat absorbent surface. This leaves the ink only in the grooves. Paper is pressed with high pressure onto the plate. The parts of the paper over the grooves sink into them and pick up ink.

Engraving and etching produce much finer lines than relief printing blocks, as you can see in this engraving by Israhel van Meckenam of him and his wife in the late 1400s. The shading is accomplished by carrying the width or spacing of the lines scored in the metal. The image is reversed left to right as in block printing. Engraving is used for fine artworks and documents such as paper currency that need to be difficult to copy. In addition to being capable of finer detail, intaglio printing plates can last much longer than relief woodcuts.

Additional printing processes

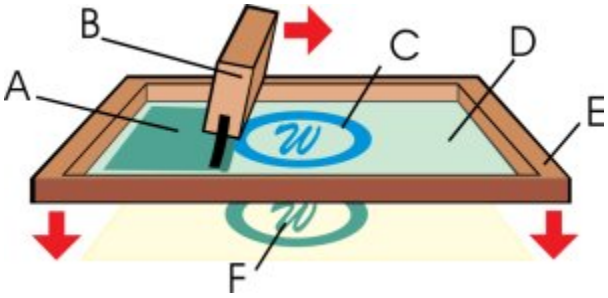
The relief and intaglio printing might be called “traditional” printing because they were in existence for hundreds of years before additional methods of printing were invented or popularized. In the 1800s additional methods of printing were developed or imported to the west.

Lithography

The lithographic printing process was developed in the 1800s and is very different than relief or intaglio printing. Here both the non-printing and printing surfaces are at the same level. This process is based on the natural repulsion of oil and water. The printing surface is a soft porous stone on which an artist draws using an oil-based substance. The stone is then dampened. Oil-based ink is applied to the entire surface but adheres only to the parts drawn on, not to the damp parts of the stone that have not drawn on. Paper is then pressed onto the stone with moderate pressure and the ink transfers to it from the parts that have been drawn on. This is how Ludwig Meidner created the lithograph here in 1918.

Silk screen printing

Screen printing is a form of stenciling that first appeared in a recognizable form in China during the Song Dynasty (AD 960–1279). It was then adapted by other Asian countries like Japan, and was furthered by creating newer methods. It was introduced to Western Europe from Asia sometime in the late 18th century, but did not gain large acceptance or use in Europe until silk mesh was more available for trade from the east and a profitable outlet for the medium discovered. In silk screen printing a fine mesh of silk (D) is stretched on a frame (E) and an artist either draws a reverse image (a negative, C) on the silk with an opaque paint or an image is formed on it using a photosensitive adhesive film and a strong light and the unexposed parts washed away. In either case the result is a mask in which the parts to print are clear silk and the parts not to print are coated with a layer impervious to ink. To print with the screen the frame is positioned on paper or cloth and ink (A) is applied to the silk and drawn across it with a squeegee (B). The frame is then lifted exposing the positive image (F). (Image courtesy Harry Wad and Wikipedia http://en.wikipedia.org/wiki/File:Silketrykk.svg)



Limitation of single-color printing

These processes are suited to printing in a single color. To produce a work in two or more colors the parts of the image to print in each color must be separated onto different woodcuts or plates. First one woodcut or plate is used to print a color, the printed material is dried, and then another woodcut or plate is used in a printing process to apply another color. The process of aligning the paper in each printing process) is error prone and many “impressions” can be ruined by misalignment (the upside down airplane on a stamp is a famous example).

Egg tempera painting[1]

Background: tempera in general

The art technique of tempera was known from the classical world and was the main medium used for illuminated manuscripts in the Byzantine world, Middle Ages, and early Renaissance Europe. Tempera painting was the primary panel painting medium for nearly every painter in Europe up to about 1500; for example, every surviving panel painting by Michelangelo was created using egg tempera.

Tempera is traditionally created by hand-grinding dry powdered pigments into a binding agent or medium, such as egg, glue, honey, water, milk (in the form of casein) and a variety of plant gums. Tempera painting starts with placing a small amount of the pigment paste onto a palette, dish or bowl and adding about an equal volume of the binder and mixing. Some pigments require slightly more binder, some require less. Distilled water may be added.

Oil paint replaced tempera as the principal medium used for creating artworks during the 1400s in the Netherlands. Around the year 1500 oil paint replaced tempera in Italy. In the 1800s and onward revivals of tempera technique have occurred in Western art among the Pre-Raphaelites, Social Realists, and others. Tempera painting continues to be used in Greece and Russia where it is the required medium for Orthodox icons.

Egg tempera

The most common form of classical tempera painting is **egg tempera**. Most often only the contents of the egg yolk is used: the membrane of the yolk is dangled over a receptacle and punctured to drain release the liquid inside. The paint mixture has to be constantly adjusted to maintain a balance between a "greasy" and "watery" consistency by adjusting the amount of water and yolk.

Pigments

Some of the pigments used by medieval painters, such as vermilion (made from cinnabar, a mercury ore), are highly toxic. Most artists today use modern synthetic pigments which are less toxic but have similar color properties to the older pigments. Even so, many modern pigments are still dangerous unless certain precautions are taken; these include keeping pigments wet in storage to avoid breathing their dust.

How it's applied

Egg tempera paint is usually applied in thin, semi-opaque or transparent layers and dries rapidly. Tempera painting allows for great precision when used with numerous small brush strokes applied in a cross-hatching technique. When dry it produces a smooth matte finish. Because it cannot be applied in thick layers as oil paints can, tempera paintings rarely have the deep color saturation that oil paintings can achieve. On the other hand, tempera colors do not change over time whereas oil paints darken, yellow, and become transparent with age. You can easily try egg tempera in a simple way by mixing egg yolk with any powdered pigment to make a thick paste, and applying the mixture to an index card using a q-tip as a simple brush.

[1] This material is extracted from `http://en.wikipedia.org/wiki/Tempera` and edited by Jim Janossy

Color technology advances in the Renaissance[1]

New pigments developed in Italy

Italians of the Middle Ages and Renaissance not only advanced art techniques but also introduced new pigments to the artist's palette. Their most important discovery was a method for extracting the brilliant blue pigment **ultramarine** from the blue mineral lapis lazuli, which contains about 10% ultramarine.

One method of extraction of ultramarine was to grind up the mineral into a fine powder and mix it with beeswax and resin. This waxy dough was kneaded in a bowl of water, releasing the blue pigment into the water while rocky grey minerals were retained in the wax. Kneading was repeated in several bowls of water to separate all of the ultramarine. The best quality of ultramarine with a bright, blue violet hue was released into the water first. Natural ultramarine was a highly prized pigment in Renaissance times and was often reserved for painting of the Virgin's mantle in religious scenes due to its high cost. The blue pigment had superior qualities, tinting strength and durability, and it continued to be the most expensive pigment until the advent of synthetically produced ultramarine.

Another pigment introduced by the Italians of the Renaissance was Naples yellow, a natural pigment found on the slopes of Mount Vesuvius. A method to manufacture it was developed about 1560. The pigment lead tin yellow, which can be prepared in a range of tones from lemon to deep yellow, was invented about this time.

Additional colored earth pigments were developed by the Italians during the Renaissance. The brown pigment umber is a mixture of iron and magnesium oxides, the name coming from the Italian “ombra” meaning shadow. **Umber** was used raw or was roasted to achieve a deep red-brown color known as **burnt umber**. **Sienna** was another natural earth pigment of yellow-brown color, composed of iron and manganese. Sienna could be used raw or after roasting in air to produce a dark brown color called **burnt sienna**.

Imported red pigments

Red was an expensive color to produce in medieval times and red clothes were an important status symbol, with the result that red dyes commanded high price. The Spanish conquest of the Mexican and Aztec civilizations of South America in the 1500s yielded the discovery of carminic acid produced by a female cochineal beetle, which produced a rich and long lasting red

[1] This writing draws much information from the multiple web-accessible references cited at in the index.

colorant. **Cochineal dye** was introduced into Europe in the late 1500s by Spanish explorers from South and Central America. Cochineal was imported into Europe in the form of the dried ground up insects. No information was provided on the source or nature of cochineal because the Spaniards closely protected their supply. In the colonial era cochineal was Mexico's second most valuable export after silver.

Dried cochineal looks like small silver-grey peppercorns or plant seeds. Before microscopes came into use European scientists argued as to whether cochineal was a plant, an animal or a mineral. Cochineal is actually a parasitic scale insect two to four millimeters in length that lives on prickly pear cactus plants (Opuntia or nopal) native to Central and South America. Scale insects are plant-sucking bugs that cover themselves with a fluffy white protective coating. The beetles are scraped from the flat leaves of cactus to harvest them, killed and dried. The cochineal beetle produces carminic acid as a by-product to deter predators. Crimson, fuchsia, raspberry and scarlet reds can be obtained from cochineal. The red colorant is used in drinks and in foods, under the code E120, and in drugs and cosmetics. It takes about 300,000 cochineal beetles to produce one pound of cochineal dye.

Cochineal is a traditional natural dye for coloring textiles in South and Central America and has been used for beautiful, lightfast and permanent scarlets, pinks and reds. Cochineal has been used in Peru for about 1500 years and in Mexico for 1200 years. Commercial production cochineal in Mexico collapsed in the late 1800s but Peru remains an important producer and accounts for 85-90% of world production. Several other countries, including Chile, Botswana and the Canary islands, also cultivate cochineal and are together responsible for the remaining 10-15% of production.

Cochineal produced a deeper and longer lasting red than madder; the distinctive redcoats of the British Army were dyed with cochineal. Cochineal quickly superseded kermes for reds because of its wider availability and stronger color. In the nineteenth century, when artificial dyes were developed, the production of cochineal declined markedly; red became very cheap to produce and was no longer valued.

Cochineal was widely used to manufacture lake pigments, some of which are still employed today. Since it is entirely organic in nature and safe to consume in foodstuffs, it's still used in cosmetics such as lipstick and nail varnish. Until recently it was used by the Starbucks chain to color some coffees.

Polish cochineal, Kermes, Lac and St John's Blood are produced from different scale insects that are related to cochineal insects. None of these produces as deep red a color as cochineal, which is why cochineal was so prized as a colorant.

Indian lac and Brazil wood

Indian lac was another red pigment of organic origin obtained from a female insect (Coccus lacca), native to India. The female lac insects spend their entire lives clustered together in large groups on trees, and when the lac was harvested sticks were simply cut down from the trees with the insects still attached. Stick lac appears more like some type of growth on the tree than a group of living insects and this led to some confusion over the origins of lac. After harvesting, the dead insects were stripped from the sticks, crushed and mixed with hot water to separate the dye. When the water was evaporated the red pigment that remained was formed into cakes ready for use by painters. Indian lac is crimson in color.

Brazil wood is a colorant produced from the wood of the Caesalpinia tree native to the East Indies and South America. It's a red pink color. The dye is made by grinding brazil wood into small chips then boiling these in a mixture of water and vinegar. Alum power is used to make the pigment coagulate out of the liquid. Brazil was a popular pigment but gradually fell out of favor because, like many natural plant-derived pigments, it tends to fade.

The Renaissance in Northern Europe

Even in the 1400s painters prepared their own paints and often made their own pigments with the help of apprentices in the workshop. They would often experiment with new ideas in much the same way a scientist would in the laboratory. Jan van Eyck (1390-1441) found the medium of egg tempera to be too restrictive for his purposes so he began to experiment with new binders; he came across the idea of using oil as a binder thus creating **oil paint**. This new style form of paint was quickly accepted by Van Eyck's contemporaries and gained popular acceptance throughout the artistic community in the North of Europe and eventually in Italy.

Oil paints were made by grinding pigments in linseed oil to form a smooth, stiff paste, which could be applied to a canvas stretched across a wooden frame. The oil paints were versatile and slow drying and could be applied in many layers with stiff brushes or palette knives. The paints could be applied as opaque layers or in glossy transparent "glazes" to provide a wide range of visual effects.[2] Van Eyck skillfully blended a limited number of basic pigments in his work to mix colors as paints and (using the glazing technique) on the canvas as light filters to create bright, colorful paintings. One of the palettes he used in the early 1400s has been analyzed and contains just eight pigments: brown earth, red madder, ultramarine, yellow ochre, green earth, orpiment, red ochre and peach stone black.

The High Renaissance

In 15th century Italy, the mediums of egg tempera and fresco were still very much in favor, and artists, having tackled the problems of perspective, began to explore light and shadows and the composition of their paintings. Representing realistic figures in perspective against a background was difficult and many early attempts were clumsy. But the master of the Renaissance, including

[2] In art, "glaze" has two meanings. The earliest meaning identifies a watery compound applied to once-fired pottery, which is then fired a second time to bind the glaze to the pottery and set its final color. As applied to oil painting, the term "glaze" means a thin transparent coating of oil paint or shellac or varnish applied to a painting.

Da Vinci, Michelangelo, and Rafael produced some of the greatest works of art such as the Mona Lisa and the frescos of the Sistine Chapel during this time. These have influenced our interpretation of religious events and painting styles ever since. Artists in this period became famous in their own right and were elevated above their traditional status as craftsmen.

Northern Europe

Watercolors are dried blocks of paint produced to be easily dispersible in water. The pigment was mixed in some type of binder, traditionally gum Arabic. The water was subsequently evaporated to give dry tablets of paint that could be readily redispersed and applied to the painting surface. Watercolor did not gain widespread popularity until the eighteenth century but was often used in the Netherlands from the time of Dürer onward.

The Reformation

A serious crisis was faced by the painters of Northern Europe as a result of the religious reformation of Martin Luther, which caused huge upheaval throughout many countries from 1517 onward into the next century. Spain, France and Italy supported the Catholic Church while England, the Netherlands and Germany became Protestant. With the Reformation came a great decline in the demand for artwork because Protestants regarded much of the religious artwork as idolatrous. Since the vast majority of commissions for artists had come from the creation of altar pieces for churches and cathedrals, a large source of income for artists was suddenly cut off. Two solutions to this problem arose. Artists such as Peter Paul Rubens (1577-1640) and his apprentice Anthony Van Dyke (1599-1641) painted vibrant living portraits that often defined moments of history during these hectic times. And the genre of still life painting was popularized, using subject matter that would not offend the Protestant church but would be attractive enough for a wealthy merchant to purchase for home decoration.

New pigments beyond the Renaissance

From the Renaissance to the 17th century a few technical discoveries were made in pigments such as Vandyke brown, a dark brown, transparent color extracted from lignin or peat deposits. Two yellow pigments were introduced to Europe from the East around 1600. One of these was **gamboge**, an organic pigment made from the gum of the Garcinia evergreen tree. The trees were tapped by making incisions in the bark to let the gum drip out; the gum was then heated and run into hollow bamboo tubes where it was left to set. Gamboge was used as a watercolor pigment and was something of a novelty, being both a pigment and a binder combined into one.

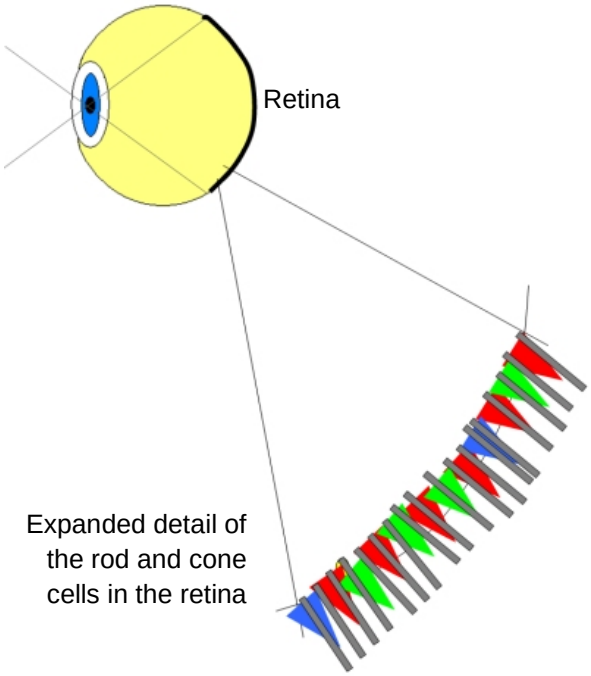
Indian yellow was another yellow pigment imported from the East. Due to its fluorescence it was especially vivid and bright in sunlight. Chemist John Stenhouse examined Indian yellow colorant balls imported from India in 1844 and reported that they were composed of gallstones from camels, elephants, or buffalos, or deposited from the urine of some of these animals, or possibly of vegetable origin. Stories persist that Indian yellow was made by feeding cows mango leaves, which caused their urine to become bright yellow. The urine was collected and heated to precipitate the yellow colorant, which was then separated and formed into lumps for sale. Little evidence has been found confirming the mango cow diet process.

Both of these yellow pigments were widely used by artists before they were replaced in the 1900s by more reliable synthetic colorants.

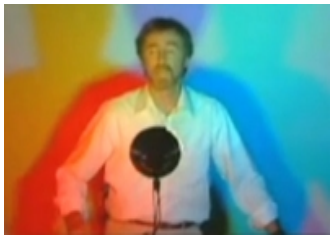
Why we see color: light and paint color mixing

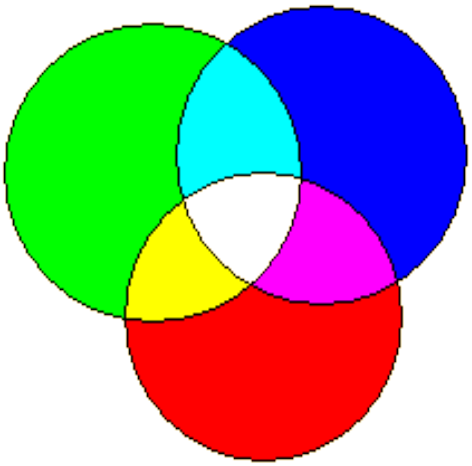
Do colors really exist? How do our eyes see color? Do we see colors the same as animals and insects do? And do two people really see the same color the same way? Let's lay the basis for answering these questions. Let's start with the human eye.

The eye is like a camera in that it has a lens that focuses an image on a surface. But it is also a transducer that generates electrical signals based on the light falling on the surface on which the image is focused. That surface, called the retina, is composed of four types of cells. One type of cell (rod cell) is sensitive to light intensity and sees all colors—in other words, it forms black and white images. It is more sensitive than the other cells (cone cells), which are each sensitive to light of red, green, or blue colors only. When the light level is low you see only in black and white because the rod cells can detect the light but the color-sensitive cells cannot. The cells are very small, from 1 to 5.5 µm (micrometers, also called micron; 1,000 microns = 1 millimeter). To give you some sense of this cell size compare this to a human hair, which is typically between 50 to 120 microns in diameter. The cells are very tiny.



The fact that the cone cells in the human eye are sensitive to red, green, and blue light should give us something to think about in connection with colors, because after all, we can see a lot more colors than just those three! And in fact it is the key to many technologies involving color such as color photography, color television, computers, and color printing. Here is the crucial point to understand: to the human eye, all colors can be represented by the combination of these three colors: red, green, and blue. View the first video in the playlist for this page and see why this is possible (the link is on the Unit 3 web page).

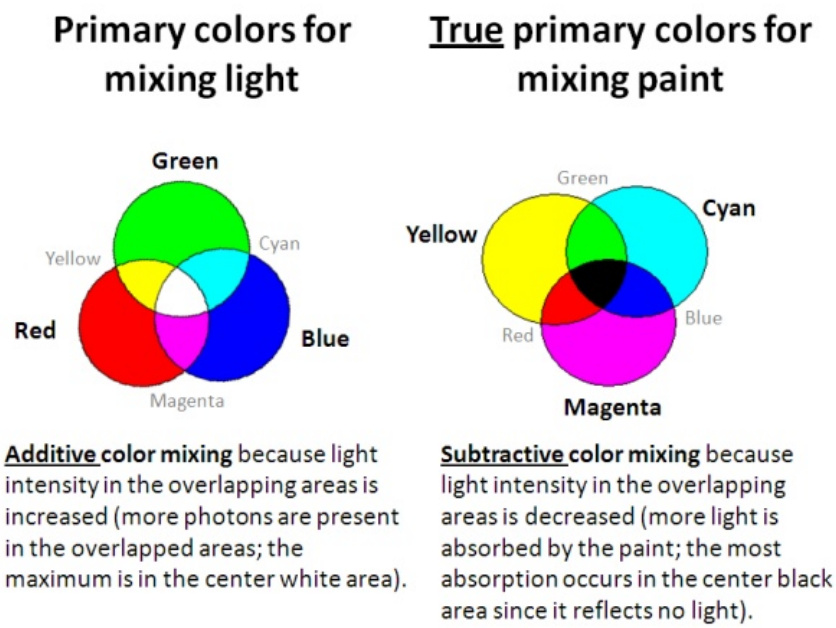




If we overlap light beams from red, blue, and green light sources the light mixes In the overlapped areas the light intensity is increased and the mixing of the light produces colors named cyan, magenta, and yellow. Now let's take a closer look at this light mixing phenomenon and how it compares to the mixing of paint and color printing.

Here is an illustration showing you the colors produced when light is mixed, and when paint is mixed. Notice **three things** about this illustration:

1. **The "primary" colors for paint mixing are NOT what you have probably been taught** (we'll explore why that is).
2. **Light mixing and paint mixing actually directly complement one another**: they work as opposites starting with and producing the same colors.
3. **Mixing all of the primary colors of light produces white; mixing all of the true primary colors for paint produces black.**



Facts 2 and 3 are the kind of logical symmetry that many scientists feel permeates all of the laws that govern the universe. But you don't believe me on the first point above about primary paint colors? Watch the second video in the playlist for this page in which Jared Bendis demonstrates true primary paint mixing. He shows you how the paint colors historically thought to be the primaries (red, yellow, and blue) are just an approximation and came to be regarded as the primaries only because it was possible to obtain them from animal, plant or mineral sources.

Differences in the way the color-sensing cells work in the eyes of different people will affect the way they perceive color. The most extreme example is with color-blind people. If the red-sensing, or green-sensing, or blue sensing cells in a person's eye are damaged or deficient, that person will see colors entirely differently than other people do.

But why do different objects appear to us to be different colors? Sunlight appears white because it contains energy across the entire electromagnetic spectrum. Our eyes are sensitive to a very confined "slice" of this energy, which account for all of the color sensations our eyes can detect and our brains turn into our perception of color. The surface of a given object absorbs some the energy and reflects some of the energy. We see what the object reflects. So for example a banana absorbs the visible energy for all colors except yellow, which it reflects; we see the banana as yellow. Watch the third video in the playlist for this page, the link is on the web page for Unit 3 at the course web site!

Introduction to Color Theory[1]

Color theory in the visual arts is a body of practical guidance for color mixing and the visual impact of specific color combinations. Categories of colors are based on a color wheel: primary color, secondary color and tertiary color. Although color theory principles first appeared in the 1400s in the writings of Leone Battista Alberti and the notebooks of Leonardo da Vinci a tradition of actual color theory began only in the 1700s with Newton's theory of color and the nature of so-called primary colors.

The foundation of pre-20th-century color theory was the idea of "pure" or ideal colors, characterized by sensory experiences rather than attributes of the physical world. This has led to a number of inaccuracies in traditional color theory principles. The most important problem has been a source of confusion between the behavior of light mixtures, called **additive color mixing**, and the behavior of paint or ink or dye or pigment mixtures, called **subtractive color mixing**. This problem arises because the absorption of light by material substances follows different rules from the perception of light by the eye. What is being “added” or “subtracted” is light intensity. In both pigment mixing and might mixing, something is being added to something else in the colloquial sense, namely pigments or lights of different color. But when light is added to light the intensity increases. When pigment is added to pigment, with each absorbing different colors, the intensity of the reflected light diminishes from that reflected by either pigment alone.

A second problem has been the failure to describe the very important effects of strong luminance (lightness) contrasts in the appearance of colors reflected from a surface, such as paints or inks, as opposed to colors of light. Colors such as browns or ochres cannot appear in mixtures of light. Thus, a strong lightness contrast between a mid-valued yellow paint and a surrounding bright white makes the yellow appear to be green or brown, while a strong brightness contrast between a rainbow and the surrounding sky makes the yellow in a rainbow appear to be a fainter yellow, or white. Most color effects are due to contrasts of three attributes that define all colors:

- Lightness (light vs. dark, or white vs. black)
- Saturation (intense vs. dull)
- Hue (e.g., red, orange, yellow, green, blue or purple).

For example, the visual impact of "yellow" vs. "blue" hues depends on the relative lightness and intensity of the hues.

These confusions arose in scientific uncertainty about color perception that was not resolved until the late 1800s when artistic notions were already entrenched. Many historical "color theorists" assumed that three "pure" primary colors can be mixed to produce all possible colors and that any failure of specific paints or inks to match this ideal performance is due to the impurity or imperfection of the colorants. In reality any three real "primary" colors of light, paint or ink can mix only a limited range of perceived colors, fewer colors than the full range of colors human eyes can perceive.

Color theory was originally formulated in terms of three "primary" or "primitive" colors—red, yellow and blue (RYB)—because these colors were believed capable of mixing all other colors. This color mixing behavior had long been known to printers, dyers and painters, but these trades

[1] This material was extracted from `http://en.wikipedia.org/wiki/Color_theory` and heavily edited to suit it to the intended readership of this workbook ☺ Jim Janossy.

preferred pure pigments to primary color mixtures, because the mixtures were too dull. For example, a real purple dye or paint was preferable to a mixture of red and blue paint.

The red, yellow and blue primary pigment colors became the foundation of 18th century theories of color vision. These theories were enhanced by investigations of a variety of purely psychological color effects, in particular the contrast between "complementary" or opposing hues that are produced by color afterimages and in contrasting shadows in colored light. These ideas and many personal color observations were summarized in two early works in color theory: the ***Theory of Colors*** (1810) by the German poet Johann Wolfgang von Goethe, and ***The Law of Simultaneous Color Contrast*** (1839) by the French industrial chemist Michel Eugène Chevreul.

German and English scientists established in the late 1800s that color perception is best described in terms of a different set of primary colors—red, green and blue violet (RGB). Subsequent research anchored these primary colors in the differing responses to light by three types of color receptors in the retina of the human eye. Concurrently, industrial organic chemistry radically expanded the color range of lightfast synthetic pigments, providing improved saturation in color mixtures of dyes, paints and inks. Three-color printing to produce a full range of perceived colors became economically feasible in mass printed media when the artists' “historical” primary pigment colors were abandoned for the “scientific” primary pigment colors cyan, magenta, and yellow. These “scientific” primary pigment colors each absorb only one of the retinal primary colors: cyan absorbs only red, magenta absorbs only green, and yellow absorbs only blue violet. By mixing the scientific primary colors very nearly all secondary and other colors can be produced more accurately and in higher saturation than with mixtures of red, blue, and yellow pigments.

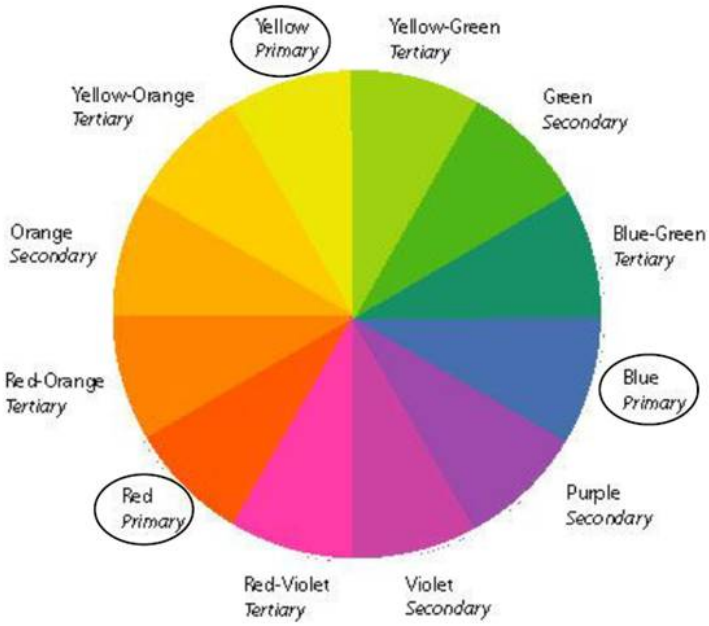
What follows is a simple summary of color theory terms and concepts sufficient to inform the discussion of art technology in parallel with the time period coverage of last half of ***The Story of Art*** by Ernst Gombrich.

Introduction to **Color Theory and Definitions**

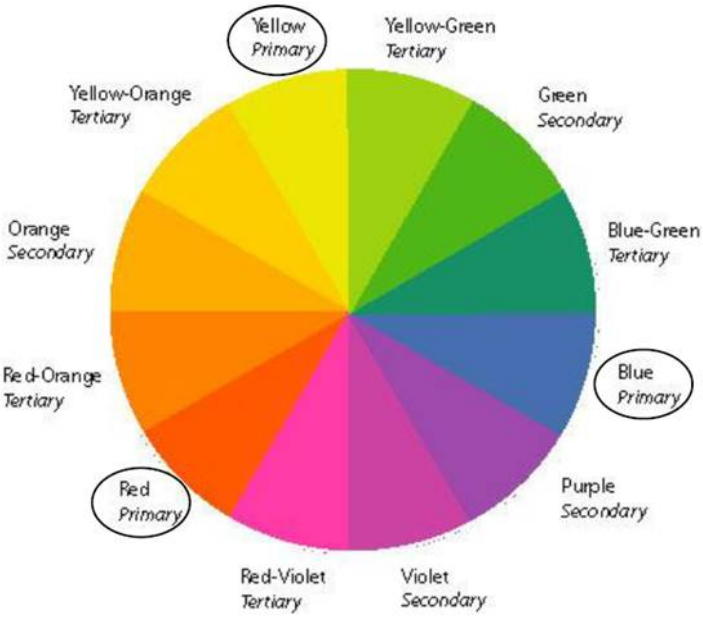
This material on color theory was originally developed under a grant by Bloomsburg University, Lock Haven University, Mansfield University, Millersville University and Shippensburg University in 2001. I have extracted 10 “lessons” from that work and arranged them in this sequence for presentation here:

Topic 1 – Hue
Topic 2 – Shades
Topic 3 – Tints
Topic 4 – Warm and cool colors
Topic 5 – Analogous colors
Topic 6 – Complementary colors
Topic 7 – Monochromatic colors
Topic 8 – Triadic colors
Topic 9 – Colors that move
Topic 10 – Color combinations to avoid

Keep in mind that the color wheel referred to by the authors of this material looks like this and relies on the **historical** definition of pigment color mixing that defines red, yellow, and blue as the primary colors. **You already know that these historical primaries are not quite accurate: the actual subtractive primary colors are magenta, yellow, and cyan.** The historical color wheel looks like this example.



When you read this these materials and they refer to "opposite" or "adjacent" colors or colors 120 degrees apart they are relying on this color wheel. The colors midway between the **primaries** here ("**secondary**") are what you get if you mix equal parts of the pigment primaries. The colors to the left and right of those mixtures ("**tertiary**") are what you get if you mix primaries in different proportions.

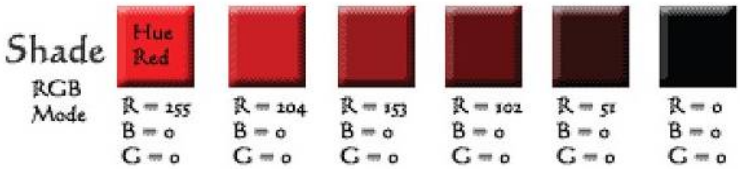


Topic 1: What is a hue?

Each individual color in the color wheel is a hue. **Hue** is the name of the color, for instance red, green, navy blue, orange, purple, lavender, turquoise. Hue is absolutely any color in the rainbow that you choose to pick. When you open a brand new box of Crayola crayons and read the name on the wrapper of each color, you are reading the hue. It doesn't matter if it is red, maroon, a shade of red, or pink, each one of those names is a hue. Unlike "color" hue has no other meaning, it is never a verb.

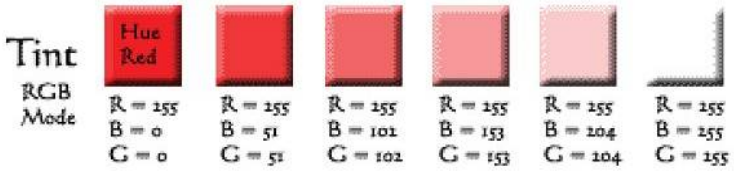
Topic 2: What is a shade?

The terms *value* and *brightness* refer to the light or dark qualities of a color. The **shades** (dark colors) are low values. Below, the hue red is shaded in RGB (red, green, blue intensity values) as coded for the web. As you move from left to right in the RGB light mixing (additive) color palette you create each shade of red by decreasing the amount of red and therefore decreasing the amount of light. In working with pigments (subtractive mixing) you progressively add black to red to create darker and darker shades of red.



Topic 3: What is a tint?

The terms *value* and *brightness* refer to the light or dark qualities of a color. The **tints** (light colors) are high values. Below, the hue red is tinted RGB mode. As you move from left to right in an RGB light mixing (additive) color palette you create each tint of red by keeping the same amount of red light and increasing the amount of both blue and green light. In working with pigments (subtractive mixing), you add more and more white to red to produce lighter and lighter tints of red.



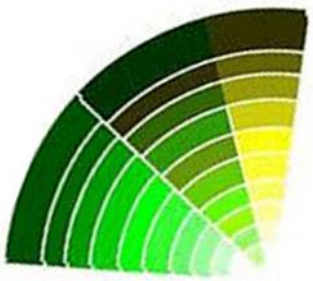
Topic 4: Warm and cool colors

Warm colors are vivid in nature. They are bold and energetic. Warm colors are those that tend to advance in space (come forward); therefore, caution needs to be taken so you do not overwhelm your content with eye catching hues. If an element in your design needs to pop out, consider using warm colors to do that.

Cool colors are soothing in nature. They give an impression of calm and rarely overpower the main content or message of a design. Cool colors tend to recede; therefore, if some element of your design needs to be in the background, give it cool tones.

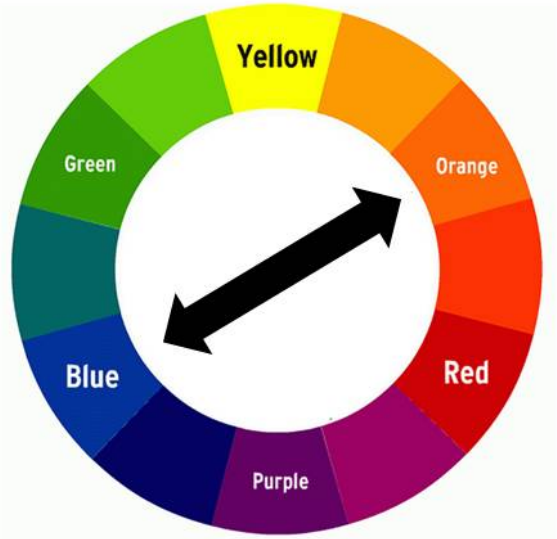
Topic 5: Analogous colors

Analogous colors are a palette of compatible color combinations that blend well together. They are ***neighbors*** on the color wheel. They tend to live harmoniously because they are relatives to each other. Analogous colors are less vivid, bright and saturated. They have less contrast and vibrational energy then complementary colors. Here's how artist Owen Demers explains analogous colors: "Think of purple, blue, and, magenta colors in a twilight sky or the yellows, golds, and oranges in an Arizona desert. A pine forest has light greens to blues and purples within its depths."



Topic 6: Complementary colors

Complementary colors are colors that are ***opposite*** each other on the color wheel. They contrast, enhance and intensify each other. Therefore, complementary colors need to be used with caution. The differences in tone and hue can be eye catching, but used to much they can be an eyesore. terms

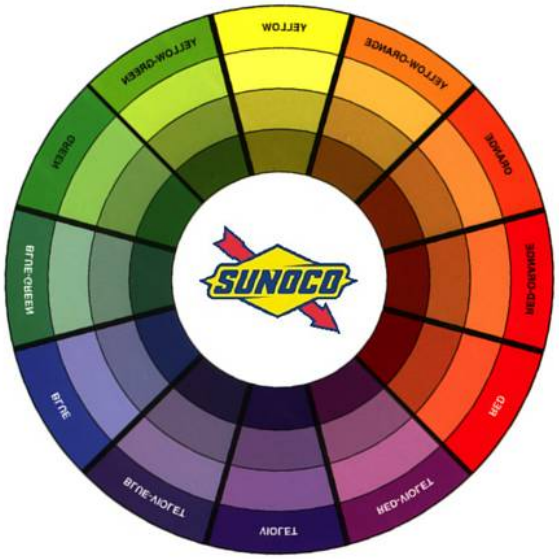


Topic 7: Monochromatic colors

Monochromatic colors are ***all the tints and shades of a single color***. As a result, the energy is more subtle and peaceful due to a lack of color contrast. Monochromatic colors offer very little contrast and may be considered boring unless there is diversity within the design.

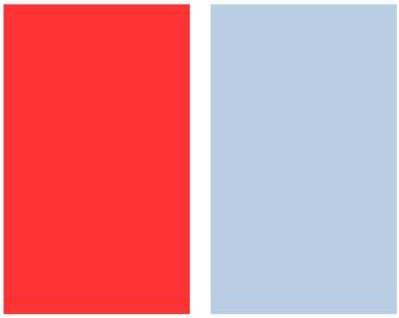
Topic 8: Triadic colors

Triadic colors are high-energy colors that are ***separated by 120 degrees*** on the color wheel. The primary (red, blue, and yellow) and secondary (purple, orange, green) colors are examples of triadic colors. Use triadic color choices when you want to make an image stand out even almost to the point of being too vivid. The Sunoco brand trademark is a good example of triadic color use.



Topic 9: Colors that move

Bright, high-intensity, warm colors advance in space—that is, they tend to look closer than the surface they are displayed on. They appear as though they are going to jump out at you. They get your attention. Low intensity, cool colors, on the other hand, recede; they make a space appear larger than it is by appearing to fade farther away. By combining these colors you can create the appearance of dimension or depth to a picture that's actually on a flat sheet or canvas.

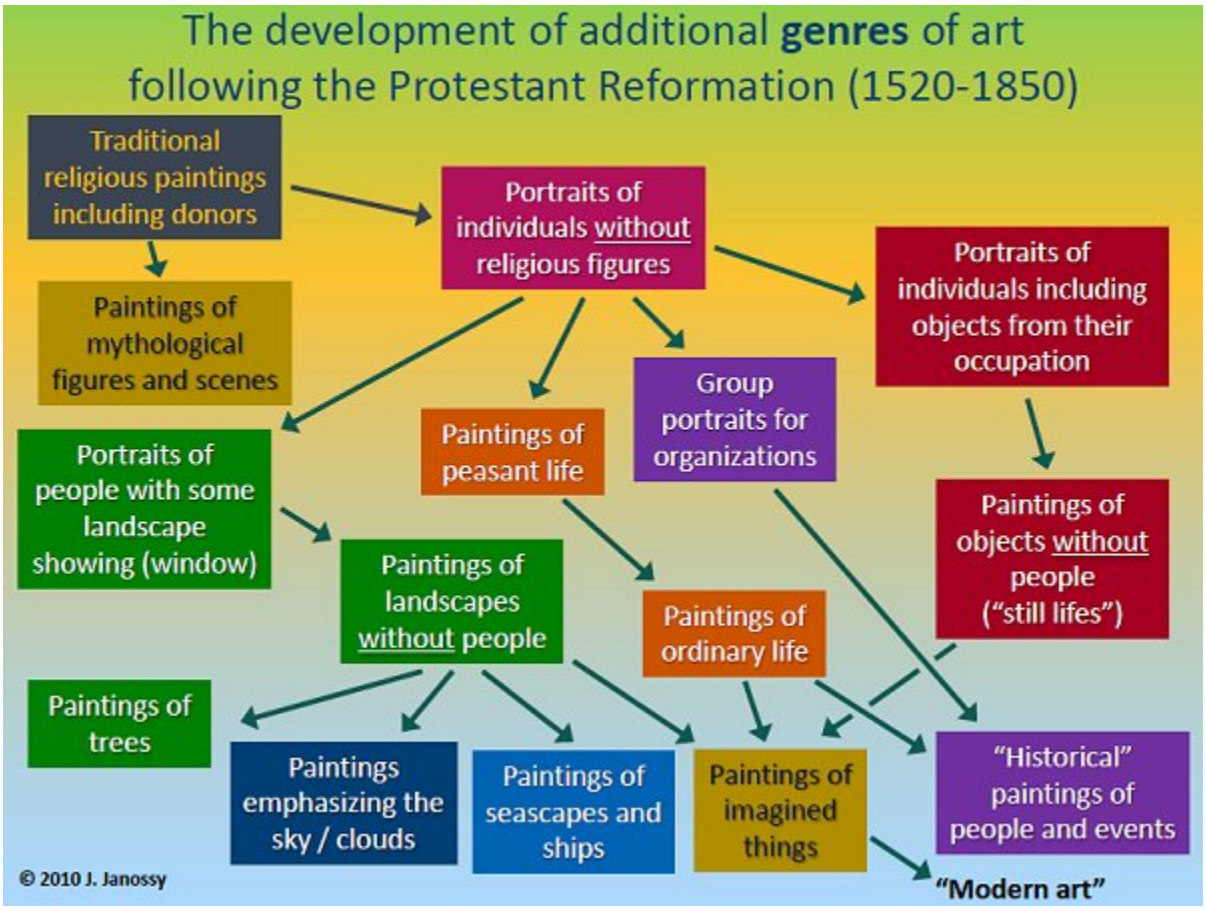


Topic 10: Color combinations to avoid

What are some color combinations that should be avoided? Many people feel that primary colors go together. And indeed, there are many times when these combinations have been used successfully, especially with children's toys. But when viewed on the computer, it can be another story. A web site design that uses too many bright primary colors can actually be painful to look at! Similarly, screens with too little contrast between text and background can be hard to read.

This lettering in blue can be hard to read against a dark background.

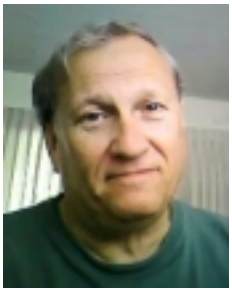
The development of genres of art



As your explorations in ***The Story of Art*** have revealed, the subject matter deemed worthy of depiction in painting was different in different civilizations. In western civilization during the Middle Ages and through the Renaissance by far the most prevalent subject matter was holy figures and sacred events, although figures and scenes from classical Greek and Roman mythological became popular during the Renaissance. But starting with the Protestant Reformation in 1517 the use of art to decorate churches fell into great decline in areas that broke away from the Roman church and adopted one of the denominations of Protestantism. You can trace the progression of subject matter development from that point onward by following the arrows from the box at the upper left.

A common practice in religious art commissioned by a private party and donated to a church was the inclusion of the image of the person—the donor—in the artwork. Portraits can be thought of as almost the same thing, except that only the donor is depicted, not a holy personage or scene. It became common to include in the portrait various implements of the person's business or trade, leading to objects being included in the portrait. At some point artists realized that the objects themselves could be painted in interesting ways without a person present, and "still life" painting began. Still life subject matter let an artist demonstrate his or her skill in painting difficult things, such as a glass container partly filled with water. A final step in that progression was the realization that an artist could paint things he or she only imagined, which never existed at all.

Project 3



A multi-part, hands-on project designed to make many of the highlights of art technology of the Renaissance **REAL** to you!

This project has **three required parts**:

1. Exploring pigments and lakes with egg tempera

2a. Exploring font use in commercial design

2b. Exploring color use in commercial design

In addition, an optional extra credit item is available to you: adding visual meaning through font use.

I have carefully designed and documented the parts of this project so that each part should be easy to follow. Each of the parts is equipped with one or more web resources such as brief readings or tutorial videos. You can submit the different parts of this project separately; there's no need to hold onto the separate parts to submit them all at once. Contact me if you have any questions or problems! ☺ Jim

Project 3

Exploring Paints, Fonts, and Color Use

Part 1 of 2: Exploring egg tempera paint

In the Middle Ages and the Renaissance egg-tempera paints and lakes were often used to create paintings. In this project you'll explore how to make egg tempera paint, how to create a lake pigment and use it with egg tempera, and will experience how these work and "feel" as paints.

Definitions

Egg-tempera paint consists of a pigment and egg yolk as a binder. Egg tempera paints dry quickly and must be made up in small batches and used within a few hours. The pigment for egg-tempera paint can consist of any substance ground up to form a fine powder.

A **lake** is a form of pigment. It consists of a powder made of crushed bone, chalk, or ground eggshells that you can think of as being "dyed" using a textile dye. A **dye** is a watery solution useful for coloring cloth. A dye can't be used directly as paint because it's too thin. You can make a dye by drying, cutting up, and boiling the roots of some plants or by drying and grinding up certain insects or shellfish. When you use a dye to color crushed bone, chalk, or ground eggshells the reaction is more complex than a simple dye process but it's fine to think of the dye as coloring the powder just as it colors cloth. (Weld photo courtesy www.essentialvermeer.com)

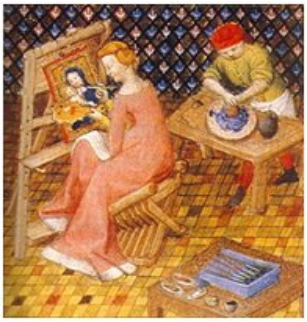
Some History

(Extracted and summarized from WikiPedia) Plants, insects, and shellfish have been used since ancient times to produce dyes. At various times in their growth the roots or leaves of some plants contain compounds that can be extracted by drying and boiling to produce a colored liquid.

■**BLUE: Indigo** lake was originally produced from the dye produced from leaves of the **woad** plant and was known in ancient Egypt. In the late Middle Ages the popularity of blue woad dye led to overplanting and soil exhaustion in many parts of Europe. After trade routes opened to the east, blue dye extracted from the indigo plant was imported from India as a substitute for woad since the indigo plant produces the same chemical but at lower concentration.

■**RED: Rose madder** lake, originally from the root of the madder plant, is also known as alizarin crimson in its synthetic form. **Carmine** lake was originally produced from the dried and ground up cochineal beetle, native to Central and South America. When the Spanish conquered the Aztec Empire about 1520 they encountered Aztec warriors garbed in an unknown crimson color made in this way. **Cochineal** became the second most valuable export from the New World after precious metals, in the form of the dried insect.

YELLOW: The **weld** plant is rich in *luteolin*, a substance that produces a bright yellow dye. The plant is cut before its fruits show fully develop, otherwise the pigment diminishes. Dye from weld serves well for linen, woolen, and silk and can produce all shades of yellow.



The person behind the woman painting the picture is her assistant, who is grinding pigment and mixing up small batches of paint so that the artist can work. Before about 1860 you could not buy ready-made paints, you had to create your own using pigments, and lakes, and use egg yolk or oil as a binder.

Doing part 1

Here is what you will need to do this part:

- an egg
- some paper or plastic cups
- metal spoon
- knife
- box of children's chalk ($1.19 at Osco)
- dinner plate (ceramic is best)
- cup of hot black coffee
- plain index card or a sheet of heavy white paper
- coin like a quarter
- several q-tips
- a few paper towels or napkins.

Here are the steps you follow:

1. Draw two circles next to one another in the middle of the paper by tracing around the coin. Write your name on the paper in letters 1" high.
2. Make a small quantity (a pile about the size of your pinky fingernail) of red or pink pigment powder by using the knife to scrape some of the red chalk into a paper or plastic cup.
3. Crack the egg into a paper or plastic cup. Wash the eggshell fragments with water (no soap) and pick out all of the sticky lining on the inside. Dry the eggshell fragments. (Keep the egg yolk and whites in the cup, we'll use it later.)
4. Using the metal spoon, crush half the eggshell on the plate. Use a rolling motion with the back of the bowl of the spoon. If you do this for about 10 minutes you should have a fairly fine powder. Put the crushed eggshell powder in a plastic or paper cup.
5. Get or make a cup of hot black coffee. You need a good dark liquid. Put a small amount of the liquid into the cup with the crushed eggshell powder and leave it sit for about 10 minutes, stirring it.

6. Pour the coffee off the crushed eggshell powder. Remove the powder and put it on a napkin, spreading it out so it can dry. Dry the "dyed" powder for several minutes, then gather it up and put it into a clean plastic or paper cup.
7. Using a spoon and your fingers and hands separate the egg yolk from the egg white without breaking the yolk. Take a look at this video at the link for this page on the Unit 3 web page of the course web site for guidance on how to do this. This silent video starts rather slowly with the artist fiddling around with a small knife and a jar of pigment but at around 42 seconds into the video she shows you how to handle the yoke to free it from all of the egg white. (NOTE: At about 75 seconds into this video the artist adds water to the egg yolk and adds too much of it. In addition to not being able to operate a camera and capture sound the well-intentioned soul who made the video added way too much water and makes a paint that is far too runny! Let's at least appreciate that she made the video at all…). You don't have to add water to the egg yolk—let's not.
8. Pierce the egg yolk and drip a few drops of the liquid yolk onto your scraped chalk pigment. Use a q-tip to mix the pigment with the yoke. Continue adding yolk in small amounts and mixing it with the red or pink pigment to make a paste-like paint.
9. Using a q-tip, paint one of the circles on the white paper with your chalk/yolk paint to neatly fill it with an even coating. Try not to have any white of the paper show through the coloring. Label this circle "chalk pigment and egg yolk binder."
10. Drip a few drops of the liquid yoke on the dry dyed eggshell powder pigment in a cup. Continue adding egg yolk in small amounts and mixing it and the dyed eggshell powder pigment to make a paste-like paint. Using a q-tip, paint one of the circles on the white paper to neatly fill it with an even coating. Try not to have any white of the paper show through the coloring. Label this circle "lake and egg yolk binder."
11. Clean up your mess and discard all of the cups, remaining egg yolk and egg shells.
12. Let the two colored dots on the paper dry overnight.
13. Once the colored dots are dry examine them carefully. **Write a paragraph describing what you think of the suitability of the pigment and egg yolk as a red/pink paint**. Does it color evenly? Is it very easy to work in great detail up to the edge of the circle (admittedly, using a q-tip as a brush is kind of crude!)?
14. Repeat step 12 to **write a paragraph to describe what you think the suitability of the dyed eggshell powder and egg yolk is for use as a brown or beige paint**. Does it color evenly? Is it very easy to work in great detail up to the edge of the circle? Is it very grainy or lumpy?
15. Take a picture of yourself holding the paper with your two painted dots so that your face, the paper and the two dots on it, and your name on the paper are all visible. E-mail the picture to the dedicated e-mail address for this course. In the message part of your e-mail copy and paste in the **two paragraphs you have written** (steps 12 and 13).

Project 3, Parts 2a/2b: typography and color

In this part of Project 3 you'll explore how an award-winning professional graphic designer and artist has used typography and color combinations in his work, and you'll provide your own perceptions and opinions of how his work follows (or doesn't follow) the "rules" of effective color use that you learned in this unit.

Carlos Segura is an internationally-recognized graphic designer who has developed several distinct typefaces (fonts). Visit a historical page from his web site (link is on the Unit 3 web page at the course web site, associated with this workbook page number) and learn about what he has accomplished. Segura has written:

> *Typography is beyond letters. Some fonts are so decorative, they almost become "visual" and when put in text form, they tell a story beyond words—a canvas is created by the personality of the collection of words on the page.*

Explore Segura's web site and get to this page which illustrates some of his graphic design work for CD recording firms. Explore all of the dozens of projects Segura has done in this area of work. Then do this:

1. Choose the graphics for three CD cases designs you the best, choosing from among designs that use **at least three different colors**. You can regard black as a color in this assignment.
2. Copy the front case image of each of the three designs you chose and put it into your word processed document (adding to the document you started for part 1) as an image about 2 inches by 2 inches, without distorting the proportions of the images.
3. In your document, create a section labeled "Part 2a: Use of Fonts". In this section write about a page in which you compare and contrast Segura's use of different fonts in each of the chosen designs with each of the other designs**. Identify which designs most effectively follow Segura's own statement above and seem most effective given its specific subject matter and musical genre.** To some degree this is subjective and depends on your own tastes, but support your identification of the strengths and weaknesses of your opinions with details and facts, considering the "personality" Segura attempts to achieve in each project through his font design. Use double-spaced lines, margins 1 inch all around and 12 point Times New Roman font.
4. In your document, create a section labeled "Part2b: Use of Color". Write a full page in which you compare **and contrast Segura's combinations of color use in the CD case designs you chose, in the language of the terminology of colors you learned in this unit.** Describe as informatively as possible Segura's use of colors on each CD case image as to hue, tint, shade, complementary or monochromatic colors. Indicate whether the overall effect is "warm" or "cool" and if you feel this is pleasing for the subject matter in each case. Support your descriptions and conclusions in specific detail in reference each design.

Project 3 Extra Credit – Typography

Typography is beyond letters. Some fonts are so decorative, they almost become "visual" and when put in text form, they tell a story beyond words—a canvas is created by the personality of the collection of words on the page.

In this extra credit assignment you get a chance to explore firsthand what Carlos Segura meant when he made the statement above. Here you are going to have the opportunity to create multiple "personalities" in the words to a classic musical work, which in itself associates different characters with different musical instruments!

Peter and the Wolf, Op. 67, is a composition written by Sergei Prokofiev in 1936 in the USSR. It is a children's story with both music and text, spoken by a narrator accompanied by the orchestra. You can read more about it at **http://en.wikipedia.org/wiki/Peter_and_the_Wolf**. To start this work, hear a performance in which the narration is done by Boris Karloff, an actor famous for his voice and the many parts he played in early horror movies. Use the link for this page at the course web site to access a recording of this performance. In the first two minutes and 40 seconds of this recording the narrator describes the musical instruments that the composer associated with each of these characters in the story: the bird, duck, cat, grandfather, the wolf, and Peter. The instruments were chosen so that the lighter, higher instruments mimic the bird, a deeper, meandering theme and tones mimic the duck, and so forth. The music itself seems to tell the story even when no words are spoken.

In a similar way, you need to associate each of these characters with a typographical font that seems to represent some of the "personality" of the character. Fonts are those different kinds of letter sets common to any modern work processor; each font has a name. For example, the bird might be represented by a font such as any of these, or even others:

bird: bird **Bradley Hand ITC**

bird: bird **Script MT Bold**

bird: bird **Blackadder ITC**

bird: bird **Brush Script MT**

Very appealing for a bird; the sloping curves of the "b" and "d" are suggestive of the way a bird stands…

while the wolf might appear something like wolf (Old English text MT) or WOLF (Algerian). Then you edit the words of the story as printed out in a document you can download from the web link for this page at the Unit 3 page of the course web site. This comes to you as a zipped file (zipped files always download instead of being opened, then you unzip them to extract the contents and work with them). The contents of the document are on the next pages for example purposes. In this example I have made the first font choices and started the process—see what you think of my choice. Make other font choices that seem appropriate to you, then change the font of all occurrences of the words in the story fragment so that each use of the word shows in the font you chose to represent it.

Project 3 Extra Credit: Meaning using fonts

To start this work, download the file for the text that follows, the link is on the Unit 3 web page at the course web site, associated with this workbook page number. Pick out a different expressive font on your word processor for each of the following characters in the story. Make the word here appear in your chosen font. Then replace the red "xxx" with the name of the font as indicated in your word processor. Once you have done that, use the fonts you have chosen to reformat the story below so that every occurrence of the word in the story appears in the font you associate with it, at 24 point size. **Bold** the word if it seems to improve the appearance as I have done here. I have started the first one for you as an example, but I formatted only the first two appearances of the word "Peter":

Peter Peter Segoe Script

Bird xxx

Duck xxx

Cat xxx

Grandfather xxx

Wolf xxx

Early one morning, Peter opened the gate and walked out into the big green meadow. On a branch of a big tree sat a little bird, Peter's friend. "All is quiet" chirped the bird happily.

Just then a duck came waddling round. She was glad that Peter had not closed the gate and decided to take a nice swim in the deep pond in the meadow.

Seeing the duck, the little bird flew down upon on the grass, settled next to her and shrugged his shoulders. "What kind of bird are you if you can't fly?" said he. To this the duck replied "What kind of bird are you if you can't swim?" and dived into the pond. They argued and argued, the duck swimming in the pond and the little bird hopping along the shore.

Suddenly, something caught Peter's attention. He noticed a cat crawling through the grass. The cat thought; "That little bird is busy arguing, I'll just grab him." Stealthily, the cat crept towards him on her velvet paws.

"Look out!" shouted Peter and the bird immediately flew up into the tree, while the duck quacked angrily at the cat, from the middle of the pond. The cat walked around the tree and thought, "Is it worth climbing up so high? By the time I get there the bird will have flown away."

Just then grandfather came out. He was upset because Peter had gone in the meadow. "It's a dangerous place. If a wolf should come out of the forest, then what would you do?" But Peter paid no attention to his grandfather's words. Boys like him are not afraid of wolves. But grandfather took Peter by the hand, led him home and locked the gate.

No sooner had Peter gone, than a big grey wolf came out of the forest. In a twinkling the cat climbed up the tree. The duck quacked, and in her excitement jumped out of the pond. But no matter how hard the duck tried to run, she couldn't escape the wolf. He was getting nearer, nearer, catching up with her. Then he got her, and with one gulp, swallowed her.

(There's more to the story but the above is sufficient for this extra credit assignment!)

Unit 4 – Baroque and Beyond

The genius artists of the Renaissance were a tough act to follow! The artists the next generation following these masters—in the years 1550-1650—had to either try to imitate the masters by copying their techniques, or strike out in different, novel ways. This was called the Mannerist Era because some artists chose to paint "in the manner of" the older masters. Others however, like Caravaggio and Giorgione, established bold new uses of light and perspective.

Artistic styles in the west coalesced into two different schools of thought. One school was **conservative** and held that the only classical subject matter—religious themes, Greek or Roman mythological characters—were valid subjects for art and that painting had to follow established methods. The work of Annibale Carracci (1560-1609) is an example. The other school of thought, pioneered by **"naturalist"** painters such as Michelangelo Merisi da Caravaggio (1571-1610), held that ordinary subject matter and the roughness of real life were valid artistic subject matter, and that refined techniques of paint application, color and composition were not the only "correct" ways to paint. From about 1600 to the mid-1800s artists and appreciators of art debated these artistic philosophies. But the classical school held the power to dictate what art was worthy of serious collectors via the official French "academy" that controlled the art marketplace.

The Baroque era built on the novel techniques of the naturalists to introduce elements into art and architecture that had no parallel in ancient works. Baroque means "strange"; this name was applied after the era as a disparaging term. The most extreme examples of Baroque art and architecture are theatrically ornate and are associated with the Counter-Reformation.

The stranglehold on what constituted "valid" artistic style and content was finally broken by two factors: the invention and refinement of photography from 1839 onward, and the constant pressure of bold and innovative artists who challenged the old ways. It was surprising to some that the art-loving public—which was probably bored by the 1860's with the old style—so rapidly accepted and embraced the new, non-classical "Impressionist" style of painting of the 1870s. That break led the way to the many new movements in art that quickly followed.

Assigned reading and viewing

1. ***The Story of Art***, chapters 19 through 25
2. ***History of Visual Technology*** Unit 4 (this chapter)
3. **Lecture and supplementary videos**; links provided on the unit web page

Work due

1. **Repeatable online Exercise 4**
2. **Unit Summary Form 4**
3. **Project 4** Symmetry and perspective
4. *Extra credit:* Scientific photography

GPH-205 Unit 4 Summary Form (USF4) Page 1

THIS IS BOTH A STUDY AID AND HOMEWORK ASSIGNMENT. Use a printed copy of this page for hand-written notes that you prepare as you accomplish the required reading and viewing. Put concise phrases in the boxes, not sentences! *Then download the editable .docx or .rtf copy of this form from the link on the course Unit 2 web page and type in your responses.* ***DO NOT COPY AND PASTE FROM TEXT OR WEB SOURCES.*** *The boxes for your responses on this form will automatically expand as necessary.* ***Submit your word-processed document NOT a scanned copy of your hand-written responses!*** *This work is integrated with your reflective essay and take-home final exam. The facts you gather form the basis for your essay and the Conclusions Work.*

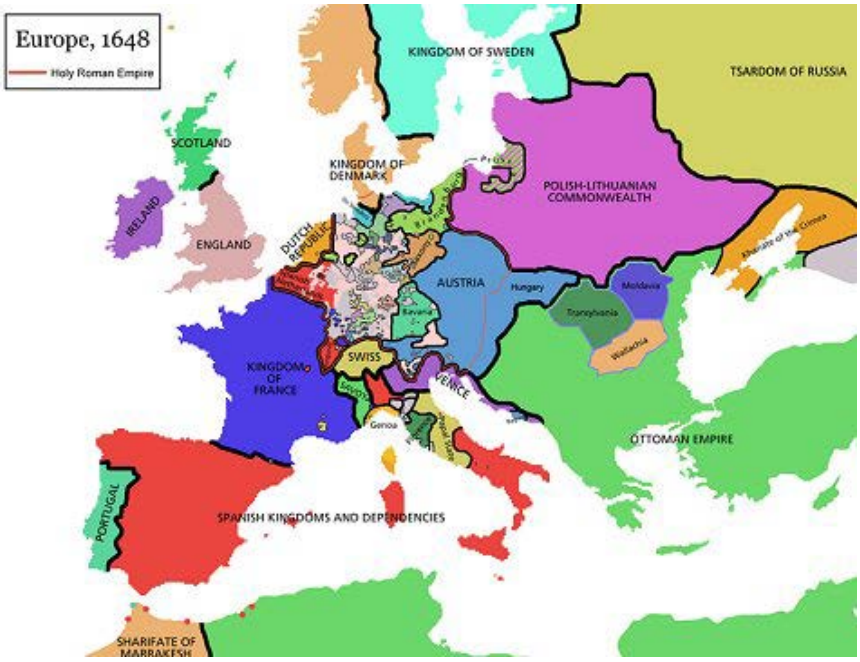
Civilization/Art movement	Art purpose(s)	Art formation rules	Art technologies	Their art's impact on our modern life
The Baroque (1600's and 1700's)				
The "School" of Annibale Carraci and Poussin				
The "School" of Caravaggio				
Dutch art genres of the 1600's				

GPH-205 Unit 4 Summary Form (USF4) Page 2

THIS IS BOTH A STUDY AID AND HOMEWORK ASSIGNMENT. Use a printed copy of this page for hand-written notes that you prepare as you accomplish the required reading and viewing. Put concise phrases in the boxes, not sentences! *Then download the editable .docx or .rtf copy of this form from the link on the course Unit 2 web page and type in your responses.* ***DO NOT COPY AND PASTE FROM TEXT OR WEB SOURCES.*** *The boxes for your responses on this form will automatically expand as necessary.* ***Submit your word-processed document NOT a scanned copy of your hand-written responses!*** *This work is integrated with your reflective essay and take-home final exam. The facts you gather form the basis for your essay and the Conclusions Work.*

Civilization/Art movement	Art purpose(s)	Art formation rules	Art technologies	Their art's impact on our modern life
"Historical" painting and "Moralizing" painting				
The Enlightenment (1685-1815)				
The Romantic Era (1750-1870)				
The Impressionist Era (1873-1900)				

Background: the 17th Century (1600-1700)[1]



The 17th century was characterized by the Dutch Golden Age, the Baroque cultural movement, the French Grand Siècle (century) dominated by Louis XIV, the Scientific Revolution, and The General Crisis of the Thirty Years' War (1618-48), the English Civil War (1642-51), and the Great Turkish War (1683-99). Colonization of the Americas began, including the exploitation of the fabulously wealthy silver deposits of Potosí in Peru and Mexico. In the Near East the Ottoman, Safavid Persian and Mughal empires grew in strength and the Sikhs began to rise to power. In Japan Shogun Tokugawa Ieyasu established the Edo period starting the isolationist policy that was to last until the 19th century. In China, the collapsing Ming Dynasty was challenged by a series of conquests led by the Manchu warlord Nurhaci finished by his grandson, the Shunzi Emperor, founder of the Qing Dynasty.

European politics were dominated by Louis XIV of France (1638-1715; Louis the Sun King ***le Roi-Soleil***). Royal power was solidified in the civil war of the Fronde, immediately after the end of the Thirty Year's War, when he reorganized French fighting forces under a hierarchy whose leaders ultimately could be made or unmade by the King. The French nobility was then subjugated to the power of the absolute monarchy through the creation of the Palace of Versailles, a gilded prison in which a greatly expanded royal court could be more easily kept under surveillance. Louis XIV expanded France to include the regions of Rousillon, Artois, Dunkirk, Franche-Comté, Strasbourg, Alsace and Lorraine.

By the end of this century Europeans were aware of logarithms, electricity, the telescope and microscope, calculus, universal gravitation, Newton's Laws of Motion, air pressure and calculating machines through the work of the first scientists of the Scientific Revolution. These included Newton, Leibniz, Galileo, Descartes, Fermat, Hooke, Boyle, van Leeuwenhoek and William Gilbert.

[1] The information on this page is an extract of `http://en.wikipedia.org/wiki/17th_century` heavily edited into a concise summary for the intended audience. See that page for much more information!

The Dutch Golden Age[1]

The Dutch Golden Age was a period in Dutch history spanning the 17th century in which Dutch trade, science, military and art were among the most acclaimed in the world. The first half is characterized by the Eighty Years' War which ended in 1648.[2] The Golden Age went on in peace time during the Dutch Republic until the end of the century.

Several factors also contributed to the flowering of trade, industry, the arts and the sciences in the Netherlands during this period. A necessary condition was the supply of cheap energy from windmills and from peat, easily transported by canal to the cities. The invention of the sawmill enabled the construction of a massive fleet of ships for worldwide trading and for defense of the republic's economic interests by military means. During the later part of the 1500s the Dutch gained an increasingly dominant position in world trade over the Portuguese and Spanish.

In 1602 the Dutch East India Company was founded, the first multinational corporation, financed by shares that established the first modern stock exchange. This company received a Dutch monopoly on Asian trade that it would keep for two centuries. It became the world's largest commercial enterprise of the 17th century. Spices were imported in bulk and brought huge profits, due to the efforts and risks involved and seemingly insatiable demand. To finance the growing trade within the region the Bank of Amsterdam was established in 1609, the first true central bank. Until 1854, the Dutch were Japan's sole window to the western world. In the 17th and 18th centuries the Dutch were the most economically wealthy and scientifically advanced of all European nations.

Social status in the 17th century in the Netherlands was determined by income. Social classes existed but in a new way. The landed nobility had relatively little importance since they lived in the more underdeveloped inland provinces; it was the merchant class that dominated Dutch society. The wealthy merchants bought themselves into the nobility by becoming landowners and acquiring a coat of arms and a seal. Merchants also started to value public office as a means to greater economic power and prestige. Universities became career pathways to such a public office.

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[1] See http://en.wikipedia.org/wiki/Dutch_Golden_Age for an excellent article of which this is just a partial and heavily edited small extract.

[2] The Eighty Years' War was the Dutch War of Independence, (1568–1648), a revolt of the Netherlands provinces against Philip II of Spain, the sovereign of the Habsburg Netherlands. Under the leadership of William of Orange the northern provinces ousted the Habsburg armies; the war ended in 1648 and the Dutch Republic was recognized as an independent country.

After aristocrats and patricians came the affluent middle class, consisting of Protestant ministers, lawyers, physicians, small merchants, industrialists and clerks of large state institutions. Lower status was attributed to farmers, craft and tradesmen, shopkeepers, and government bureaucrats. Below that stood skilled laborers, maids, servants, sailors, and other persons employed in the service industry. At the bottom of the pyramid were “paupers:” impoverished peasants, many of whom tried their luck in a city as a beggar or day laborer.

Due to its climate of intellectual tolerance the Dutch Republic attracted scientists and other thinkers from all over Europe. The renowned University of Leiden, established in 1575 by the Willem van Oranje, became a gathering place for these people. For instance French philosopher René Descartes lived in Leiden from 1628 until 1649. Christiaan Huygens (1629–1695) was a famous astronomer, physicist and mathematician. He invented the pendulum clock, which was a major step forward towards exact timekeeping. Among his contributions in astronomy was his explanation of Saturn's planetary rings. He also contributed to the field of optics. The most famous Dutch scientist in the area of optics is certainly Anton van Leeuwenhoek, who was the first to methodically study microscopic life. He was the first person to describe bacteria.

Due to the Dutch climate of tolerance, book publishers flourished. Many books about religion, philosophy and science that might have been deemed controversial abroad were printed in the Netherlands and secretly exported to other countries. Thus during the 17th Century the Dutch Republic became more and more Europe's publishing house.

The Low Countries witnessed a cultural development that stood out from neighboring countries. **The Baroque movement did not gain much influence; is exuberance did not fit the austerity of the largely Calvinistic Protestant population. Dutch Golden Age painting followed many of the tendencies that dominated Baroque art in other parts of Europe, such as naturalism, but the lack of Counter-Reformation church patronage that dominated the arts in Catholic Europe resulted in the great number of "scenes of everyday life" or genre paintings, and other non-religious pictures.** Dutch landscapes and seascapes reflect the land reclaimed from the sea and the sources of trade and naval power that mark the Dutch Golden Age. One subject quite characteristic of Dutch Baroque painting is the large group portrait, especially of civic and militia guilds, such as Rembrandt van Rijn's ***Night Watch***. Today, the best-known painters of the Dutch Golden Age are the period's most dominant figure Rembrandt, the Delft master of genre Johannes Vermeer, the innovative landscape painter Jacob van Ruisdael, and Frans Hals, who infused new life into portraiture.

Artemisia Gentileschi: Italian Baroque artist[1]

Artemisia Gentileschi (1593-1656) was a female Italian Baroque painter, today considered one of the most accomplished painters in the generation after Caravaggio. In an era when female painters were not easily accepted by the artistic community or patrons she was the first female painter to become a member of the Accademia di Arte del Disegno in Florence. She was born in Rome, the eldest child of the Tuscan painter Orazio Gentileschi, and was introduced to painting in her father's workshop where she learned drawing and how to mix color and how to paint. Her father's style took inspiration from Caravaggio and her style was just as heavily influenced by him. But her approach to subject matter was different from her father's; her paintings are highly naturalistic whereas Orazio's are idealized.

The first known work of the young 17-year-old Artemisia was ***Susanna and the Elders*** completed in 1610.[2] In 1611, her father was working with Agostino Tassi. Tassi raped Artemisia and her father pressed charges against him. In the trial it was discovered that Tassi had planned to murder his wife, had committed in adultery with his sister-in-law, and had planned to steal some of Orazio's paintings. During the trial, Artemisia was humiliated and tortured, a curious way to treat a victim but emblematic of the time when neither the testimony of a woman or a slave could be accepted without torture. At the end of the trial Tassi was sentenced to imprisonment for one year although he never served the time. Needless to say the ordeals she suffered infused Artemisia's art with passion reminiscent of the theme of her first painting. Her painting ***Judith Beheading Holofernes*** (1613) is striking for the violence portrayed.

She married Pierantonio Stiattesi, a modest artist from Florence, moved there in 1613, and became a successful court painter, enjoying the patronage of the Medici family. Artemisia and Pierantonio had four sons and one daughter. She was the first woman accepted into the Florentine Academy of the Arts of Drawing. Despite her success, financial excesses born by herself and her husband led to problems with creditors and with she fell out with her husband; she returned without him to Rome in 1621.

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[1] See `http://en.wikipedia.org/wiki/Artemisia_Gentileschi` for an excellent article of which this is just a partial and heavily edited small extract.

[2] The story of Susanna in the Book of Daniel is not universally regarded as an original part of the Hebrew bible, it is an additionl considered apocryphal by Protestants. As the story goes a beautiful wife named Susanna was falsely accused by lecherous voyeurs. As she bathes in her garden two lustful elders secretly observe her; they accost her, threatening to claim that she was meeting a young man in the garden unless she agrees to have sex with them. Susanna refuses to be blackmailed, is arrested and about to be put to death for adultery when a young man named Daniel interrupts, shouting that the elders should be questioned. The two men are separately questioned about what they saw but tell different things about the tree where Susanna supposedly met her lover. The first says they were under a mastic, the second says they were under an evergreen oak. The great difference in size between a mastic and an oak makes the elders' lie plain to all the observers. The false accusers are put to death and virtue triumphs.

Artemisia arrived in Rome and remained there to raise her daughter Prudenzia and another daughter born in 1627. Artemisia tried, with almost no success, to teach them the art of painting.

Despite her artistic reputation, her strong personality and her numerous good relationships, Rome was not as lucrative for her as she hoped. Her style and tone of defiance and strength relaxed: she painted more relaxing and feminine works. Sometime between 1627 and 1630 she moved to Venice, perhaps in search of richer commissions, as verses and letters were composed in appreciation of her and her works in Venice. In 1630 Artemisia moved to Naples, a city rich with workshops and art lovers, in search of new and more lucrative job opportunities. Many other artists, including Caravaggio, Annibale Carracci, Simon Vouet had stayed in Naples for some time in their lives, and at that time, Jusepe de Ribera, Massimo Stanzione, and Domenichino were working there; later, Giovanni Lanfranco and many others would flock to the city. The Neapolitan debut of Artemisia is represented by the ***Annunciation***. Naples was for Artemisia a kind of second homeland. She received letters of appreciation, being in good relations with many renowned artists, among them Stanzione, with whom, the writer Bernardo de' Dominici says, she collaborated.

In Naples for the first time Artemisia worked on paintings in a cathedral. She painted the ***Birth of Saint John the Baptist*** now located in the Museo del Prado in Madrid, and ***Corisca and the Satyr***. In these paintings Artemisia again demonstrates her ability to renew herself with the novelties of the period and handle different subjects, instead of the usual Judith, Susanna, Bathsheba, and penitent Magdalenes for which she was already known.

In 1638 Artemisia joined her father in London at the court of King Charles I of England, where Orazio became court painter and received the important job of decorating a ceiling in Casa delle Delizie of Queen Henrietta Maria of France in Greenwich. Father and daughter were once again working together, although helping her father was probably not her only reason for travelling to London: King Charles I had asked her to his court and it was not possible to refuse. Charles I was a fanatical collector, willing to ruin public finances to follow his artistic wishes. The fame of Artemisia probably intrigued him and it is not a coincidence that his collection included a painting of great suggestion, her ***Self-Portrait as the Allegory of Painting***.

Her father Orazio suddenly died in 1639. Artemisia had her own commissions to fulfill after her father's death. She had already left England by 1642 when the civil war was just starting. In 1649 she was in Naples again, corresponding with Don Antonio Ruffo of Sicily who became her mentor. The last known letter to her mentor is dated 1650 and makes clear that she was still fully active. She was still accepting commissions in 1654, though increasingly dependent on her assistant, Onofrio Palumbo. It is thought that she died in the devastating plague that swept Naples in 1656 which virtually wiped out an entire generation of Neapolitan artists.

Roberto Longhi, a noted Italian critic, commented that *"There are fifty-seven known works by Artemisia Gentileschi and 94% feature women as protagonists or equal to men. These characters intentionally lacked the typical feminine traits—sensitivity, timidness and weakness—and were courageous, rebellious, and powerful personalities."* See the video link for this page for insights into another female painter of an earlier generation, Sofonisba Anguissola.

Hierarchy of genres[1]

The hierarchies in art were formalized and promoted by the academies in Europe of which the most influential was the French Académie of Painting and Sculpture. The fully developed hierarchy (according to Félibien; see below) distinguished between:

- History painting; narrative religious, mythological, allegorical
- Group portrait painting
- Portrait painting
- Scenes of everyday life
- Animal painting
- Landscape, cityscape, seascape
- Still life

The hierarchy was based on a distinction between art that made an intellectual effort to "render visible the universal essence of things" and that which just consisted of "mechanical copying of particular appearances." Idealism was privileged over realism.

The hierarchy grew out of the struggle to gain acceptance of painting as one of the Liberal arts, and then controversies to establish an equal or superior status within them with architecture and sculpture. Against the sculptors, Leonardo argued that the intellectual effort necessary to create an illusion of three-dimensionality made the painters' art superior to that of the sculptor, who could do so merely by recording appearances. Alberti had argued that multi-figure history painting was the noblest form of art, it required mastery of all other genres, and because it had the greatest potential to move the viewer. He placed emphasis on the ability to depict the interactions between the figures by gesture and expression.

Theorists of the Early and High Renaissance accepted the importance of representing nature closely. However, by the time of Mannerist theorists such as Lomazzo and Zuccari this was far less of a priority. Both emphasized beauty as "something which was directly infused into the mind of man from the mind of God, and existed there independent of any sense-impressions," a view bound to further reduce the status of works depending on realism. Decorum also ruled: comic, sordid or frivolous subjects or treatment ranked lower than elevated and moral ones.

The new genres of landscape, genre painting, animal painting and still life came into their own in the 17th century with the nearly complete cessation of religious painting in Protestant countries and the expansion of picture buying by the prosperous middle class. An influential formulation of 1667 by André Félibien, a historiographer, architect and theoretician of French classicism, became the classic statement of the theory (stated from least to most consequential genre):

> *He who produces perfect landscapes is above another who only produces fruit, flowers or seafood. He who paints living animals is more estimable than those who only represent dead things without movement, and as man is the most perfect work of God on the earth, it is also certain that he who becomes an imitator of God in representing human figures, is much more excellent than all the others ... a painter who only does portraits still does not have the highest perfection of his art, and cannot expect the honor due to the most skilled. For that he must pass from representing a single figure to several together; history and myth must be depicted; great events must be represented as by historians, or like the poets, subjects that will please, and climbing still higher, he must have the skill to cover under the veil of myth the virtues of great men in allegories, and the mysteries they reveal".*

[1] See `http://en.wikipedia.org/wiki/Hierarchy_of_genres` for an excellent article of which this is just a partial and heavily edited small extract.

The Enlightenment[1]

Paul Brians
Washington State University, 1998

Although the intellectual movement called "The Enlightenment" is usually associated with the 18th century, its roots in fact go back much further. But before we explore those roots, we need to define the term. This is one of those rare historical movements which in fact named itself. Certain thinkers and writers, primarily in London and Paris, believed that they were more enlightened than their compatriots and set out to enlighten them.

They believed that human reason could be used to combat ignorance, superstition, and tyranny and to build a better world. Their principal targets were religion (embodied in France in the Catholic Church) and the domination of society by a hereditary aristocracy.

Background in Antiquity

To understand why this movement became so influential in the 18th century, it is important to go back in time. We could choose almost any starting point, but let us begin with the recovery of Aristotelian logic by Thomas Aquinas in the 13th century. In his hands the logical procedures so carefully laid out by the ancient Greek philosopher Aristotle were used to defend the dogmas of Christianity; and for the next couple of centuries, other thinkers pursued these goals to shore up every aspect of faith with logic. These thinkers were sometimes called "schoolmen" (more formally, "scholastics,") and Voltaire frequently refers to them as "doctors," by which he means "doctors of theology."

Unfortunately for the Catholic Church, the tools of logic could not be confined to the uses it preferred. After all, they had been developed in Athens, in a pagan culture which had turned them on its own traditional beliefs. It was only a matter of time before later Europeans would do the same.

[1] With thanks to Paul Brians for permission to include this essay in the workbook!

The Renaissance Humanists

In the 14th and 15th century (1300-1499) there emerged in Italy and France a group of thinkers known as the "humanists." The term did not then have the anti-religious associations it has in contemporary political debate. Almost all of them were practicing Catholics. They argued that the proper worship of God involved admiration of his creation, and in particular of that crown of creation: humanity. By celebrating the human race and its capacities they argued they were worshipping God more appropriately than gloomy priests and monks who harped on original sin and continuously called upon people to confess and humble themselves before the Almighty. Indeed, some of them claimed that humans were like God, created not only in his image, but with a share of his creative power. The painter, the architect, the musician, and the scholar, by exercising their intellectual powers, were fulfilling divine purposes.

This celebration of human capacity, though it was mixed in the Renaissance with elements of gloom and superstition (witchcraft trials flourished in this period as they never had during the Middle Ages), was to bestow a powerful legacy on Europeans. The goal of Renaissance humanists was to recapture some of the pride, breadth of spirit, and creativity of the ancient Greeks and Romans, to replicate their successes and go beyond them. Europeans developed the belief that tradition could and should be used to promote change. By cleaning and sharpening the tools of antiquity, they could reshape their own time.

Galileo Galilei, for instance, was to use the same sort of logic the schoolmen had used—reinforced with observation—to argue in 1632 for the Copernican notion that the earth rotates on its axis beneath the unmoving sun. The Church, and most particularly the Holy Inquisition, objected that the Bible clearly stated that the sun moved through the sky and denounced Galileo's teachings, forcing him to recant (take back) what he had written and preventing him from teaching further. The Church's triumph was a pyrrhic victory, for though it could silence Galileo, it could not prevent the advance of science (though most of those advances would take place in

Protestant northern Europe, out of the reach of the pope and his Inquisition).

But before Galileo's time, in the 16th century (1500-1599), various humanists had begun to ask dangerous questions. François Rabelais, a French monk and physician influenced by Protestantism, but spurred on by his own rebelliousness, challenged the Church's authority in his series of five novels named ***Gargantua and Pantagruel***, ridiculing many religious doctrines as absurd.

Michel de Montaigne

Michel de Montaigne, in a much more quiet and modest but ultimately more subversive way, asked a single question over and over again in his Essays: "What do I know?" By this he meant that we have no right to impose on others dogmas which rest on cultural habit rather than absolute truth. Powerfully influenced by the discovery of thriving non-Christian cultures in places as far off as Brazil, he argued that morals may be to some degree relative. Who are Europeans to insist that Brazilian cannibals who merely consume dead human flesh instead of wasting it are morally inferior to Europeans who persecute and oppress those of whom they disapprove?

This shift toward cultural relativism, though it was based on scant understanding of the newly discovered peoples, was to continue to have a profound effect on European thought to the present day. Indeed, it is one of the hallmarks of the Enlightenment. Just as their predecessors had used the tools of antiquity to gain unprecedented freedom of inquiry, the Enlightenment thinkers used the examples of other cultures to gain the freedom to reshape not only their philosophies, but their societies. It was becoming clear that there was nothing inevitable about the European patterns of thought and living: there were many possible ways of being human, and doubtless new ones could be invented.

The other contribution of Montaigne to the Enlightenment stemmed from another aspect of his famous question: "What do I know?" If we cannot be certain that our values are God-given, then we have no right to impose them by force on others. Inquisitors, popes, and kings alike had no business enforcing adherence to particular religious or philosophical beliefs.

It is one of the great paradoxes of history that radical doubt was necessary for the new sort of certainty called "scientific." The good scientist is the one is willing to test all assumptions, to challenge all traditional opinion, to get closer to the truth. If ultimate truth, such as was claimed by religious thinkers, was unattainable by scientists, so much the better. In a sense, the strength of science at its best is that it is always aware of its limits, aware that knowledge is always growing, always subject to change, never absolute. Because knowledge depends on evidence and reason, arbitrary authority can only be its enemy.

The 17th Century (1600-99)

René Descartes, in the 17th century, attempted to use reason as the schoolmen had, to shore up his faith; but much more rigorously than had been attempted before. He tried to begin with a blank slate, with the bare minimum of knowledge: the knowledge of his own existence ("I think, therefore I am"). From there he attempted to reason his way to a complete defense of Christianity, but to do so he committed so many logical faults that his successors over the centuries were to slowly disintegrate his gains, even finally challenging the notion of selfhood with which he had begun. The history of philosophy from his time to the early 20th century (1900-1999) is partly the story of more and more ingenious logic proving less and less, until Ludwig Wittgenstein succeeded in undermining the very bases of philosophy itself.

But that is a story for a different course. Here we are concerned with early stages in the process in which it seemed that logic could be a powerful avenue to truth. To be sure, logic alone could be used to defend all sorts of absurd notions; and Enlightenment thinkers insisted on combining it with something they called "reason" which consisted of common sense, observation, and their own unacknowledged prejudices in favor of skepticism and freedom.

We have been focusing closely on a thin trickle of thought which traveled through an era otherwise dominated by dogma and fanaticism. The 17th

century (1600-1699) was torn by witch-hunts and wars of religion and imperial conquest. Protestants and Catholics denounced each other as followers of Satan, and people could be imprisoned for attending the wrong church, or for not attending any. All publications, whether pamphlets or scholarly volumes, were subject to prior censorship by both church and state, often working hand in hand. Slavery was widely practiced, especially in the colonial plantations of the Western Hemisphere, and its cruelties frequently defended by leading religious figures. The despotism of monarchs exercising far greater powers than any medieval king was supported by the doctrine of the "divine right of kings," and scripture quoted to show that revolution was detested by God. Speakers of sedition or blasphemy quickly found themselves imprisoned, or even executed. Organizations which tried to challenge the twin authorities of church and state were banned. There had been plenty of intolerance and dogma to go around in the Middle Ages, but the emergence of the modern state made its tyranny much more efficient and powerful.

It was inevitable that sooner or later many Europeans would begin to weary of the repression and warfare carried out in the name of absolute truth. In addition, though Protestants had begun by making powerful critiques of Catholicism, they quickly turned their guns on each other, producing a bewildering array of churches each claiming the exclusive path to salvation. It was natural for people tossed from one demanding faith to another to wonder whether any of the churches deserved the authority they claimed, and to begin to prize the skepticism of Montaigne over the certainty of Luther or Calvin.

Meanwhile, there were other powerful forces at work in Europe: economic ones which were to interact profoundly with these intellectual trends.

Political and Economic Background

During the late Middle Ages, peasants had begun to move from rural estates to the towns in search of increased freedom and prosperity. As trade and communication improved during the Renaissance, the ordinary town-dweller began to realize that things need not always go on as they had for centuries. New charters could be written, new governments formed, new laws passed, new businesses begun. Although each changed institution quickly tried to stabilize its power by claiming the support of tradition, the pressure for change continued to mount. It was not only contact with alien cultural patterns which influenced Europeans, it was the wealth brought back from Asia and the Americas which catapulted a new class of merchants into prominence, partially displacing the old aristocracy whose power had been rooted in the ownership of land. These merchants had their own ideas about the sort of world they wanted to inhabit, and they became major agents of change, in the arts, in government, and in the economy.

They were naturally convinced that their earnings were the result of their individual merit and hard work, unlike the inherited wealth of traditional aristocrats. Whereas individualism had been chiefly emphasized in the Renaissance by artists, especially visual artists, it now became a core value. The ability of individual effort to transform the world became a European dogma, lasting to this day.

But the chief obstacles to the reshaping of Europe by the merchant class were the same as those faced by the rationalist philosophers: absolutist kings and dogmatic churches. The struggle was complex and many-sided, with each participant absorbing many of the others' values; but the general trend is clear: individualism, freedom and change replaced community, authority, and tradition as core European values. Religion survived, but weakened and often transformed almost beyond recognition; the monarchy was to dwindle over the course of the hundred years beginning in the mid-18th century to a pale shadow of its former self.

This is the background of the 18th-century (1700-1799) Enlightenment. Europeans were changing, but Europe's institutions were not keeping pace with that change. The Church insisted that it was the only source of truth, that all who lived outside its bounds were damned, while it was apparent to any reasonably sophisticated person that most human beings on earth were not and had never been Christians—yet they had built great and inspiring civilizations. Writers and speakers grew restive at the omnipresent censorship and sought whatever means they could to evade or even denounce it.

Most important, the middle classes—the bourgeoisie—were painfully aware that they were paying taxes to support a fabulously expensive aristocracy which contributed nothing of value to society (beyond, perhaps, its patronage of the arts, which the burghers of Holland had shown could be equally well exercised by themselves), and that those useless aristocrats were unwilling to share power with those who actually managed and—to their way of thinking,—created the national wealth. They were to find ready allies in France among the

impoverished masses who may have lived and thought much like their ancestors, but who were all too aware that with each passing year they were paying higher and higher taxes to support a few thousand at Versailles in idle dissipation.

The Role of the Aristocrats

Interestingly, it was among those very idle aristocrats that the French Enlightenment philosophers were to find some of their earliest and most enthusiastic followers. Despite the fact that the Church and State were more often than not allied with each other, they were keenly aware of their differences. Even kings could on occasion be attracted by arguments which seemed to undermine the authority of the Church. The fact that the aristocrats were utterly unaware of the precariousness of their position also made them overconfident, interested in dabbling in the new ideas partly simply because they were new and exciting.

François-Marie Arouet (1694-1778), known by the nom de plume Voltaire, moved easily in these aristocratic circles, dining at their tables, taking a titled mistress, corresponding with monarchs. He opposed tyranny and dogma, but he had no notion of reinventing that discredited Athenian folly, democracy. He had far too little faith in the ordinary person for that. What he did think was that educated and sophisticated persons could be brought to see through the exercise of their reason that the world could and should be greatly improved.

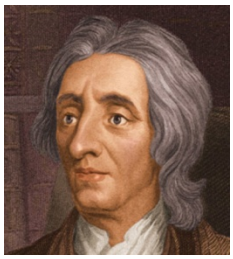
Rousseau vs. Voltaire

Not all Enlightenment thinkers were like Voltaire in this. His chief adversary was Jean-Jacques Rousseau, who distrusted the aristocrats not out of a thirst for change but because he believed they were betraying decent traditional values. He opposed the theater which was Voltaire's lifeblood, shunned the aristocracy which Voltaire courted, and argued for something dangerously like democratic revolution. Whereas Voltaire argued that equality was impossible, Rousseau argued that inequality was not only unnatural, but that—when taken too far—it made decent government impossible. Whereas Voltaire charmed with his wit, Rousseau ponderously insisted on his correctness, even while contradicting himself. Whereas Voltaire insisted on the supremacy of the intellect, Rousseau emphasized the emotions, becoming a contributor to both the Enlightenment and its successor, romanticism. And whereas Voltaire endlessly repeated the same handful of core Enlightenment notions, Rousseau sparked off original thoughts in all directions: ideas about education, the family, government, the arts, and whatever else attracted his attention.

For all their personal differences, the two shared more values than they liked to acknowledge. They viewed absolute monarchy as dangerous and evil and rejected orthodox Christianity. Though Rousseau often struggled to seem more devout, he was almost as much a skeptic as Voltaire: the minimalist faith both shared was called "deism," and it was eventually to transform European religion and have powerful influences on other aspects of society as well.

Across the border in Holland, the merchants, who exercised most political power, there made a successful industry out of publishing books that could not be printed in countries like France. Dissenting religious groups mounted radical attacks on Christian orthodoxy.

The Enlightenment in England



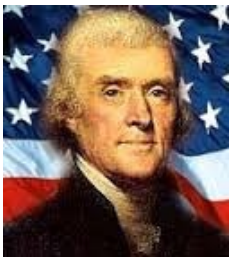
Meanwhile Great Britain had developed its own Enlightenment, fostered by thinkers like the English thinker John Locke, the Scot David Hume, and many others. England had anticipated the rest of Europe by deposing and

decapitating its king back in the 17th century (1600-1699). Although the monarchy had eventually been restored, this experience created a certain openness toward change in many places that could not be entirely extinguished. English Protestantism struggled to express itself in ways that widened the limits of freedom of speech and press. Radical Quakers and Unitarians broke open old dogmas in ways that Voltaire was to find highly congenial when he found himself there in exile. The English and French Enlightenments exchanged influences through many channels, Voltaire not least among them.

Because England had gotten its revolution out of the way early, it was able to proceed more smoothly and gradually down the road to democracy; but English liberty was dynamite when transported to France, where resistance by church and state was fierce to the last possible moment. The result was ironically that while Britain remained saturated with class privilege and relatively pious, France was to become after its own revolution the most egalitarian and anticlerical state in Europe—at least in its ideals. The power of religion and the aristocracy diminished gradually in England; in France they were violently uprooted.

The Enlightenment in America

Meanwhile, across the Atlantic, many of the intellectual leaders of the American colonies were drawn to the Enlightenment. The colonies may have been founded by leaders of various dogmatic religious persuasions, but when it became necessary to unite against England, it was apparent that no one of them could prevail over the others, and that the most desirable course was to agree to disagree. Nothing more powerfully impelled the movement toward the separation of church and state than the realization that no one church could dominate this new state.



Many of the most distinguished leaders of the American revolution—Jefferson, Washington, Franklin, Paine—were powerfully influenced by English and—to a lesser extent—French Enlightenment thought. The God who underwrites the concept of equality in the Declaration of Independence is the same deist God Rousseau worshipped, not that venerated in the traditional churches which still supported and defended monarchies all over Europe. Jefferson and Franklin both spent time in France—a natural ally because it was a traditional enemy of England—absorbing the influence of the French Enlightenment. The language of natural law, of inherent freedoms, of self-determination which seeped so deeply into the American grain was the language of the Enlightenment, though often coated with a light glaze of traditional religion, what has been called our "civil religion."

This is one reason that Americans should study the Enlightenment. It is in their bones. It has defined part of what they have dreamed of, what they aim to become. Separated geographically from most of the aristocrats against whom they were rebelling, their revolution was to be far less corrosive—and at first less influential—than that in France.

The Struggle in Europe

But we need to return to the beginning of the story, to Voltaire and his allies in France, struggling to assert the values of freedom and tolerance in a culture where the twin fortresses of monarchy and Church opposed almost everything they stood for. To oppose the monarchy openly would be fatal; the Church was an easier target. Protestantism had made religious controversy familiar. Voltaire could skillfully cite one Christian against another to make his arguments. One way to undermine the power of the Church was to undermine its credibility, and thus Voltaire devoted a great deal of his time to attacking the fundamentals of Christian belief: the inspiration of the Bible, the incarnation of God in Jesus Christ, the damnation of unbelievers. No doubt he relished this battle partly for its own sake, but he never lost sight of his central goal: the toppling of Church power to increase the freedom available to Europeans.

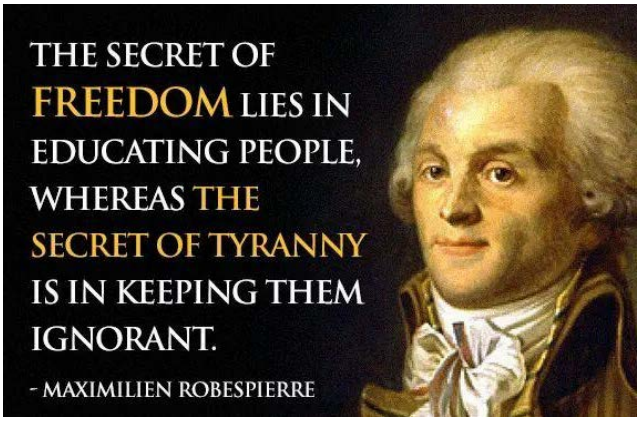
Voltaire was joined by a band of rebellious thinkers known as the philosophes: Charles de Montesquieu, Pierre Bayle, Jean d'Alembert, and many lesser lights. Although "philosophe" literally means "philosopher" we use the French word in English to designate this particular group of French 18th-century (1700-1799) thinkers. Because Denis Diderot commissioned many of them to write for his influential Encyclopedia, they are also known as "the Encyclopedists."

The Heritage of the Enlightenment

Today the Enlightenment is often viewed as a historical anomaly, a brief moment when a number of thinkers infatuated with reason vainly supposed that the perfect society could be built on common sense and tolerance, a fantasy which collapsed amid the Terror of the French Revolution and the triumphal sweep of Romanticism. Religious thinkers repeatedly proclaim the Enlightenment dead, Marxists denounce it for promoting the ideals and power of the bourgeoisie at the expense of the working classes, postcolonial critics reject its idealization of specifically European notions as universal truths, and postructuralists reject its entire concept of rational thought.

Yet in many ways, the Enlightenment has never been more alive. The notions of human rights it developed are powerfully attractive to oppressed peoples everywhere, who appeal to the same notion of natural law that so inspired Voltaire and Jefferson. Wherever religious conflicts erupt, mutual religious tolerance is counseled as a solution. Rousseau's notions of self-rule are ideals so universal that the worst tyrant has to disguise his tyrannies by claiming to be acting on their behalf. European these ideas may be, but they have also become global. Whatever their limits, they have formed the consensus of international ideals by which modern states are judged.

If our world seems little closer to perfection than that of 18th-century France, that is partly due to our failure to appreciate gains we take for granted. But it is also the case that many of the enemies of the Enlightenment are demolishing a straw man: it was never as simple-mindedly optimistic as it has often been portrayed. Certainly Voltaire was no facile optimist. He distrusted utopianism, instead trying to cajole Europeans out of their more harmful stupidities. Whether we acknowledge his influence or not, we still think today more like him than like his enemies. His most influential work, ***The Philosophical Dictionary***, helped lay the groundwork for modern patterns of thought.



People of the Enlightenment -1600s & 1700s

Name	From	Wrote	Main Ideas
John Locke	England	"Two Treatises on Government"	Preserve Life, Liberty, and property People should rule
Hobbes	England	"Leviathan"	Government should control evil behavior not divine right.
Montesquieu	France	"The Spirit of Laws"	Separation of Powers...3 branches
Rousseau	France	"The Social Contract"	Government should have a contract between government and rulers
Voltaire	France		Life is better with liberty Free Speech

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Romanticism and the Romantic Era[1]

Romanticism was an artistic, literary and intellectual movement that originated in the late 1700s in Europe and gained strength in reaction to the Industrial Revolution. In part it was a revolt against aristocratic social and political norms of the Age of Enlightenment, and a reaction against the scientific rationalization of nature. **Whereas the thinkers of the Enlightenment emphasized the primacy of reason, Romanticism emphasized intuition, imagination, and feeling to a point that has led to some Romantic thinkers being accused of irrationalism.**

Romanticism was embodied most strongly in the visual arts, music, and literature. Contrary to popular misinterpretation of the word "romantic" this era has nothing in common with "romance" in the sense of infatuation. It isn't associated with hearts-and-flowers fantasies as played out in today's "romance novels". But some of the characters of this era do appear as "affected" with feigned, droopy-eyed world-weary "wisdom" much like the fellow who appears in the brief video in the playlist for Unit 3.

The movement validated strong emotion as an authentic source of aesthetic experience. It emphasized such emotions as horror and terror and awe—especially that which is experienced in confronting the sublimity of untamed nature. It elevated folk art and ancient custom to something noble, made spontaneity a desirable characteristic (as in the musical impromptu), and argued for a "natural" understanding of human activities conditioned by Nature.

Romanticism reached revived medievalism in an attempt to escape the confines of population growth, urban sprawl and industrialism. It also attempted to embrace the exotic, unfamiliar, and distant harnessing the power of the imagination to envision and to escape. The modern sense of a romantic character may be expressed in the sense of a gifted, perhaps misunderstood loner, creatively following the dictates of his inspiration rather than standard ways of society.

The movement prized intuition and emotion over Enlightenment ("scientific") rationalism. The ideologies and events of the French Revolution laid the background from which Romanticism emerged. Romanticism elevated the achievements of what it perceived as heroic individualists and artists, whose pioneering examples would elevate society. It legitimized the individual imagination as a critical authority, which permitted freedom from classical notions of form in art.

[1] This information was extracted from WikiPedia at `http://en.wikipedia.org/wiki/Romanticism` and was edited to reduce it to size and content appropriate to this workbook.

"Romanticism" has been used to refer to certain artists, poets, writers, musicians, as well as political, philosophical and social thinkers of the late 18th and early to mid 19th centuries. It has equally been used to refer to various artistic, intellectual, and social trends of that era. Despite this general usage of the term, a precise characterization and specific definition of Romanticism has been the subject of debate in the fields of intellectual history and literary history throughout the 20th century, without any great measure of consensus emerging. Romanticism focuses on nature, a place free from society's judgments and restrictions.

The Romantic movement developed the idea of the absolute originality and artistic inspiration by the individual genius, which performs a "creation from nothingness." This Romantic ideology of literary authorship created the notion of plagiarism and the guilt of derivativeness. **This idea was in contrast with the preceding artistic tradition in which copying had been seen as a fundamental practice of the artistic process.** In European painting, led by a new generation of the French school, the Romantic sensibility contrasted with the neoclassicism being taught in the academies. In a revived clash between color and design and the expressiveness and mood of color, the works of J.M.W. Turner, Francisco Goya, Théodore Géricault and Eugène Delacroix emphasized the new prominence of the brushstroke and impasto (the artist's free handling of paint[2]). In this sense the movement carried forth elements originated by Caravaggio and Giorgione in the Renaissance

Romanticism had its counterpart in the American visual arts, most especially in the exaltation of an untamed American landscape found in the paintings of the Hudson River School. Painters like Thomas Cole, Albert Bierstadt and Frederic Edwin Church depicted ancient ruins of the old world. These works reflected feelings of death and decay; they show the Romantic ideal that Nature is powerful and will eventually overcome the temporary creations of man. Albert Bierstadt's *The Rocky Mountains, Lander's Peak* idealizes Native Americans living in harmony with the natural world. The Romantic movement spawned the Pre-Raphaelite Brotherhood, a minor movement in which artists attempted to return to the artistic emphases and techniques preceding the Renaissance.

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[2] The Italian word impasto refers to a technique used in painting where paint is laid on an area of the surface (or the entire canvas) thickly, usually thickly enough that the brush or painting-knife strokes are visible. Paint can also be mixed right on the canvas. When dry, impasto provides texture and the paint appears to be coming out of the canvas. (http://en.wikipedia.org/wiki/Impasto)

The Political Revolutions of 1848[1]

Art exists within the environment of the society in which it is created, and the events occurring in that society affect what art represents and means. To a European of 1848 it must have seemed that the whole world was being turned upside down, including the world of art, in which the classical establishment of the French Academy was being challenged by artists bent on abandoning old principles that they felt were stale constraints. Political revolutions erupted and the challenges to established artistic principles must have seemed like microcosms of that turmoil.

The European Revolutions of 1848, known in some countries as the Spring of Nations, Springtime of the Peoples or the Year of Revolution, were a series of political upheavals throughout Europe in 1848. This revolutionary wave began in France in February, and immediately spread to most of Europe and parts of Latin America. Over 50 countries were affected but there was no coordination or cooperation among the revolutionaries in different countries. Five factors were involved:

- widespread dissatisfaction with the political leadership
- the demand for more participation and democracy
- the demands of the working classes for a higher standard of living
- the upsurge of nationalism;
- the regrouping of the reactionary (conservative) forces based in the royalty, the aristocracy, the army, and the peasants.

The uprisings were led by shaky ad-hoc coalitions of reformers, the middle classes and workers, but it could not hold together for long. In many place protests were violent and in total tens of thousands of people were killed and many more forced into exile.

These revolutions arose from such a wide variety of causes that it is difficult to view them as resulting from a coherent movement or social phenomenon. Numerous changes had been taking place in European society throughout the first half of the 1800s:

[1] This material is extracted from Wikipedia at `http://en.wikipedia.org/wiki/Revolutions_of_1848` and has been heavily streamlined and edited into more concise form to shape it for the intended audience.

- liberal reformers and radical politicians were reshaping national governments
- technological change was revolutionizing the life of the working classes
- a popular press extended political awareness, and new values and ideas such as popular liberalism, nationalism and socialism began to spring up
- some historians emphasize the serious crop failures, particularly those of 1846 that produced hardship among peasants and the working urban poor
- large swathes of the nobility were discontented with royal absolutism or near-absolutism
- The population in French rural areas had rapidly risen, causing many peasants to seek a living in the cities. Many unskilled laborers toiled from 12 to 15 hours per day when they had work, living in squalid, disease-ridden slums.
- traditional artisans felt the pressure of industrialization, having lost their guilds
- Parts of Prussia were beginning to industrialize. During the decade of the 1840s mechanized production in the textile industry brought about inexpensive clothing that undercut the handmade products of German tailors. Reforms ameliorated the most unpopular features of rural feudalism while industrial workers remained dissatisfied with these and pressed for greater change.
- In the years 1845 and 1846 a potato blight caused a subsistence crisis in Northern Europe. As a result of harvest failures, food prices soared through the roof and the demand for manufactured goods decreased, causing an increase in unemployment; artisans and unemployed workers destroyed industrial machines when their social demands were neglected.
- aristocratic wealth (and corresponding power) was synonymous with the ownership of farm lands and effective control over the peasants.

Peasant grievances exploded during the revolutionary year of 1848. Working class objectives tended to fall in line with those of the middle class. The middle and working classes shared a desire for reform and agreed on many of the specific aims. Their participations in the revolutions, however, differed. While much of the impetus came from the middle classes, much of the cannon fodder came from the lower. The revolts first erupted in the cities.

Despite forceful and often violent efforts of established and reactionary powers to keep them down, disruptive ideas gained popularity: democracy, liberalism, nationalism, and socialism. In the language of the 1840s democracy meant universal male suffrage. Liberalism fundamentally meant consent of the governed and the restriction of church and state power, freedom of the press and the individual. Nationalism believed in uniting people bound by some mix of common languages, culture, religion, shared history, and of course immediate geography. At this time what are now Germany and Italy were collections of small states. Socialism in the 1840s was a term without a consensus definition, meaning different things to different people, but was

typically used within a context of more power for workers in a system based on worker ownership of the means of production.

Alexis de Tocqueville remarked in his *Recollections* of the period that "society was cut in two: those who had nothing united in common envy, and those who had anything united in common terror."

Aftermath

> ***. . . We have been beaten and humiliated . . . scattered, imprisoned, disarmed and gagged. The fate of European democracy has slipped from our hands.***
>
> —Pierre-Joseph Proudhon

In the post-revolutionary decade after 1848, little had visibly changed and most historians considered the revolutions a failure, given the seeming lack of permanent structural changes. The revolutions were most important in France, Germany, Poland, Italy, and the Austrian Empire, and did not reach Russia, Great Britain, Spain, Sweden, Portugal, or the Ottoman Empire.

By 1849 conservative forces had won out and the political revolutions collapsed. The only significant lasting reforms were the abolition of serfdom in Austria and Hungary, the end of absolute monarchy in Denmark, as well as the definitive end of the Capetian monarchy in France—the line to which Louis XVI, executed in 1792 in the French Revolution, belonged; this line had been restored to rule France with Louis XVIII in 1814.

European middle classes made political and economic gains over the next twenty years; France retained universal male suffrage. Russia would later free the serfs on February 19, 1861. The Habsburgs finally had to give the Hungarians more self-determination in the Ausgleich of 1867. The revolutions inspired lasting reform in Denmark as well as the Netherlands.

There were multiple memories of the Revolution. Democrats looked to 1848 as a democratic revolution, which in the long run insured liberty, equality, and fraternity. Marxists denounced 1848 as a betrayal of working-class ideals by a bourgeoisie that was indifferent to the legitimate demands of the proletariat. For nationalists, 1848 was the springtime of hope when newly emerging nationalities rejected the old multinational empires. They were all bitterly disappointed in the short run. 1848, at best, was a glimmer of future hope, and at worst, it was a deadweight that strengthened the conservatives and delayed further progress.

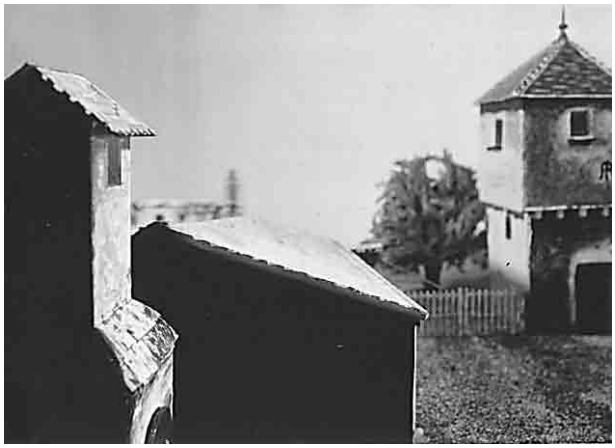
The special case of France

Revolutions occurred in France in 1830 and 1871, as well as 1848. In 1830 king Charles X was deposed and replaced by King Louis-Philippe, and in 1871 the Paris Commune held Paris for two months after the defeat of France by Prussia. It was against this background of intense political turmoil in France that photography was invented there (1839) and placed into the public domain, the Academy was challenged and classical art rules overturned (1863), and artistic revolt crystallized in the movement that was soon named Impressionism (1873)—which was the "permanent revolution" that Gombrich describes in chapter 25 of ***The Story of Art***.

Photography from 1827 to the present!

It's hard to imagine a world in which photography did not exist. Yet it has been possible to record things photographically only since about 1839. Photography was made practical about 65 years after the founding of the United States and about 20 years before the American civil war. The first permanently-recorded (albeit crude) image we can point to as a form of photograph was made in June, 1827 by **Joseph Niepce** (pronounced "neeps") in France. Niepce had experimented with the "camera obscura," a device known even in the Renaissance, and had struggled with a way to chemically record an image that the camera obscura focused on a metal plate. He succeeded to a degree and his first photograph is shown at the left below. The photo at the right helps to interpret the subject matter of Niepce's first photograph, which was taken from an upstairs window of a house facing a farmyard.

Reproduction of the first photograph made by Joseph Niepce in 1827. This reproduction is reversed left-to-right from the original image made on a metal plate.

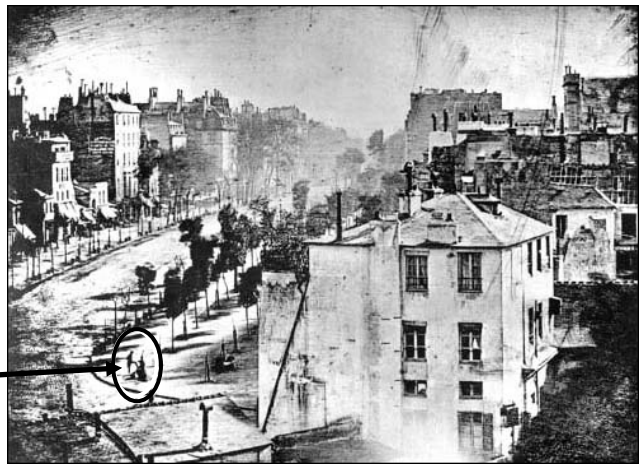


What the scene probably looked like with greater detail. This is a modern photo taken using a model of the Niepce farm constructed from descriptions dating from 1830.

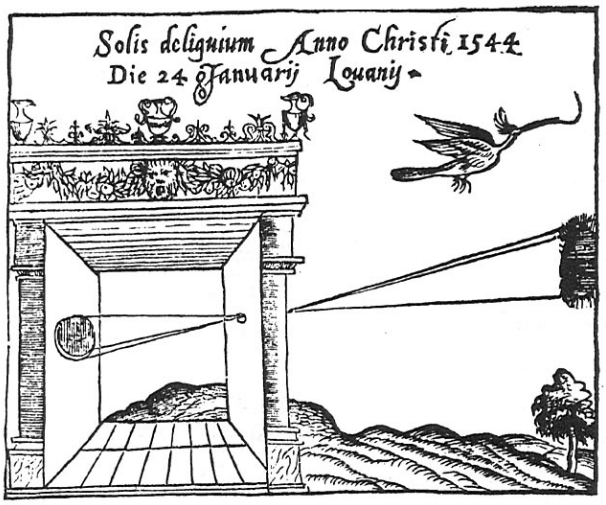
Joseph Niepce died in 1833. But by 1829 he had established a partnership with **Louis Daguerre**, who perfected a method of sensitizing a metal plate with metallic chemicals, exposing them with a camera using a lens to focus light, and then "developing" the plate using other chemicals that would stop the process of change in the surface caused by light. The image was made on a copper plate coated with polished silver. Through a series of treatments with noxious gases such as hot mercury vapor and bromides, the plate's surface became light sensitive. These were chemicals that could literally kill! The image was "fixed" with chemicals that stopped the development process and secured the image. Because the image is on a silver plate, it looks like a mirror. Turn the image one way and it's invisible; turn it another and it seems to jump out at you. "A mirror with a memory" is how the **Daguerreotype** was cleverly marketed.

The French government obtained the rights to the process and on August 19, 1839 announced it publicly. In an act of generosity to the world the French government made the use of the process freely available to all. Within a few years Daguerreotypes became commonplace throughout the world.

This is the first photograph in which a human being appears as recorded by the Daguerreotype process. It was made in the summer of 1839. The Parisian street seems empty because the long exposure time needed wasn't able to record moving objects. However, a man stopped to have his shoes shined and his image and that of the shoe shiner were captured. Although these two people will forever remain anonymous they are the first human beings ever photographed!



The **camera obscura** is basically a large box camera without any means to preserve an image other than manual tracing. If you take a light-tight box and put a pinhole in one side the pinhole acts like a lens and an inverted image of the scene on that side of the box will form on the inside of the box. This is a sketch of a form of camera obscura published in 1558 in a book entitled ***De Radio Astronomicoet Geometica***. It depicts how Gemma Frasius observed a partial eclipse of the sun by the moon in Belgium in 1544. Since the sun's light direct light is so intense its inverted image formed on a wall by a pinhole is visible even without the camera obscura being fully enclosed. The sun's light reflecting from a landscape scene will also form an image in the same way although much dimmer. A camera obscura described by **Leonardo da Vinci** in 1490 worked on this same principle. In that, a small hole made in a sheet of iron "focused" light on a sheet of paper. The image could be viewed through the paper if it was thin enough. Leonardo wrote that



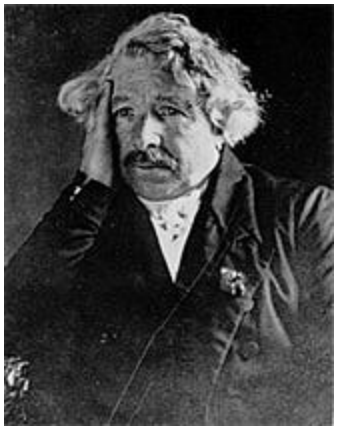
"*These images, being transmitted from a place illuminated by the sun, will seem as if actually painted on this paper, which must be extremely thin and looked at from behind.*"[1]

Joseph Nicéphore Niepce
(1765-1833)

Since the time of Leonardo various artists would construct light-tight camera obscuras large enough to go into and trace the image formed on the wall. Various refinement using mirrors were eventually worked out to reverse the reversed image so that a scene would appear in the image in the same way as it did to the naked eye. This served as an aid to drawing, especially in refining concepts of linear perspective. But it was viewed as a curiosity, perhaps one indulged in by artists who needed a "crutch" to "get it right." It's well documented that Vermeer used one.

The amount of light gathered by the camera obcura for the image could be increased by replacing the pinhole with a glass lens as a focusing device. This is one of the experiments conducted by Joseph Niepce in the 1820's as

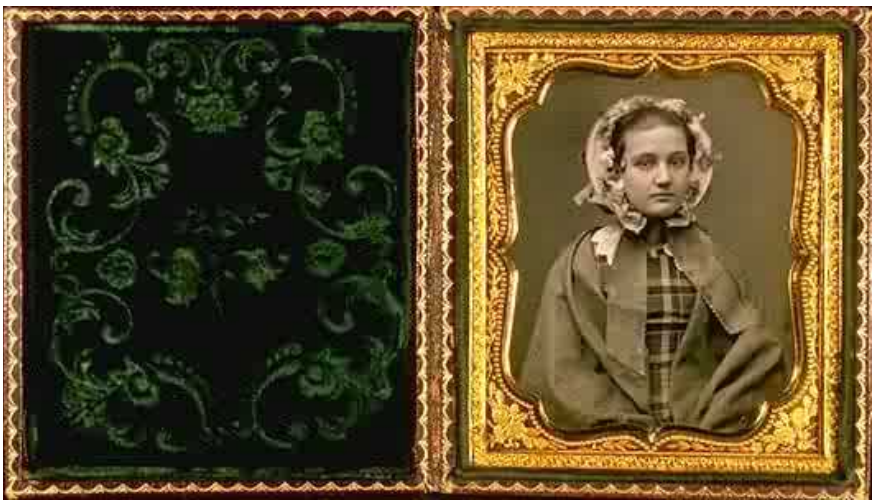
[1] I.A. Richter, *Selections from the Notebooks of Leonardo da Vinci*, Oxford University Press, Oxford, 1977, p. 115-16, as cited in *Vermeer's Camera*, by Philip Steadman, Oxford University Press, Oxford, 2002.



he tried various substances to replace the paper mentioned by Leonardo. Niepce was trying to find a substance that could somehow be changed by the image to capture it. One problem was that any substance that would be changed by light would continue to be changed even after the image formed on it so the image could not be made permanent.

The key to making an image captured in this way permanent was perfected by **Louis Daguerre** about 1833. The nature of the light-sensitive substance had to be changed chemically to make it insensitive to additional light once the image had formed. We owe the name "Photography" to **Sir John Herschel**, who first used the term in 1839, the year the photographic process became public. The word is derived from the Greek words for "light" and "writing". Wes Cowan, a Cincinnati, Ohio, auctioneer, has observed that…

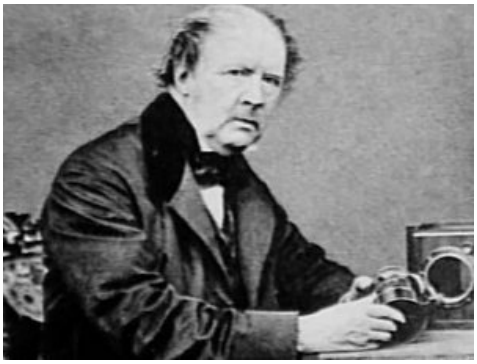
"The daguerreotype was… the first commercially successful photographic process. Before it arrived, anyone who wanted their portrait taken had to hire a painter, a miniaturist or someone who cut out silhouettes; all costly processes. Daguerreotypes brought portraits to the masses. In the 1850s, a photo cost just 50 cents *[but realize that the cost was still more than a day's wages for most people! –JJ]*. With its realistic image the daguerreotype put many of these artists out of business and inspired others to become daguerreotype artists themselves.



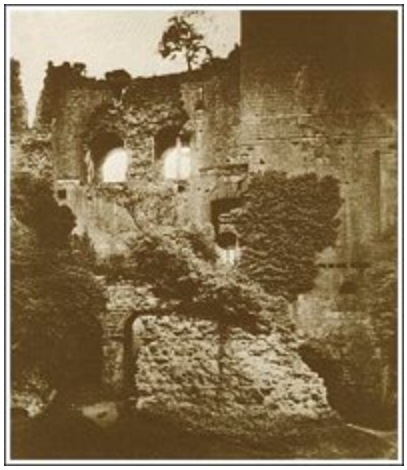
"The Frenchman J. M. Daguerre invented the process and taught it to American inventor Samuel B. Morse (as in Morse code) when Morse visited Paris in 1839. Morse brought the process back to the United States, teaching it to paying students. 'The daguerreotype spread like wildfire enjoying great popularity from the 1840s until the mid-1850s. Thousands of daguerreotype photographers learned the trade. "Itinerant photographers literally went to rural areas and knocked on doors asking people, 'Would you like your picture taken?'

"'The daguerreotype was the most superior photographic image ever produced,' Wes asserts. 'But they are a pain in the neck to make.' The image was also extremely delicate and susceptible to tarnish and corrosion because of the silver. Wes offers a word of advice: "don't ever try to polish a daguerreotype because you will literally rub away the picture." Daguerreotypes were usually sealed behind glass in cases with hinged covers to keep air away from the silver surface, which would tarnish much as silver utensils do. They had a number of other disadvantages, including the fact that they could not be reproduced.

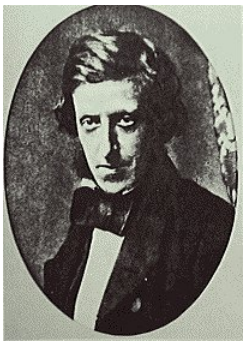
Photography beyond Daguerreotypes[2]



In 1834 **Henry Fox Talbot** created permanent (negative) images using paper soaked in silver chloride and "fixed" (made permanent) with a salt solution. Talbot created positive images by contact printing onto another sheet of paper. Talbot didn't do much with his invention until he patented his process in 1841 under the name "**calotype**". His process produced a **negative** image on paper. The exposed paper was then placed over a second sheet of sensitized paper and exposed to a bright light, producing a positive image. This process enabled photographers to make multiple copies of a single image. This was not possible with a daguerreotype which produced a positive image directly on a metal plate. The downside to the calotype is that since it was transferred through a paper negative it wasn't as clear as the daguerrotype.



In 1851 **Frederick Scott Archer**, a sculptor in London, improved the resolution of photographic processes by spreading a mixture of collodion (nitrated cotton dissolved in ether and alcohol) and chemicals on sheets of glass, creating light-sensitive wet plates. **Wet plate collodion photography** was much cheaper than Daguerreotypes, the image was high quality, and the process which involved negative/positive steps made possible unlimited reproductions. But the process required performing all the necessary operations on the spot because development could not wait; this was why photographers like Matthew Brady (see below) had to have wagons in the field to house their equipment and chemicals.



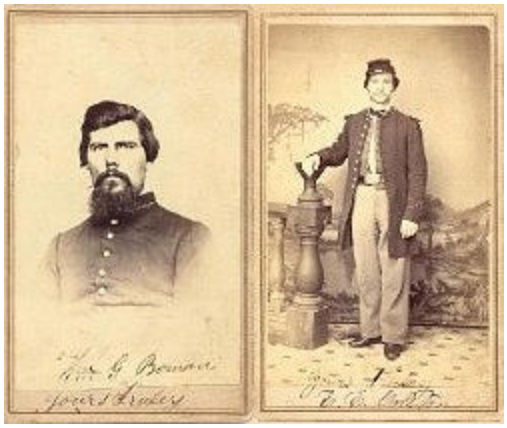
Adolphe Disderi invented **carte-de-visite photography** in Paris in 1854. This was a type of small photograph similar to a baseball trading card of later years. It was usually made of an albumen print, which was a thin paper photograph mounted on a thicker paper card. The size of a carte de visite is about 2.5 inches by 4 inches, a little bigger than today's business cards. Disdéri also patented a method of taking eight separate negatives on a single plate, which reduced production costs.

The **albumen print**, also called albumen silver print, was invented in 1850 by Louis Désiré Blanquart-Evrard, and was the first commercially exploitable method of producing a photographic print on a paper base

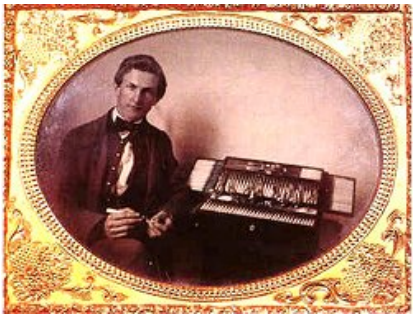
[2] Some of this material is from a web site associated with the art department of Maine East High School in Park Ridge, Illinois. I accessed it using Google's cache on October 31, 2010.

from a negative. It used the albumen found in egg whites to bind the photographic chemicals to the paper and became the dominant form of photographic positives from 1855 to the turn of the 20th century, with a peak in 1860-90. During the mid-19th century, the carte de visite became one of the more popular uses of the albumen method.

Disdéri published Emperor Napoleon III's photos in the carte-de-visite format in 1859 which made the format an overnight success. The popularity of the new format became known as "cardomania" and eventually spread throughout the world. Such photograph cards were traded among friends and visitors and led to the publication and collection of photographs of prominent persons. The craze spread throughout Europe and then quickly to America. Albums for the collection and display of cards became a common fixture in Victorian parlors. This format was very popular item during the American Civil War, providing soldiers, friends and family members a means of inexpensively obtaining photographs and sending them to loved ones in small envelopes. Photos of Abraham Lincoln, Ulysses S. Grant, and other celebrities of the era became an instant hit with the public. By the early 1870s, cartes de visite were supplanted by "cabinet cards," which were also usually albumen prints mounted on cardboard backs that were slightly larger. Cabinet cards remained popular into the early 20th century, when Kodak introduced the Brownie camera and home snapshot photography became a mass phenomenon.



Pictures began to be taken in pairs, with a separation of a few inches between images, starting about 1855. When viewed with a holder that focused each eye on only one of the images, the scene appeared in three dimensions. **Stereoscopic pictures** became a novelty and sets of images of places, people and scenes started to be sold as entertainment items.

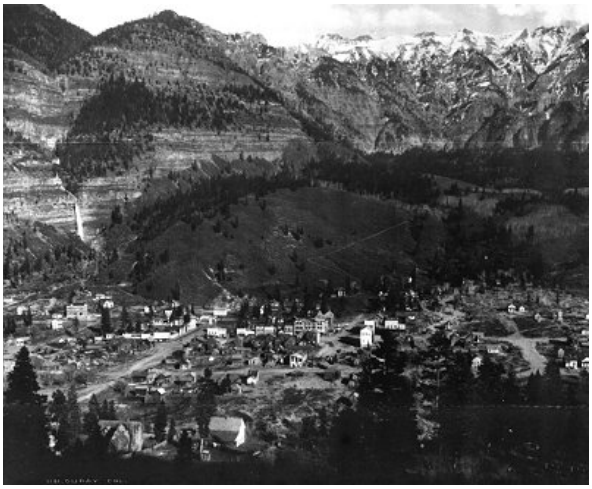


The **ambrotype** process was developed in 1855-57. This produced direct positive images on glass and metal (tintypes or ferrotypes) and became popular in the United States. The process involved under-exposing collodion on a glass negative, bleaching it, and then placing a black background behind it. Ambrotypes somewhat resemble Daguerreotypes but the method of production was very different and much safer and they were much less expensive and required less exposure time.

In 1861 Scottish physicist **James Clerk-Maxwell** demonstrated color photography involving three black and white photographs, one each taken through a red, green, or blue filter. The photos were made into lantern slides and projected in alignment with the same color filters. This is the "color separation" method by which color photography eventually was made practical and the first demonstration of a photographic process making color photography possible. In 1868 **Ducas de Hauron** published a book proposing a variety of methods for color photography. In the early

1900s the **Lumiere brothers** of France developed a way to use this method to make practical color slide images, which were popular until color film using the same principles became available in the 1930s. This still life which you see here is actually an autochrome taken in about 1910. View the web resources for this page to see several more autochromes and the stunning color of which they were capable.

Using the wet plate collodion method **Mathew Brady** and his staff created over 7,000 images of the American Civil War between 1861-65. This was the first time that the carnage of the battlefield could be viewed by people not actually present at the scene; this began dispelling the glory associated with “the field of honor” and replacing it with the images of its true gore.



By 1870 the U.S. Congress sent photographers out to the West to document it. The most famous images were taken by **William Jackson** and **Tim O'Sullivan**, an apprentice to Brady. In documenting the geological formations of Yellowstone Jackson had to think about the aesthetic and promotional impact of his images. He was required to make artistic choices that could deliver the awesomeness of the country to his audience: Congress and the American public.

Richard Leach Maddox, an English doctor, in 1871 proposed the use of an emulsion of gelatin and silver bromide on a glass plate, the **"dry plate" process**, to replace the wet-plate collodion process. By 1878, dry plates were being manufactured commercially.

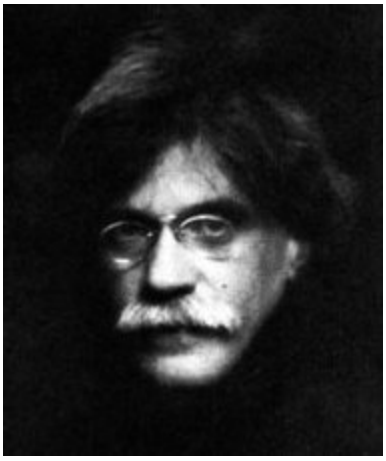
George Eastman, at the age of 24, established the Eastman Dry Plate Company in Rochester, New York in 1880. The **Eastman Kodak Company** grew into one of the largest photographic supply companies in the next decades, but by 2002 it was in serious decline as digital imagery began replacing consumer film photography. Eastman Kodak declared bankruptcy in 2012.

The first **half-tone printed photograph** appeared in a daily newspaper, the New York Graphic, in 1880. The process made it possible to reproduce photographs in newspapers, replacing line image drawings that had previously been the only way to print images.

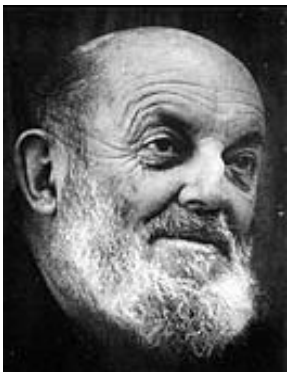
In 1888 Kodak produced its first **Kodak snapshot camera**, containing a 20-foot roll of light-sensitive paper, enough for 100 2.5-inch diameter circular pictures. The camera was simple, with just a box, a lens, a cord and a button to release it, and a crank to advance the film. When the

film was used up, the whole camera was sent to the Eastman Kodak Company, where it was developed, reloaded and returned, ready for another 100 photographs. In 1889 an improved camera was produced using a roll of film instead of paper. This was a milestone, as flexible film replaced the clumsy, heavy glass plates that had been the means of photography up to this time.

In 1901 Dr. Richard Leach Maddox received the British Royal Photographic Society's Progress Medal for inventions to the film industry. He had freely made his ideas known and never patented the process; sadly he ended his days in poverty.



In 1902 photography began to be recognized as an art form. Photography **Alfred Stieglitz** (1864-1946) organized the "Photo Secessionist" show in New York City. Stieglitz's career spanned the transition from the Victorian era to the modern world. His efforts to improve the way photographs were presented at exhibitions and reproduced in periodicals were effective in the campaign for the recognition of the photograph as an art object, while his openness to new techniques and styles enabled him to introduce Americans to European modernism and to the avant-garde styles of native artists. In his role and expressive photographer and as an impresario he has had a more profound influence on the course of aesthetic photography in America than any other single individual.



Ansel Adams (1902-1984) was an American photographer and environmentalist, best known for his black-and-white photographs of the American West, especially in Yosemite National Park. The Stieglitz gallery hosted his ***An American Place*** exhibit in New York in 1936; the exhibition proved successful with both the critics and the buying public and earned Adams strong praise from the revered Stieglitz.

Digital camera technology became practical (but prohibitively expensive) by 1965 when the first flyby spacecraft image of Mars was taken from Mariner 4 on July 15, 1965 with a digital camera designed by NASA/JPL.

The first recorded attempt at building a **digital camera for the consumer market** was made in 1975 by **Steven Sasson**, an engineer at Eastman Kodak. It used the then-new solid-state CCD image sensor chips developed by Fairchild Semiconductor in 1973.

By 2002 two- megapixel cameras were available in the United States for less than $100, with some one-megapixel cameras for under $60. At the same time, many discount stores with photo labs introduced a "digital front end" making it possible for consumers to obtain true chemical prints (as opposed to ink-jet prints) in an hour. Most manufacturers of film camera stopped production of them between 2004-2006 and as of 2016 it’s increasingly difficult to find a source of supply for consumer film itself, or commercial processing services for it.

Autochromes: commercial color photography

Autochrome photographic plates were invented in 1903 and held sway for 30 years as the only way to capture full color images. They make clever use of microscopic dyed potato starch grains as filters to capture red, green, and blue light intensities separately in very closely adjacent tiny spots on ordinary black and white film. When viewed as slides with sunlight or a white light source behind them autochromes can produce brilliant color images.

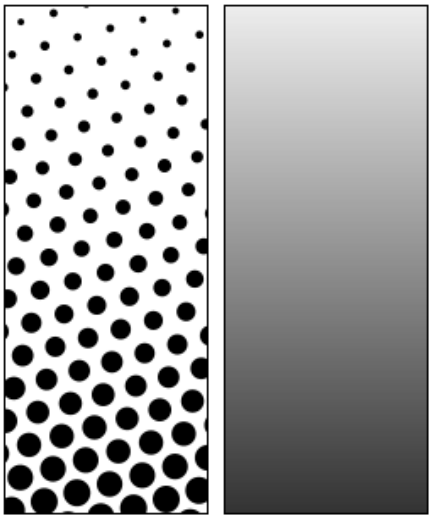
Autochromes made more than 100 years ago are like peering backwards into a time for which very nearly all our records and mental images are black and white. It's easy to imagine a color image like that of the man asleep on a reclining chair having been made yesterday. But the man pictured here must surely have turned to dust even before your parents were born because it was taken in Casablanca in 1908!

The other images on this page were also created in the first decade of the 1900s and are all more than 100 years old.

View the link associated with this page on the course web site to learn more about the autochrome process and to see more examples of these kinds of images.

Photograph printing: newspapers, magazines[1]

Halftone is the reproduction technique that simulates continuous tone imagery through the use of dots, varying either in size, in shape or in spacing. The halftone process reduces visual reproductions to an image that is printed with only one color of ink. This reproduction relies on a basic optical illusion—these tiny dots are blended into smooth tones by the human eye. In the illustration here you can see the dots at the left, greatly magnified. The black dots at the lower part of the image are large, creating a dense pattern of ink. Moving upward, the dots have the same spacing but are smaller and smaller in size, creating less ink density. With the dots printed hundreds per inch the human eye perceives the appearance of this image as gradient shading from dark gray to light gray.



The idea for halftone printing originated with William Fox Talbot. In the early 1850s he suggested using "photographic screens or veils" in connection with a photographic intaglio process. This is how photographs were printed in black and white in newspapers. Here is a picture of the first printed photo using a halftone in the December 2, 1873 issue of the New York Daily Graphic. Prior to this time the only way to publish an image was to create it by hand as a relief print or an intaglio print. The relief halftone process proved to be a success almost immediately and their use in popular journals became regular during the early 1890s and continues to the present.

Color photographic printing is made possible by repeating the halftone process for each subtractive color—most commonly using what is called the "CMYK color model" (cyan-magenta-yellow-“key” where “key” is usually black). This model is based on the science of perceived color, unlike the common red, blue, yellow “historical” pigment primary colors, which only approximate accurate color mixing and color production.

CMYK halftone printing gives less than full intensity of the pigment primary colors. For example, magenta printed with a 20% halftone produces a pink color, because the eye perceives the tiny magenta dots and the white paper between the dots as lighter and less intense than the color of pure magenta ink.

[1] This information was extracted from `http://en.wikipedia.org/wiki/Halftone` and edited for this purpose

With CYMK halftoning a full continuous range of colors can be produced. In the illustration of the mountain scene you see here the original photograph contains hundreds of different colors as shadows and light interplay with the various colors in the scene.

To accomplish full color halftone printing the original image is separated using optical filters to obtain three different monochrome images. The filters are colored cyan, magenta, and yellow. When the image of the original scene is projected through each filter the intensity of the selected color is recorded on black and white film (or digitally) and is used to create a halftone. Printing is done in light-to-dark ink order. The yellow-filtered image is printed with yellow ink, then the magenta-filtered image and then the cyan filtered image. When the magenta and cyan halftone printing is done directly on top of the yellow halftone printing the images combine to produce the original coloration.

In commercial halftone work an ordinary halftone in black and white, without any color filtering, is usually also made and printed last over the three CYM colors. With this process the black and white separation is made first and the density it accounts for is “subtracted” from the original image before the CYM color separations are made. This is done because it conserves the amount of colored inks required to produce the image. The black and white separation becomes the “key” by which the CYM separations are aligned. Compare the three color CYM color separations at left with the four color separations at the right and you’ll see the effect of this on the CYM printing density. We are mixing pigments here so this is referred to as “subtractive” color mixing since light intensities are reduced by each color.

Colorants and paints: Baroque and beyond[1]

Until the 1800s artists had to produce their own pigments and paints. With the advent of art academies and an increase in the number of amateur painters painting for enjoyment there arose a place for someone to supply pigments and colors to the art community. The new trade of the artist's “colorman” began, with businesses being set up to supply pigments, paints, brushes, canvases and all other materials to the professional and amateur artist alike.

Industrialization in Europe also influenced the world of art and many dazzling scientific discoveries made in the field of chemistry rapidly unfolded to yield new and exciting pigments for the artist's palette. Artists were sometimes slow to take up these new discoveries but as more new pigments were discovered the artist's colormen came into a world of their own.

The Industrial Age

The industrial history of pigments began between 1704 and 1710 with the synthesis of the first synthetic inorganic pigment: **Prussian blue**. The pigment was discovered accidentally by a Berlin color maker named Diesbach. While working on the synthesis of a red lake from cochineal, ferrous sulphate and alkali, he ran short of potash. He asked a nearby alchemist named Dippel if he could have some potash to continue with his reaction. The resulting lake obtained was very pale and when Diesbach tried to concentrate it the mixture turned purple, then deep blue. Diesbach later realized that the potash he had borrowed had been contaminated with animal oil from one of Dippel's experiments and had actually been set aside to throw away. After working out what had occurred the blue impurity was named Prussian blue.

The method for making Prussian blue was kept a secret until 1724 when it was finally published. Prussian blue was the first synthetic blue pigment that could be used in place of ultramarine, although it was susceptible to attack by alkali. The main benefit of Prussian blue was the price, which was only a tenth that of ultramarine, and it was very attractive to artists of the time.

Blue and green verditer were by-products of an industrial process and so were favorably cheap, but because of their tendency for color change they were not always widely used by famous artists. It was not until the French chemist Pelletier analyzed verditer in the 18th century that a reliable method of production was developed. Both pigments were recommended for beginners or, as a last resort, when the more expensive blue and green pigments were beyond reach.

Advances in chemistry

The discovery of new elements played an important role in the discovery of new pigments around this time, one of the most important elements discovered being **chromium**. In 1770 a beautiful orange mineral named **chrocoite** was found in the mountains of Siberia and it rapidly became popular with collectors in Europe. The French chemist **Nicholas Louis Vauquelin** (1763-1829)

[1] This writing draws much information from the multiple web-accessible references cited in the index.

obtained a sample of the mineral and analyzed it in 1797. He discovered that chrocoite contained an unknown element that formed a variety of intense red, yellow and green precipitates. The new element was named chromium from the Greek word meaning colored. Vauquelin initially had trouble procuring chromium ores but by 1809 a source had been found in France and the bright yellow pigment **lead chromate** was synthesized. Some time seems to have elapsed before the widespread production of **chrome yellow** for the artist's color market. The first person to manufacture the pigment in England was a Dr. Bollman (1769-1821), a German-trained medic who settled in England. Bollman became interested in manufacturing chemistry and set up a pigment factory producing, among other things, chrome yellow. The pigment was very popular. Princess Charlotte had her carriage painted with the flamboyant color which perhaps started the trend of the yellow taxi cab later in history.

During the course of his experiments Vauquelin also discovered **chromic oxide**, and he published the first account of this green pigment in 1809. Chromic oxide was being used in the ceramics industry at this time but was later introduced for artists' use; it was considered to be a very reliable green pigment with excellent fastness properties but poor color strength. Vauquelin carried out many experiments with chromium and discovered several compounds that were also used as pigments.

In 1838 the French color maker Pannetier developed a stronger, more transparent variety of hydrated chromic oxide, known as viridian, which became very popular with artists and is still widely used today.

French ultramarine

At the beginning of the 19th century, as at all times in history, the demand for natural ultramarine far outweighed supply. The best quality lapis lazuli was mined in the Kokcha valley of Afghanistan, which was a very inaccessible region, forcing the cost of the pigment even higher than usual. Chemists turned the resources of the burgeoning science of chemistry to the synthesis of this pigment.

Analytical experiments carried out at the end of the 1700s showed that ultramarine was composed of soda, silica, alumina and sulfur. By 1806 two French chemists, Desormes and Clément, had found that a blue impurity that occurred in the slag of soda furnaces was chemically similar to ultramarine. This discovery led to a number of scientific prizes being offered to anyone who could devise a method of making artificial ultramarine.

The Société d'Encouragement pour l'Industrie Nationale offered a prize of six thousand francs in 1824 to anyone who could make the pigment for less than three hundred francs per kilo. Four years later the prize was claimed by the French manufacturer Guimet who did not reveal his method. The synthesis of ultramarine was later published by a German chemist named Gmelin who had

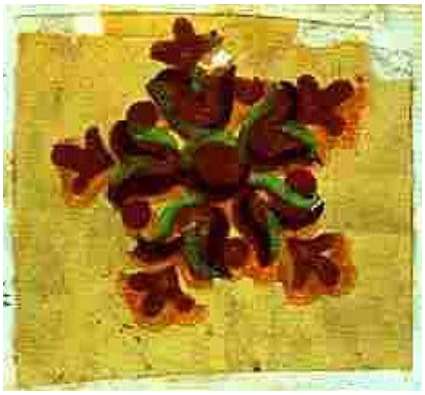
discovered the method independently. Full-scale industrial production of the blue pigment was begun immediately and French ultramarine was widely used by artists. Natural ultramarine, however, is still considered to be superior for the purposes of fine art despite its high price.

Copper-based green pigments

Several green copper-based pigments were being produced in the late 1700s and early 1800s that came about by the chemical investigation of new elements. The Swedish chemist **Carl Wilhelm Scheele** manufactured a green pigment of **copper arsenite** in 1775. This was named **Scheele's Green** and was discovered during investigations into arsenic.

Details of Scheele's discovery were published in1778 by the Stockholm Academy of Sciences. To manufacture the green pigment some potash and arsenic oxide were dissolved in water and heated; then the solution was added slowly to a warm solution of copper sulfate to precipitate copper arsenite. Scheele warned of the toxic nature of the green substance but it was accepted as an artist's pigment and patented in Britain in 1812. By the end of the 1800s it replaced the older green pigments based on copper carbonate.

Efforts to improve upon Scheele's green produced another highly toxic green pigment known as emerald green. This was copper acetoarsenite and was first manufactured commercially by Russ and Sattler in 1814. Emerald green was made by dissolving the pigment verdigris in warm vinegar, then adding a solution of arsenic oxide slowly to form a green precipitate. The pigment was a very popular color but had only limited use in art due to its tendency to turn black on exposure to heat and because of its highly toxic nature.



Emerald green was widely used in wallpaper printing. A number of fatalities caused the poisonous nature of the pigment to be fully realized, and it then began to be used as a highly effective rat poison. Considerable speculation exists that Napoleon Bonaparte, exiled to the island of St. Helena after his defeat by the British in 1814, occupied rooms there decorated with wallpaper that used this pigment, and that the dampness caused a fungus to grow on the paper that discharged the arsenic in the form of highly toxic arsine gas. When Napoleon died in exile in 1821 it was thought that he died of stomach cancer. But tests on samples of his hair performed in the 1960 indicated that he may have died of arsenic poisoning. An interesting article of that era that tells of a sample of that wall paper (picture above) having been taken as a souvenir by a servant and passed down through his family. That sample, when analyzed, confirmed that Emerald green colorant is present on it. Emerald green was featured in several murder cases and, unbelievably, was still in use until the 1960s!

Early 1800s in art

Two English painters, Joseph Mallord William Turner (1775-1851) and John Constable (1776-1837) were both landscape painters but adopted very different styles. Turner produced fantastic, swirling land- and sea-scapes with strangely lit skies. Constable set out to paint exactly what he could see with his own eyes. Constable was one of the first famous painters actually to go outside the studio and paint scenes using the colors he saw in the real world. He was not a popular painter at the time and was often criticized. His choice of muted browns in many of his works limited their appeal to art lovers who favored bright colors.

Turner was, and still is, regarded as one of the greatest colorists. He is known to have used a wide variety of pigments. Analysis of his watercolor box has shown a large range of pigments, including several chrome yellows, cobalt blue, blue verditer, chalk, Indian yellow, red madder, yellow ochre, vermilion, red ochre, raw sienna, gamboge and carmine presumably from cochineal.

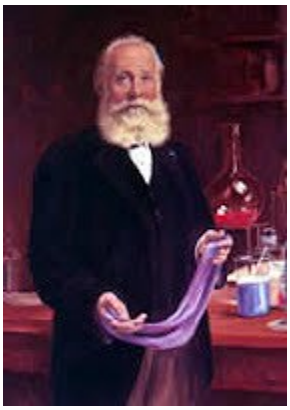
New pigments

Zinc white, or zinc oxide, was introduced as a pigment from the beginning of the 1800s although the substance had been known since antiquity. An important reason for its development was concern about the toxicity of lead. The primitive production methods used to make **lead white** were causing an increasing number of cases of poisoning and a replacement white pigment was needed. **Zinc oxide** was a by-product obtained from the production of brass, where copper and zinc spar were heated in a furnace, and was used for medicinal purposes. **Zinc white** came to prominence as a pigment after the element zinc was isolated and identified by Henckel in 1721, which led to a method for its production.

Cobalt green was invented in 1780 by the Swedish chemist Rinman but was not widely used for about another 50 years. It was made by forming an aqueous solution of cobalt and zinc nitrates, then adding an alkaline carbonate and heating to form a precipitate. The bright green precipitate had good pigment properties but fairly low color strength. It was introduced as an artist's pigment in 1835 and is still used today.

Coal tar (aniline) colors

During the Victorian era a revolution in color history took place. It began when August Wilhelm Hofmann (1818-92) identified the organic chemical **aniline** in coal tar in 1843. At this time Hofmann was working as a chemist in Germany but two years after his discovery he became the first director of the Royal College of Chemistry in London. In 1853 Hofmann took on the 15-year-old William Perkin as a student of chemistry. Perkin showed such a natural aptitude for chemistry that he was quickly promoted to the position of honorary research assistant. During the course of his studies Perkin carried out a project attempting the synthesis of quinine from aniline. At this time the structure of organic molecules was a great mystery to chemists and most research was carried out purely by trial and error.



Perkin's experiments with quinine were not successful. However, instead of synthesizing quinine he did produce a black precipitate that yielded a bright purple solution. Perkin recognized the potential of this discovery as a dyestuff. He discovered that it dyed silk a beautiful deep purple shade that was very resistant to light. Perkin's purple product was the first synthetic organic colorant, which he named **mauveine**.

With the patenting of mauveine Perkin quickly resigned his academic position to set up as an entrepreneur of dyestuff manufacturing. The invention of mauveine occurred at a time when there was huge expansion in Europe of the textile industry. Perkin could not have chosen a better time or place for his discovery. England was in the midst of the Industrial Revolution and coal tar, the major source of his raw material, was being produced in large quantities as a waste product of coal gas and coke. The Victorians had acquired a taste for all things oriental, and purple

became associated with oriental style. Mauveine became a great success as a dye and helped to set new fashion trends along with crinoline, which had only been introduced three years earlier. Mauveine was not just popular as a dyestuff but was also laked to produce a widely used pigment. The bright purple pigment was popular with artists because of its unusual color, The discovery and synthesis of mauveine permanently changed the world of colorants.

France in the 19th Century

As the 19th century dawned many more industrial, technical and chemical innovations affected the art world. The traditions of craftsmanship were being replaced by the advent of mass-produced goods. This applied in art to some extent because of the invention and rise in popularity of photography, which was seen to take the traditional role of portrait painting, and depiction of country landscapes and houses. With photography, a mirror could be held up to the world, which did not require the skill of an artist, and this meant that the art world had to search for a new function. The center of culture in Europe was Paris, where not only the arts flourished but a profusion of scientific inventions were also born.

French Impressionism

Dramatic changes occurred in art in Paris that were brought about by a paradigm shift throughout Europe in the way the world was viewed. Many influences converged: the French Revolution, industrialization, scientific advancement and the rise of common man in the eyes of society. In Paris artists began to look at the world in a completely new way. They left their studios for the first time and actually saw the scenes around them with fresh eyes.

Artists of the period began to investigate the interplay of light and shadow, movement and color. They did not paint according to the traditional methods of the academies but rather tried to create an impression of real life. The term “impressionism” was adopted for this group of painters; it was initially used by critics as an insult for their lack of technique in painting but the name stuck and became very appropriate, and was adopted to name the style and era.

Early artists of this Impressionist revolution included **Edouard Manet** (1832-1883), **Claude Monet** (1840-1926), **Pierre Auguste Renoir** (1814-1919), **Berthe Morisot** (1841-1895), and **Camille Pissaro** (1830-1903). They painted everyday scenes in a style that suggested form through the use of intentional lack of detail, crude brush strokes, outdoor light and high contrast, rather than defining shapes using chiaroscuro. They were subjected to criticism and derision at the time and were even rejected from the official Salon exhibition of the Academie. The Impressionists banded together to exhibit their work separately in 1864, and many people went along simply to laugh at their efforts. This stormy period in art took about 20 years to pass before the Impressionists gained popular acceptance and eventually became wealthy and famous.

The Impressionists used color in a new way and this was reflected by their choice of pigments. In the days prior to Impressionism many artists had chosen palettes containing a great number of pigments. The impressionists were more interested in studying the effects of mixing simple colors and light so they often chose a simple palette of a few base colors. A study of Pissaro's palette showed that it was limited to seven pigments, all squeezed from prepared paint tubes. These pigments were: white lead, chrome yellow, vermilion, rose madder, ultramarine, cobalt blue and cobalt violet. This palette shows an absence of green and, more surprisingly, black.

Expansion of Organic Chemistry

The invention of **mauveine** prompted chemists throughout Europe to investigate and experiment to produce new colorants from coal tar products. In 1858 in France, **Verguin** (1814-1864)

discovered the second coal tar color, which he named **fuchsine**, although this was also widely known as magenta. The bright-pink colorant was an immediate success and was also produced as a pigment by laking.

New industrial processes led to the discovery of the third aniline color in 1860. Magenta was being manufactured industrially in France using aniline and arsenic acid, and one day a workman in the factory seems to have confused the two chemicals. Instead of adding arsenic acid to the magenta reaction vessel, too much aniline was added by mistake, yielding a blue color instead of the expected pink. Two chemists, Girard and De Laire, happened to observe this unexpected phenomenon, and later patented a method for the synthesis of a new blue colorant, which they simply named **aniline blue**. The chemistry of these new dyestuffs was not very well understood but the dyes themselves were hugely successful.

Dominance of Germany

The colorant industry at this time was mostly based in Britain and France, but a gradual shift of industrial development to Germany and Switzerland took place in the 1860s. Sound chemical theory also began to replace trial-and-error experimentation. These changes occurred partly because of the work of August Kekulé in 1865, who came up with the concept of the six-member carbon ring structure for benzene. This discovery gave chemists some insight into the structure of organic molecules. It allowed them to start designing reactions and to expand their knowledge of many other compounds. It was a turning of the tide for organic chemistry.

Alizarin Red

Chemists began to investigate natural organic products. Some of the first colorants to undergo this treatment were the plant products of madder and indigo, both of which were widely used in the 1800s. **Madder** was a popular pigment and dyestuff for cotton, often known as **turkey red**. The economic importance of madder had long been recognized, and in Napoleon had signed a proclamation urging the development of madder dyeing for wool. In 1820 the Société Industrielle de Mulhouse offered a substantial prize for the best chemical investigation of madder.

No one was awarded the Mulhouse prize, but two Parisian chemists, Colin and Robiquet, managed to isolate a red substance from madder. This substance was named **alizarin**. It generated much from chemists of the time who tried to identify the structure of the mystery compound with the aim of producing a synthetic madder dyestuff. Chemists throughout Europe worked on the puzzle of alizarin but it was eventually a team of German chemists who made the crucial breakthrough and determined the correct structure. **Adolf Bayer** (1835-1917), **Carl Graebe** (1841-1927) and **Carl Lieberman** (1842-1914) worked on alizarin from 1865 until 1868 and finally invented a method to produce it which they patented in 1868. Industrial production of the alizarin began in Germany soon afterwards and caused the total demise of the natural madder industry throughout Europe.

Synthetic Indigo

During the 1860s and 1870s the vast majority of **natural blue indigo** was imported from the British colony of India into London and Liverpool. The British had a tight monopoly on the

indigo trade in Europe and could keep the colorant at inflated prices, which angered many European industrialists. Adolf Bayer had started to research indigo compounds between 1860 and 1865 but had been unable to identify the structure of the blue coloring matter in the plant. By 1869 he had succeeded in preparing a synthetic product similar to indigo. The influential chemist Kekulé believed that he was within reach of synthesizing indigo himself so put a stop to Bayer's research. As it turned out Kekulé's ideas were not correct and Bayer did not return to his elusive quest for synthetic indigo until 1876. It did not take Bayer long to succeed in his task. By 1880 he had synthesized indigo and filed a patent for it and by 1883 the correct chemical structure had been determined.

The industrial production of **synthetic indigo** did not begin immediately because of the difficulty in finding a production method economical enough to compete with natural indigo. Full-scale manufacture began in 1897 and this prompted competitive price decreases in the natural product. By the turn of the century the sales of synthetic indigo had overtaken those of the natural product and the indigo plantations of India were suffering badly due to the crumbling of the British trade monopoly. By 1914 over 90% of all indigo came from synthetic manufacturing. During this period laked indigo was very popular as an artist's pigment because it was easily available from two competing sources and the price rapidly dropped.

The abandonment of industrial use of natural indigo and madder marked the end of an era for natural colorants. It was no longer economically viable to grow plants, collect lichens or crush rocks to obtain colorants and these small cottage industries collapsed. Some natural products remained for specialist applications, and some can still be found today, but on the whole they vanished from use.

Beginnings Of Modern Art

Artists of the post-impressionist era were living in times of discovery and invention which influenced the new styles of art produced. Three artists of the late 1800s century greatly influenced the schools of modern art that were to follow in the 1900s.

Paul Cézanne (1839-1906) retired from the Impressionist art world of Paris to live in the countryside. Cézanne painted scenes from nature but tried to keep the light and suggestion of the impressionists without losing the depth and distance of traditional art. He developed a system of building blocks of colors which later influenced the style of cubism. An analysis of Cézanne's color palette shows that a wide range of pigments was being used at the turn of the 20th century. Cézanne's palette had 17 individual pigments, some of which had only recently been discovered. He used cadmium yellow, Naples yellow, chrome yellow, yellow ochre, raw sienna, vermilion, red ochre, burnt sienna, red madder, alizarin crimson lake, burnt lake, emerald green, verona green earth, cobalt blue, ultramarine, Prussian blue and peach stone black.

Vincent Van Gogh (1853-1890) led a painfully disturbed and lonely life that ended with his suicide at the age of 37. His most famous paintings were created during three years of intense activity and despair at the end of his life. Van Gogh painted in unconventional strokes and splashes of pure color that make the paintings appear to move and to express the emotions of the painter. He deliberately distorted images to achieve his aims. He died relatively unrecognized but later was to have a huge artistic influence on the field of expressionism.

Paul Gauguin (1848-1903) was a companion and colleague of Van Gogh for a time. Gauguin began to paint late in life after giving up his job as a stockbroker. He became disillusioned with the civilized art of France and eventually went to remote Tahiti to rediscover simplicity and even

barbarity in his art. Gauguin used bold color schemes and simple forms, often ignoring depth in his paintings. Later on the work of Gauguin strongly influenced the idea of a return to primitive art in Europe.

Azo colors

More than half of the European colorants industry in the late 1800s was based in Germany, and many important innovations in pigment technology were made there. Modern industrial research was also beginning, with collaboration between industrial and academic scientists, and publication of new scientific research journals that facilitated the communication of new ideas. One innovation to benefit from the expansion of communication was the development of **azo colorants**. Azo colors grew from the discovery of the diazo intermediate by **Peter Greiss** in 1858; the first azo dye was synthesized in 1863. This dye was a bright yellow color named **Field's yellow** synthesized by Fredrick Field.

The first azo colors were not well understood chemically but in 1870 Kekulé and Hidegh actively coupled diazonium salts to engineer azo dyes of known structure. The new azo dyes gave very bright, predominantly yellow, orange and red hues and caused great enthusiasm and excitement. Many of these products were laked to offer an abundance of new pigments for artists, but unfortunately many of these pigments were not tested sufficiently for fastness properties. Artists became overwhelmed with bright colors, some of which proved unsatisfactory for painting, having poor light fastness (being fugitive in oils). Colormen slowly implemented stricter testing procedures for artists' pigments.

True Organic Pigments

The very first true azo pigment was **tartrazine yellow**, patented in 1884 and still in use as an artist's pigment today. Chemists were now able to build molecules with greater understanding and vast numbers of new azo pigments were rapidly introduced. A whole range of azo dyes and pigments was introduced after 1895, many of which are still in use today such as **toluidine red**.

Cadmium Colors

A range of yellow, orange and red inorganic pigments based on the element of cadmium were commercially introduced around 1900. Yellow cadmium sulphide was actually discovered by Stromeyer in 1817 when he observed a sample of zinc carbonate that formed an oxide that was bright yellow in color rather that white. Stromeyer deduced that the color was due to a new element which he identified and named cadmium. He suggested that this yellow substance was suitable for use as an artist's pigment, but at the time this was not possible due to the scarcity of cadmium. By the 1840s cadmium was being produced industrially and a small amount of the yellow pigment became available to artists. Winsor and Newton introduced **cadmium yellow** to Britain 1851. It was prized as a bright yellow pigment with very good light fastness but was expensive. Mercury and cadmium pigments were also introduced to give other orange and red shades. All of the cadmium pigments were very popular with artists for all types of painting and drawing media, and some are known to have been used by Monet, Van Gogh and Matisse. Cadmium pigments are still being used today but are gradually being phased out because of concerns over the toxicity of cadmium.

The Arts and Crafts Movement[1]

Arts and Crafts was an international design philosophy that originated in England and flourished between 1860 and 1910, continuing its influence until the 1930s. The Arts and Crafts style started as a search for aesthetic design and decoration and a reaction against the styles that were developed by machine-production. The movement stressed traditional craftsmanship using simple forms and often medieval, romantic or folk styles of decoration. It also included advocacy of economic and social reforms and has been considered as essentially anti-industrial.

The main developer of the Arts and Crafts style was **William Morris** (1834–1896), who had been a part of the Pre-Raphaelite Brotherhood. Morris was inspired by the writings of **John Ruskin** (1819–1900), who thought machinery was to blame for many social ills and that a healthy society depended on skilled and creative workers. Like Ruskin, Arts and Crafts artists tended to oppose the division of labor and to prefer craft production, in which the whole item was made and assembled by an individual or small group. They were concerned about the decrease of rural handicrafts, which accompanied the development of industrialization, and they regretted the loss of traditional skills and creativity. "Because craftsmen took pleasure in their work", Morris wrote, "the Middle Ages was a period of greatness in the art of the common people. ... The treasures in our museums now are only the common utensils used in households of that age, when hundreds of medieval churches, each one a masterpiece, were built by unsophisticated peasants." The movement was contemporaneous with the currents flowing through art in the 1860s as new ideas, leading to Impressionism, eventually broke the stranglehold on creative expression long held by the classical, conservative academic artistic establishment.

During 1861 Morris and some of his friends formed a company, Morris, Marshall, Faulkner & Co., which designed and made decorative objects for homes, including wallpaper, textiles, furniture and stained glass. In 1890 Morris established the Kelmscott Press, for which he designed a typeface based on Nicolas Jenson's letter forms of the fifteenth century. This printed fine and deluxe editions of contemporary and historical English literature. Morris & Co. was active until 1940 and some of its designs are still being produced.

Arts and Crafts objects are simple in form, without superfluous decoration, and how they were constructed is often still visible in the finished product. They tend to emphasize the qualities of the materials used ("truth to material"). In order to express the alleged beauty of craft, some products were deliberately left slightly unfinished, resulting in a certain rustic and robust effect.

[1] Extracted from Wikipedia at `http://en.wikipedia.org/wiki/Arts_and_Crafts_Movement` and edited by Jim Janossy

They often had patterns inspired by British flora and fauna and used the domestic traditions of the British countryside.

Morris's ideas spread during the late nineteenth and early twentieth century and resulted in the establishment of many associations and craft communities. A hundred and thirty Arts and Crafts organizations were formed in Britain, most of them between 1895 and 1905. Morris's ideas were adopted by the New Education philosophy during the late 1880s, which incorporated handicraft work in schools.

In the United States, the Arts and Crafts style initiated a wide variety of attempts to reinterpret European Arts and Crafts ideals for Americans. While the Europeans tried to recreate the virtuous craft labor that was being replaced by industrialization, Americans tried to establish a new type of virtue to replace heroic craft production: well-decorated middle-class homes. They claimed that the simple but refined aesthetics of Arts and Crafts decorative arts would ennoble the new experience of industrial consumerism, making individuals more rational and society more harmonious. The American Arts and Crafts philosophy was the aesthetic counterpart of its contemporary political philosophy, Progressivism. Characteristically, when in Chicago the Arts and Crafts Society began during October 1897, it was at Hull House, one of the first American settlement houses for social reform.

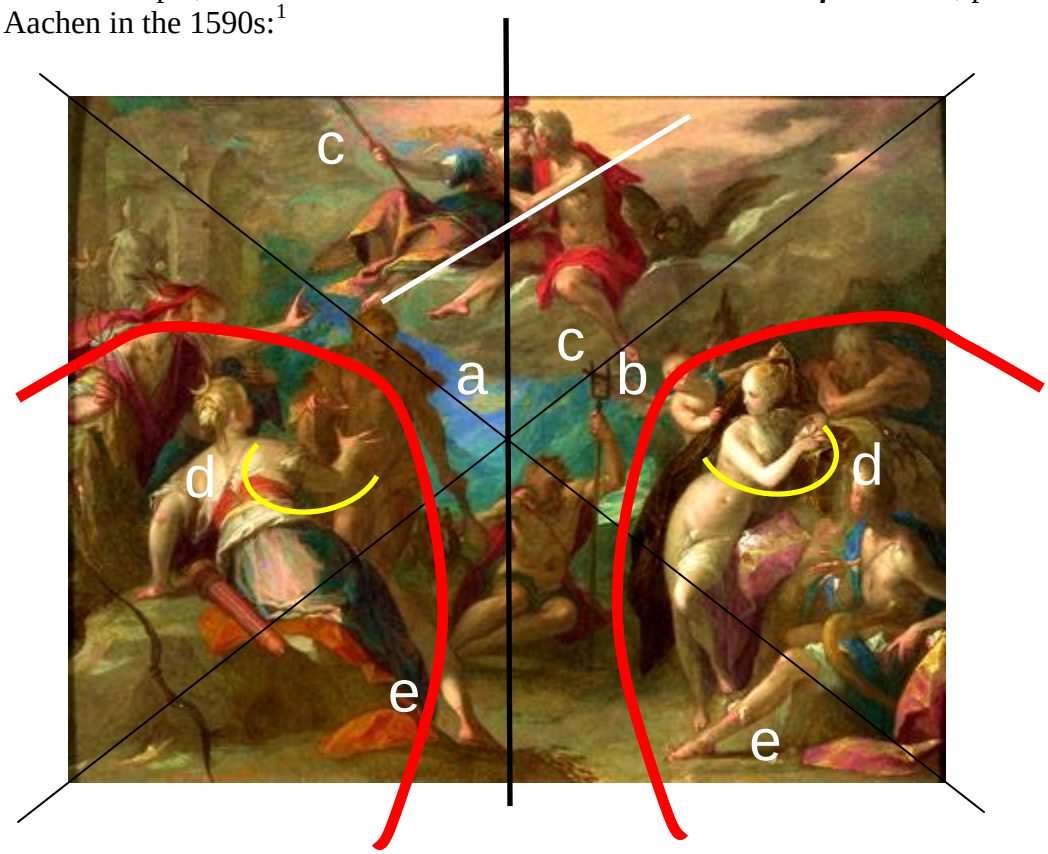
By the end of the nineteenth century, Arts and Crafts ideals had influenced architecture, painting, sculpture, graphics, illustration, book making and photography, domestic design and the decorative arts, including furniture and woodwork, stained glass, leatherwork, lace-making, embroidery, rug making and weaving, jewelry and metalwork, enameling and ceramics.

Owen Jones (1809–1874), an early proponent of the movement, declared that "Ornament ... must be secondary to the thing decorated" and that there must be "fitness in the ornament to the thing ornamented". This comes quite close to Louis Sullivan's later incisive architectural dictate that "form follows function." The "Prairie School" of Frank Lloyd Wright, George Washington Maher and other architects in Chicago, the Country Day School movement, and the bungalow style of houses are some examples of the American Craftsman style of architecture. Mission Style, Prairie School, and the California bungalow styles of residential building remain popular in the United States today.

Widely exhibited in Europe, the Arts and Crafts style's simplicity inspired designers like Henry van de Velde and styles such as Art Nouveau, the Dutch De Stijl group, Vienna Secession, and eventually the Bauhaus style. Some regarded the style as a prelude to Modernism, which used simple forms without ornamentation.

Symmetry as a composition technique

Symmetry refers to the way an image is composed. Symmetry is most often arranged to "balance" the left and right sides of an image as defined by a vertical line drawn to divide the picture into equal halves. An easy way to draw this line is to connect the corners of the picture to find the center of the image and then to draw a vertical line through the point where these lines cross. Here's an example, based on an artwork entitled ***The Amazement of the Gods***, painted by Hans von Aachen in the 1590s:[1]



Is this image composed in a symmetrical way? In fact, this artwork makes a lot of use of symmetry but not in quite so simple a manner as artists of the Middle Ages often composed their images. As you can see I've marked up this painting to help answer this question:

1. A different number of people exist on the left and right, but the shapes defined by them are very much the same. I have drawn red lines indicating these major shapes.
2. The artist has taken great pains to make the picture look natural but has provided two opposing shapes as the tip of the object behind the sleeve of the figure standing close to the vertical line at the left (a) and the tips of the trident at the right (b).
3. The two opposing 45 degree lines of the staff of the left upper figure and the extended left leg of the right upper figure are symmetrical about a line defined by the slant of the right figure's left arm (c).
4. The curves of the arms of the two main opposing figures are symmetrical in shape (d) as are the legs of the seated figure at the left and the seated figure at the right (e).

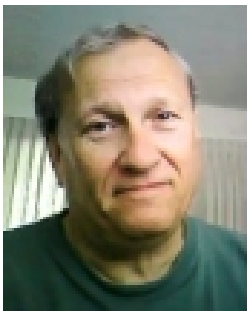
[1] This painting at the National Gallery in London can be viewed at `http://www.nationalgallery.org.uk`

Take a look at the same artwork below, without the clutter of the explanatory lines I drew on the image earlier. See how the symmetry of the image becomes apparent and adds to the "satisfying" nature of this composition:

Can you find even four more examples of balance via symmetry in this figure that I have not pointed out above? One involves the shape roughly circular shape of color at the center of the image as defined by the cross corner lines. Another is very subtle and involves an extended arm and the left and the bottom edge of a cloud at the right. Yet another involves the bow leaning at the lower left corner and something with an opposing defining edge at the lower right. And another example is the waving hand of the figure at left and triangular shape above and to the right of the head of the baby at the right.

Symmetry was very important to artists of the European Middle Ages; they almost always strove to achieve it even at the expense of an image that appeared realistic as the eye would view a scene. Symmetry hinted at the order of the cosmos created by God. This notion of the "goodness" of an image based on its symmetry continued in Western art through the Renaissance and Baroque and still in some ways still affects us today. On the other hand, symmetry was not a rule of composition for some Asian cultures, as ***The Story of Art*** notes concerning Chinese meditation scroll art and Japanese woodcut art of the 1800s.

Project 4



A multi-part project that review important concepts that you need to bring down to earth for yourself and make sure you understand, and to prepare you for the take-home final exam!

This project has three **required parts**:

1. Recognizing and identifying symmetry
2. Recognizing and identifying each of the scientific perspectives; this work takes you into the exploration of several online art galleries!
3. Experiencing how your take-home final works, and how it is focused on critical thinking.

In addition, an optional extra credit item is available to you exploring a specialized type of photography used in studying slow and fast processes. I have carefully designed and documented the parts of this project so that each part should be easy to follow. Each of the parts is equipped with one or more web resources such as brief readings or tutorial videos. You can submit the different parts of this project separately. Contact me if you have any questions or problems! ☺ Jim

Project 4

Symmetry and Scientific Perspective

Throughout the Middle Ages symmetry was a dominant theme in the composition of Western art. This often led artists to place the figures and objects in an artwork in particular positions to "balance" each side of the image. This guiding principle was not a factor in much of the art of China so it is by no means the only way that a painting can be made to look pleasing to the eye. In fact, excessive use of symmetry can force a painting to look awkward and clumsy. A mark of a genius such as Leonardo da Vinci was that he could use symmetry without being obvious about it! The idea of balance through symmetry persisted into later eras of Western art and in some ways still applies in the formation of images along "classical" lines.

A major Renaissance achievement was the discoveries of various psychological "cues" that make flat artwork appear to have depth. With the desire to make two-dimensional art as realistic as possible, artists of the Renaissance could use the scientific perspective to create paintings that were more realistic than people had ever seen before. Artists of all subsequent periods benefit from and have relied on these techniques.

In this project you have three parts to accomplish and you need to do all of them. Part 1 deals with the issue of symmetry, and Part 2 deals with the five types of scientific perspective. Part 3 provides some experience with the kind of work you will be doing for your take-home final exam, which relies on your use of your own reflective essay first-person story as an oral history. It's easiest to submit this work as three separate documents.

Project 4 Part 1: Looking for symmetry

After doing the assigned readings in ***The Story of Art*** and the supplementary readings in this workbook take a close look at the picture above. To view it in larger form click on or visit the link for this page on the course web site unit page.

At least five placements of things in this painting have been arranged by the artist following guidelines of symmetry—even more if you look closely at shape and pose! Identify as many uses of symmetry in this artwork as you can and clearly explain what elements are symmetrical how the symmetry is achieved. Sum up your analysis by indicating if the use of symmetry here results in a natural-appearing picture or one that is forced in composition.

Project 4 Part 2: Examples of scientific perspective

Using any online gallery of art you wish (links to several are located at the course web site associated with this workbook page) locate **five Renaissance paintings or frescos,** one for each of the types of scientific perspective, and **five Baroque paintings**, one for each of the types of perspective: 10 paintings in all. Each work you identify might incorporate more than one type of perspective. But you need to locate **for each type of scientific perspective** an example that makes **significant use** of that type of perspective. The summary on workbook page 90 lists and describes all five of the scientific perspectives. It's best if you organize your paintings in the same sequence as those perspectives are listed.

You then need to copy the image of the art and embed it in a document with this information, as shown in the example below:

1. Indicate the era (Renaissance or Baroque)
2. Describe the type of perspective it uses and how it uses it—where it is located on the artwork
3. Identify and state the name of the artwork and the year it was created
4. Include name of the artist who created the work, his/her birth and death years
5. Identify where (what city or country) the artist worked
6. Identify by name the gallery or site you copied the picture of the art from.

Painting 1 - Renaissance Period - Atmospheric perspective

1. Renaissance Period
2. Atmospheric perspective – this painting has a bluish cast in the background of this painting, if you looked closely the farther that it recede the bluish it gets.
3. The Mond Crucifixion, 1502-1503
4. Raphael, 1483-1520
5. Italy
6. The National Gallery, London http://www.nationalgallery.org.uk/paintings/raphael-the-mond-crucifixion

For this project you CANNOT use artworks that are contained in *The Story of Art.* In order to count towards your grade the artworks you choose must be different from any of those already illustrated and described in the text!

In doing Part 2 make sure that you follow these instructions:

1. Use the timeline on pages 660-61 of ***The Story of Art*** as a guide to artists of these periods (those pages have no page numbers but are labeled "Table Three").
2. The pictures you embed in the document should be no larger than 3 inches in any dimension. **Make sure the pictures are .jpg format, not .tiff (Mac users beware!) because I can't readily handle .tiff pictures on a PC!**

Project 4, Part 3: Intro to your take-home final: Conclusions Work

Background

Based on my experience with the type of take-home final you'll encounter in this course it's apparent that some undergraduate students have already developed skills in critical thinking and some have not. This last part of Project 3 is designed to help put everyone on the same level when it comes to critical thinking and documenting an argument in support of what facts seem to tell you. Your take-home final will be posted in the 8th week of the term (or at the 80% point in terms shorter than 10 weeks). The work described here is a prelude to that assignment. **Do this BEFORE attempting the conclusions work!**

When you do this part of Project 3 you'll be seeing the result of my having taken the same kind of actions you are going to have to take, using the same form you will be using, when you work on your take-home final. But in this example case the subject matter has nothing to do with art or technology. I am using for example purposes a short history written by my older brother Andy when he helped one of his kids with a middle school assignment on family history. I'll use Andy's writing as an "oral history" to make a conclusion about something that his writing seems to make evident. When Andy wrote his short document he didn't have in mind the conclusion that I will make—he had no conclusions at all in mind, just as you are not intended to draw any conclusions in your reflective essay. Your first-person story essay is much the same as Andy's family history: it's a recounting of what you see and experience, period. **Your essay does not contain conclusions.**

In this part of Project 3 I will use a conclusions form to state a conclusion that I develop from Andy's writing. You are simply going to confirm that I have cited the facts accurately. This is mainly to force you to go through this example to become more aware of how critical thinking works and how facts are documented in a logical argument. What you do in this part of Project 3 **IS NOT** what you will do in the take-home final work, but this will help you see how to do that work.

Later, in your take-home final, use the same kind of form and the facts you have woven into your reflective essay to judge whether conclusions statements that I will give you are true or false. You will have to support your true/false determinations of my statements in those cases. Seeing this example will help you understand critical thinking better without getting bogged down in academic arcania like footnote punctuation. The form I will use, and will give you to use, presents a very simplified form of fact citation which makes it much easier to document facts that you cite. I am interested in the soundness and logic of your arguments, not silly and arbitrary rules of punctuation.

WHAT YOU ARE TO DO

Here are the steps you need to follow to complete this part of Project 3:

1. Read the example oral history on the next page. It's a brief example of an oral history document that spans only five pages, followed by a conclusions form **that serves as an example (only!)**. I have broken that "essay" up into the appearance of five pages to simulate pages for example purposes. The go on to step 2 following it.

Growing up in Los Angeles 1950-80

Andrew Janossy Nov. 3, 1998

Page 1

As a child of 7 I remembered being taken at an even younger age to a merry-go-round by my mom. We lived in south Los Angeles and the year was about 1954. The merry-go-round was located on Manchester Avenue at Western Avenue, on the southwest corner. These were wide four-lane roads with parking, and there were some stores, houses, and a park nearby. Walking west along Manchester from Halldale Avenue, the street we lived on, we passed vacant fields with a lot of grass and a creek running through. There was also a large old farmhouse

Page 2

with a silo at the back; my dad and I explored it once. But these were recollections. By the time I was 7 the merry-go-round was gone, replaced by a Shell gas station, and the vacant lots has become the parking lot for a health clinic that had been constructed. The creek was gone, probably replaced by a drain pipe hidden under paving. The old farmhouse and silo were no more; now a car lot was there. We moved in 1955 to an area several miles to the south, away from a residential street to a busy one, when my dad opened a real estate office and we lived in

Page 3

the house behind it. Across the street was an open field. But not for long. Soon, in the middle of the night, a huge truck pulled a whole building down the street. It had been uprooted and set on wheels. The building had been in the way of a new freeway and had been auctioned off. It was rolled down the street and placed on a foundation on the new site. It became a motel. As a teenager my friends and I used to collect frogs from swamps near the high school. We passed open fields and hills on our bikes. One of my uncles lived south of us and a dairy cow pasture was located behind his back fence—less

Page 4

than pleasant smells wafted by his place most afternoons. He had got a good deal on the house I guess… By the time I came home from college in the 1970s new housing tracts had filled in between streets and the dairy was gone. In fact two other dairies with cow pastures that had been located close by were also gone—replaced by industrial buildings and the new parking lot for a junior college. Street cars had been removed and replaced by busses. When I returned to Los Angeles for the 1984 Olympics even the swamps had been filled in and

Page 5

shopping centers were there now. Flying in to Los Angeles International Airport south Los Angeles looked, from the plane, like it was filled with buildings and roads and flat industrial buildings. Even the hills in downtown L.A. were gone, as was the old funicular railway there, called Angels Flight—replaced by high rise office buildings. The roads were wider and there were more cars.

GPH-205 Conclusion Form *EXAMPLE ONLY*
Your name: Jim Janossy
Conclusion # 0 *EXAMPLE NOT A HEAD START!*

1. Conclusion statement

South Los Angeles rapidly and intensively urbanized between 1950 and 1985.

2. Your determination

I feel that this statement is **TRUE.**

3. Your argument supporting your determination

Approaching the middle of the 20th century south Los Angeles still had a rural character with vacant land and streams [1]. But between 1950 and 1980 vacant areas and old structures such as farm buildings were replaced by gas stations [2], office and commercial buildings [3], parking lots and car lots [4]. Rural industries like dairies were replaced by tracts of newly-constructed houses [5]. Swampy areas were filled in and shopping centers constructed there [6]. Hills were bulldozed to make level land for large buildings [7]. Streetcar lines were abandoned [8] and replaced by busses [9]; roads were widened to handle more cars [10].

4. Summary sentence

By 1985 rural south Los Angeles was gone; it had become a built up, paved-over urban area.

5. Citations

[1] "Growing up in Los Angeles in the mid-1900s", p. 1

[2] ibid., p. 2

[3] ibid., p. 2

[4] ibid., p. 2

[5] ibid., p. 4

[6] ibid., p. 4

[7] ibid., p. 4

[8] ibid., p. 4

[9] ibid., p. 4

[10] ibid., p. 5

How the endnotes on this form document cited facts…

The conclusions form is designed to make it easy for you to develop and submit your conclusions work concisely. It's designed to streamline and simplify the way to identify the facts and the origin of the facts that you cite. The simplified citation format for this work consists of three elements:

1. **Endnote reference numbers that you include in your argument paragraph that look like a number within square brackets.** An example is [1]. This number is **NOT** the essay page number where the fact is located; each is an identifier for an endnote.
2. **Endnotes at the bottom of the form matching the endnote reference numbers.** For every citation reference number in your argument paragraph there will be one endnote. The endnote identifies the source of the fact. In this case all of the facts must come from your own reflective essay body which is being treated as an "oral history".
3. **The fact itself, located within your essay body.** *The essay body where the fact is located is not changed at all by the conclusions work that references it.* Don't put reference numbers into your essay document! If that were a published work written by someone else you could not possible alter the content of it.

Instructions for Project 4, Part 3 (continued)

Look at the conclusion statement I have provided on the form and my determination about that statement: it's true.

2. Look at the argument I make to substantiate my contention that the conclusion statement is true and how I have cited facts and their origin as described above.
3. **Click here** to download an editable copy of my brother's writing. You can either take the following steps with it using your word processor, or by printing it and hand-marking it.
4. "Look up" each fact that I have cited in my conclusions argument using the endnote for the fact to see what page in the writing the fact is on. Locate the fact on your downloaded copy of Andy's writing, or on your printed copy of the writing. Highlight it using your word processor or if you prefer, by and on your printed copy using a yellow marker, a red pencil, or a pen or pencil circling the fact.
5. Continue repeating step 5 above until you have located each of the 10 facts. Then answer the following questions:
    a. Is every fact I cited in the writing?
    b. Is each fact on the page the endnote says it's on?
    c. Is my argument believable?
6. Submit your work for Project 4 Part 3 by sending me your marked-up copy of Andy's writing as the edited file, or by taking a picture of your printed page of Andy's writings on which you have highlighted the place where the cited facts are located. E-mail the file or picture it to me at the dedicated class gmail address. In the e-mail that conveys it, copy the three questions at point 5 above and answer each with "yes" or "no".

By completing steps 1 through 5 of Project 4 Part 3 you have just done what I will do to check your conclusions work!

Looking ahead to your take-home final…

Follow the pattern I used on this example conclusions form when you develop your conclusions work. The instructions and forms for that work will appear on the Unit 5 web page at the start of the 8th week of the term. In doing that work, I will give you three separate conclusions statements to consider. My conclusions statements are separate from one another and have no connection with each other; each may be true or false in its own. For each statement you will have to determine if the statement is true or false. You will then have to make an argument supporting your determination with a logical argument that cites 10 facts from your own reflective essay, in just the same way that I did in the example. You'll have to use endnote references in the form [n] and matching endnotes that indicate where (what page) in your essay the fact occurs. Quite obviously this means that your reflective essay will need to be page-numbered. If you don't yet know how to have your chosen word processor apply page numbers, do a Google search for information on how to do that; you can't be taken seriously as a user of a word processor if you don't know how to apply page numbers! But you can cure that situation with a simple Google search!

Project 4 extra credit: scientific photography

Film or digital photography can be used to study processes and events that happen too rapidly or too slowly to be directly observed. Specialized techniques of photography can make these things observable to study. Here are just three of nine of these techniques pioneered by a scientist named **Harold E. Edgerton** (1903-90) in his work at the Massachusetts Institute of Technology:

Time lapse photography is a special form of photography in which a camera was set to record image frames at a slower rate than it is later projected. The effect is to speed up the motion when the recording is viewed at normal speed. Ordinary film cinema is recorded in the United States at 30 frames (images) per second to synchronize with television. If for example a movie is shot at 3 frames per second and played back at normal 30 frames per second viewing speed, the motion will be speeded up 10 times as fast as the action occurs. Whatever was captured by the movie or video will appear to take place much faster than it really did.

High speed photography is the opposite of time lapse photography; the frames of a video are shot at a much faster rate than projected back. If the equipment making this type of video is capable of recording detailed images very fast (thousands or even millions of frames per second) the result can be a video showing how a bullet tears through an apple and the apple explodes from the shock, how an explosion occurs in slow motion, or any other similar high-speed event actually occurs if you could slow it down to observe it.

Stop motion photography records a single image of something that happens very quickly, using an ordinary camera. This is readily done by leaving the shutter of the camera open and by using a light source that flashes very briefly—such as a few millionths of a second. If the light source is sufficiently intense, enough light will illuminate the action to expose the film or digital element, but will be brief enough to capture the action without blurring.

Harold Edgerton developed equipment to perform the types of photography described above as well as several more types of scientific photography. In this assignment you'll investigate examples of the above and additional ones as documented at the MIT web site. Do this:

1. Use the link associated with this page at the course web site (see footer below) to view the "Techniques" web page at the Edgerton site.
2. View each of the nine techniques. For each technique:
   a. Take notes on what the technique involves and the kind of phenomenon it could study
   b. Capture an image from the site created using the technique
   c. Compose a paragraph of about 100 words that describes the technique, how it works, and how it was used, incorporating the image you captured to illustrate it.
3. After doing step 2 for each of the nine techniques, compose a paragraph of about 100 words that gives a brief biography of Harold Edgerton and include a small photo of him. Follow it with each of your paragraphs from step 2. Form this writing into a single article that could be published in the Sunday edition of an ordinary newspaper—in other words, could be understood by a person who had no special technical knowledge.

Your finished product will be an informative article (no citations or bibliography) about 4 to 5 pages in length double spaced, that will include your 10 illustrations each measuring no more than 1.5 inches square (size them this way using an editor or your word processor's "crop" tool).