

JINS 331: The Chemistry of Art

Fall 2000

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GOALS OF THE COURSE: Because the materials available to artists affect what types of artistic work they are able to produce, and because the drive to produce different artistic works can influence the development of materials for those artists, we will explore the relationships between chemistry and art by:

- ◆ Describing the interaction of light and matter to produce color.
- ◆ Understanding the chemistry of the materials that artists use, including differences experienced over time and location.
- ◆ Synthesizing, experimenting with, and/or being creative with various chemicals which are used as art media and materials.
- ◆ Introducing some of the scientific and aesthetic techniques used to explore the authenticity of certain works of art or artifacts. (beginning with the *Feast of the Gods*, painted by Bellini, Dossi, and Titian, as documented at www.webexhibits.com/feast)

NOTE: this 3-credit-hour course meets each week for 2 hours of lecture and a 3-hour lab.

	Day	Time	Location
Lecture: Section 01	Tuesday	1:30 to 3:20 pm	BT 251
Laboratory: Section 51	Wednesday	1:30 to 4:20 pm	MG 261

REQUIRED MATERIALS: (All materials available at the Campus Bookstore)

Textbook: "Chemistry and Artists' Colors" by Mary Virginia Orna (MVO), with supplemental readings available on reserve in PML.

Lab Notebook/Journal (LNJ): Permanently bound composition or lab notebook with duplicate pages. Spiral bound notebooks or glue bound notebooks are not acceptable.

Safety Goggles: O.S.H.A. approved goggles must be worn in the laboratory at all times.

Tie-Dye Supplies: Shirt and dyes provided by Alpha Chi Sigma: \$10.

TENTATIVE GRADING SCHEME:

Quantity	Description	Value	Total Points
12	LNJ reflections on lectures and reading assignments	20	240
10	LNJ lab experiment preparation, observations, and reflections	25	250
1	First Draft of Case Study	20	20
1	Peer Editing	20	20
1	Second Draft of Case Study	30	30
1	Final Draft of Case Study	100	100
1	Poster of Case Study	50	50
14	Attendance and Class Participation	5	70
2	Exams: Midterm and Final Exams	100	200
	Total Points:		980

GENERAL DESCRIPTION:

Summary. In this course, we will survey some of the interactions and manipulations of matter (chemistry) in order to create an aesthetically pleasing or emotionally evocative physical form (art). A comprehensive exploration of these subjects is much too broad to cover in a single semester course, so we will focus primarily on the chemistry and aesthetics of paintings, and briefly discuss glass and ceramics towards the end of the course.

Topic List. Because color is used extensively to express the artist's message, we will begin with the interaction of light and matter to produce color (molecular level) and move on to color mixing exploring both additive and subtractive perspectives (macroscopic level). After our study of color, we will examine paintings on a layer-by-layer basis. We'll start these discussions with the supports (paper, canvas, wood, etc.), move on to paints (the synthesis, isolation, and use of both pigments and binders), and examine the special case of frescoes. Finally, we will touch on other artistic media including dyes, glasses, and ceramics. Each of these chemical materials will be presented with a historical perspective of its usage in art, and how this usage affected the techniques of various artists. The expected timeline for the semester is included in a table at the end of this General Description section.

Pulling It All Together. We'll finish the semester by discussing some of the techniques that art historians and conservators use to analyze different works of art. These techniques include both scientific methods (such as ^{14}C -dating, IR spectroscopy, and X-Ray techniques) and the aesthetic evaluation of the styles and methods developed by various artists through the course of time. The results of these analyses can be used to indicate whether a particular work of art could have been made during a particular time period or by a particular artist.

More on the Interplay of Materials and Art. As stated in the Goals section, the materials available to artists affect what types of artistic work they are able to produce. Furthermore, the drive to produce different artistic works may influence the development of materials that can best suit artists' inclinations. The student should expect to use the perspective of a chemist in order to understand the materials of art, and the perspective of an artist in order to understand how artistically to exploit the materials presented. In addition, the student should understand how these materials and their uses have evolved over time.

For example, the supports upon which paintings have been created have evolved over time. The earliest paintings that we know of were on the walls of cave dwellings. More modern frescoes were also immovable, since they are a part of the plaster on the walls of buildings. Later paintings utilized the mobility of wooden panel supports. Eventually, artists began to paint on canvas stretched over a wooden frame. Each of these changes affected the artwork produced in that time period.

Furthermore, the paint pigments available to artists have changed over time, as new compounds became available through increased trade and through the chemical synthesis of new pigments. A prime example of this phenomenon is the evolution of a quality blue pigment. Early artists mixed other pigments to approximate a blue color. Then, with increased world trade, natural ultramarine (lapis lazuli) was ground and used as a blue pigment. The availability of this natural ultramarine was limited to its existence in nature (primarily in today's Afghanistan), making it more highly valued than gold. Eventually, in the early nineteenth century, chemists were able to synthesize ultramarine, causing its price to drop dramatically and blue pigment use to rise in artistic works.

Is This Painting What It Seems? (The Case Study Assignment). The intersection of chemical and artistic perspectives presented in this course will be dramatically illustrated in each student's peer reviewed/edited paper on the analysis and evaluation of the materials and techniques used for a particular work of art. The paper must include both a proposal for scientific analysis of the artwork's materials and an aesthetic analysis of the artistic style(s) and technique(s) used by the purported artist. During the research for this paper, the students will be exposed to the literature from multiple disciplines and will incorporate these diverse perspectives into a cohesive and educational narrative.

Each student will choose a painting from a pre-approved listing, with the list being taken from paintings on display in either the Nelson-Atkins Museum of Art (Kansas City) or the St. Louis Art Museum. All students will work on their "own" painting with no duplication within the class (or from other semesters). Near the inception of the project, the class will take a field trip to the appropriate museum to

view the paintings in person, as well as any other holdings in which the students may be interested. Additionally, resources from the museum's library and the perspective of a museum staff member may be accessed during this trip as support for the research paper. After the papers are due, each student will also prepare a summary poster presentation for an in-class Poster Session, so that all students can benefit from each other's research. More details of the finer points of this requirement will be forthcoming early in the semester.

The Laboratory. Both chemists and artists highly value personal interaction and experimentation with materials. This laboratory component of the course is central for each student's individual growth of understanding of these media. The projects are selected to give the student a broad exposure to the particular chemical substances used in the creation of art, as well as an opportunity to create artistic works with them. While true artistic talent is NOT required, we hope that our straightforward explorations of the materials' properties as they apply to the creation of art objects will lead to the creation of some interesting and evocative works of art. A list of the experimental topics is included in the table following this General Description section.

The Laboratory Notebook/Journal. The students will keep a laboratory notebook and journal (LNJ) as a record of their observations and experiences in lab. It must be a "carbon-copy" style, permanently bound notebook, so that the writing may be turned in to the instructor for evaluation readily, while not inhibiting the student from pursuing the next writing assignment. Writing will be turned in prior to each class period, and at the end of each lab. Two types of entries will be expected. Through these two types of entries, deeper and more personal understanding can be achieved about the nature of artistic materials and how to be creative with them.

First, students must enter straightforward directions for the lab procedures prior to the lab session in preparation for the experiment(s). During the lab period, these directions will be annotated with any observations and adjustments made to the procedure by the individual student. Their objective lab notes should include (but are not limited to) direct observations of the chemical/physical or aesthetic properties of the materials in use. In addition, the students should record whatever valuable insights they gain in regard to abstract chemical and aesthetic concepts.

Second, personal reflection about the lab experience, as well as the recent course material, is required. After the lab experience, each individual should reflect on the success of their own experiment by whatever gauge they deem appropriate. For example, did they gain deeper understanding of the physical nature of the materials that they explored? Did they have a flash of inspiration for a new way of using this material in their own artistic pursuits? Did they gain a greater appreciation for the masters of the past, and their skills in creating enduring artistic pieces in this medium? Furthermore, the student might describe in these reflections how they might change the procedures to evoke different effects for their own personal use. Focus questions for the reading material assigned (in texts or web-based) will also be recorded in the lab notebook/journal. These subjective written evaluations of both the lab experiences and the lecture materials are intended to allow the student to clarify and express the new knowledge they have personally gained from them.

JINS Requirements. The Chemistry of Art is a writing-enhanced, junior-level inter-disciplinary course. As such, certain criteria must be addressed. First, the "intersections or tensions between [Chemistry and Art] ... with respect to applied methods or tools of inquiry" will be vigorously explored. Each of the layers of paintings will be examined from both a molecular and an aesthetic perspective. By examining the changes in the paintings themselves as the materials available to the artists changed, we can see that each discipline has an influence and/or an impact on the other.

Additionally, the ways that the materials of artistic expression are "understood and questioned" by professional chemists and artists differ greatly, and these ways will be explored on an individual basis by each student in the peer-reviewed Case Study Assignment. The exploration of both scientific and aesthetic "modes of inquiry" are required to fully explain the production of a particular painting, by a particular artist, at a particular time in history. (While we fully expect that our students may be drawn from

either the chemistry or art disciplines, we are not viewing the course material exclusively through "the lens" of either discipline's perspectives.)

Second, the students will "engage in knowledge of, and reflection on, how advanced level content from" chemistry with its molecular properties of materials "interact" with the creation of works of art, the physical expression of the emotions of the artists. These advanced level concepts from both the scientific and artistic professions will be presented in the classroom, in the reading assignments, and in the laboratory experiments.

Third, "students will also have engaged in integrated analysis and reflection informed by approaches or methods from two or more disciplines." These ideas and interactions of chemical and artistic perspectives will be presented on a layer by layer basis for paintings and will culminate in the Case Study Assignments. As described above, both perspectives must be presented to analyze the authenticity of a particular work of art.

Writing Enhanced Requirements. "As a writing enhanced course, the [Chemistry of Art] course will emphasize writing as a means of achieving a deeper understanding of the subject material" through two types of writing assignments: the laboratory notebook/journal (or LNJ) and the Case Study Assignment.

The LNJs will provide opportunities for objective recording of the "facts" of an experiment, and the subjective evaluation of the success of the exploratory lab. They will allow the student to summarize what they learned from a reading assignment, and thus to clarify that knowledge in their own minds. The LNJ writing will be collected at each meeting of the course; thus "the course will include writing assignments of a quantity and frequency appropriate to the designation of *writing-enhanced*." Feedback will be returned by the instructor in a timely fashion, so that the student's writing can improve over the course of the semester.

This LNJ writing might be classified as "private" writing, since its primary purpose is to clarify the ideas and concepts of the course for the individual student. However, it is critical as preparation for the more "public" writing assignment, the Case Study, so that these concepts are used correctly. The audience of the Case Study includes people with some background and interest in both chemistry and art, however these Case Study Papers and Posters must clearly illustrate the chemical and aesthetic analyses necessary to "authenticate" a work of art.

This Case Study Paper will be peer-edited and instructor-edited before the final draft is due. Thus, this assignment "will foster the writers' habits of rethinking and revising drafts, seeking external critiques of the early drafts, and editing drafts for mechanical errors (copy-editing) as standard practices of good writing." In addition, "by the end of the course, the successful student will have produced a high-quality writing appropriate for inclusion in their LAS portfolio.... Developing these types of writing skills will be a primary goal of the course."

About the Reading Assignments:

- ◆ The text pages noted as MVO in the schedule above are from Mary Virginia Orna's Chemistry and Artists' Colors (College of New Rochelle, ISBN 0-9637747-0-0). This author is an award winning chemical educator, who taught for many years in a liberal arts college environment prior to taking on the Directorship of the Othmer Museum and Library of Chemical History in Philadelphia, PA. This text focuses on the chemistry and historical context of artists' materials.

Other author's books are available from the reserve desk at Pickler. These books include:

- ◆ Dave Dempsey's History and Technology of Papermaking (Smith College Museum of Art, ISBN 0-87391-047-8). Dempsey curates the Smith College Museum of Art and his short booklet (~20 pages) details the historical development of various production techniques of paper and writing materials.
- ◆ Robin Richmond's Michelangelo and the Creation of the Sistine Chapel (Crescent Books, 1995, ISBN 0-517-14194-9). Richmond is a painter, illustrator, and professor of art history. Her book details Michelangelo's early life, his commission of the Chapel ceiling, artistic interpretations of the work,

full color photographs of the ceiling, including comparison photos of before and after the recent restoration, as well as a description of the process of fresco painting.

- ◆ Additional resources may be described in class.

Tentative Topics for Lecture and Lab -- Any changes will be announced in class!

Dates	Lecture Topic (<i>Reading Assignment</i>)	Lab Topics	Case Study
Aug 22-23	Light and Its Interaction with Matter (<i>MVO 1 – 68</i>)	* Understanding Color and Light using Computers	Introduce Case Study
Aug 29-30	Light, etc. continued (<i>MVO: 69 – 138</i>)	* Check-In * Cyanotypes	Select Art Piece
Sept 5-6	SLAM Trip -- Tuesday	No lab	Research
Sept 12-13	Supports/Polymers (<i>Dempsey: all</i>)	* Paper Making * pH of Paper * Shrinky Dinks	Continue Research and Begin Writing
Sept 19-20	Pigments (<i>MVO: 281 – 302</i>)	* Synthesis of Prussian Blue * Synthesis of Orange II	Continue Writing
Sept 26-27	Other Colorants: Dyes and Fibers (<i>MVO: 257 – 280</i>)	* Synthesis of Indigo * Analysis of Colorants	First Draft Due (Peers)
Oct 3-4	Binders and Varnishes (<i>MVO: 303 – 330</i>)	* Binding Media: Preparations and Comparisons	Return First Drafts
Oct 10-11	Scientific & Artistic Evaluations of Paintings (<i>Readings?</i>)	* MIDTERM EXAM	Revise
Oct 17-18	Fakes and Forgeries Case Studies: " <i>Feast of the Gods</i> " by Michael Henchman & Michael Douma – www.webexhibits.com/feast	* Dye-Fabric Interactions * Tie-Dye	Revise
Oct 24-25	Ceramics, Glasses, and Glazes (<i>MVO: 371 – 392</i>)	* Boron Glass * Glass Etching	Second Draft Due (AEM)
Oct 31- Nov 1	More Ceramics, Glasses, and Glazes	* Glazes * Egyptian Paste (Part I)	Return Second Drafts
Nov 7-8	Frescos (<i>Richmond: 95-119</i>)	* Egyptian Paste (Part II) * Fresco (Part I)	Revise
Nov 14-15	More about Frescos	* Fresco (Part II)	Revise
Nov 21	Thanksgiving Week -- NO Class.	NO LAB DAY!	Prepare Poster
Nov 28-29	Poster Session: Case Study presented in Poster format in lecture and lab....	* Poster Session....	Final Draft Due
Dec 5	Review and Wrap up the Semester	No lab -- Reading Day!	
Dec 8	Friday, 11:30 am - 1:20 pm, FINAL EXAM		