

BROOKLYN COLLEGE
DEPARTMENT OF CHEMISTRY

CHEM 1012 CHEMISTRY IN THE ARTS AND ARCHAEOLOGY

Lecture: 3 hours per week

Credits: 3

The CUNY-BC China program “STUDY IN CHINA”

Examples of the arts and archaeological artifacts will be taken from Chinese art museums and other Chinese art / archeological sources.

TEXTBOOK

”*Chemistry and Artists’ Colors*”, Mary V. Orna and Madeline P. Goldstein, 3rd edition, 2013.

ADDITIONAL MATERIALS

”*Traces of the Past: Unraveling the Secrets of Archaeology through Chemistry*”, by J. B. Lambert, Basic Books; 1998.

”*Doing Chemistry at the Art/Archaeology Interface*”, Mary Virginia Orna, Journal of Chemical Education, Volume 74, Number 4, April 1997, 373-376.

Selected scientific articles available on-line from CUNY libraries

COURSE DESCRIPTION

General background in basic concepts of chemical structure and activity, with an emphasis on examples from the visual arts and archaeology. Topics include the nature of color; color mixing; chemical properties, synthesis and use of dyes, pigments, paints, metals, ceramics, glasses and glazes; chemical analysis of archaeological artifacts; the chemistry of art preservation and authentication of art objects; and the chemical hazards in the arts.

GENERAL EDUCATION OBJECTIVES

- Use analytical reasoning skills and apply logic to understand the scientific study of materials used in the construction of works of art, and methods used in investigations of archaeological artifacts and works of art.
- Integrate knowledge to qualitatively and quantitatively understand the connection between chemistry and the arts and archaeology.
- Become knowledgeable in how to properly and safely handle potentially hazardous chemicals that artists use in their daily operation.
- Identify the problems related to the arts and archaeology, such as art and artifacts deterioration and forgery, and use scientific methods learned in the course to find solutions to these everyday life problems.
- Communicate clearly through speaking, writing, and reading.

OUTCOMES ANTICIPATED FOR COURSE

At the end of the course, students understand the basic facts, principles, theories and methods of chemistry. They are able to balance chemical equations, understand the principle of conservation of mass, interpret graphs in the lay literature, understand the problems associated with materials and methods used in the arts and archaeology, and discuss the chemical principles knowledgeably. Students understand key events in the history of science and recognize that science is an evolving body of knowledge. Students recognize the social and cultural implications of scientific discoveries and understand the potential of science and technology to address problems of the contemporary world.

METHOD OF ASSESSMENT

Assessment of students’ knowledge of the course material: Specific questions designed to address the course material will be included in in-class problem sets, class exams and the final exam. The outcome of these specific questions will report on students’ understanding of terminology and concepts associated with chemical compounds, chemical methods and techniques in the field of the arts and archaeology.

Assessment of students’ communication skills: During the semester, students will complete four reports and one oral presentation.

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METHOD OF EVALUATION

In-class problem sets will be assigned, discussed and logged in. Two midterm exams will be given, after 3 weeks, and after 9 weeks. A comprehensive final exam will be given. Four group projects (groups of 2-3 students) will be assigned, and students will prepare four written reports. Based on one of these reports, a PowerPoint presentation will be prepared. These presentations will be available on Blackboard to all students; they will be presented by students during last three classes. Both the written reports and oral presentations will be graded.

The FINAL GRADE will be determined as follows:

Class participation (in-class problem sets):	15%
Two midterm exams:	25%
Written reports (4 projects):	20%
Oral presentation:	15%
Final exam	25%

ACADEMIC INTEGRITY

Academic dishonesty is prohibited in the City University of New York. Cheating, plagiarism, internet plagiarism and obtaining unfair advantages are violations of policies of academic integrity and are punishable by penalties, failing grades, suspension and expulsion. For more information about CUNY policy on academic integrity see <http://web.cuny.edu/academics/info-central/policies/academic-integrity.pdf>

STUDENT DISABILITY SERVICES

In order to receive disability-related academic accommodations students must first be registered with the Center for Student Disability Services. Students who have a documented disability or suspect they may have a disability are invited to set up an appointment with the Director of the Center for Student Disability Services, Ms. Valerie Stewart-Lovell at 718-951-5538. If you have already registered with the Center for Student Disability Services please provide your professor with the course accommodation form and discuss your specific accommodation with him/her.

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COURSE OUTLINE

Chapters from: "Chemistry and Artists' Colors", Mary V. Orna and Madeline P. Goldstein, 3rd edition, 2013.

Week	Readings	Topics	Hrs
1	Ch. 1-3 Ch. 4-6	1. Introduction to Light and Color Electromagnetic Radiation and Electromagnetic Spectrum Measurement and Metrics, Exponential Notation Wave/Particle Theory of Electromagnetic Radiation 2 Visible Light Wavelength, Frequency and Color Properties of Light: Refraction, Reflection, Bending <i>Project 1: How Rainbows work?</i>	3
2	Ch. 7-8	3. Energy and Composition of Matter Energy States Atoms and Elements Sub-atomic Particles and Isotopes Electrons in Atoms and Atomic Orbitals	3
3	Ch. 9 Ch. 11-12	4. Interaction of Light with Matter Transmittance and Absorption of Light Why objects Appear Colored Color Wheel Beer/Lambert Law 5. Colored Objects Subtractive vs. Additive Color Mixing, Color Wheel Pure/Impure Colors	3
4		<i>Exam 1</i>	1.5
4, 5	Ch. 13 Ch. 14	6. Chemistry Alphabet and Vocabulary Chemical Symbols, Names of Chemical Elements Chemical Formulas, Names of Chemical Compounds Chemical Equations Illustrate Chemical Reactions 7. The Periodic Table and Periodic Properties <i>Project 2: "Elements Are Everywhere" Crossword Puzzle</i>	3 1.5
6, 7	Ch. 15 Ch. 16 Suppl. Articles	8. Electrons in Atoms Electron Configurations 9. Chemical Compounds Chemical Bonding: Ionic vs. Covalent Molecules and Chemical Compounds Colored Chemical Compounds Types of Chemical Reactions 10. Oxidation Reduction Reactions Metal Etching Corrosion Metals in the History of Art and Technology	6
8	Ch. 17 Ch. 18	11. Dyes Dye Adhesion, Natural Dyes, Fiber-Reactive Dyes 12. Pigments Artists' Pigments and Commercial Pigments	1.5 1.5

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		<i>Project 3: Inorganic and Organic Pigments</i>	
9	Ch. 19	13. Paints Oil Paints Acrylic Paints Tempera Paints Water Colors Gouache Paints	1.5
9		<i>Exam 2</i>	1.5
10, 11	Ch. 23	15. Artists' Safety Chemical Hazards in the Arts	1.5
	Suppl. Articles	16. Deterioration of Materials and Art Conservation Environmental Effects: Acid rain, Photolysis, Erosion, Humidity changes, Paper problems Art Preservation and Restoration	3
11, 12	Suppl. Articles	17. Authentication of Art Objects Famous Forgeries Detected using Chemistry <i>Project 4: Chemical Art Detective</i>	3
12, 13	Suppl. Articles	18. Chemical Analysis of Archaeological Artifacts 14C Isotope Dating Identification of Materials X-ray diffraction and fluorescence	3
13, 14		Projects Presentations	4.5
		<i>Final Exam</i>	