Chemistry 126 Fall 2020
Chemistry of Art
Syllabus

Instructor: Dr. G. Govindarajoo (Dr. Rajoo)
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Course Description:
This introductory chemistry course for non-science majors explores the intersection of chemistry with the visual arts. Basic principles of chemistry will be applied to the topics of color, paint, paper, clay, glass, metals, photography, art restoration, forgeries and discussions of sustainable art and the impact of climate change. Each topic will include instruction in basic quantitative and analytical skills that further illustrates the role that chemistry plays in that particular aspect of art. No prior knowledge of chemistry is assumed. Basic math skills are required. Lectures will have integrated demonstrations to illustrate the interplay of chemistry and art.

Prerequisite: 01:640:025 or placement (Elementary Algebra)

Learning Outcomes:
After completing the course:

1) Students should be able to understand and use basic chemical principles and terminology.
2) Students should possess an awareness of the influence of chemistry in the visual arts.
3) Students should be able to assess the relationship among assumptions, methods, arguments and theory in scientific analyses when examining the role of chemistry in the various visual arts fields
4) Students should be able to identify the chemicals and/or materials used in various works of art.
5) Students will be able to solve problems that are presented using quantitative and analytical skills introduced in the course
6) Students should be able to form opinions based on sound scientific reasoning.

Texts:

Selected Chapters from Chemistry in Focus: A Molecular View of the World, 7th edition. by Tro, N. (2018) ISBN-13: 978-1337399692 (CF)

Recommended Text: The Artist's Handbook: 3rd edition (2009) by Smith. R. ISBN-13: 978-0756657222 (AH)

Readings also may be selected from the following:

Artists' Pigments: A Handbook of their History and Characteristics Vol. 1 (1987) by Feller, R.L.

The Chemistry of Light and Photography (2017) by Vogel, H.W.

The Colouring, Bronzing, and Patination of Metals (1991) by Hughes, R.

The Potter's Dictionary of Materials and Techniques (2015) by Hamer, F.

The Deterioration and Conservation of Painted Glass (1974) by Newton, R.G.

The Organic Chemistry of Museum Objects (1999) by Mills, J. and White, R.

Copper and Bronze in Art (2002) by Scott, D.

Other readings: Journal articles accessible using databases in the library

Other needs for the course:

High-speed internet necessary, printer and scanner (or scanning app so that documents can be converted into pdf format for uploading) recommended.

Course Grading (Method of Assessment)
1) Class attendance, participation, and Exit slips (10%) (30 points prorated)
2) Playposit quizzes (15%) (45 points)
2) 2 midterms (36%) (2 x 54 points = 108 points)
3) Out of class assignments (15%) (Total 45 points)
4) Final (24%) (72 points)

Total: 300 points

Class Attendance and Participation
i) Attendance will be recorded and preparation will be assessed using Quizzes on Canvas and polls on Zoom on previous lecture material and the readings for the current lecture. There will also be exit slips with questions for the demonstrations shown, presentations by guest speakers and our virtual Zimmerli tours.

ii) Participation: Students are required to participate in in-class discussions and analysis based on the Question of the Day and/or demonstrations during lecture. There will be a paper submission of the analysis as well.

All class attendance and participation points will then be prorated to be worth 10% of total points (30 points) for the course. In order to earn an A in the course, students must have earned at least 80% of the class attendance and participation points.

Playposit Quizzes
Mastery quizzes with deadlines to ensure mastery on concepts learned.

Midterms
Midterms will be a combination of multiple choice and short answer questions. A review sheet will be posted about topics that will be tested on the midterms.

Out of Class Assignments
1) Museum project (going *virtually* to any Art Museum - try the Zimmerli!) detailing analysis of materials used in two pieces of art from different eras (1-2 pages). A guideline will be provided on areas of analysis for this assignment.

2) Research Paper (Topics to be selected based on discussions in class) using Library Resources (3-5 pages). A guideline will be provided on what should be discussed in the paper.

Final
Combination of multiple choice and short answer questions based on lectures, readings and in-class demonstrations. A review sheet will be posted on topics that will be tested on the final

Your final grade will be based on your overall percentage and number of points earned, An approximate idea of the grading scale would be as below (there would be more lenient adjustments based on curve of the course)

A	$\geq 85\%$
B	75-84%
C	60-74%
D	50-59%
F	$\leq 50\%$

Course Policies:

Lectures: Attendance in lectures is essential in order for a student to do well in this course. Significant amounts of additional material are provided in the lecture. Much of the exam material will be provided during the lecture for the course in conjunction with the textbook. There will also be participatory activities in lecture that will count towards your grade.

Absences: For an absence to be excused, Dr. Govindarajoo **must** be contacted immediately. Valid documentation MUST be provided **within a week of the absence** to Dr. Govindarajoo. ADDITIONALLY, you must use the University absence reporting

website https://sims.rutgers.edu/ssra/ <https://sims.rutgers.edu/ssra/> also within a week of the absence to indicate the date and reason for your absence. If any of the above steps are not followed, the absence will not be excused.
Vacation plans are NOT valid reasons for absences.

Written Exams (Midterms) will be given on the specified dates during lecture period on Canvas. The material for the midterms will come from your readings and lecture material. Since the midterm exams are during the lecture period, students CANNOT have a conflict with the exam. You will NOT be able to postpone/take the exam on a different date just because you have other exams that same week – you have plenty of notice and the review sheet is posted significantly ahead of time. Please plan accordingly. **NOTE**: If you end up falling ill on the day of a midterm, you have to make the decision if you take the midterm or not. If you decide not to take it, get a doctor's or dean's note to excuse you for that absence. If you do decide to take the midterm even though you are ill, be prepared to accept the consequences of the score you earn if you end up with a low score. Your score cannot be disregarded after the fact just because you took the midterm while you were ill.

Final: The material for the final will come from your readings, lecture material and in-class demonstrations. The date of the final will be determined by the Final Examination Schedule according to days and times the course meets.

Website: We will be using Canvas (URL: https://tlt.rutgers.edu/canvas) - (you can access it by going to canvas.rutgers.edu) as a classroom management system. You should check this site regularly. If you check it now, you will find a number of documents posted under "Modules". If you are registered in the course and a Rutgers Student, you will automatically be a "member" of the online class.

Students with Disabilities: If you have a disability, you are urged to speak to the course instructor to make the necessary arrangements to support a successful learning experience. Also, you must arrange for the instructor to receive a letter from your College's Disability Concerns Coordinator verifying that you have a disability. The student must contact the Office of Disability Services to determine his/her Coordinator (848-445-6800 or dsoffice@echo.rutgers.edu).

Academic honesty You are being graded on the work you perform. Use of other graded course material from other students (past or present) is expressly forbidden. **Both the lender and the borrower are subject to severe penalties.** If you are confused, please ask for help. Academic honesty also applies to all exams, papers and other submitted materials in this course.

The Rutgers honor pledge will be included on all (major) assessments for you to sign: *On my honor, I have neither received nor given any unauthorized assistance on this examination/quiz/ assignment.*

Rutgers University takes academic dishonesty very seriously. By enrolling in this course, you assume responsibility for familiarizing yourself with the Academic Integrity Policy

and the possible penalties (including suspension and expulsion) for violating the policy. As per the policy, all suspected violations will be reported to the Office of Student Conduct. Academic dishonesty includes (but is not limited to):

- Cheating
- Plagiarism
- Aiding others in committing a violation or allowing others to use your work
- Failure to cite sources correctly
- Fabrication
- Using another person's ideas or words without attribution–re-using a previous assignment
- Unauthorized collaboration
- Sabotaging another student's work. When in doubt, please consult the instructor

Use of external website resources such as Chegg.com or others to obtain solutions to assignments, quizzes, or exams is cheating and a violation of the University Academic Integrity policy. Cheating in the course may result in grade penalties, disciplinary sanctions or educational sanctions.

Posting assignments, quizzes or exams, to external sites without the instructor's permission may be a violation of copyright and may constitute the facilitation of dishonesty, which may result in the same penalties as plain cheating.

Almost all original work is the intellectual property of its authors. These works may include syllabi, lecture slides, recorded lectures, homework problems, exams, and other materials, in either printed or electronic form. The authors may hold copyrights in these works, which are protected by U.S. statutes. Copying this work or posting it online without the permission of the author may violate the author's rights. More importantly, these works are the product of the author's efforts; respect for these efforts and for the author's intellectual property rights is an important value that members of the university community take seriously.

Netiquette:

Be Respectful - Be very mindful that all your communication with the course instructor, lab instructor and fellow classmates is respectful and does not border on being disrespectful, discourteous, inappropriate or abusive. If you encounter any disrespectful behavior from your fellow course participants, please let Dr. Govindarajoo know. We all understand that remote learning is unusual and can cause undue stress but please understand that all of us are dealing with this situation.

Allow for time for responses to queries – Please understand that the course instructor and lab instructors have many other responsibilities and the standard time to wait for a response is a **full business day**. Most times you will receive a response much sooner but please be aware of this standard.

Be Professional - Coursework is more than learning facts; it is a professional activity. Your conduct in this course should reflect this. Your communication should follow standard rules for grammar and spelling (unless in an online chat) and be clear, concise, courteous, and to the point.

Topics: PLEASE NOTE - TOPICS MAY BE REARRANGED BASED ON SCHEDULE/TOPICS OF MUSEUM VISITS.

ON WEEKS DURING MUSEUM VISITS AND GUEST SPEAKERS, LECTURE MATERIAL WILL BE POSTED AS A VIDEO

Week 1 (9/4-9/8 – PLEASE NOTE THAT TUESDAY 9/8/20 MEETS ON A MONDAY SCHEDULE)
Light and color:
- atoms and subatomic particles, atomic theory
- electron configuration and periodic table
- excited atoms
- electromagnetic spectrum
- absorption and refraction of light
- color and energy
- impact of light on art
- how light is worked into works of art

Readings: AH: pg. 345-346; CF: pg. 177-191

Week 2 (9/9-9/14)
Pigments:
- Elements, Compounds and Ions
- Inorganic pigments (sources, history, synthesis, nomenclature)
- Organic pigments (natural and synthetic) (sources, history, synthesis, nomenclature)
    - functional groups

Readings: AH: pg. 11-29; CF: pg. 53-59, 83-89, 142-157

Week 3 (9/16-9/21)
Paint
-History
-Paint Composition
-Unsaturated, Saturated, and Supersaturated Solutions
-Types of solutions
-Physical Properties of solutions
-Temperature Effects

Readings: AH: pg. 128-146, 180-190; CF: pg. 10-15, 310-323

Week 4 (9/23 - 9/28)
Paint Media
-Transparent Watercolor
-Egg Tempera
-Oil
-Acrylic
-Poster (or Tempera)
-Patina
Making Paint
-Pigments
-Binders

Readings: AH: pg. 30-31, 160-171, 202-222; CF: pg. 94-99, 157-168

Week 5 (9/30 - 10/5)
Solvents
-Solubility – like dissolves like
-Functional groups, structure, polarity
-Chemistry of solvents
-Solubility of pigments - application and cleaning

Readings: AH: pg. 38-39, 333-334; CF: pg. 127-129, 159-160, 310-322

Exam 1 (10/7/20) : Testing on Topics from Week 1-5

Week 6 (10/12-10/14)
Art on Textile and Fabric
- Dyeing
- Screenprinting
- Batik
Supports and Grounds
-History
-Preparing Grounds
    Whiting Compounds
    Gesso Grounds
    Acids and Bases (reactions, balancing equations)
-Paper Supports
    Papermaking
    Oxidation-Reduction Reactions (reactions, balancing equations)
-Printmaking
Readings: AH: pg. 42-59, 177-183, 229-256; CF: pg. 117-118, 340-347, 359-372, 418,

Week 7 (10/19-10/21)
Clay
-History
-Types of Composition of Clay
-Glaze and Glass
    Atomic, Ionic, and Molecular Crystalline Structures
    Acid-Base Chemistry
    Glass Formation
    Glass Etching
    Glaze Preparation
Readings: AH: pg. 294-309 ; CF: pg. 56-59, 86-88, 339-349

Week 8 (10/26-10/28)
Sculpture
-Plaster
-Heat of Reaction
-Polymers
-Marble - effects of acid
-Metals
-Chemical and Physical Properties of Metals (Corrosion, Oxidation-Reduction, balancing equations)

Readings: AH: pg. 280-287; CF: pg. 243, 249-250, 277, 350-353,370-372

Week 9 (11/2-11/4)
Alloys
Metalworking Techniques
Electrochemistry (Reactions, balancing equations)
Protective Coatings
Electrochemical Cells
Jewelry

Readings: CF: 359-370; Supplementary material
Week 10 (11/9-11/11)
Photography
    Chemistry of Photography
        Light-sensitive Chemicals
        Solubility
        Equilibrium
    Printing Negatives
    Reactions involved in Photograph Development

Readings: AH: pg. 272-276; Supplementary material

Week 11 (11/16-11/18)
Art Forgeries, and Art Conservation and Restoration

History
Qualitative Analysis and Detection of Forgeries
Instrumentation and Purposes in Chemistry
Theory behind the Instrumentation
Use of instrumentation in Art

Readings: AH: pg. 327-339; Supplementary material

Exam 2 (11/23/20): Testing on Topics from Week 6-10

NO CLASS ON WEDNESDAY 11/25/20 - FRIDAY CLASSES

Paper Due

Week 12 (11/30-12/2)
Conservation
Restoration vs. Preservation
The Chemistry Involved

Readings: AH: pg. 327-339; Supplementary material

Week 13 (12/7-12/9)
Chemical Hazards in Art
Toxicity
Precautions
Sustainable art and chemistry
Museum conditions

Readings: AH: pg. 364-365, 370-371; Supplementary material

Comprehensive Final (TBD or 12/17/20)