

## Art & Chemistry: Beautiful Together: 50:160:120

### Syllabus Spring 2024

Canvas will be used for assignments/class postings, etc.

Students registered for the course who have a Rutgers Net ID (Rutgers email account) can access.

Outlines of notes and assignments will be posted each week. It is the student's responsibility to check the Canvas site regularly for any important information.

**Class meets:** Tuesday/Thursday 9:35 am – 10:55 am **Room: FA 225**  
(Please arrive prior to the start of the class)

**Instructor:** G. A. Arbuckle-Keil Office: Science Building Room 306B  
Arbuckle@camden.rutgers.edu

**Office Hours:** T/Th 12 noon – 1:30 pm and by appointment

**Text:** The Beauty of Chemistry: Art, Wonder and Science, Philip Ball, MIT Press, 2021

**No need to purchase book! Available from Rutgers Library with RU NetID log-in and via Canvas: Reading List**

**Course Description:** In this introductory course for non-science majors, the relationship between chemistry and art will be discussed from historical and scientific perspectives. The nature of color, creating color, and the art and science of color in chemistry will be discussed. The chemical techniques used to follow these processes will be discussed. Basic chemistry concepts will be presented in the context of organic and inorganic pigments. Topics covered will include the properties of light, crystal formation, metals and their compounds, ceramics, photography, and art conservation science.

**Learning Goals:** This course will meet at least three of the physical and life science (PLS) learning goals (General Education requirement).  
At the conclusion of the semester, students should be able to demonstrate an introductory knowledge of simple chemical concepts. Students should be able to understand and discuss the role of chemistry in art (paints, ceramics, photography, etc.) including the application of chemistry in art conservation (LG 1: broad understanding of scientific principles & the ways scientists in particular disciplines conduct research.)  
Students will demonstrate the ability to 'communicate scientific ideas clearly & effectively.' (LG 6) A final oral presentation and written report of a topic of interest to the student is required.  
Application of art conservation and analytical chemistry methods will be discussed with regards to fakes and forgeries. Students will learn to 'critically evaluate scientific arguments and understand the limits of scientific knowledge.' (LG5)

### Expectations:

Learning results from a process of both discussing and thinking about new concepts. This course provides the opportunity for students to learn by engaging via on-line readings, weekly assignments and an end of semester report. The student's responsibility to maximize learning includes the following:

1. Attend all classes
2. Read all assigned materials
3. Actively participate in class discussions and complete in-class worksheets
4. Submit all assignments on time
5. Follow academic integrity policy and code of conduct

Attendance: In accordance with university policy, (Rutgers Camden Undergraduate Catalog: [http://catalogs.rutgers.edu/generated/cam-ug\\_current/pg473.html](http://catalogs.rutgers.edu/generated/cam-ug_current/pg473.html))

"Students are expected to attend all scheduled sessions of the courses for which they are registered. Absences normally impair both student proficiency and the accuracy of their instructor's evaluations. Students with excessive absences (as determined by the instructor) may, at the discretion of the instructor, be given a failing grade in the course."

This course will involve class participation; regular attendance is mutually beneficial to all learners. Late submissions may be accepted for partial credit only with the submission of a 'documented mitigating circumstance.' Students are expected to mark their calendars at the start of the semester with the exam dates and reschedule other conflicts so that exams are a priority.

Requests for excused exam absence MUST be presented BEFORE the date of the anticipated absence. It is the student's responsibility for missed class and assignments. Contact the instructor ASAP.

Rutgers University Self Reporting Absence (on-line)

<https://sims.rutgers.edu/ssra/>

Instructor Communication: Communications from the instructor to the entire class will come via Announcements in Canvas and/or Canvas emails. Reminders, clarifications and announcements will be forwarded when new material is uploaded.

To ensure that you receive these announcements/emails, please make sure your Canvas Notifications are set to alert you when about new announcements immediately.

Late submissions: Assignments are expected to be completed each week (up-loaded to Canvas) before the posted deadline. As each assignment is only worth 5-10 pts, assignments received one week late will not be worth any points but may be completed for practice.

Campus Resources: Basic Needs Security:

If you are having difficulty affording groceries or accessing sufficient food to eat, lack a safe & stable place to live, and/or do not have regular access to technology and believe this may affect your performance in your coursework, you are urged to contact the Dean of Students for support and/or utilize the Rutgers Camden Food Pantry.

Dean of Students: call 856-225-6050, email [deanofstudents@camden.rutgers.edu](mailto:deanofstudents@camden.rutgers.edu) or visit: <http://deanofstudents.camden.rutgers.edu/>

Rutgers Camden Food Pantry: call 856-225-6005, email [scarlet-raptor-foodpantry@camden.rutgers.edu](mailto:scarlet-raptor-foodpantry@camden.rutgers.edu) or visit: <http://wellnesscenter.camden.rutgers.edu/ru-camden-raptor-pantry/>

### **Academic Integrity and Rutgers Code of Student Conduct:**

Rutgers University-Camden, seeks a community that is free from violence, threats, and intimidation; that is respectful of the rights, opportunities, and welfare of students, faculty, staff, and guests of the University; and that does not threaten the physical or mental health or safety of members of the University community and includes classroom space.

As a student at the University you are expected to adhere to the University Code of Student Conduct as explained on the Rutgers Student Affairs site:

<http://studentconduct.rutgers.edu/student-conduct-processes/university-code-of-student-conduct/>

Note that the conduct code specifically addresses disruptive classroom conduct, which means "engaging in behavior that

substantially or repeatedly interrupts either the instructor's ability to teach or student learning. The classroom extends to any setting where a student is engaged in work toward academic credit or satisfaction of program-based requirements or related activities."

By enrolling in this course, each student assumes the accountability and the responsibility to be an active participant in Rutgers community of scholars in which **everyone's** academic work and behavior are held to the highest academic integrity standards. Academic misconduct compromises the integrity of the university. Cheating, fabrication, plagiarism, unauthorized collaboration, and helping or allowing others commit these acts are examples of academic misconduct, which can result in disciplinary action. This includes but is not limited to failure on the assignment/course, disciplinary probation, or suspension. All cases of academic misconduct will be forwarded to the Office of Community Standards for additional review. Students are to uphold the principles of academic integrity. Failure to follow these principles can result in academic consequences ranging from grade penalty to expulsion from the institution.

<http://academicintegrity.rutgers.edu/academic-integrity-at-rutgers/>

### **Disability Services statement:**

Rutgers University welcomes students with disabilities into all of the University's educational programs. In order to receive consideration for reasonable accommodations, a student with a disability must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: <https://ods.rutgers.edu/students/documentation-guidelines>. If the documentation supports your request for reasonable accommodations, your campus's disability services office will provide you with a Letter of Accommodations.

This letter must be presented to the instructor before any accommodations can be made.

To begin this process, please complete the Registration form on the ODS web site at: <https://ods.rutgers.edu/students/registration-form>.

On the Camden campus, contact Director of Disability Services:

Erin Leuthold; (856) 225-2717

Rutgers-Camden Learning Center, Armitage Hall, Room 235

**CARES:** Rutgers-Camden has a wide range of resources to help students stay on track both personally and academically. Raptor Cares: <https://deanofstudents.camden.rutgers.edu/raptor-cares>

connects you to the Dean of Students Office and they can assist students with a variety of concerns: medical, financial, mental health, or any life issue which impacts academic performance.

CLASS: The Center for Learning and Student Success (CLASS) provides academic support and enrichment services for students, at no additional cost, including one-on-one tutoring, small-group tutoring and workshops, online tutoring, writing assistance, student success coaching, learning assessment, and metacognition training. Armitage Hall, Second floor, Suite 231.

<https://class.camden.rutgers.edu/>

Pronouns:

This course affirms people of all gender expressions & gender identities. If you have a chosen name or preferred name other than what is listed on the roster, kindly let your instructor know. If you would like to have your name officially changed on the Rutgers Camden roster, please complete the form at:

<https://deanofstudents.camden.rutgers.edu/chosen-name-application>

Office of Military and Veterans Affairs and Rutgers Camden supports our students who have served and their family members, including explanation of benefits, referrals to resources on and off campus, supporting students who are deployed for active duty and answering questions. If you are in need of assistance and are an active duty, National Guard or veteran (or are a family member), the Office of Military and Veterans Affairs can assist. Find more information by calling 856-225-2791 or visiting:

<http://veterans.camden.rutgers.edu/>

Office of International Students and Programs - International (F-1) students:

If you are an international student at Rutgers Camden and need assistance with documentation, travel, campus assistance and/or advising, the Office of International Students and Programs provides support services. You can obtain more information by calling 856-225-6832, emailing [ois@camden.rutgers.edu](mailto:ois@camden.rutgers.edu) or by visiting:

<https://international.camden.rutgers.edu>

Title IX and Violence Prevention & Victim Assistance Office:

If you have experienced any form of gender or sex-based discrimination or harassment, including sexual assault, sexual harassment, relationship violence, or stalking, know that help & support are available. The Rutgers University-Camden community is committed to helping create a safe learning environment for all students and the university as a whole. Rutgers Camden has staff members trained to support survivors in navigating campus life, accessing health & counseling services, providing academic and housing accommodations, and more. The University strongly encourages all students to report any such incidents to the University. If you wish to speak to a free, confidential employee who does not have reporting responsibility, you can speak to staff in the Office of Violence Prevention & Victims Assistance. You can learn more about these resources by calling 856-225-2326 or by visiting:

<https://respect.camden.rutgers.edu/>

**Syllabus:** All 10 chapters of the Beauty of Chemistry book will be covered in sequence according to the tentative schedule listed below (supplemental resources will be posted on Canvas):

**Exam Dates:** Thursday, February 22; Thursday, April 11, 2024

**Final Exam:** Thursday, May 2, 2024 (8 am – 11 am)

Last day to add/drop a course (**January 25**); warning grade period: **February 28 - March 11**: last day to withdraw from a class with a W (Withdraw) grade: **April 1, 2024**

### Grading:

Course:	<u>120</u>
Two exams	40 % (20 % each)
Final exam	30 %
<b>Oral presentation and paper (Color Element topic)</b>	15 %
End of semester presentation and written report	
In-class worksheets/Reading discussions/on-line quizzes	15 %

### Tentative Schedule

- Week 1: January 16 & 18: Course overview/introduction  
Reading: Elemental: Charisma of Chemistry  
what is art; what is chemistry; how are they related; what is color; what do scientists do; in what ways do both artists and scientists observe the world (similarities/differences)  
Language of chemistry: chemical symbols: periodic table
- Week 2: January 23 & 25:  
Reading: Chapter 1: Effervescent: Bubbles  
Solid/Liquid/Gas: Physical vs. chemical properties  
Structure of the atom: protons/neutrons/electrons; isotopes
- Week 3: January 30 and February 1:  
Reading: Chapter 2: Orderly: The Charm of Crystals  
Detection of color (eyes/retina); what we see/perceive as color  
Relationship between color and chemistry (atomic structure)  
Pigments vs. dyes: Gems, Minerals, X-Ray structure  
Read Orna book: Chapter 1: Introduction: Colors, Natural & Synthetic, in the Ancient World
- Week 4: February 6 & 8:  
Reading: Chapter 3: Insoluble: Precipitates  
Organic vs. inorganic compounds; chemical bonding (covalent vs. ionic)  
Naming of simple molecules and salts  
Natural dyes (insects); organic colorants  
Balancing simple chemical equations; polar vs. nonpolar  
Read Orna: The Chemical Causes of Color

Week 5: February 13 & 15:  
Reading: Chapter 4: Exuberant: Dendritic Growth  
Fractals, shapes of crystals, nucleation of crystals

Week 6: February 20 & 22:  
Review and Exam  
**February 22: EXAM ONE**

**Selection of report/presentation topic required; paragraph describing selection due**

Week 7: February 27 & 29:  
Reading: Chapter 5: Incendiary: Flames  
Causes of color: light, reflection, refraction, absorption, emission  
Heat causes chemical reactions: Combustion, reactivity, fireworks  
Variation of color in transition metal complexes, ceramics

Week 8: March 5 & 7:  
Reading: Chapter 6: Galvanizing: Enchantment of Electrochemistry  
Oxidation/reduction; balancing redox reactions  
Reflective gold, chrome, electrolysis, corrosion, batteries; Metal working, glazing  
**Written report outline including (at least 3) citations (not web sites) due  
(Schedule mtg with instructor to discuss topic)**

**SPRING BREAK (March 11 – 15)**

Week 9: March 19 & 21:  
Reading: Chapter 7: Chromatic Color Changes in Plants  
Chlorophyll; anthocyanin; alizarin; indigo; madder  
Acid & base color changes; pH  
Counting atoms in molecules (formulas); multiple bonds

Week 10: March 26 & 28:  
Reading: Chapter 8: Calescent: Helpfulness of heat  
Thermodynamics: Enthalpy & Entropy  
Stained glass: glass blowing  
Thermal imaging; glow-sticks

Week 11: April 2 & 4:  
Reading: Chapter 9: Organic: Chemical Gardens  
Silicates; colors in gems  
Frescoes; chemistry

Week 12: April 9 & 11:  
Review and exam  
**April 11: EXAM TWO**

Week 13: April 16 & 18:  
Reading: Chapter 10: Creative: Profusion of Patterns  
Oscillation reactions; creativity  
Art Conservation/analytical methods of analysis

Week 13: April 23 & 25:  
Reading: Postscript: Art, Wonder & Science  
**Student presentations and discussion of student topics**  
Presentations and reports must be uploaded by 9 am on April 23 for full-credit.  
A minimum of 5 pts/day will be deducted for late submissions (unless documented extenuating circumstances)  
(Presentations and reports can be completed early (inform instructor that you are requesting early review) to receive feedback and option to edit and re-submit)

**FINAL EXAM: Thursday, May 2, 2024: 8 am – 11 am**

**Do not attend class if you are not feeling well. Please email the instructor briefly stating that you will not be attending and when you expect to return to class. Most assignments can be obtained from Canvas, completed and up-loaded. As each assignment is only worth 5-10 points, credit will not be given for assignments received late without a documentation for the absence.**

**Students are expected to abide by the Rutgers University Code of Student Conduct:**  
<https://studentconduct.rutgers.edu/processes/university-code-student-conduct>