

# Chemistry 105

## The Chemistry of Color

### from Fireworks to Gemstones

Welcome to Chemistry 105! This is a course designed for non-science majors to learn about fundamental principles of chemistry in the context of color. The theme of color is inherently interdisciplinary, so we will be drawing upon other areas of science, technology and the arts in the course of our studies. We will explore the answers to many common questions such as why the sky is blue, what makes blue jeans blue, and why rubies are red and sapphires are blue. As we explore each of these questions, we will learn the basic chemistry necessary to understand the topic. Chemistry is primarily an experimental science, so we will be exploring chemical concepts in the laboratory as well as in lecture. The course description from the catalog is as follows:

*This class explores the natural world through the theme of color. The chemistry behind the color of everyday objects such as neon lights, fireworks, natural and synthetic dyes, and gemstones will be used to introduce fundamental chemical concepts. Concepts include: atomic structure, chemical bonding, chemical reactions, solution chemistry, structure of molecules and solids, organic functional groups, and properties of gases, liquids and solids. The relationship of chemistry to other fields such as physics, life sciences, earth science, art, and modern technology will be discussed throughout the course.*

*Primarily for non-science majors. This course is offered on-line with required in-class laboratory meetings. Permission of instructor required.*

This course satisfies the General Education requirement for The Natural World Category.

### General Information

**Instructor:** Dr. Kimberly Lawler-Sagarin      **Phone:** (630) 617-3202 (x 3202 on campus)  
**Office:** Schaible Science Center 218      **e-mail:** ksagarin@elmhurst.edu

**Office Hours:** M 2-3 pm, W 1:30-3:30 pm, F 1:30-2:30 pm, or by appointment  
*my regular office hours will begin week 2*

**Laboratory:** This is an on-line course with 6 required laboratory meetings as follows:  
Saturdays, 9 a.m. to 1 p.m.: 9/8, 9/22, 10/13, 10/27, 11/10, 12/1  
(meet in SC 203 or as directed) Make up lab day: 12/8  
NOTE: The 10/27 day may be moved due to a conflict  
- we will discuss options at our first meeting.

**Required Materials:** Text: *Chemistry for Changing Times, 11th Edition*  
(by John W. Hill and Doris K. Kolb)  
Second Text: *Colour: Why the World Isn't Grey* by Hazel Rossotti  
Approved eye protection for the laboratory (goggles)  
A Scientific calculator  
This course will use the Blackboard course management system. Please make sure your  
Elmhurst Blackboard i.d. points to an e-mail address you check frequently.  
Access to the Internet, a web browser, and a pdf viewer (such as Acrobat).

**Optional:** Student Study Guide for *Chemistry for Changing Times, 11th Edition*

**Web Site:** The course web site is available from the "course web sites" menu  
of the department home page (<http://elmhurst.edu/~chm>)  
or by going directly to <http://elmhurst.edu/~ksagarin/color>.

## Course Structure and Grading in Chemistry 105

### Overall Grading Philosophy

As your instructor, my goal is to help and encourage you to learn. All students learn differently, thus I try to utilize a broad range of methods and assignments. This means that there will be a lot of different opportunities for you to apply the concepts we will be investigating this semester. Correspondingly, there are many different ways to earn points and demonstrate your understanding of the material in this course.

At first glance, this entire section on grading may seem a little long. Being graded, especially in science courses, can create a certain degree of anxiety. What I have tried to do here is to write out all of my grading policies so that both you and I know what to expect. *Please* read this and subsequent sections carefully. If you find you have a grading situation or question that is not addressed here, please do not hesitate to ask.

### Points and Assignments

Grades on all assignments will be given in points. The maximum number of points is 1000. Grading criteria within each of these categories varies and is discussed in the individual sections of the syllabus.

	Points Each	Total Points	Percentage of final grade
Exams (3)	120	360	36%
Homework (6)	20-25	140	14%
Laboratory Meetings (6)	30	180	18%
Weekly Discussion Questions (12)	15	180	18%
Concept Quizzes (12)	5	60	6%
Mini-Essays (2)	Mini-Essay Initial Drafts (2)	10	
	Mini-Essay (#1&2) Peer Review (2)	10	
	Mini-Essay (#1&2) Final Drafts (2)	20	
Total Mini-essays		80	8%
Total Possible		1000	100%

### Grading Scale

Students must complete the minimum course requirements (described in the next section) to successfully complete the course objectives and receive a passing grade in this course.

The grading scale will depend in part on my assessment of the difficulty of exams. However, the grading scale, for those students meeting all course requirements, will not be raised *above* the following:

900-1000	A
800-899	B
700-799	C
600-699	D
599 and below	F

This means if you receive 900 points and complete all course requirements, you will get an A. If you have, 899 points (and you have completed all course requirements) you will be guaranteed *at least* a B. Students not fulfilling all course requirements will be subject to specific grading policies defined in the next section.

Students within 15 points of the next highest grade *may* be given the higher grade at the discretion of the instructor based on consideration of a high homework percentage, excellent participation, instructor evaluation, and overall performance pattern.

## Course Requirements

This course is designed with many different types of activities and assignments. Students are asked to participate actively in all portions of the class. A baseline set of course requirements is established below. These baseline requirements are considered essential for success in the course.

To be graded on the grading scale defined in the previous section, you must complete or meet all the following course requirements. These are listed below:

1. Pass the lecture (on-line) portion of the course (492 points in lecture)
2. Pass the laboratory portion of the course (108 points in lab)
3. Attend six laboratory meetings
4. Achieve an average of 50% on the exams
5. Complete and participate in at least 10 of the 12 discussions in a timely manner
6. Turn in all homework assignments and mini-essays
7. Adhere to all safety precautions in the laboratory
8. Attempt all concept quizzes

**Please Note:** Not meeting the course requirements can have a *significant* effect on your grade in the course. Below, you will find the rationale for these policies, as well as the effect they may have on a course grade.

- Both portions of this course, the lecture and the laboratory, are essential to the course objectives. Thus, all students are required to obtain a passing grade in both the lecture and the laboratory portions of the course.
- The laboratory is an experiential learning opportunity, thus attendance and active participation is essential. Because of this essential experiential nature of the lab, lab sessions are mandatory.
- As an on-line course, an essential part of this course is weekly discussions. Students must participate in at least 80% of the on-line discussions. Furthermore, the discussions are designed to allow you to share ideas and information with other students, thus all students should participate in the discussion during its assigned week.
- The mini-essays are designed to help meet some of the course objectives, general education category objectives and across the curriculum initiatives, thus student participation in the mini-essays is considered essential. All students must complete all the mini-essays.
- Achieving a combined average of 50% on the exams is considered essential for demonstrating that you have met General Education Objective 1 for category The Natural World. (Investigation of the basic concepts and principles of a particular discipline in the natural sciences.)
- Safety in the chemical laboratory is very important for your own well-being as well as the well-being of others. A recurring disregard for safety precautions may adversely affect your overall grade in the course by as much as an entire letter grade.

In the very unlikely case that a student does not meet one of the above course requirements, that student may not receive a passing grade in this course, depending on the nature and extent of the un-met requirements. In general, the student will receive a one-letter grade penalty for a requirement that was not completed.

## College Policies

College policies on incompletes/drops/unauthorized withdrawals will be followed. Also, **read carefully** the Code of Academic Integrity and the Student Rights and Responsibilities section of the current Student Handbook (E Book) to understand College policies regarding plagiarism, cheating, non-discrimination, and policies regarding privacy with regard to student records. All such policies will be strictly enforced.

If you have a diagnosed disability or believe that you have a disability that might require reasonable accommodations for academic instruction please contact the Disability Services Provider (630) 617-3753. It is your responsibility to initiate a request for services from DSP and to provide appropriate verification of disability. Upon disclosure of a disability verified by DSP, any reasonable accommodation will be made.

## Lecture Assignments

The “lecture” portion of this on-line class will be conducted via the Blackboard discussion board. There are twelve discussions planned, each will last one week. To prepare for the discussion, there will be:

- Readings from the textbooks
- Virtual “lecture” notes - Generally either written by me, from external web resources, or some combination of the two.
- Discussion questions assignments - each student will receive several questions (about 3-4) to answer and post to the website each week. Sometimes one of the questions will be to comment on the response of another student.
- Concept quizzes related to each virtual lecture will be administered via Blackboard.

After reviewing the readings, lecture notes and web pages, draft your discussion question answers in a word processor. Save your work in this format before trying to paste it into the discussion board. I will give guidelines for the length of the answers I am expecting with each question.

**Please do not paste to the discussion board directly directly from the web.** Direct quotations are only allowed if they are fully cited (in quotes, with source listed). I want to hear what everyone has to say in their own words. I know this is sometimes difficult with technical subjects, however it is the process of writing ideas in your own words that helps create understanding. Also, people in the class are more likely to understand something written by one of their peers, so it benefits the class as well. Pasting material directly from web sites to the discussion board as your own work is considered plagiarism and will be dealt with according to college policies.

Discussions will be graded out of 15 points. The grading scale is as follows:

- 15 points = very good to excellent, all questions complete with only minor errors or issues.
- 12 points = good, all questions complete, some minor issues or errors on most questions, or significant problems with one question.
- 10 points = acceptable, all questions attempted, more than minor problems found for two or more answers, or generally just a minimal effort on all question.
- fewer than 10 points = incomplete or unacceptable - points will be based on the extent of completion of the discussion.

In general, with a good, conscientious effort, you may expect to receive 12-15 points for your discussion questions.

Discussions will run from Monday morning through Sunday evening for the week they are scheduled. After the first week, the discussion will happen in two phase. In the first, each student is responsible for posting an answer to at least one of the questions by Wednesday at midnight. Remaining answers should be posted by 7 p.m. on Sunday evening. Missing the first deadline will result in a two-point deduction.

Late discussion entries will be accepted and considered for grading up to one week after the close of the discussion, but will receive a maximum of 10 points, or a late certificate may be used. The discussion will be “closed” one week after the due date.

Discussions will take place within the Blackboard course management system on the Chemistry 105 electronic discussion board. To get there, go to Blackboard through the link on the course home page or go directly to <http://bb.elmhurst.edu> . Log in and choose “chemistry of color” under “my courses”; then choose “discussion board” and you will see a forum for each week’s discussion.

Concept quizzes associated with each virtual lecture will be placed on blackboard. These will be multiple choice/short answer questions scored on-line. You will be able to use books and other materials to take the

quiz. In most cases, it will be possible to take the quiz multiple times in order to improve your score. Attempting these quizzes is a course requirement. The quizzes will remain available for one week after the discussion ends.

Here is a site put together by the library which has details about logging in to Blackboard and changing your personal information, and also what to do if you've lost your password:

<http://www.elmhurst.edu/library/ecresources/bbhelp/basicsstu.html>

Please contact me ahead of time if you anticipate an extended period in which you will be unable to access the discussion board.

### Homework Problem Sets

Six problem sets will be assigned. As often as possible, these are due at the laboratory meetings. There will be an opportunity during these scheduled lab meetings to ask questions about the homework before turning it in.

**IMPORTANT:** If the assignment is due on a week that we do not have a laboratory scheduled, you are still responsible for turning the assignment in on time (Saturday by 3 p.m.). I have an INBOX outside of my door (SC 218) that is accessible whenever the Schaible Science Center is open. Typically, the building is open from 7 a.m. to 10 p.m. M-Th, 7 a.m. to 10 p.m. Friday and 7 a.m. to 3 p.m. on Saturdays. Dropping off the assignment is preferred. However, in a pinch, you can fax it to my attention at (630) 617-3735, or it can be mailed to me (postmarked on or before the due date) at the following address: Dr. Lawler-Sagarin, Elmhurst College box 148, 190 Prospect Avenue, Elmhurst, IL 60126. I can also receive faxes at home with advanced notice - contact me for details.

Guidelines for preparing homework assignments are as follows:

1. Show all your work on mathematical problems. No credit will be given for such problems if your work is not shown.
2. Final answers must always include correct units (i.e. grams (g), nanometers (nm)) for full credit.
3. Please also put your name at the top of your homework set and staple all pages together (unless faxing)

Keys to the homework will be available at the Chemistry 105 Web Site shortly after the lab meeting in which the assignment was due. This is easiest to access by going to the Chemistry home page (<http://www.elmhurst.edu/~chm>) and following the links to the Chemistry 105 home page.

### Grading of problem sets is as follows.

1. Each problem set will be worth 20 or 25 points (total of 140 points).
2. You will receive 10 points for just attempting *all* the problems. The remaining 10 or 15 points will be assigned based on successful completion of the problems (occasionally, only selected problems will be chosen - in this case, graded problems will be the same for everyone in the class).
3. Homework assignments turned in on the due date will be eligible for full credit. If you are not attending that laboratory session, you may drop off, mail, or fax your assignment in ahead of time.
4. Late assignments will be accepted with a 10 point penalty up to the next exam, or a late certificate may be used. Any assignments turned in after the exam will not receive credit.

### Writing Assignments (Mini-Essays)

There will be two mini-essays required in this course. Mini-essays are short essays (about 2 pages, double spaced) considering the historical, social, philosophical, or ethical relevance of recent course topics. I will provide a list of suggested topics for each mini-essay. You may choose one of the suggested topics or select another topic subject to my approval in advance.

The cycle for the first two essays is as follows:

1. Write a draft mini-essay (10 points)
2. Peer review the mini-essays of two other students (10 points)
3. Revise your essay based on instructor and peer comments (20 points)

Initial drafts should be sent via e-mail to me either as text (simply paste the text into an e-mail message) or as an attachment in a common format (pdf, .doc, etc). Text within a message is preferred. I will respond individually to each draft, and send copies to two other students for peer review.

For the peer review assignment, you will receive two mini-essays written by fellow students. Read these essays and provide feedback to the writer by filling out the essay review form available on the website. The review form will automatically be sent to me when you submit the form. I will record your points for the review and forward your review to the student writer. These reviews are meant to be constructive in nature and will include the names of the author and reviewer.

When all the reviews are completed, you will receive comments on your own essay, and then you will revise your paper and send the final version to me.

Mini-essay assignment due dates appear on the course schedule. Mini-essay assignments (drafts, reviews, final copies) are due by midnight on Sunday. Late mini-essay drafts and peer reviews will be accepted though the following Tuesday evening. Such assignments will lose 2 points per day. Any further delays require the use of a late certificate.

You must turn in a draft mini-essay to participate in the peer review process.

Late final copies will also be accepted through the following Tuesday, losing 4 points per day. Any further delays require the use of a late certificate.

If you receive a draft to review or comments on your own mini-essay late, your due date will be extended for the next step in the process.

### **Certificates for Late Assignments**

Each student starts the term with two late certificates. A late certificate allows you to turn in an assignment up to one week late with no penalty. (One week = one work week when course is in session.) To redeem these, simply attach your certificate when you turn in the assignment. If the assignment is on-line, you can fill out a form on the course website indicating you are using a late certificate. Don't forget to mark on your certificate that you have used it (for your own reference).

Please save these certificates for unexpected or unusual occurrences, such as illness, computer crashes, family emergencies or times when your other coursework or job demands a lot of your time.

If you simply need an extra day or two to work on an assignment, late penalties are structured such that the impact on your grade will be minor. If you need more than two days, a late certificate should be used.

In general, you must either take the late penalty or use a virtual late certificate when turning in an assignment late. Special situations, as defined by college policies include: (1) serious illness; (2) an order from the U.S. Military; (3) officially representing the College; (4) death in the immediate family. Such instances may lead to the granting of additional time to complete assignments at the instructor's discretion. All such instances will require documentation. If you have such a situation, please contact me as soon as is feasible to let me know.

### **Exams**

There will be three midterm exams. Two exams will be given during a laboratory meeting and the third one will be given during final exam week. This exam may be taken on Wednesday, Wednesday 12th between 5 and 7 p.m. or on Saturday, December 15th between 10 a.m. and noon. The exam should take about an hour, so the exam must be started by 6 p.m. on Wednesday (allowing those coming from work time to get to campus) or 11 a.m. on Saturday.

If you must miss a Saturday lab for which an exam is scheduled, you must arrange to take a make-up exam in advance. (Time must be arranged in advance, but the exam may be taken in the 1 week prior to, or the 1 week following the original exam date.) Otherwise, I will grant permission to make up an examination if the absence is due to any combination of the following: (1) serious illness; (2) an order from the U.S. Military; (3) officially representing the College; (4) death in the immediate family. All such instances will require documentation. In other situations (unplanned, unavoidable absences), instructor discretion will be used. If you expect to have such an absence, please contact me as soon as is feasible to let me know.

Exams will include material from assigned readings in the texts, assigned reading from the web including virtual lecture notes, homework, laboratory and discussion assignments. In addition to homework and laboratory assignments which will be collected and graded, I will compile a list of recommended problems prior to each exam. Practicing these problems is considered essential for doing well on the exams.

Exam guidelines are the usual strict guidelines for in class closed book exams, and are as follows: closed book, no talking, no sharing calculators, no hats. Bring pens/pencils, scientific calculator. Scratch paper will be provided. Periodic tables will be provided. No exams will be dropped.

## The Laboratory

There are six required laboratory meeting. These are Saturdays, 9 a.m. to 1 p.m. on the following dates: 9/8, 9/22, 10/13, 10/27, 11/10, 12/1 with a makeup lab day scheduled for 12/8. The meeting on 10/27 may have to be moved due to a conflict. We will discuss possible options at our first meeting. Prior to each lab meeting, you will receive a lab handout describing the activities for the week.

On lab days, we will generally start out with a short introduction to the concepts and procedures involved in the lab. Once in the lab, you will be asked to, record your observations (color or other appearance changes, heat generation, etc.), record data in tables or charts where appropriate and answer questions and/or perform calculations as directed in the laboratory handout. Class discussions will often be held at the end of class.

Each lab meeting is worth 30 points. Points will be determined based on completing all the activities and the three items above. Other activities scheduled for lab days may include introductory lectures, group activities, homework question review, exams, and question and answer sessions.

## Goals and Objectives

This course fulfills the General Education Requirement for the Natural World Category. This category is linked to several of the eleven educational goals of the college. The most relevant goals are:

- *Goal 1: Carry through life the desire to learn, and the ability to solve problems and think clearly and independently, with tolerance and openness tempered by healthy skepticism and intellectual vigor;*
- *Goal 2: Are conversant with the heritage of Western culture, as embodied in the humanities, sciences, and social sciences;*
- *Goal 5: Understand the natural world and issues related to humankind's place in it, and have experience with the methods of science and technology;*

The Natural World Category Objectives linked to these and other goals are as follows:

- Objective 1: Investigation of the basic concepts and principles of a particular discipline in the natural sciences (linked to Educational Goal 5).
- Objective 2: Active exploration of the unifying paradigms of science; namely, the development of inductive inquiry skills as illustrated by the scientific method and of deductive skills via use of the "discovery" method of scientific inquiry (linked to Educational Goals 1 and 5).

- Objective 3: Consideration of the scientific, historical, social, philosophical, and ethical contexts in which science is practiced (linked to Educational Goals 2 as well as 7 and 9).

Chemistry 105 will meet these goals through a combination of on-line and traditional assignments, and laboratory meetings.

### Getting Help:

I have office hours each week which you should try to take advantage of. You may also feel free to stop by my office at times other than those posted. I do not have an evening classes this semester, so if you need to see me in the evening, contact me to set up a specific time to ensure I will be available. I will try to have occasional help sessions in the early evening when we have homework due, if there is interest.

One of the best ways to contact me is by e-mail (ksagarin@elmhurst.edu). I will generally respond via e-mail fairly quickly. The class web site will have many resources. Check it frequently for announcements, updates, and helpful links.

The Elmhurst College Learning Center provides a variety of services to Elmhurst College students. Students can receive one-on-one tutoring in math, reading, writing, and study skills areas. A variety of other resources are also available including workshops, handouts, videotapes and on-line resources. The Learning Center is located in Frick Center 229. (x 3155)

The Writing Center, located inside the Learning Center in the Frick Center, offers one-on-one tutorials to help students at all levels to improve their writing. (x 5689)

### The Class Web Site:

You can reach the Chemistry 105 Web Site from the Chemistry Department Web Site (<http://elmhurst.edu/~chm>), through Blackboard (<http://bb.elmhurst.edu>) or directly at the following URL:

**<http://elmhurst.edu/~ksagarin/color>**

The main course web site (above) will serve as a clearing house for information regarding the course and will be linked to the Blackboard site for Chemistry 105. Discussions and grades will be handled via Blackboard, but most other information will appear on the main course site. Keys to the homework, course documents, virtual lecture notes and discussion assignments will be available on the main (non-Blackboard) web site. Links from Blackboard to the relevant pages on the main site will be provided.

### Tentative Schedule:

On the next page is a tentative schedule of topics and assignments. I may find it necessary to change the order of some of the topics as the semester progresses. Due dates for assignments are assumed to be fixed, though they may occasionally be postponed as necessary.

*“Color... it’s just a pigment of your imagination.”*

- random quote from the Internet

*Mere colour, unspoiled by meaning, and unallied with definite form, can speak to the soul in a thousand different ways.*

-Oscar Wilde

*“...all nature manifests itself by means of colours to the sense of sight.”*

- Johann Wolfgang von Goethe *Theory of Colours*, trans. Charles Lock Eastlake (London, 1840)

Week #	Dates	Text	Discussion Topics	Exams and Assignments Due	Lab Meetings
1	Aug. 27 - Sept. 2	1	Discussion 1: Introductions What is light?		
2	Sept. 3-9	7	Discussion 2: Why is the sky blue? What causes sunsets?		lab meeting 1 Sat. Sept. 8
3	Sept. 10-16	2	Discussion 3: How do rainbows form? What makes fireworks colorful?	ME 1 Draft	
4	Sept. 17-23	3	Discussion 4: How do neon signs work?	Homework 1	lab meeting 2 Sat. Sept. 22
5	Sept. 24-30	3	Discussion 5: What causes the Northern Lights? What is a chemical reaction?	Peer Rev. 1	
6	Oct. 1-7	4	Discussion 5 continues	Homework 2	
7	Oct. 8-14	6	Discussion 6: What are pigments? What is the "Solid State"?	Exam1 Final ME 1	lab meeting 3 Sat. Oct. 13
8	Oct. 15-21		Discussion 7: How are paints made? How are frescoes made?		
9	Oct. 22-28	9	Discussion 8: Why are rubies red and sapphires blue?	Homework 3	lab meeting 4 Sat. October 27 (may be changed)
10	Oct. 29- Nov. 4	10	Discussion 9: Why are metals shiny? How do photo-diodes work?	Homework 4	
11	Nov. 5-11	10	Discussion 9 continues	Exam 2	lab meeting 5 Sat. November 10
12	Nov. 12-18	6	Discussion 10: What is <i>Organic</i> Chemistry? What makes blue jeans blue?	ME 2 Draft	
13	Nov. 19-25	6	Discussion 11: Why are leaves green? Why are autumn leaves orange?		
14	Nov. 26 - Dec. 2	9	Discussion 11 continues	Homework 5 ME 2 Peer Rev.	Lab meeting 6 Sat. December 1
15	Dec. 3-9	*	Discussion 12: How do fluorescent dyes and glow in the dark toys work? What makes fireflies glow?	Homework 6	Make-Up Lab Day Sat. December 8
16	Dec. 10-15	-		All Outstanding Assignments Due Final ME 3	Exam 3 W 5/12, 5 pm OR S 5/15, 10 am

Table 1: Tentative Schedule - Chemistry 105 - Spring 2006