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# AN ONLINE INTERCOLLEGIATE CHEMISTRY COURSE (OLCC): CHEMICAL SAFETY: PROTECTING OURSELVES AND OUR ENVIRONMENT

by

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## I. ABSTRACT

This paper describes a collaborative intercollegiate undergraduate course on chemical safety to be offered during the Fall of 2004. The course will be sponsored by the ACS Division of Chemical Education and the ACS Division of Chemical Health and Safety. One of the purposes of this paper is to inform chemical educators about the course in the hope they will serve as course instructors at their schools. Each school is responsible for recruiting students and assigning grades. The course is expected to be a learning experience for the students and the instructors. No fee is assessed by the sponsors. Local instructors are facilitators for the course and do not have to be experts in chemical health and safety.

## II. INTRODUCTION

During the fall of 2002 an online CONFICHEM Conference was held, entitled "Teaching Safety in High Schools, Colleges and Universities". (<http://www.ched-ccce.org/confchem/2002/c>). At the end of the conference the possibility of organizing an online course on chemical safety for undergraduate students was discussed. On-Line Chemistry Courses (OLCC) have previously been offered by the ACS Division of Chemical Education's Committee on Computers in Chemical Education (CCCE) (see <http://www.ched-ccce.org/olcc/>). The discussion of the Chemical Safety Course was of sufficient interest that private online discussions continued after the conference. Those involved in the discussions were James M. Beard, Harry Elston, Robert H. Hill, Wavell Fogleman, Dawn Lee, George R. Long, Donald Rosenthal, Ralph Stuart, Gary Trammell, Scott E. Van Bramer and George Wahl. As a result of these early discussions, a course title and textbook were selected and some decisions about course format and topics were made. It was decided that the course would be offered in the Fall semester (or term) of 2004. A course Organizing Committee was formed with Gary Trammell as Chair. The ACS Division of Chemical Health and Safety (DCHAS) and ACS Division of Chemical Education (CHEMED) have agreed to co-sponsor the course.

## III. THE COURSE FROM THE PERSPECTIVE OF THE INSTRUCTOR

The online intercollegiate chemistry courses (OLCC) provide an opportunity for a collaborative effort among instructors, the organizing committee, the authors of OLCC website papers and students. Initial discussions and additional work by the Organizing Committee provides faculty with a draft course outline, selected reference materials and a list of websites. Authors who have expertise in particular

aspects of chemical safety have been recruited. Their papers will be read and discussed by the students and authors online as part of the course ([http://science.widener.edu/svb/olcc\\_safety](http://science.widener.edu/svb/olcc_safety)).

Course instructors will interact with one other, the Organizing Committee and authors of papers via a private OLCC-FAC Majordomo discussion list. The OLCC course structure provides an opportunity for instructors to solicit and give advice to each other.

This provides an opportunity to offer a course for a small number of students without having to devote an enormous amount of time, and to offer a course on topics that might otherwise not be feasible.

Course instructors will be responsible for offering a three credit course during the Fall 2004 Semester (or term). The course may be entitled "Chemical Safety: Protecting Ourselves and Our Environment", "Directed Study" or something similar at all the schools involved. Students who have had at least a year of General Chemistry and a year of Organic Chemistry will be eligible to take the course. Ideally, the course would have at least half a dozen students, but in some cases the course may be offered as an independent-study course for one student. Each participating school will have a course instructor.

Each course instructor will meet with the students during the first few weeks of the course and briefly discuss the course outline and schedule. Students will require access to online computers able to send and receive e-mail messages and access the course website ([http://science.widener.edu/svb/olcc\\_safety](http://science.widener.edu/svb/olcc_safety)). Each student will have an e-mail address.

Course instructors will meet weekly with their students to discuss pertinent topics; instructors may lecture, provide time for student discussion, and/or provide computer laboratory sessions. Instructors at their discretion may schedule examinations and provide problem assignments. (Some suggested assignments can be found at the OLCC website - [http://science.widener.edu/svb/olcc\\_safety/assignments.html](http://science.widener.edu/svb/olcc_safety/assignments.html).) Each instructor will be responsible for assigning grades to each student in his or her course.

Instructors who already offer courses on safety may find it useful to offer this course because of the different perspective that the authors of papers, other instructors and students may have and the resources available via the OLCC website, OLCC-STU and OLCC-FAC Discussion Lists. Instructors do not need to be experts in chemical safety, but can act as facilitators for the course.

The course is intended to be a learning experience for the instructors as well as their students.

#### IV. THE COURSE FROM THE PERSPECTIVE OF THE STUDENT

Students will interact with students and instructors at their schools as well as with students at other schools. They will have an opportunity to ask questions and discuss papers that are on the course website with the authors and other students via the OLCC-STU Majordomo Discussion List. In addition to reading assignments there will be homework assignments. Some assignments will involve collaboration between students.

Students will have an opportunity to communicate via e-mail, to access information on the World Wide Web and to use search engines and the library in order to find information.

This OLCC course provides an opportunity to take a course on a topic that might otherwise not be available.

#### V. WHY LEARN ABOUT CHEMICAL SAFETY? WHY TEACH CHEMICAL SAFETY?

- It is important to protect ourselves, others and the environment from possible dangers associated with hazardous materials, chemical experiments gone awry and improper use of laboratory equipment.
- In order to do this we need to know the hazards and to introduce practices to minimize the

risks.

- o People, universities, industrial and government laboratories and other agencies are concerned about safety and the consequences of unsafe practices.
- o We all need to know about relevant regulations, safe practices, emergency procedures, consequences of unsafe practices and to take all necessary precautions.
- o We need to acquire attitudes and behaviors in which safety is as much a part of experimental planning as theoretical knowledge and good techniques. Learning prudent behavior in the laboratory is a necessary part of our training as laboratory professionals.
- o In today's research and manufacturing environments, employers expect new employees to have a basic understanding and respect for compliance with safety.
- o Much of the information learned is relevant to life outside the laboratory, classroom and factory - the home, the land, the water and the air.

Federal, state and local regulations provide guidelines for chemical safety.

The subject of safety is important enough for the American Chemical Society to have established a Division of Chemical Health and Safety (<http://membership.acs.org/c/chas/>). The Division of Chemical Education (<http://www.divched.org/>) has a Committee on Safety (CS). The American Institute of Chemical Engineers has established a Safety and Health Division (<http://www.shdiv.aiche.org>) and SACHE - The Safety and Chemical Engineering Program. SACHE develops and provides materials that can be used in teaching safety (<http://www.aiche.org/sache/>).

## VI. SOME QUESTIONS TO BE ANSWERED IN THE COURSE

- o How are we exposed to chemicals?
- o How can we evaluate the hazards of the materials we work with?
- o How do I use equipment properly?
- o How do I handle and manage the chemicals I work with?
- o How can I minimize generation of waste?
- o How do I handle the wastes generated in my work?
- o How can I prevent accidents?
- o How do I respond to an emergency?
- o What rules and regulations cover my work in the laboratory?
- o What steps should be taken to protect my safety, the safety of others and the environment?

## VII. COURSE SCHEDULE

One problem in offering an intercollegiate course is that different colleges and universities have different academic calendars - some schools and some semesters (or terms) start and end earlier or later than others. Vacation periods are not all the same. The proposed schedule has online intercollegiate components scheduled between September 5 and November 20. Most semesters and terms will include this time frame. Whenever necessary, instructors may need to modify the schedule for their students. The detailed Course Outline will be presented in a subsequent section.

Where a sufficient number of students are enrolled, it is expected that regular class and computer laboratory sessions will be scheduled by instructors at each of the participating schools. The exact local configuration is at the discretion of the local instructor.

The time prior to September 5 will be used for preliminary orientation, presentation of the Course Outline, familiarizing the students with the course website, e-mail and the OLCC-STU Discussion List. While some suggestions will be made, instructors will have latitude in deciding what they will do during the pre-September 5 period. Some suggested assignments are found in Table A.

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### TABLE A.

SUGGESTIONS FOR ASSIGNMENTS:

Suggested assignments are intended to accompany each topic of the course. Students are NOT expected to do all assignments. The lists are provided as possible assignments or as ideas for independent projects.

### INTRODUCTION TO THE COURSE (prior to September 5)

- o Examine some of the links from the course website and write a brief description of what you found. ([http://science.widener.edu/svb/olcc\\_safety/links.html](http://science.widener.edu/svb/olcc_safety/links.html))
- o Try several search engines to find information on a topic related to laboratory safety. Which search engines seemed to be the best at providing the requested information?
- o Look up and summarize recent laboratory or industrial accidents at the Chemical Incident Report Center at <http://www.chemsafety.gov/circ/>, [OSHA SIC 8221 for colleges and Universities](#), or [OSHA SIC 8211 for K to 12](#). Suggest steps that could have prevented or minimized the incident.
- o Make a list of some of the major things you know about laboratory safety. What questions do you have?
- o Make a list of some things you would like to learn from this course and share it with your class and the other participants via OLCC-STU.
- o Obtain a list of laboratory safety rules at your school and a copy of your school's Chemical Hygiene Plan, if available.

For additional suggested assignments, see:

[http://science.widener.edu/svb/olcc\\_safety/assignments.html](http://science.widener.edu/svb/olcc_safety/assignments.html)

The September 5 to November 20 period will involve prescribed reading assignments from the course texts and in-class and on-line discussion of the reading assignment and course topics. This is expected to occur during the first part of each week (Monday to Wednesday). A paper will be available on the course website. It is to be read - discussed in class on Wednesday and then via the OLCC-STU Discussion List on Thursday and Friday. Online discussion will be asynchronous (students, authors and instructors will not have to be signed on at any prescribed time). Some possible homework questions and assignments will be suggested. Each instructor will need to decide which assignments, if any, to use. Students may be asked to work separately or collaboratively.

Scheduled class time may be used for lecturing and/or discussion.

The Course Outline (see below) provides details about the September 5 to November 20 schedule.

### VIII. COURSE TEXTBOOKS

Two course textbooks are prescribed:

1. "Prudent Practices in the Laboratory: Handling and Disposal of Chemicals", Washington, DC: National Academy Press (1995). [PP] <http://www.nap.edu/books/0309052297/html>
2. "Safety in Academic Chemistry Laboratories, Vol. 1 7th Ed., Washington, DC: American Chemical Society (2003). SACL] [http://membership.acs.org/c/ccs/pubs/SACL\\_Students.pdf](http://membership.acs.org/c/ccs/pubs/SACL_Students.pdf)

While both of these texts are available on the World Wide Web, students may wish to purchase a copy of Prudent Practices [PP] and request a free copy of SACL.

Instructors are urged to request free copies of SACL Volumes 1 and 2. (Volume 2 - [http://membership.acs.org/c/ccs/pubs/SACL\\_faculty.pdf](http://membership.acs.org/c/ccs/pubs/SACL_faculty.pdf))

(See [http://science.widener.edu/svb/olcc\\_safety/syllabus.html](http://science.widener.edu/svb/olcc_safety/syllabus.html) for additional information).

**IX. COURSE OUTLINE AND ACTIVITIES**

A tentative Course Outline is available on the OLCC website (see [http://science.widener.edu/svb/olcc\\_safety/lecture.html](http://science.widener.edu/svb/olcc_safety/lecture.html)).

One of the major course components is TOPIC I - How Does a Prudent Person Plan a Laboratory Experiment? Various aspects of this topic will be considered for three weeks (September 19 to October 9). The outline for the week of September 19-25 is presented in Table B.

**TABLE B.**

TOPIC I. HOW DOES A PRUDENT PERSON PLAN A LABORATORY EXPERIMENT?  
How are we exposed to chemicals? (September 19-25)

## TOPICS

- Routes of exposure
- Nature of chemical hazards Reactivity, Corrosivity, Toxicity, Flammability
- Practical Toxicology: mechanism of action

## READINGS FROM COURSE TEXTBOOKS

- PP Ch. 3 - Evaluating Hazards and Assessing Risks (pp 35-57)
- SACL 1 (pp 10-11)

## IN CLASS AND ONLINE (OLCC-STU) DISCUSSION

## READING PAPER FROM WEBSITE

- Paper by George Wahl, Jr.

## IN CLASS AND ONLINE (OLCC-STU) DISCUSSION

## ADDITIONAL ASSIGNMENT ?

The three sub-topics to be considered are Routes of Exposure, Nature of Chemical Hazards, and Practical Toxicology.

Prior to the first class meeting (Monday) students are expected to have read the two textbook reading assignments. The students will have an opportunity to discuss the topics and reading assignment and the instructor might lecture on the material. Online messages regarding the reading assignments and discussion might be sent via OLCC-STU on Monday or Tuesday.

Prior to a second class meeting (Wednesday) students are expected to have read the paper by George Wahl, Jr. which will provide in depth coverage of one or more of the sub-topics. This second class meeting could be used to further discuss the sub-topics and/or the paper by George Wahl. Students may have questions about George Wahl's paper - they may need clarification of some statements or concepts. They are expected to send SHORT QUESTIONS via the OLCC-STU Discussion List on or before Wednesday. SHORT QUESTIONS may be addressed by the students to the author and/or other students. The author may send questions to the students. Thursday and Friday will be used for sending answers to SHORT QUESTIONS and for discussion of the paper via OLCC-STU.

The website contains some possible assignments that may be used by any instructors (see Suggested Assignments).

Suggested activities include:

- A. Having the students examine and critique their school's Laboratory Safety Rules and Chemical Hygiene Plan, or develop a set of rules and a plan.
- B. At a rather late stage in the course, have the students conduct one or more laboratory safety inspections and write a report making specific recommendations. This could be done with the course instructor, school safety officer and graduate students serving as members of the inspection group. If the number of individuals involved is large, it might be useful to have more than one inspection group and compare safety reports. Follow-up inspections might be made to determine whether recommendations were implemented.

The course structure described above is only one possible scenario. Instructors may modify the structure to fit their individual circumstances. However, all instructors are expected to keep to the basic schedule as indicated in the course outline. If the course is being taught as a directed study course for one or a few students, formal classes may not be desirable. Individual schools may need to modify the schedule somewhat based upon scheduled vacations during the term or semester.

## X. PAPERS TO BE READ AND DISCUSSED ONLINE

Individuals with considerable chemical safety experience have been recruited to write papers for this course. Information about the authors can be found on the course website ([http://science.widener.edu/svb/olcc\\_safety/presentors.html](http://science.widener.edu/svb/olcc_safety/presentors.html))

## XI. CHEMICAL SAFETY WEBSITES

The course website contains many links to Chemical Safety and Safety related sites ([http://science.widener.edu/svb/olcc\\_safety/links.html](http://science.widener.edu/svb/olcc_safety/links.html))

Both students and instructors are expected to explore this resource.

## XII. CONCLUDING REMARKS AND A MESSAGE TO READERS OF THIS PAPER

While the authors believe that the actual course will not deviate substantially from the course as described in this paper, the course description is to be regarded as tentative. Instructors involved in teaching the course may want to suggest modifications.

The authors of this paper welcome any comments, suggestions and corrections from readers.

Readers interested in offering the course at their college or university should register with Scott Van Bramer, Department of Chemistry, Widener University, Chester, PA 19013 - [svanbram@science.widener.edu](mailto:svanbram@science.widener.edu) - 610-499-4516.

Questions about the course should be directed to Gary Trammell, Chair - OLCC Chemical Safety Course, Department of Chemistry, University of Illinois at Springfield, Springfield, IL 62703 - [trammell.gary@uis.edu](mailto:trammell.gary@uis.edu) - 217-206-7344.

The authors of this paper would like to thank all those who helped to organize the course. Many features of this course have been suggested by others. We would especially like to thank James Beard, Kathy Benedict, Harry Elston, Wavell Fogleman, Barbara Foster, Robert Hill, Todd Houts, James Hutchison, Dawn Lee, George Long, John Pingel, John Singley, Ralph Stuart, George Wahl, among others.

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Additional information about the course can be found at [http://science.widener.edu/svb/olcc\\_safety](http://science.widener.edu/svb/olcc_safety)

Information about previous and possible future courses can be found at <http://www.ched-ccce.org/olcc/> and

<http://www.clarkson.edu/~rosen2/olcc.html>

<http://www.ched-ccce.org/olcc/rosenthal1996.html>

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Last Updated 9/23/2003