

**UNIVERSITY OF NORTHERN COLORADO**  
**COLLEGE OF NATURAL AND HEALTH SCIENCES**  
**OFFICE OF EXTENDED STUDIES**  
**SCED 535: Context-Based Conceptual Chemistry (3)**

**Jerry P. Suits, Ph. D.**

jerry.suits@unco.edu

Office: 3580 Ross Hall

970.351.1169 (Office) & 970.396.8531 (Cell)

Office hours: --by arrangement--

**Course Description:** The emphasis of this course is on how to teach chemistry concepts within the context of the kitchen, medicine cabinet, household cleaning, and the garden.

**Prerequisite:** CHEM 111 and CHEM 112 or equivalent. No credit for Chemistry M.S. or Chemical Education Ph.D.

Course Dates:

**June 29<sup>th</sup> to July 24<sup>th</sup> 2009**

Online synchronous discussions: Every **Tues & Thurs** from 4:00 to 7:00pm

On-campus weekend at UNC: July 10<sup>th</sup> to July 12<sup>th</sup> . TIMES tbd

**Course Objectives:**

- To develop a thorough understanding of how ‘conceptual chemistry’ contributes to chemistry knowledge traditionally taught in chemistry courses.
- To experience laboratory activities that lead to authentic scientific investigations conducted within a complex domain, e.g. kitchen chemistry or medicinal chemistry.
- To participate in experimental work that uses modern scientific instruments for analysis of chemicals found in the kitchen, medicine cabinet, or garden.
- To write and critique a teaching module based on an extension of a topic covered in the course on chemicals and chemical processes found in the kitchen, medicine cabinet, or garden.

**Method of Evaluation:**

On-line Participation	30 %
Lab Reports for “Kitchen Investigations”	15 %
On-Campus Weekend Chemistry Laboratory Activities	15 %
Final Project on Teaching Context-Based Chemistry	30 %
On-line final exam	10 %

A ≥ 90, B ≥ 80, C ≥ 70, D ≥ 60, F < 60

**Required Texts:**

Required:

*Kitchen Chemistry*, T. Lister & H. Blumenthal, Text & CD, Royal Society of Chemistry © 2005. (Code: **Kit-Chem**)

*Chemistry in the Marketplace*, 5<sup>th</sup> ed., Ben Selinger, Sydney: Harcourt Brace, 1998. (Code: **C-Mark**)

Access to a reliable internet-connected computer for on-line Blackboard ([www.bb.unco.edu](http://www.bb.unco.edu)) and email communications

Recommended:

*General Chemistry*, any recently published college textbook—for brief review of topics.

**Disability Support Services:**

*Students who believe that they may need accommodations in this class are encouraged to contact Disability Support Services (970) 351-2289 as soon as possible to ensure that accommodations are implemented in a timely fashion.*

**Outline of Course Content:**

<u>Problem-solving Domains:</u>		
Session #	<u>Context-Based Chemistry(CBC)</u>	<u>Chemistry Content Knowledge (ChCK)</u>
#1:	<i>Transition States: From Middle → High School → College</i>	Why is chemistry difficult to learn?
#2:	Chemistry of health and risk (Ch. 2, <i>C-Mark</i> )	Measurement
#3:	Chemistry in the kitchen (Ch 4, <i>C-Mark</i> ; <i>Kit-Chem KC01-03</i> )	Colligative properties
#4:	Chemistry in the kitchen (Ch 4, <i>C-Mark</i> ; <i>Kit-Chem KC04-06</i> )	Titration
#5:	Chemistry in the kitchen (Ch 4, <i>C-Mark</i> ; <i>Kit-Chem KC07-09</i> )	Stoichiometry
#6:	Chemistry in the kitchen (Ch 4, <i>C-Mark</i> ; <i>Kit-Chem KC11-13</i> )	Reaction Rates & Enzymes
#7:	Chemistry in the kitchen (Ch 4, <i>C-Mark</i> ; <i>Kit-Chem KC14-16</i> )	Organic Structures & Rxns
#8:	Chemistry of food additives (Ch 15, <i>C-Mark</i> )	Oxidation/Reduction; Aromatics
#9:	Chemistry of food processing and radiation (Ch 16, <i>C-Mark</i> )	Nuclear chemistry
----- <i>On-Campus Weekend Chemistry Laboratory Activities</i> -----		
#10:	Chemistry of cosmetics (Ch 5, <i>C-Mark</i> )	Lipids; Insoluble metal compounds
#11:	Chemistry in the garden (Ch 7, <i>C-Mark</i> )	Nutrient elements; Solubility
#12:	Chemistry in the medicine cabinet (Ch 13, <i>C-Mark</i> )	Sulfa drugs; Metabolism
#13:	Chemistry in the laundry ( <i>Ch 3, C-Mark</i> )	Surface chemistry; Toxicity
#14:	<i>Presentation of Final Projects</i>	<b>Final Project Due</b>
#15:	<b>On-line Final Exam</b>	

**Course Requirements:**

- *On-line participation*-- Student contributes to discussions (not just “me too...”) and inspires other students to participate. You should reflect (think it over in your mind ☺) on ideas before presenting them and truly listen to other ideas while giving the other person feedback as appropriate. You should provide evidence (cites sources) for your ideas. You should socialize but remain “focused” on the topic being discussed most all the time.
- See Evaluation Rubrics for “On-Line Participation”

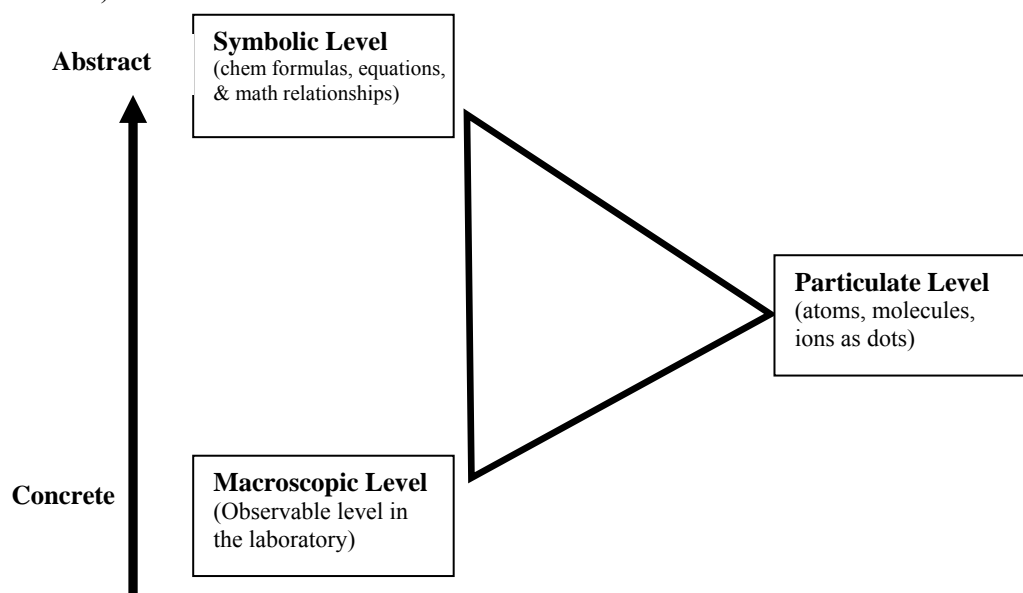
- *Kitchen investigations*—The student should make observations in the kitchen (or other place with proper facilities, e.g. sink, source of water, good ventilation, etc.). The goal should be to fully understand the chemical concepts underlying a kitchen phenomenon and understand the linkages among the three types of chemistry representations: the phenomenon (macroscopic), symbolic (equations & formula), and particulate levels (atoms, ions, molecules shown as dots). Each investigation should be well organized based on the laboratory report format for this course. All investigations should be organized in a three-ring notebook.
- See Evaluation Rubrics for “Kitchen Investigations”
- *On-Campus Weekend Chemistry Laboratory Activities*--During the on-campus weekend, you will participate in laboratory activities (which includes use of analytical instrumentation, e.g. gas chromatograph-mass spectrometer) and engage in class discussions. You should cooperate with the other participants while remaining *focused* on the chemistry topics that are developed within a particular context (e.g., quantitative analysis of the “hot” ingredient in chili peppers). You will write a laboratory report with your lab group, and contribute some original evidence-based ideas to your group and the whole-class discussions.
- See Evaluation Rubrics for On-Campus Laboratory Activities
- *Final Project on Teaching Kitchen Chemistry*--Your Final Project should be an original project that you selected or an extension/elaboration of an existing project that improves it in a substantive manner. All learning objectives should be connected to Colorado and/or NSES standards (including inquiry standards). Each section should be clearly written and grade-level appropriate. The module should be a realistic plan for classroom use of the project. The chemistry content in the Project should interrelate the activities to all three of the chemistry representational levels: macroscopic level (equipment, chemicals), the particulate level (atoms/molecules/ions) and the symbolic level (chemical formulas and equations).
- See Evaluation Rubrics for Final Project
- Examples of Projects: [http://www.chatham.edu/pti/Kitchen\\_Chem/abstract\\_page.htm](http://www.chatham.edu/pti/Kitchen_Chem/abstract_page.htm)
- *Final Examination*-- The exam will be given on-line and it will consist of two separate parts:
  - 25-multiple choice questions based on both the chemistry content knowledge (ChCK) and context-based chemistry topics (CBC) as shown in the schedule below.
  - Three essay questions that emphasize the integration of the context of chemistry applications (CBC, below) and chemistry content knowledge (ChCK).

*Course Philosophy:* Chemistry is a challenging subject to learn because of its multidimensional nature, which requires mathematical ability needed to understand quantitative and symbolic relationships, acquisition of a huge technical vocabulary of specialized terms (e.g., dative bond), ability to visualize abstract entities and processes (e.g. atoms/molecules/ions and their interactions during chemical processes), ability to perform laboratory investigations at the macroscopic/ observable level, and ability to connect all of these representations into a coherent, meaningful whole (i.e., a conceptual framework; see Figure 1). The goal of this course is to present these representations in a meaningful way such that middle and high school science/chemistry teachers can understand the underlying chemical concepts as they apply to real-world context, such as the chemistry of foods and cooking in the kitchen, interaction of selected prescription and over-the-counter drugs found in the medicine cabinet, chemicals used in household cleaning, and chemicals used in the garden. Each module begins with a *motivating*

*question* designed to perk student interest in the real world context of a phenomenon that has an underlying chemical conceptual framework. The subsequent learning objectives for each module vary along two different dimensions: concrete activities to abstract ideas, and context-oriented questions (e.g., the best way to cook asparagus) to chemistry-oriented solutions (e.g. temperature needed to cook asparagus as related to the boiling points of pure water, salty water, and oil). So teachers, and ultimately their students, should be able to “see” literal connections between real-world contexts and the underlying chemical concepts. Students should be more motivated to learn chemistry and more able to learn it with a deep/meaningful manner rather than in a surface/memorization manner.

Honor Policy- We will follow the policy of the University of Northern Colorado governing scholastic dishonesty. Collaboration is permitted and encouraged when working on homework and in-class problems. Plagiarizing will result in a grade of zero. Always cite the source(s) of your information.

Figure 1: The three different representational levels needed to truly understand chemistry (adapted from: Johnstone, A. H. (1982). Macro- and micro-chemistry. *The School Science Review*, 64, 377–379).



### **Library Services for Distance Education and Off-Campus Students: Obtaining Materials from UNC Libraries**

Off-campus students residing within 50 miles of the UNC campus are required to come to the library and borrow materials in person. Students residing more than 50 miles from campus may request that materials be delivered to them. All requests must include complete citations. We will supply materials from the UNC Libraries, as well as materials from other libraries obtained via Interlibrary Loan. Articles will be delivered via email. Books will be mailed first class. Delivery time by U.S. postal service is approximately 1 week. It is the responsibility of the student to return books by the date due. UNC does not pay return postage on books. For information on document delivery, call (970) 351-1446.

Requests for materials may be made through the following methods:  
Online: <http://www.unco.edu/library/forms/distancerequest.htm>  
By email: [library.ocp@unco.edu](mailto:library.ocp@unco.edu)

By fax: (970) 351-2540

### **Disability Support Services**

Students who believe that they may need accommodations in this class are encouraged to contact the UNC Disability Support Services at 970-351-2289 as soon as possible to ensure that accommodations are implemented in a timely fashion.

### **Honor Code**

All members of the University of Northern Colorado community are entrusted with the responsibility to uphold and promote five fundamental values: *Honesty, Trust, Respect, Fairness, and Responsibility*. These core elements foster an atmosphere, inside and outside of the classroom, which serves as a foundation and guides the UNC community's academic, professional, and personal growth. Endorsement of these core elements by students, faculty, staff, administration, and trustees strengthens the integrity and value of our academic climate.

### **UNC's Policies**

UNC's policies and recommendations for academic misconduct will be followed. For additional information, please see the Dean of Student's website, Student Handbook link <http://www.unco.edu/dos/handbook/index.html>

### **Notice**

The Office of Extended Studies reserves the right to cancel or reschedule courses based upon enrollment. Enrolled students will be contacted with information of any change.

### **Student Satisfaction Evaluation**

Participants will be asked to evaluate the workshop for instructors' knowledge, interest and enthusiasm as well as providing additional information on classes or topics which you would like to see developed as a future offering from UNC.

### **Portable Electronic Devices**

Please extend courtesy to your instructor and fellow students by turning off your portable electronic devices such as: cell phones, pagers, and iPods. Although not an audio issue, text-messaging is a distraction to other students and prevents you from full participation in class. You should keep your portable electronic devices in your backpack or purse during class. Your personal electronic devices should not be on your desks. If you know that you may need to accept an emergency phone call during class or if you have children in childcare or school, please let the instructor know. If you need to take a phone call during class, please step out of the classroom while you complete your call. Thank you for your cooperation.

### **Course Withdrawal Information**

In accordance with University and Colorado Department of Higher Education policy, if you drop this class after the course starts you will be assessed a drop fee. The drop fee is pro-rated up to the half-way point in the class. You are legally responsible for payment of full tuition once 50% of this course has been concluded. In order to be eligible to receive any refund of tuition, you must contact the Office of Extended Studies (1-800-232-1749) to formally withdraw from your class. Your refund, if applicable, will be based on the date of contact with our office.

Withdrawals received via telephone during non-business hours will be processed and dated on the next working day. Failure to notify us will result in UNC tuition being owed even though you do not attend or complete the coursework.