

**CHEM 696: Section 600**  
**Modern Application in Chemistry:**  
**Molecular Visualization**  
**Fall 2006**

**Instructor:**

Dr. Vickie M. Williamson  
williamson@ tamu.edu  
HELD 408  
(409) 845-4634

**Tentative Reading**

1. TEKS <http://www.tea.state.tx.us/teks/112toc.htm>
2. NSES <http://www.nap.edu/readingroom/books/nses/html/index.html>
3. Thomas B. Fordham Foundation recently released appraisals of state standards in the five core academic subjects of English, history, geography, math, and science  
<http://www.channell.com/users/udson/standards/best.html>
4. No Child Left Behind <http://www.channell.com/users/udson/index.html>
5. Journal of Chemical Education <http://jchemed.chem.wisc.edu>
6. Class webpage, with links to visualizations and programs  
<http://chemed.tamu.edu/molvis>

**Course Objectives:**

The course will focus on visualization techniques in the pre-college classroom and the use of these techniques in a manner compatible with good scientific inquiry. The course will be a combination of individual work and regular classes. The participants must attend two weekend on-campus sessions. These are currently set for Sept. 22-23 and Oct. 27-28. The on-campus sessions begin at 1pm on Friday and conclude about 4:30 on Saturday. These will be intensive and will include lecture, laboratory, and discussions over lunch, which will be provided. In addition, the individual portions of the course could include reading, homework, lesson plans, projects, experiments, etc. to be done at home or in the school laboratory. Reporting of these will occur via a Web activity or e-mail. These electronic methods will also allow the participants to pose questions, report progress, respond to questions, and interact with the instructor and instruction team.

**Prerequisites:**

The course is designed for the in-service teacher who is responsible for teaching chemistry concepts, a chemical education graduate student, or a graduate student who will work with freshman classes. The only prerequisites are that a participant should have the equivalent of one year of college chemistry and hold an undergraduate degree. Degree-seeking graduate students must have permission from their graduate committee and from the instructor to enroll.

**Enrollment:**

Three hours of graduate credit in chemistry. Teachers not working on a graduate degree can apply for admission as “non-degree-seeking” which requires an additional \$50 admissions fee. Admission will require a letter from the school district stating that the teacher has a bachelor’s degree or a transcript. Some school districts have Eisenhower or other funds available to support graduate work.

## Grades:

This is a graduate level course. The desired outcome is the growth of the individual teacher through interactions with other teachers, chemists, and chemical educators. It is assumed that all assignments will be done and submitted in a timely manner. Grades for the course will be determined by the quality and completeness of assignments. Specific assignments will be made as the class progresses; these will include:

| <u>Assignment</u>  | <u>Percent of Grade</u> |
|--|-------------------------|
| Class participation in discussion of reading assignments, class activities, etc.   | 10%                     |
| Web Activities<br>(critiques/summaries/analysis of articles, standards, research on the use of mol-vis on learning/teaching, and existing molecular visualizations,) | 40%                     |
| Learning Activities (use of modeling software, web navigation, use of programs)  | 40%                     |
| Final draft of inquiry-based classroom application of molecular visualizations   | 10%                     |

## Tentative Agenda--Big Picture

- Explore TEKS, NSES
- Read/report/summarize research on misconceptions of particulate nature of matter, learning with mol-vis, and types of mol-vis.
- Explore existing mol-vis and begin to critique them via standards/research
- Explore use of mol-vis freeware and low-cost programs
- Choose mol-vis, develop activities for classes, and design professional development experience to tell other teachers
- Practice classroom activities with students
- Practice, Delivery and Reports of professional development sessions

## Tentative Activities:

Participants will investigate the areas in which students are most likely to hold misconceptions of chemical concepts. Participants will read literature that documents misconceptions that exist due to the lack of understanding of the particulate nature of matter. It also shows that students fail to connect the macroscopic (what happens in the lab), the particle level, the symbolic level (equations), and the mathematical level. Participants will investigate the effects of the use of visualization information technology on student learning. Including reading literature that shows that use of visualizations depicting chemical processes may help students understand on the conceptual level and that mental models must be developed on all levels, if students are to have more expert-like understanding.

Participants will identify Grade 7 – 12 curricula connections such as: **NSES Standards:** *Grades 9–12:* Science as Inquiry – abilities necessary to do scientific inquiry and understanding about scientific inquiry; Physical Science – structure of atoms, structure and properties of matter, chemical reactions. Unifying Concepts and Processes – systems, order, and organization; evidence, models, and explanation; constancy, change, and measurement; evolution and equilibrium; and form and function. The **Texas Essential Knowledge and Skills** for chemistry and integrated physics and chemistry will also be investigated.

Participants will look to literature, other projects, etc. for possible solutions involving

visualizations to overcome the identified misconceptions. Participants will investigate animations or other curricular material that exists already (especially as a result of nationally funded projects), propose information technology that might be developed, and hypothesize how materials could be used to achieve conceptual change to address the problem. Where possible pilot-testing of visualizations including pre and post-testing of student understanding of the concepts and their attitudes toward use of the materials may be collected for a few specific concepts.

Participants will design an effective professional development experience for teachers in order to prepare them to implement the use of the information technology in their classrooms and thus enhance student learning. These experiences promote the implementation of information technology in teaching and learning of the identified science concepts and processes. Objectives of the professional development experience include inquiry-based, learning cycle activities that involve visualizations, including both student and teacher materials. At the conclusion of the professional development experience, teachers should: (1) be able to verbalize the benefits of visualization technologies on the learning of content, (2) have the information needed to access or use visualizations, and (3) hopefully, should agree to implement the use of information technology in the classroom to address the areas of frequent misconceptions. After practice, participants will then be asked to deliver the professional development experience to other teachers.

### **Academic Dishonesty:**

Students are expected to be the sole source for any work submitted in their name. The utilization or submission of work of others is a violation of Texas A&M University scholastic dishonesty policies and disciplinary steps will be taken. Only **authorized** electronic or printed materials or equipment may be used in or near the classroom. As commonly defined, plagiarism consists of passing off as one's own the ideas, words, writings, etc., which belong to another. In accordance with this definition, you are committing plagiarism if you copy the work of another person and turn it in as your own, even if you should have the permission of that person. Plagiarism is one of the worst academic sins, for the plagiarist destroys the trust among colleagues without which research and knowledge cannot be safely communicated.

If you have questions regarding plagiarism, please consult the latest issue of the *Texas A&M University Student Rules*, under the section "Scholastic Dishonesty."

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