Workshop 4

Theory and Practice in Chemical Systems

Problem Solving: This program shows how a theoretical understanding of the driving force for chemical systems can lead to further development of new technologies and to the discovery of new phenomena in practice. In teaching, this is done through the creation of a close relationship between the science and mathematics of chemical processes, through problem-solving activities. These activities, which are based on a systematic interpretation of chemistry into mathematics, make the connection between theory and practice. These basic skills form the foundation for learning about chemical systems.

Learning Objectives

- To relate theory and practice in teaching chemistry
- To use problem-solving skills in order to teach about chemical systems

Pre-Workshop Preparation

1. Read the following: "Enhancing Problem Solving," by Dorothy Gabel, in *ChemSource,* version 2.1 (Orna, Mary Virginia, O.S.U.; Schreck, James O. & Heikkinen, Henry, eds.), vol. 1, PEDA, pp: 18–20, 1998 (in the Appendix of this guide). What are the ways by which problem solving enhances chemistry teaching? Describe the methods by which this process may be simplified. Bring examples from your own classroom.
2. Build a lesson plan for relating theory and practice in systems in chemical equilibrium. Demonstrate how you use problem-solving activities to enhance the understanding of related concepts.
3. Measurement is practice in chemical systems. Go to the Web site http://www.angelfire.com/oh/cmulliss/ or any other site which you receive using the key words: "significant figures." Explain when a figure is significant, the rules for rounding up numbers, and the difference between precision and accuracy in measurement. Give an example with numbers to illustrate.

Workshop Sessions (On-Site)

Getting Ready (30 minutes)

Discuss the role of problem solving in teaching chemistry concepts. Present the examples that you prepared at home about theory and practice in equilibrium systems. What are the main concepts about equilibrium that problem solving may aid in teaching? Bring examples from your classroom.

Watch the Workshop Video (60 minutes video/60 minutes discussion)

Focus

This workshop is about the relationship between theory and practice, both in advanced research and industry and in chemistry teaching by problem solving.

Unit 4.2. Chemical Systems in Everyday Life

Stop the video following the slide about water softening.

Ms. Baptiste uses this class laboratory as an introductory lab to attract students to chemistry. How does this lab present chemical systems to the students? At what point in the curriculum would you insert this laboratory? Would you add or change anything in the procedure?

Unit 4.3. Significance and Measurement

Stop the video following the slide about scaling the micro.

Discuss how you would explain the significance of a measurement. Relate to your homework assignment and to Dr. Clarke's activity. Explain the difference between theory and practice in the measurements that the students conduct. What would be a follow-up activity that can discern what explanation is the correct one?

Unit 4.4. Mixtures and Discrepant Events

Stop the video after Mr. Pratuch's activity about the activity series.

Compare students' involvement in inquiry between Mr. Sugimura's class and Mr. Pratuch's class. What would be a better way: videotaped demonstrations or class work in small groups? What are problem-solving skills which students use in both laboratories? Does it help them understand the new concepts?

Unit 4.6. Chemical Systems in Equilibrium

Stop the video after the end of Ms. Walsh's demonstration of equilibrium.

How does Ms. Walsh's demonstration present equilibrium as a chemical system? Can you think of a chemical demonstration about equilibrium that can be used instead to show the same principles and involve problem-solving skills?

Unit 4.7. Using Concrete Examples

Ms. Walsh invests a lot of time in finding ways to represent difficult chemical concepts. Discuss the representations that she uses. How can the connection to the mathematics, which describe the phenomena, be made?

Going Further (30 minutes)

Discuss how the use of everyday chemicals in class may aid in explaining about practice in chemical systems. Does it make it easier to explain about the theory behind the phenomena this way? What are main obstacles in teaching the mathematics of these phenomena? Suggest problem-solving activities that relate to these experiments/demonstrations.

Between Sessions (On Your Own)

Homework Assignments

1. Choose a chemical phenomenon that you are now teaching in your own classroom, and build an activity for relating theory and practice through problem solving for this phenomena. Define your goals in doing it, and write in your journal about the implementation of this activity in class. You may want to consult the Activities Guide of this or another workshop.
2. Go to the Quotes section in the Appendix and explain how the experts see the delicate balance between theory and practice today and in earlier times: Do theory and practice always match? What comes first? Give examples and explain how you would use them in class.
3. Go to http://www.chm.davidson.edu/ronutt/che115/EquKin/EquKin.htm about chemical equilibrium. Follow the instructions and summarize your conclusions in your notebook. Try other conditions and remark about them, too. How does this practice strengthen your understanding of the theory of the equilibrium process?

For additional information and activities about chemical equilibrium, go to the ChemSource Web site at http://intro.chem.okstate.edu/ChemSource/chemsource.html.

In particular, go to the Extensions section at http://intro.chem.okstate.edu/ChemSource/chemequil/er10.htm and use the Extensions activities in class [*ChemSource,* version 2.1 (Orna, Mary Virginia, O.S.U.; Schreck, James O. & Heikkinen, Henry, eds.), vol. 2, EQIL, p: 27, 1998].

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