# Workshop 5
# Chemical Design

**Facilitating Laboratory Learning:** This program deals with basic concepts that are required for the understanding of chemical design. The idea is brought about by experiences from everyday life, such as the stoichiometry of baking, the ingredients of soft drinks, the components of drugs, and the chromatography of markers. The tools of the chemical designer—the chemist—are found in the laboratory, and the procedure which leads to the development of new materials is based on scientific investigation. These tools are applied to chemistry teaching in the classroom and to the facilitation of laboratory learning.

## Learning Objectives

- To study about the importance of chemical design in future development
- To emphasize the use of scientific investigation skills to facilitate laboratory learning

## Pre-Workshop Preparation

1. Read the following: "Facilitating Laboratory Learning," by Dorothy Gabel, in *ChemSource,* version 2.1 (Orna, Mary Virginia, O.S.U.; Schreck, James O. & Heikkinen, Henry, eds.), vol. 1, PEDA, pp: 21–24, 1998 (in the Appendix of this guide).
2. Which methods can be used to facilitate laboratory learning? What can laboratory learning contribute to a deeper understanding of chemical and scientific principles by students? Support your answer with examples from your own classroom.
3. Read the Quotes section in the Appendix about chemical design. Demonstrate the role of the chemist as a molecular engineer, based on what you've read and on your everyday life experience. How would you use this in your own classroom?

# Workshop Sessions (On-Site)

## Getting Ready (30 minutes)

Carry out an open discussion about the importance of laboratory learning: What are the skills that laboratory periods develop most? What concepts would you rather teach in the laboratory? When would you teach the subject before the laboratory, and when otherwise? Bring as an example the principles of the lesson plan that you have prepared and stories from your own classroom.

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

### Focus

This workshop is about chemical design, its applications, and the way that scientific thinking leads to it. It also shows how scientific thinking leads to new designs in chemistry.

### Unit 5.2. Stoichiometry

*Stop the video after the slide about carbonated water.*

What would you do during the baking period in the stoichiometry lab (about half an hour)? Would you: Sum up the activity so far, introduce chemical processes of baking and some formal calculations, or do something completely different? What would you emphasize?

### Unit 5.3. What's in Things?

*Stop the video at the end of the Cherry Coke distillation laboratory.*

Discuss the value of the demonstration of carbonated limewater before the Cherry Coke distillation laboratory. How does the pre-laboratory discussion affect students' understanding of the subject matter? How can the laboratory be related to chemical design?

### Unit 5.5. Designing Molecules

*Stop the video following the slide about baking powder*.

Notice the students' reactions to the research topic and the variety of skills that they have to use in order to conduct their research. What has changed in their understanding during the work on their project? What are the difficulties and advantages in assessing their knowledge that way?

### Unit 5.6. Mixture Design and Separation

The activity results in many trials and observations, which are collected in class. Suggest a way to conduct the concluding discussion, such that most information would be collected from the students and the maximum number of observations discussed.

## Going Further (30 minutes)

Compare the ways that the laboratory is conducted in each of the segments. What principles does each laboratory emphasize, regarding variables such as types of laboratory exercises, timing in the curriculum, pre- and post-laboratory discussions, and development of investigation skills? Could you suggest any changes in the teaching procedures or address different issues?

# Between Sessions (On Your Own)

## Homework Assignments

1. Go to http://www.chm.davidson.edu/ChemistryApplets/stoichiometry/CH.html. Use it to practice the basics of stoichiometry. Answer the questions related to your work in the site. Discuss how you could use it in your own teaching.
2. Do you agree with Ms. Morine (The Stoichiometry of Cooking) in her assumption that beginning a subject "through an activity like this, rather than a worksheet with lots of math calculations" is the best way to start? In what ways does Ms. Morine connect the baking activity to chemistry? Do the students make the connection? Compare to the way you teach about stoichiometry. Consult also the Activities Guide in the Appendix for the teacher's guide.
3. Safety first: What are safety and other problems which may arise during the Cherry Coke distillation experiment? How would you make sure that you could prevent them? See the Activities Guide for further reference. What are the safety precautions that you take in your own laboratory teaching?
4. Search the Web for "self-healing materials." Explain into which topics you could integrate this subject in your classroom and how it could help you teach basic chemistry concepts.

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

In particular, go to the Extension 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, pp: 27, 1998].

# Notes