

Introduction:

This collection of discovery-based, or inquiry-based, exercises has been crafted for the purpose of giving students the opportunity to perform simple chemistry labs (30 – 60 minutes each) with minimal instructor assistance. In fact, the point of most of these is to get the student to think more deeply about the activity than they would in a highly prescriptive, guided environment. Many times, the learning experience is closely tied with the struggle to determine what to do with the information provided. However, you (the instructor) should be aware that many of these will be inherently frustrating for the student and should offer supportive encouragement as much as possible. To obtain the maximum usefulness to the student, you should refrain from giving too much help too early. This will require you to stay “tuned in” to individual students so you can intervene only when necessary to keep a student from “checking out” and giving up. Encourage them to think more deeply and apply what they know. Many students know more than they are willing to admit to themselves but they are afraid to take a leap of intuition. However, if you can encourage them to do so, the payoff is huge.

Purpose:

The Mini-Lab program is designed to encourage students to view the laboratory as a place to obtain data and, hopefully, generate answers to questions they may have. These activities should help them to see the value of collecting data and recording observations when they are attempting to discover something and determine the answer to a question that has either been posed to them, or that they have thought up themselves. Often, students are confronted with direct evidence that their concept of natural or scientific principles is flawed in some way. However, even then, they are often

reluctant to give up their preconceived notions. Since they interact with the natural world on a daily basis, students already have fairly firm mental models about how the world works. Sometimes these mental models are correct, but often they are not. Convincing students to change or replace their models is the supreme challenge of science teachers.

This manual is designed to provide you with the information necessary to help the students through trouble spots in the activities and to give you some ideas for post-activity discussions. Discussing the Mini-Lab afterward gives the students an opportunity to make some connections between what they have learned in the Mini-Lab activity and what they have learned in lecture or elsewhere.

Sources:

The activities themselves were gleaned from four sources: The USAFA Chemistry Department Demo Manual (2005), The USAFA Lab Procedures (*Chemtrails*), the Royal Chemistry Society's *Classic Chemistry Experiments* Booklet (http://www.chemsoc.org/networks/learnnet/classic_exp.htm), and the SCALE-UP chemistry website at North Carolina State University (<http://www.ncsu.edu/PER/scaleup.html>). The hard work that went into creating these demonstrations and experiments is greatly appreciated.

Acknowledgements:

Dr. Matt Morgan of Hamline University, contributed many hours to helping me improve these activities and editing the Instructor's Manual.

Also, special thanks to Dr.'s Barry Hicks and Rick Deans (USAF Academy Chemistry Department) for their

indispensable assistance, advice and encouragement in initial the creation of this program.

Each of these Mini-Labs started out as a fairly traditional experiment or demonstration. They were re-cast as “Mini-Labs” with three principles in mind:

- 1) Simplicity – a student should be able to complete the activity in its entirety in less than one hour -- including a brief wrap-up discussion.
- 2) Conservation – each activity strives to provide the minimum information necessary to complete the task. The activities are organized by subject matter, and one assumption is that the student has had at least a basic introduction to the subject. Similarly, the students should strive to use the minimum amount of resources necessary to complete the activity.
- 3) Connectivity – when possible, the Instructor Notes provide ideas to link the discoveries in the Mini-Labs with related subjects in General Chemistry, as well as other areas of science.