CHAPTER 6

Connecting Lab Experiences to the Real World

Most professional chemists think of chemistry as an amazing way to understand the world around them. It is not uncommon to hear them say "chemistry is everywhere," because all matter is made of chemicals. One goal of any chemistry course is to help students begin to see how knowledge of chemicals and chemical reactions can help them better understand the world around them. Creating a lab experience that is interesting and real to your students takes planning and knowledge of your students' interests. A topic we as teachers find interesting may not appeal at all to a student. A student survey at the beginning of the year, or simply observing and talking with them during the first week, can help identify areas of student interest. A student interested in cars may be interested in alloys, new fuels, engine efficiency. One into computers may get interested in materials used for video screens or computer memories. Another student may be interested in art and the components of different pigments in paintings, clays, and glazes in pottery. Some students might enjoy crime TV programs using forensic science. From the topics students are interested in, questions can be generated for labs using real-world issues.

REAL-WORLD CONNECTIONS TO INVESTIGATIVE LABS

Students are often curious about how what they are learning in school is connected to the world outside of school. Lab experiences need to have meaning and relevancy in order to truly engage students. Each of the labs in this manual lends itself to many possible explorations of related applications. The table below contains two such ideas for each lab. Teachers may want to suggest that students who are interested research one of these topics. The ideas in the table are not an exhaustive list, just examples for teachers and students to consider.

Lab	Connections to Content or Techniques Used
1. Spectroscopy: *What Is the Relationship Between the Concentration of a Solution and the Amount of Transmitted Light Through the Solution?*	• Measuring emissions from car exhaust • Determining if artwork is fake or real
2. Spectrophotometry: *How Can Color Be Used to Determine the Mass Percent of Copper in Brass?*	• Measuring blood alcohol levels in suspected drunk drivers • Determining concentration of lead in drinking water

Lab	Connections to Content or Techniques Used
3. Gravimetric Analysis: *What Makes Hard Water Hard?*	• Elemental analysis of ores (rocks) • Water softening methods
4. Titration: *How Much Acid Is in Fruit Juice and Soft Drinks?*	• Uses of citric acid • Soft drinks as rust removers
5. Chromatography: *Sticky Question: How Do You Separate Molecules That Are Attracted to One Another?*	• Testing urine for illegal drugs • Forensic analysis
6. Bonding in Solids: *What's in That Bottle?*	• Accidents caused by mislabeled chemicals at factories • Mislabeled prescription drug accidents
7. Stoichiometry: *Using the Principle That Each Substance Has Unique Properties to Purify a Mixture: An Experiment in Applying Green Chemistry to Purification*	• Presidential Green Chemistry Challenge • The National High School Journal of Science (peer-reviewed journal with many articles by high school students)
8. Redox Titration: *How Can We Determine the Actual Percentage of H_2O_2 in a Drugstore Bottle of Hydrogen Peroxide?*	• Measuring iron content of foods or drugs • Wastewater treatment with hydrogen peroxide
9. Physical and Chemical Changes: *Can the Individual Components of Quick Ache Relief Be Used to Resolve Consumer Complaints?*	• Health risks of expired drugs • Painkiller synthesis — how aspirin, Tylenol, Advil are manufactured
10. Kinetics: Rate of Reaction: *How Long Will That Marble Statue Last?*	• Rate of bacterial growth on food (food spoilage) • Effects of different pollutants on air quality and smog
11. Kinetics: Rate Laws: *What Is the Rate Law of the Fading of Crystal Violet Using Beer's Law?*	• Designing biodegradable containers and plastics • Predicting radioactivity levels and health risks of nuclear waste
12. Calorimetry: *The Hand Warmer Design Challenge: Where Does the Heat Come From?*	• The energy content (calories) in food • Comparing different types of biodiesel and alternative fuels
13. Equilibrium: *Can We Make the Colors of the Rainbow? An Application of Le Châtelier's Principle*	• The Haber process — applications in industry and manufacturing • Chlorination of wastewater
14. Acid-Base Titration: *How Do the Structure and the Initial Concentration of an Acid and a Base Influence the pH of the Resultant Solution During a Titration?*	• Swimming pool and aquarium maintenance • Acidosis/alkalosis in humans — causes and symptoms
15. Buffering Activity: *To What Extent Do Common Household Products Have Buffering Activity?*	• Enzymes and buffers in the stomach and small intestine • Buffered aspirin vs. unbuffered (regular) aspiring

Lab	Connections to Content or Techniques Used
16. Buffer Design: *The Preparation and Testing of an Effective Buffer: How Do Components Influence a Buffer's pH and Capacity?*	• Soil management for farming and gardening • Monitoring pollution and environmental effects in seawater

RESOURCES FOR REAL-WORLD CONNECTIONS

The following is a list of just a few resources that help give real-world contexts to chemistry.

- Carnegie Mellon and the Chem Collective:
  http://www.chemcollective.org/find.php
- *ChemMatters* (an ACS publication for high school students):
  http://portal.acs.org/portal/acs/corg/content?_nfpb=true&_pageLabel=PP_MULTICOLUMN_T2_66&node_id=1090&use_sec=false&sec_url_var=region1&__uuid=abfa5da8-58cc-4fce-91f3-d78c8c38167c
- Environmental Protection Agency (EPA):
  http://www.epa.gov
- Color in Art:
  http://www.webexhibits.org/pigments/intro/look.html
- American Chemistry Council:
  http://www.americanchemistry.com/news
- Science Daily:
  http://www.sciencedaily.com/news/matter_energy/chemistry/
- *Science Magazine*:
  http://www.sciencemag.org/
- Chemistry News at PhysOrg:
  http://phys.org/chemistry-news/
- *The New York Times* science pages:
  http://www.nytimes.com/pages/science/
- BBC News on science and the environment:
  http://www.bbc.co.uk/news/science_and_environment/