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APPENDIX A: STUDENT COMMENTS ON THE MOST IMPORTANT THING THEY LEARNED IN THE COURSE

In a general sense, what is the most important thing you learned in this laboratory course?

Category 1: Scientific Skepticism
Environmental Lab, N = 50; Regular Lab, N = 4

Lab section	Code	Comment
E	1	That interactions, no matter how small, affect the outcome and results of environmental problems.
E	1	There are no black and whites, especially with the pesticide issue. Also, I liked the speaker during the lead module very much. Though there are a lot of (nasty, it seems) politics involved, people with knowledge can still make a difference!
E	1	That tackling big problems requires small, focused increments of work and thought and that nothing, in that sense, is impossible. The glamour of the rhetoric is backed by a more tedious, but more important 'behind the stages' process. I'm glad I've been introduced to that.
E	1	Perceived and actual risk, the viability of different method of testing (epidemiological, Ames, etc.).
E	1	The most important concept was that problems do exist, they are becoming larger in our industrialized society and that more research needs to be done.
E	1	Greatly increased understanding of scientific method, considering all factors before making conclusions.
E	1	I learned that the things around us that we take for granted such as food, soil, and water aren't necessarily safe. I also learned a little bit about the work of a researcher.
E	1	Not to dye my hair, wash my fruit, and not eat paint chips. Also that there are a million ways to get a wrong result in a lab by a simple mistake and that computers aren't necessarily correct. Oh, I also learned how the structure of a molecule affects its solubility --I thought that was really interesting.
E	1	How important it is to understand the bigger picture. Environmental issues become even more complex when you suddenly see both sides of the picture and begin to understand what chemical processes are actually occurring.
E	1	There are a lot of environmental problems that can quantitatively be evaluated in order to understand the extent of the problem.
E	1	Uncertainty and difficulty of making clear conclusions and being positive on something.
E	1	It takes many tests to determine whether or not water, soil, hair dyes, or pesticides are hazardous (or safe). The process is more complicated than I thought.

ISSN 1430-4171
http://journals.springer-ny.com/chedr

S 1430-4171 (96) 04053-8

Lab section	Code	Comment
E	1	The limitations of scientific data collection. That the answers are sometimes hard to find. Science is real.
E	1	The difficulty of measuring and assessing risks of multiple related factors and confounding factors.
E	1	How scientists really get their results. What scientific work requires. How research is done. Gave a good view of what it is like to be a research scientist.
E	1	Not to jump to conclusions too quickly before carefully analyzing and testing what you have concluded.
E	1	Not to always trust computers, but when doing an experiment, use your own common sense when interpreting data.
E	1	You can rely on yourself to find out information. Do not depend on government!
E	1	That there are a lot of things associated with each other.
E	1	Look at all sides of issues. Different perspectives can lead to different conclusions.
E	1	How little we or the EPA can actually be sure.
E	1	To question, or at least to look closer at what I eat, drink, bathe in and how I live; its effects on the environment and my own health.
E	1	That not all research is done and proven to be fact; that there are a lot of possibilities for students in scientific fields. The most important aspect of this lab is that it made you think and qualify your data, not just regurgitate the fundamental principles you were studying.
E	1	Rarely are environmental problems easily solved. There are always a multitude of factors which need to be considered. Parties involved may all have legitimate interests.
E	1	The ability of scientists to experiment and find absolute results is actually pretty low. All data has to be interpreted by biased people, all machines screw up sometimes, etc., etc. Those studies they talk about in aspirin commercials probably don't mean much. In general, I have a much more cynical view of chemistry laboratory studies.
E	1	That there are a lot of things associated with each other.
E	1	That all results are relative, and rarely do you get simple "yes or no" answers for anything. A great deal of personal judgment is needed.
E	1	Hard for chemists and other scientists to come up with solutions to real life problems.
E	1	Government can't be trusted.
E	1	Things are not always so cut and dry. There may be problems, but nothing can be done about them. A great deal of people don't realize what a mess a lot of the world is in.
E	1	There is a large potential for error in scientific research.
E	1	To realize we're in such a dangerous, hazardous world.
E	1	To question causes and consequences, and to understand that there is generally more to the situation than the media presents, and that one cannot oversimplify the issues.
E	1	What we do really can be important. Not everything is by the book.

ISSN 1430-4171
http://journals.springer-ny.com/chedr
S 1430-4171 (96) 04053-8

Lab section	Code	Comment
E	1	There are problems that exist in everyday life that most people don't know about. We should be curious and always questioning.
E	1	I learned that it's very difficult to make sound decisions on everyday matters w/o at least a background knowledge of chemistry.
E	1	I always think of things that I'd love to know, such as what is on my food, why things are toxic . . . but it was mind boggling when I actually thought of how to find out the answers. Now I know it can be done. Also: Even the environmental section is an environmental hazard. I don't know if we should be using so much of what we did (acids, etc.)
E	1	Things aren't always what they seem and that all factors of the widest range need to be considered.
E	1	I learned that things aren't always what they appear to be.
E	1	Limits of science.
E	1	That things are not set in stone. The procedures change, the outcomes change, and that science has to be really precise.
E	1	Weighing out the data, i.e. pesticides are harmful, but how do we solve the problem reasonably for agribusiness and environmentalists? Or there's lead in the park, but does the data show it's dangerous enough to close the park?
E	1	I learned that it's hard to tell if something is really a risk.
E	1	Life is not always fair and that humans make lots of errors.
E	1	Many corporations and other groups are not treating the environment responsibly and may even be putting people at risk. Someone has to be around to check on them and make sure they are complying with environmental laws.
E	1	That scientific "meaning" is a product of technique and approach. Natural systems are complex and interactive.
R	1	That things are really found out and not just reported to me by someone else. I can figure things out and draw conclusions from doing stuff by myself.
R	1	Chemistry is not an exact science. A lot of it depends on probability and chance.
R	1	The meaning of , Science of change. All the changes that undergo in our process of living. I have a better understanding now about how complex life itself is.
R	1	Following directions and thinking about why these steps were performed

ISSN 1430-4171
http://journals.springer-ny.com/chedr
S 1430-4171 (96) 04053-8

Category 2: Connection of chemistry to the real world
Environmental Lab, N = 87; Regular Lab, N = 29

Lab section	Code	Comment
E	2	Chemistry is not something detached from our life.
E	2	The harmful effects human needs and desires wreak on not only the environment but our health as well.
E	2	How useful and applicable the machines in lab are.
E	2	Chemistry and the environment are very entangled subjects.
E	2	I learned that there are so many kinds of things that are dangerous to use and the environment, and in such little quantities too!
E	2	How chemistry concepts are applied to real world applications.
E	2	I learned that in dealing with environmental issues, it is very, very important to understand chemistry and its concepts. . . .
E	2	A sense of the amount to which the environment is affected by the things we do.
E	2	Fecal coliform is bad.
E	2	How lab experiments can actually relate to something affecting other people, and also how to write better lab reports.
E	2	The reasons for each module. More aware of the hazards involved with the modules.
E	2	A lab isn't 'isolated' from the world--it is an essential part of it."
E	2	Environmental issues
E	2	Factors influencing the safety of the environment.
E	2	That pesticides remain in the soil for long periods of time.
E	2	That the environment affects us all and that it needs to be taken care of. I also learned that it needs to be of high importance to everyone.
E	2	Chemistry that is learned in the classroom is directly related to the world we live in.
E	2	How chemistry applies to our daily lives. It really made me realize how interesting chemistry is outside of the textbook.
E	2	That chemistry pervades all aspects of life and having an exposure to the subject (Chemistry) will allow me to contribute to the resolution of environmental problems in the future.
E	2	The exposure to topics such as hazards in the environment that I really didn't think about before.
E	2	Chemistry explains many environmental problems and can be used to solve them.
E	2	Why we have lab. That the stuff we do is meaningful. It's more than just making us do things.
E	2	Applications of chemistry to our world. All my life, chem. has sort of been a laboratory class. This semester, we actually went out and took samples, and then did tests on them, which was neat. Chem. no longer remained a lab thing only. We actually applied the concepts to the real world. Neat-o.

ISSN 1430-4171
http://journals.springer-ny.com/chedr

S 1430-4171 (96) 04053-8

Lab section	Code	Comment
E	2	Actual dangers (from pesticides, metals, etc.) are for the most part much lower than the public generally believes.
E	2	I think I'm a lot more aware of some of the contaminants in the environments. I had never really thought about how water supplies are contaminated or lead in the soil. I am also more aware of how things are determined to be carcinogenic and what really is a risk.
E	2	Learned issues and environmental chemistry which I would otherwise have never known had I not taken this course.
E	2	Don't eat grapes because the pesticides won't wash off.
E	2	Spread sheet manipulation. Increased awareness for environment.
E	2	What a large role Chemistry plays in the environment. I usually thought about it as a biology thing solely.
E	2	That our world is in danger and we must become more environmentally aware.
E	2	I learned about the incredible effect that humans have on the environment, and how we basically hurt ourselves.
E	2	The importance of clean water.
E	2	It really helped me look at the issues from a different perspective, chemistry has never been something I've seen as practically applicable and this lab helped me see it as that.
E	2	How to isolate and identify contaminants from samples taken from my environment.
E	2	Learning the processes used to test for pesticides, carcinogens or contaminants in general was what was important to me.
E	2	Analyze data and do scientific guesses. I think that the application of science to the practical natural environment is a very interesting topic.
E	2	Chem. can be applied to something meaningful and interesting.
E	2	Chemistry is actually useful on an everyday basis. It isn't just an abstract phenomenon reserved for those in lab coats and goggles. Chemistry can actually be enjoyable (w/the right group of people organizing innovative techniques to bring Chemistry down to earth). All you have to do is study and do the HW problems to do well on the exams
E	2	Widespread environmental science issues
E	2	Why chemistry is important, and how chemistry can be used for actual experiments, to obtain data, and form conclusions about health and safety.
E	2	How to do dimensional analysis. A better sense of the role of contaminants and the existence of contaminants in the environment. A better understanding of what types of chemicals or elements may contaminate, e.g., that elemental Pb is not as dangerous as Pb^{+2}. A better idea of the health of the environment in a quantitative sense. The effects of pesticides and Pb on people and the environment and standard quality of water.
E	2	How dirty the environment is, i.e. fecal coliform found in water.
E	2	That chemistry is an important part of the environment, and that chemicals can cause great harm to the environment.
E	2	Pesticide.

ISSN 1430-4171
http://journals.springer-ny.com/chedr
S 1430-4171 (96) 04053-8

Lab section	Code	Comment
E	2	That chem. is everywhere and affects much of the activities that goes around in our world.
E	2	That chemistry is very necessary to understanding and solving environmental problems.
E	2	Many areas are not environmentally safe.
E	2	I learned that there are many environmental problems in our society. I learned to calculate ppm.
E	2	The extent to which our environment has been affected by man.
E	2	Report writing, environmental concerns.
E	2	I learned to be more aware and observant of my environment. I enjoyed learning about things that seemed applicable to everyday life.
E	2	Environmental problems must be solved beginning on a local scale.
E	2	I learned how to think about chemistry as an everyday part of life. I notice chem. around me and can think about it in a Chem. aspect.
E	2	There are some really scary things in the environment (contaminants) that I had never thought about before
E	2	I learned how to connect the principles we learn in the science course to my daily life, to current events. I also finally learned how to go about studying for a science course. I learned how to budget time, how to ask for help, how to focus on important things.
E	2	I became aware of the many contaminants present in the environment.
E	2	I learned that our environment is worse off than I thought. I learned I need desperately to improve my study habits.
E	2	Mindset change towards pesticides and toxins in general.
E	2	I have learned about the factors in the environment that affect us---it's not just a vague feeling; it is now backed by some knowledge.
E	2	That not everything that is "natural" is good, but that some non-natural things are very very bad. Chemistry relates to everything around us. Environmental chemistry is very pertinent to real life...it can be used to analyze daily problems, etc.
E	2	There are a lot more environmental problems than I thought.
E	2	There's a lot of things going on in our environment that I had no clue about before!
E	2	There are many hidden things existing on the microscopic level that I am not aware of (such as the potential lead poisonings in the soils of playgrounds).
E	2	How things relate in the environment.
E	2	How to apply science to real world problems in the environment, to define what a true risk is.
E	2	To be able to evaluate the overall situation after analyzing and calculating samples and data. I understand how all this fits into society and industry in more detail than I knew of before.
E	2	How to relate schoolbook work and understanding to an understanding of the real world.
E	2	That interactions, no matter how small, affect the outcome and results of environmental problems.

ISSN 1430-4171
http://journals.springer-ny.com/chedr
S 1430-4171 (96) 04053-8

Lab section	Code	Comment
E	2	Learned how to apply and make use of our knowledge about chemistry to common daily situations.
E	2	That there is plenty of testing to do!
E	2	I learned that chemistry plays a huge role in environmental issues, and chemistry is often at the core of environmental stresses on our society today.
E	2	I think just the overall view of the environment and science was good. It was good to be exposed to 'real' lab equipment such as the IC, GC, AAS, etc.
E	2	There is not as much to worry about as I expected. I was worried that Lake Anza would be a swamp full of deadly harmful levels of junk, that Lowell Park would be full of lead shot, that one exposure to a hairdye would kill you and that our food is loaded with pesticides. This wasn't the case, and now I understand the information better and can make better judgments. Hopefully, that's not too naive.
E	2	That the world around us is polluted. What we think is safe is not. I learned about inability to wash off pesticides.
E	2	Practical applications of chemistry, as they pertain to the environment.
E	2	Everything I learned in this laboratory course is important to me, especially in the Lead module.
E	2	I learned how to go about testing certain issue of environmental concern and I learned how certain things that we read in scientific journals were compiled.
E	2	It is important to watch what you put into the environment.
E	2	I learned about things that are important to my everyday life--what kinds of things are found in water, about pesticide content in fruits and vegetables. I feel I really have a firm grasp on what we were testing and analyzing and I understand the concepts really well.
E	2	I learned about possible environmental hazards, to become more aware of them from a scientific perspective and how laboratory experiments work to determine real things.
E	2	How to relate chemistry (abstract chemistry) to the world I live in.
E	2	Every little thing counts and takes a toll against the environment.
E	2	Application towards environment, not just experiments that don't pertain to much.
E	2	The chemical processes involved in environmental degradation. The importance of interpretation of data.
E	2	Learned about problems with water quality, how people's decisions affect their health, how some people are putting themselves at risk without knowing it.
E	2	To integrate lab with the real world.
E	2	About lead as a contaminant and sources of drinking water, what is bad for your health.
R	2	it connects lecture with --- abstract chemistry, application ----> reality
R	2	I learned to work together with my partners and also to interpret the result in a logical way as to apply it to our lives.
R	2	the application of course material in the "practical real-world" investigations, such as experiments 7 (chemistry of natural waters) and 4 (lead analysis)...etc.

ISSN 1430-4171
http://journals.springer-ny.com/chedr

S 1430-4171 (96) 04053-8

Lab section	Code	Comment
R	2	I learned to be very precise in my measurement because you need to be accurate. I also found out that the area around the Golden Gate Bridge is becoming very hazardous to human contact.
R	2	that chem affects everything!!
R	2	Chem is hard. It explained a lot of practical things that occur in nature and in life. that was interesting
R	2	that our experiments have practical applications (i.e. lead lab and salinity lab) which professionals in the field also use. I also felt that I learned that chemistry is prevalent in almost everything and it is more alive that I first thought.
R	2	I learned simple and practical experiments, which I can apply to normal everyday things around me. These experiments were fun and I can now stare my experiments and explain physical properties of those around me.
R	2	–technique and how class room chem applies to real life
R	2	Don't wear hair spray and then put your head by a bunsen burner. don't drink any of the lab water. 0.1 M HCL is not to be used to eye wash
R	2	I learned how to conduct experiments that related to everyday life. I was able to use lab equipment and perform tasks.
R	2	Laboratory skills and how to relate science to the real world
R	2	To apply ideas of chemistry to realistic situations in life.
R	2	About our environment and the importance of making sure it is safe for both us and wildlife, etc.
R	2	Salt intrusion was the most interesting. The most important would probably be that lab because it combined a lot of different things.
R	2	The ecosystem of the Bay-Delta is seriously threatened by a need for water in south
R	2	How the world around me is because of science and Chemistry
R	2	I learned that chemistry concepts and chemistry lab techniques have very important practical implications, especially in the 2 labs "Lead in our Environment" and "The Chemistry of Natural Waters"
R	2	learned to apply theory to real problems
R	2	I finally understand why pressure affects boiling point! And I finally understand why rock salts helps make ice cream freeze.
R	2	How important chemical processes are to everyday, unnoticeable events, i.e. acid-base rxns, water salinity which affects the environment, etc.
R	2	I learned a background, or introduction, to the ways and wherefores of the chemistry behind everyday life. That may sound artificial, but I honestly had "chemistry on the brain" where I wanted to know why everything happened the way it did on a chemical level. (ex. why do we put salt in t he water when we're boiling things, i.e. spaghetti)
R	2	I learned about the general concepts and their importance on our world.
R	2	That chemistry could be related to real life.

ISSN 1430-4171
http://journals.springer-ny.com/chedr

S 1430-4171 (96) 04053-8

Lab section	Code	Comment
R	2	How the concepts I learned from the book actually work. It helps me understand better when I test the concepts instead of just reading about them.
R	2	–how to use different materials and understanding the toxic dangers in our environment
R	2	–General lab techniques. I learned why my eggs take longer to cook in Denver rather than here
R	2	applications of Chemistry to real problems in society (i.e. Lead and salinity of Bay)
R	2	how to write lab reports; titration; chemistry and how it connects to real life situations

Category 3: Procedures, techniques, concepts
Environmental Lab, N = 64; Regular Lab, N = 152

Lab section	Code	Comment
E	3	What procedures are used in testing--how to obtain as valid results as possible--how to handle samples--everything, I feel has been important.
E	3	I understand now how vital it is to have duplicate/backup data. And to take careful and thorough notes!
E	3	Working in labs is hazardous! Female TA's and professors are much better than male. I need to take my old batteries to the hazardous waste disposal site. NOW!
E	3	How to work by myself and put data into a report.
E	3	Spending a great deal of time on each module enabled me to really understand the concepts.
E	3	How to use the instruments and what questions to ask when evaluating data.
E	3	How to write a scientific lab report.
E	3	The chemical processes involved in environmental degradation. The importance of interpretation of data.
E	3	The importance of being exact. How to analyze results.
E	3	That chemistry takes extreme precision.
E	3	The use of many experimental apparatus and what each was used for.
E	3	Understand the material thoroughly before starting!
E	3	Chemistry!
E	3	I learned how to use the computers that can test the samples for components. These machines are precise and used in the field of research today.
E	3	I learned that lab procedures, analysis, etc. are essential components of any scientific hands-on research career. It's not all fun field trips, it's hard work.
E	3	How to analyze samples for substances of interest.
E	3	Use of computer in manipulation of data.
E	3	Dilutions, working with lab equipment.

ISSN 1430-4171
http://journals.springer-ny.com/chedr
S 1430-4171 (96) 04053-8

Lab section	Code	Comment
E	3	I learned how different machines work and are used for analysis of samples. I am impressed that we could use technology that real chemists/scientists actually use. I am happy because I actually understand how the machines (GC, AA, etc.) work and how to interpret the data. I also learned a great deal about the effects of lead, pesticides, solubility of water. All of the modules have helped me to look at the environment in a different way.
E	3	The value of statistical analysis in environmental problems.
E	3	The building blocks of matter.
E	3	I learned to be careful when working with potentially harmful chemicals and not to dump them down the sink or with the regular trash.
E	3	The application of lecture.
E	3	Solubilities, proper lab procedures
E	3	I think from the Anza lab and Pesticide lab, I really learned a lot. How to research for topics supporting/disagreeing with my conclusions (not that I got to use too much of it) is definitely number 1 for me. Also as a consequence of learning where to look for info, I learned too much can be very counter-productive indeed!
E	3	Lab experience.
E	3	Safety.
E	3	To pay attention and be careful when working during exp. To remain focused.
E	3	The necessity for caution and precision and how easy things are when taken step-by-step.
E	3	Always acid wash equipment in order to get accurate results.
E	3	How to write a lab report. Excellent for future career opportunities
E	3	The use of the GC, SFE, and IC. The knowledge of how these machines work was useful not only in the lab but at my home. I now know how to do much of the basic analysis in most chemistry labs. The course was very updated with present technology (i.e. use of computers and GC graphs etc.)
E	3	What an environmental lab is and does.
E	3	That samples are very delicate and can easily be messed up.
E	3	How useful and applicable the machines in lab are.
E	3	The most important thing I learned in this class was the importance of keeping the equipment free of contaminants.
E	3	How to go about an experiment from start to finish.
E	3	More about scientific writing.
E	3	There is an endless list of contaminants that can be studied.
E	3	Working with lab materials. Working in groups. Being very accurate.
E	3	Lab work takes patience and the desire to retrieve precise measurements. Also it takes great responsibility and good writing skills for the writeups.

ISSN 1430-4171
http://journals.springer-ny.com/chedr
S 1430-4171 (96) 04053-8

Lab section	Code	Comment
E	3	How to carry out lab procedures, how chemicals react in different conditions and how they get into the body, how to analyze substances for the presence of different methods (GC, AAS, etc.)
E	3	How to work in a lab and how much is expected in these courses.
E	3	Analyzing data and interpreting.
E	3	The process of collecting, analyzing, and interpreting chemistry-related material to answer a hypothesis. The lab reports were a good experience and really helped my grasp of the procedure and the chemistry concepts.
E	3	How to write an accurate, thorough scientific report.
E	3	Solubility.
E	3	How to perform a scientific project on my own.
E	3	How to analyze data and make sense of lots of numbers and recognize trends in the data.
E	3	The function of items/equipment.
E	3	I learned about using scientific methods in designing and carrying out a project and then how to analyze the results.
E	3	Safety first! Acid wash everything, and be careful w/your fingers. It's very effective in learning concepts.
E	3	The different ways of testing the contents of substances.
E	3	I really thought that being able to work with all the different instruments before organic chem. will be beneficial
E	3	Meet deadlines, learned lots about chem. machines
E	3	Just preparing to analyze is the biggest part of the work.
E	3	How to work quickly and efficiently in labs.
E	3	The exposure to the different kinds of instruments.
E	3	How the equipment works. How environmental chemists work. The chemistry of environmental issues.
E	3	Use of equipment. An understanding of what is possible, what isn't. Thank goodness there was no error analysis!!!
E	3	How to use the machines.
E	3	Be concise and make sure the containers used are clean.
E	3	I felt the field work was the most important.
R	3	Nothing specific, overall nature of reactions and answered a lot of my "why" questions.
R	3	How to conduct labs, additional info that added to lecture info.
R	3	learning to analyze trends, discrepancies in the trends, and details.
R	3	The most important thing I learned is how to write a lab report and/or lab paper. These will be good skills to have if/when I go to medschool.
R	3	Experimental techniques

ISSN 1430-4171
http://journals.springer-ny.com/chedr
S 1430-4171 (96) 04053-8

Lab section	Code	Comment
R	3	How to study for sciences and how to conduct a lab. This is what I want to do (work in a test kitchen) for the rest of my life so I need to know this!
R	3	PRACTICAL EXPERIENCE
R	3	HOW TO CALCULATE AND ANALYZE DATA
R	3	The importance of knowing concepts, the importance of being earnest. And that liquid nitrogen hurts if you drink it.
R	3	Phase diagrams–seriously
R	3	I mostly learned how to relate actual experiments w/ things in the textbk.
R	3	–Quantum Mechanics, –chemical equilibrium
R	3	Wear goggles. Experimental errors are easily made due to poor lab-technique
R	3	just concepts of safety and how to operate all the equipment was helpful.
R	3	Quantum Mechanics
R	3	The details of molecular orbitals and the laws
R	3	I think lab skills in general and the value of being prepared for labs.
R	3	good, precise laboratory technique and experiment design. It was neat to a physical law actually demonstrate itself.
R	3	How to apply what we learn in lecture to lab and experiments
R	3	How to be careful when handling hazardous junk
R	3	It was important applying the concepts I learned. It made it easier to remember the concepts after actually working out an experiment about what I learned.
R	3	I think the Boiling Pt. Depression and basically the whole colligative property and phase change section was important
R	3	How hard it is to conduct lab experiments. Gained an appreciation for lab technique and the difficulty in being accurate.
R	3	In general, lab techniques learned will be beneficial towards the performance of other lab in the future.
R	3	Quantum mechanics, indeterminary principle.
R	3	The way to do some science research
R	3	Good lab technique prevents extended explanations of what could go wrong in the experiments.
R	3	Basic concepts and how it deals with the lab
R	3	techniques
R	3	to be careful with unknown substances
R	3	I learned how to write-up a lab. I learned how to work well with others and I have a broader sense of the course and what I have to learn.
R	3	safety
R	3	I learned applications of theories. eg. Applications of Hess' Law

ISSN 1430-4171
http://journals.springer-ny.com/chedr
S 1430-4171 (96) 04053-8

Lab section	Code	Comment
R	3	how to apply the lecture material into a hands-on experience
R	3	The idea that you can prove the laws
R	3	How to do labs
R	3	Concepts!! Not much lab skills.
R	3	to be careful making measurements
R	3	Lab somewhat reinforced the concepts of lecture
R	3	Learn to use those equipments. Interesting lab -- understand more about lecture know how to performance lab
R	3	The concepts and lab techniques of chemistry
R	3	Be careful of what's being handled
R	3	acid-base rxns
R	3	I learned how to apply equations that discussed in class
R	3	Importance to details of procedure
R	3	Lab safety
R	3	How to work with lab equipment
R	3	I learned to better my test taking ability and learned how to study for conceptual tasks. I learned to think about problems logically and visually. Also, I learned so much Chemistry then I ever learned. Actually, in high my teacher gave us study guide with the test answers on it, so I just memorized it for the test. So, I didn't' learn anything that year. This year was tough because I had to learn everything for the first time. I think I learned a lot this semester.
R	3	NRC, chemicals are recycled, never did it in high school
R	3	Efficiency, accuracy are keys to lab experience.
R	3	Time efficiency and accuracy–doing the labs quickly, but with accuracy and precision.
R	3	general stoicheometry
R	3	To understand the lectures by doing experiments.
R	3	General lab skills
R	3	I learned how many different laboratory procedures can be used to obtain unknown information.
R	3	Writing lab reports/ scientific papers
R	3	I learned you must be very alert during labs
R	3	Spectroscopy
R	3	How to go about conducting a hands-on "hard" science experiment (I'm more experienced in the social sciences and techniques are a little different)
R	3	I learned concepts behind the way calculations worked. I went through high school never reading the Chem book, never bothering to understand what I was calculating. Here I now know the reason for doing things.
R	3	use w/ chemical equip

ISSN 1430-4171
http://journals.springer-ny.com/chedr
S 1430-4171 (96) 04053-8

Lab section	Code	Comment
R	3	Even though accuracy and repeating experiments was stressed to some degree in high school, it was not until this Chem 1A lab course that I actually realized how important accurate results are.
R	3	more detailed explanations of concepts--laboratory
R	3	most important: the knowledge of being able to conduct my own experiments in lab
R	3	Make sure you always wear goggles inside a lab.
R	3	Particle in the Box and know a little more specific about Chem than in High School
R	3	Greater understanding of quantitative science
R	3	General lab work.
R	3	–Preciseness and accuracy is necessary in getting good results
R	3	I learned how to write better lab reports, and what information is important in a lab.
R	3	techniques
R	3	safety first, avoid the worse, always clean, don't be mean; I had a cool TA, nothing else to say
R	3	lab techniques
R	3	Careful attention to the detailed things.
R	3	to follow directions precisely and remember the errors that are constantly happening.
R	3	I learned to use the equipment without being afraid to break them.
R	3	always wear goggles
R	3	I gained an intro to doing labs
R	3	I learn to interpret data table or information in my own words.
R	3	How to prepare for chem lectures
R	3	using equations
R	3	How careful you have to be in order to not get bad results
R	3	How to copy down data into my lab notebook efficiently so I could better use it later.
R	3	How to approach a lab in an orderly fashion.
R	3	How to take careful notes during the process of the procedures.
R	3	the resin bed stuff. Also I learned about general chemicals and how to determine compounds in unknowns.
R	3	how to use the graphing functions/programs on my computer
R	3	how to interpret data
R	3	how to operate equipment. Basic laboratory skills--helped to become more familiar w/ lab equipment and procedures
R	3	solid basic concepts in chemistry. Working with others in lab groups
R	3	I learned how to analyze data and do research paper on the designed topics
R	3	read procedures well. make careful measurements

ISSN 1430-4171
http://journals.springer-ny.com/chedr
S 1430-4171 (96) 04053-8

Lab section	Code	Comment
R	3	the importance of atomic structure in chemical reactions
R	3	Be careful, if you make a small mistake, you'll have to start over.
R	3	1) Read all materials (including relevant chapters and lab manual) before you walk into lab. Be prepared. 2) Get some sleep the night before
R	3	Applications of Scientific procedures. Analysis of data to corroborate or contradict hypotheses.
R	3	Safety, precision and accuracy, presentation of results
R	3	To wear your goggles and to always accurately measure chemicals and to repeat experiments a couple of times in order to get the most accurate answer.
R	3	New aspects: phase diagram P vs. D
R	3	–How to use the equipment to make precise measurements and calculations
R	3	technique; understanding what the prof talks about
R	3	Cleaness, safety, organization is very important.
R	3	That I don't like 12M HCl
R	3	–be accurate and precise
R	3	–always wear safety glasses, be very precise and accurate, follow lab manual closely
R	3	To read lab before coming to class
R	3	How to combine scientific data with writing.
R	3	Interaction of Chemicals (Acid, Base) and how electrons and molecule react to each other
R	3	Generalities about certain solutions and lab basics
R	3	How not to get myself killed on hot burners.
R	3	Safety before all else. Be prepared and use the right equipment needed to perform your experiment safely and accurately.
R	3	Quantum Mechanics
R	3	to be accurate
R	3	how to mix stuff. The last lab, although long and difficult, was educational and interesting.
R	3	How to carry out an experiment in organization not to be prepared.
R	3	How to work in a lab. What the procedure is when doing a lab.
R	3	Work slowly and carefully to get the best results
R	3	–Experience with laboratory environment and techniques.
R	3	It is very hard. Gave me a general feeling of what future science courses will be like. I also learned how to work with other people. Most important be very careful when handling an acid.
R	3	new techniques and skills
R	3	learned about nature and how chemicals and molecules interact.

ISSN 1430-4171
http://journals.springer-ny.com/chedr
S 1430-4171 (96) 04053-8

Lab section	Code	Comment
R	3	Follow directions exactly and very slowly
R	3	Hess's law
R	3	–how to write scientific paper, –grays work
R	3	How that you must pay attention in order to get the right answers.
R	3	To go to lab well-prepared and knowing what the lab involved
R	3	following procedures and learning how to measure things as accurate as possible.
R	3	lab write ups
R	3	How to write a lab paper and do lab write ups.
R	3	I met people which was fun. I learned to be very careful when dealing with acids.
R	3	Safety
R	3	The salinity experiment, the last one that we did
R	3	To be prepared for labs
R	3	accuracy is important
R	3	use of different techniques to determine certain properties of chemicals. become familiar with the lab, which will be useful for Chem 3A and so forth.
R	3	The safety procedures and disposal rules
R	3	The basic concepts of chemistry which could be built upon in other chemistry courses and enough to help other courses
R	3	I learned how to estimate to see if my numbers were reasonable in a question
R	3	Familiarity w/ lab techniques
R	3	The techniques of titration, safety guidelines, and skills of writing reports.
R	3	Safety requirements and general titration and problem solving techniques.
R	3	titrations
R	3	titration
R	3	Titration
R	3	working with other students. I believe titration was the most important thing I learned in lab.
R	3	titration
R	3	titration
R	3	How to titrate
R	3	Techniques such as titrations, preparing for Lab reports.
R	3	how to do titration
R	3	Titration!
R	3	General laboratory skills such as the handling of laboratory equipment. Didn't know how to titrate or resin exchange before.

ISSN 1430-4171
http://journals.springer-ny.com/chedr
S 1430-4171 (96) 04053-8

Category 4: Other Positive Comments
Environmental Lab, N = 14; Regular Lab, N = 45

Lab section	Code	Comment
E	4	That we are all environmental chemists now, capable of researching relevant topics.
E	4	Don't wait until the last minute to do lab reports.
E	4	That research, especially field work, is what I want to do.
E	4	Go to the Golden Bear Center if you have learning/testing disability.
E	4	Not procrastinating.
E	4	That chemistry can be personable and it's not just people in labs in white coats.
E	4	Maybe I'll minor in Envi. Science.
E	4	How to be effective and efficient in lab.
E	4	Chemistry!
E	4	Being outside is better than being in a laboratory
E	4	The application of lecture.
E	4	It was just generally good and served to depart from the standard high school lab, while the regular lab sections seemed to still be doing the high school stuff.
E	4	Be organized.
E	4	I came into this class VERY VERY cynical. But. . . I can verify . . ."And remember the word, the BIGGEST word of all: LOOK. Everything you need to know is out there, somewhere. . ." Robert Fulghum All I needed to know I learned in kindergarten.
R	4	to work with others in gathering data-performing the experiment-it makes lab go a lot faster. Lab is actually one of the highlights of chemistry.
R	4	Patience
R	4	Organization
R	4	I'm not sure because I have taken chem before and we practiced the same techniques.
R	4	well
R	4	I learned that science can be both fun and challenging
R	4	To not procrastinate when doing labs
R	4	Tolerance, persistence, and efficiency
R	4	That chemistry isn't really as difficult as the professors try to make it seem.
R	4	chem is easy.
R	4	Cooperation with other students, group work; trial and error.
R	4	Interacting with my group members.
R	4	Do the work early; don't procrastinate
R	4	Sometimes it was fun, sometimes a pain
R	4	The ability to get to know your Lab TA and classmates. To help each other out instead of being competitive like it will be in Ochem.

ISSN 1430-4171
http://journals.springer-ny.com/chedr

S 1430-4171 (96) 04053-8

Lab section	Code	Comment
R	4	The most important thing I learned is that chemistry is actually interesting. High school discouraged me into taking any chem class, until I took the course to Pre-med req. I learned how to connect concepts, learned my lectures and apply it to lab work.
R	4	how to work independently under stress for a relatively short time period.
R	4	I thought Chemistry would be really hard, coming in knowing that most people already took AP chem in high school and were ahead. I learned that sciences aren't that hard and not to let it intimidate me. Just as long as I consistently worked at it, everything would turn out all right.
R	4	The most important thing that I learned in Chemistry 1A lab course is something about people, in general. I learned the importance of cooperation, understanding and tolerance for other people. Laboratory techniques did not teach me this but instead working with other people. I think this realization will greatly help me in the future, if I work towards better understanding of other people.
R	4	Working together is really important, as well as trusting people you work with. Also, if you like the people you work with, everything seems to get done a lot faster. And the TA is a very important factor in the whole lab experience. My TA was great, so I liked lab.
R	4	Time management
R	4	to learn how to follow directions!!!
R	4	Do homework!! It's the only way to learn chemistry
R	4	Chemistry is hard and requires a lot of time and commitment. The most important thing I learned : better study habits.
R	4	How to study and learn on my own
R	4	I learned diligence is a must before undertaking this course. If you don't have it, you will get it.
R	4	To trust my intuitions when following instructions without worrying about making so many mistakes.
R	4	Chemistry is lots of hard work, yet labs can be entertaining and interesting
R	4	How not to procrastinate.
R	4	I've learned to use my time better to get all the work done.
R	4	I guess I learned how hard to work just to keep up, in other words, work ethics.
R	4	being efficient
R	4	A more in-depth review of chemistry than in high school.
R	4	I learned quite a lot more than what I have expected. All in all, I enjoyed this laboratory course
R	4	Prepares for Exams
R	4	–teamwork
R	4	To work with others (i.e. get outside and help from study groups and friends) to get help for this class because I didn't get any sort of help in understanding from my lab ta or my discussion ta.

ISSN 1430-4171
http://journals.springer-ny.com/chedr
S 1430-4171 (96) 04053-8

Lab section	Code	Comment
R	4	How to organize my time and really take time to concentrate and learn a subject.
R	4	How to pace myself
R	4	time management
R	4	What kind of discipline it takes to succeed here, and the necessity of keeping on top of things.
R	4	following directions carefully
R	4	I learned to keep up and to self-motivate myself. I learned the importance of good study habits and paying attention in class.
R	4	Not procrastinating
R	4	many

Category 5: Negative Comments
Environmental Lab, N = 7; Regular Lab, N = 35

Lab section	Code	Comment
E	5	I should have taken calculus and physics first.
E	5	I learned that patience and determination go a long way. The first day at check in, my lab locker was pretty much barren and it had none of the things it should have had. I asked my TA and he said wait and I learned that the Berkeley Bureaucracy can stretch even into the labs. Finally, I received my equipment one and half hours later. I decided at that point to not give up or give in to the rigors of bureaucracy.
E	5	That a lot of people are ignorant and really don't want to hear about environmental concerns.
E	5	That I never want to take chem. ever again.
E	5	Pairing up and working with 'strangers' can sometimes be very difficult. I felt ashamed to ask my TA (Heather) for help sometimes because I wasn't doing so well. In such a challenging course, one can't help but to feel intimidated.
E	5	To be perfectly honest, very little. I've had a great deal of lab experience in the past, and I sort of knew what this would be like.
E	5	That I don't want to take, can't take Chem. 3A (organic). Also. . . even if you like a class, a subject, etc., it can still drive you crazy.
R	5	That I don't want to take anymore lab science classes.
R	5	That there are certain experiences you just have to endure.
R	5	Nothing
R	5	Learning to depend on oneself only. Don't ask your lab partner, they are mean. Different TAs have totally different answers for most lab question.
R	5	Uh can't think of one yet
R	5	Absolutely nothing.

ISSN 1430-4171
http://journals.springer-ny.com/chedr

S 1430-4171 (96) 04053-8

Lab section	Code	Comment
R	5	nothing... there is nothing that can't be learned by just someone telling you.
R	5	I learned that I should change my major to CS because I have a strong dis-interest in natural science.
R	5	Because my high school chemistry class was excellent, I did not learn much in the chemistry 1A lab course that I hadn't learned in high school.
R	5	Uh I am not smart.
R	5	Nothing to really help me in the future. Perhaps safety.
R	5	It sucked.
R	5	I learned shit.
R	5	Not to take anymore hardcore science courses
R	5	It seems like I didn't learn anything new in lab besides what I learned already in high school.
R	5	That chem 1A is very poorly designed. Not a supportive environment. It's a weeder course with no intent of hiding this fact. Undergrads are shown that they do not count.
R	5	Honestly nothing comes to mind. I did not learn or grasp any concepts out from this lab.
R	5	Nothing, it is a waste of time and it tries my patience. I really don't care much for it. The labs are stupid because you have a general idea of what the results might be like already.
R	5	I learned that this course is poorly designed. It's only intent is to weed out students, making things more difficult than they should be.
R	5	You're not really reading this right now, are you? If so, I really feel for you. It must be the most thankless job. No good suggestions on these sheets, anyway. Besides, if there were any good ideas, nothing would anything change anyway. One thing I've learned is that habit is ruling society, nothing else. That is what I've learned from lab.
R	5	It's a lot of work. Time consuming.
R	5	I learned how to cram a 20-page lab report in 6 hours. I also learned that my lab session is a waste of my time because lab ta sucks.
R	5	That it's a lot of work.
R	5	That sciences are a lot of hard work and effort, and that they require a lot of work.
R	5	It's tedious and long
R	5	Nothing particular comes to mind.
R	5	Nothing
R	5	Chemistry is not for me.
R	5	That old piece of crap cost me $40. Trash sometimes is expensive they can make gold out of stone. we pay for it, but don't get the keep it.
R	5	Nothing.
R	5	1) The crazy and extreme limits of stress. 2) That working hard in this class (studying, trying best) doesn't pay off (seems to be "weeding out" course" 3) That I don't know much about chemistry.

ISSN 1430-4171
http://journals.springer-ny.com/chedr
S 1430-4171 (96) 04053-8

Lab section	Code	Comment
R	5	None
R	5	Not very much
R	5	Honestly, that there are many people in science-oriented majors who are ruthlessly unhelpful and in general completely self-occupied with grades. *it's sad, but true.

Category 6: No Answer
Environmental Lab, N = 35; Regular Lab, N = 49