



PROGRAM REVIEW – CURRICULUM REVIEW
2015-16

Chemistry

Courses with CID Designation

Course Name	CID #	CID Name	COR Effective Term
CHEM G130	CHEM 101	Introduction to Chemistry	F2013
CHEM G180	CHEM 110	General Chemistry for Science Majors I, with Lab	F2011
CHEM G180 + CHEM G185	CHEM 120S	General Chemistry for Science Majors Sequence A	F2013
CHEM G220	CHEM 150	Organic Chemistry for Science Majors I, with Lab	F2013
CHEM G220 + CHEM G225	CHEM 160S	Organic Chemistry for Science Majors Sequence A	F2011

Dual Listed Courses

Course Name	Dual Listed
N/A	

List of Active Courses offered or not offered in the last 3 years

Course ID	2012-2013			2013-2014			2014-2015		
	Summer	Fall	Spring	Summer	Fall	Spring	Summer	Fall	Spring
CHEM G110		X	X		X	X		X	X
CHEM G130		X	X		X	X	X	X	X
CHEM G180	X	X	X	X	X	X	X	X	X
CHEM G185		X	X	X	X	X	X	X	X
CHEM G220		X	X		X	X		X	X
CHEM G225		X	X		X	X		X	X



PROGRAM REVIEW – SLO ASSESSMENTS 2015-16

Chemistry

*Assessment status reflects assessments between Fall 2013 through Summer 2015

Assessment status for courses with active cSLOs

Course Name	# of cSLOs	# of cSLOs Assessed	Status
CHEM G110	5	1	↔
CHEM G110L	5	1	↔
CHEM G130	5	2	↔
CHEM G130L	5	2	↔
CHEM G180	8	1	↔
CHEM G180L	8	1	↔
CHEM G185	5	3	↔
CHEM G185L	5	3	↔
CHEM G220	5	2	↔
CHEM G220L	5	2	↔
CHEM G225	5	1	↔
CHEM G225L	5	1	↔

↑ Fully assessed
↔ Partially assessed
↓ No assessment

Courses with cSLOs that still need to be assessed

Course Name	cSLO #	cSLO
CHEM G110	cSLO 1	Demonstrate the mathematical knowledge to understand the meaning of a balanced chemical equation and to solve chemical problems involving equations, units, solution concentrations, buffers, equilibrium and the gas laws.
CHEM G110	cSLO 2	Explain the fundamental laws, principles, and theories that regulate chemical processes.
CHEM G110	cSLO 4	Evaluate some of the many ways that humans interact with the environment.
CHEM G110	cSLO 5	Relate chemistry lecture materials to the laboratory activities to demonstrate an understanding of the connection between the two.
CHEM G110L	cSLO 1	Demonstrate the mathematical knowledge to understand the meaning of a balanced chemical equation and to solve chemical problems involving equations, units, solution concentrations, buffers, equilibrium and the gas laws.
CHEM G110L	cSLO 2	Explain the fundamental laws, principles, and theories that regulate chemical processes.
CHEM G110L	cSLO 4	Evaluate some of the many ways that humans interact with the environment.
CHEM G110L	cSLO 5	Relate chemistry lecture materials to the laboratory activities to demonstrate an understanding of the connection between the two.
CHEM G130	cSLO 2	Explain the principles of basic atomic structure, chemical periodicity, the mole, chemical equations, stoichiometry, molecular geometry, solutions, elementary acid/base concepts, and gas laws.
CHEM G130	cSLO 3	Use the language, symbols, and nomenclature of inorganic chemistry correctly.
CHEM G130	cSLO 5	Relate chemistry lecture materials to the laboratory activities to demonstrate an understanding of the connection between the two.
CHEM G130L	cSLO 2	Explain the principles of basic atomic structure, chemical periodicity, the mole, chemical equations, stoichiometry, molecular geometry, solutions, elementary acid/base concepts, and gas laws.
CHEM G130L	cSLO 3	Use the language, symbols, and nomenclature of inorganic chemistry correctly.
CHEM G130L	cSLO 5	Relate chemistry lecture materials to the laboratory activities to demonstrate an understanding of the connection between the two.
CHEM G180	cSLO 1	Explain the historical development and the current role of chemistry in society.
CHEM G180	cSLO 2	Recall the causes of chemical reactions and the changes that occur in the participating species.
CHEM G180	cSLO 4	Evaluate experimental results in terms of pertinent chemical theories.
CHEM G180	cSLO 5	Relate atomic and molecular structure to chemical and physical properties.
CHEM G180	cSLO 6	Compare the uses and limitations of models for explaining chemical and physical phenomena.
CHEM G180	cSLO 7	Identify and apply the laws of conservation of matter, energy, and electrical charge on which chemistry is based
CHEM G180	cSLO 8	Describe the common states of matter.
CHEM G180L	cSLO 1	Explain the historical development and the current role of chemistry in society.
CHEM G180L	cSLO 2	Recall the causes of chemical reactions and the changes that occur in the participating species.

Courses with cSLOs that still need to be assessed

Course Name	cSLO #	cSLO
CHEM G180L	cSLO 4	Evaluate experimental results in terms of pertinent chemical theories.
CHEM G180L	cSLO 5	Relate atomic and molecular structure to chemical and physical properties.
CHEM G180L	cSLO 6	Compare the uses and limitations of models for explaining chemical and physical phenomena.
CHEM G180L	cSLO 7	Identify and apply the laws of conservation of matter, energy, and electrical charge on which chemistry is based
CHEM G180L	cSLO 8	Describe the common states of matter.
CHEM G185	cSLO 1	Explain the mechanisms and rate laws of elementary reactions, the differences and similarities in the various types of chemical equilibria, and nuclear reactions and energetics.
CHEM G185	cSLO 3	Solve for quantitative aspects of equilibrium (for gas-phase reactions, solution chemistry, and acid base reactions).
CHEM G185L	cSLO 1	Explain the mechanisms and rate laws of elementary reactions, the differences and similarities in the various types of chemical equilibria, and nuclear reactions and energetics.
CHEM G185L	cSLO 3	Solve for quantitative aspects of equilibrium (for gas-phase reactions, solution chemistry, and acid base reactions).
CHEM G220	cSLO 1	Use correct names for organic molecules containing alkyl, cycloalkyl, alkene, alkyne, alcohol, ether, halide and amine groups; draw the structures of such compounds from the names; draw three-dimensional structures of organic compounds; determine hybridization, geometry, orbitals, and stereochemistry; and analyze stability of different conformations of alkanes and cycloalkanes.
CHEM G220	cSLO 3	Evaluate reactive sites within a molecule by locating them and drawing correct electron-pushing arrows for reactions based on electronic properties and structure instead of rote memorization of mechanisms
CHEM G220	cSLO 4	Conduct a retrosynthetic analysis of a given compound and outline the forward steps and reagents that are required using reactions learned in this semester.
CHEM G220L	cSLO 1	Use correct names for organic molecules containing alkyl, cycloalkyl, alkene, alkyne, alcohol, ether, halide and amine groups; draw the structures of such compounds from the names; draw three-dimensional structures of organic compounds; determine hybridization, geometry, orbitals, and stereochemistry; and analyze stability of different conformations of alkanes and cycloalkanes.
CHEM G220L	cSLO 3	Evaluate reactive sites within a molecule by locating them and drawing correct electron-pushing arrows for reactions based on electronic properties and structure instead of rote memorization of mechanisms
CHEM G220L	cSLO 4	Conduct a retrosynthetic analysis of a given compound and outline the forward steps and reagents that are required using reactions learned in this semester.
CHEM G225	cSLO 1	Use the correct names for organic molecules containing aromatic or carbonyl groups or draw the structure of such compounds from the name.
CHEM G225	cSLO 3	Evaluate reactive sites within a molecule by locating them and drawing correct electron-pushing arrows for reactions based on electronic properties and structure instead of rote memorization of mechanisms.
CHEM G225	cSLO 4	Conduct a retrosynthetic analysis of a given compound and outline the forward steps and reagents that are required using reactions learned in this semester.
CHEM G225	cSLO 5	Carry out laboratory procedures such as devising and implementing a procedure to separate and identify and unknown mixture, performing a multistep synthesis, obtaining a purified product in reasonable yield and analyzing spectra to determine the structure of a molecule.
CHEM G225L	cSLO 1	Use the correct names for organic molecules containing aromatic or carbonyl groups or draw the structure of such compounds from the name.
CHEM G225L	cSLO 3	Evaluate reactive sites within a molecule by locating them and drawing correct electron-pushing arrows for reactions based on electronic properties and structure instead of rote memorization of mechanisms.
CHEM G225L	cSLO 4	Conduct a retrosynthetic analysis of a given compound and outline the forward steps and reagents that are required using reactions learned in this semester.
CHEM G225L	cSLO 5	Carry out laboratory procedures such as devising and implementing a procedure to separate and identify and unknown mixture, performing a multistep synthesis, obtaining a purified product in reasonable yield and analyzing spectra to determine the structure of a molecule.

Courses Assessed and their Action Plans

Course Name	cSLO #	Semester Assessed	Action Plans
CHEM G110	cSLO 3	2013 - 2014 (Fall 2013)	It was clear that the students were able to apply knowledge learned throughout the semester to basic physiologic/metabolic processes of the human body. Based on direct student feedback, Unit 12 seemed to be the point in which many of the students started to appreciate all of the previous organic chemistry contents they were learning in the previous 5 units. It may

Courses Assessed and their Action Plans

Course Name	cSLO #	Semester Assessed	Action Plans
CHEM G110	cSLO 3	2013 - 2014 (Fall 2013)	<p>be of particular value for instructors to incorporate some slides into lecture describing the relevance of why students are learning organic chemistry (naming and reactions) in units 7 through 11.</p> <p>It is quite apparent that the students were able to apply knowledge learned throughout the semester to completing chemical equations that occur during important physiological processes.</p> <p>Perhaps improvement can be achieved by giving students open-ended questions rather than multiple choice items so they have an opportunity to receive partial credit for a reaction with multiple products were they predict only one product incorrectly yet receive no credit for their partially correct answer.</p> <p>The students were responsible for course information covered throughout the semester and were expected to know and understand a substantial amount of chemical reactions. It may be too much information in a semester's time. The instructor could look at providing only questions with reactions that yield only one product or providing open-ended exam items so that students have the possibility of receiving partial credit for the correct portion of their response.</p>
CHEM G110L	cSLO 3	2013 - 2014 (Fall 2013)	<p>It was clear that the students were able to apply knowledge learned throughout the semester to basic physiologic/metabolic processes of the human body. Based on direct student feedback, Unit 12 seemed to be the point in which many of the students started to appreciate all of the previous organic chemistry contents they were learning in the previous 5 units. It may be of particular value for instructors to incorporate some slides into lecture describing the relevance of why students are learning organic chemistry (naming and reactions) in units 7 through 11.</p>
CHEM G110L	cSLO 3	2013 - 2014 (Fall 2013)	<p>The goal was to assess if students were able to apply knowledge they had acquired throughout the course to complete chemical reactions that take place during important physiological processes. Moreover, to demonstrate a general understanding of the chemistry that takes place during these processes. Students were required to study and learn the aforementioned reactions, understand how the main products were formed in each type of reaction, and then were tested on information throughout units 7 through 13 of the course. Students were told that they would be tested on these series of reactions on the final exam. All reactions were reviewed before the final examination.</p> <p>Student performance in the Monday-Wednesday evening section was fair with students scoring the highest percentage (90.9%) of correct responses on questions related to amide reduction. The lowest percentage (63.6%) of correct responses corresponded to questions regarding reduction of aldehydes and oxidation of alcohols.</p> <p>The intermediate scores included the following percentages of correct responses for the following types of reactions: halogenation of alkenes and carboxylic acid reactions (86.4%), combustion of cycloalkanes (81.8%), alkene hydration along with cycloalkane halogenation (77.3%), and benzene reactions (72.7%).</p> <p>When considering the average percentage score of correct answers for all the reaction types students were tested on, the results seem to be acceptable. However, there is still room for improvement. Particularly in the area of reduction of aldehydes and oxidation of alcohols.</p>

Courses Assessed and their Action Plans

Course Name	cSLO #	Semester Assessed	Action Plans
CHEM G130	cSLO 1	2014 - 2015 (Summer 2014)	The summer session is unique in that there is a beneficial instructor to student ratio. Students get a great amount of instructor time and are in a small class where personalized attention occurs daily. Additionally, students are only enrolled in one course, allowing the student complete focus. I attribute these reasons to such success over the summer 2014 semester.
CHEM G130	cSLO 1	2013 - 2014 (Fall 2013)	When students learned these major concepts, I included it as part of a large exam. These concepts were included on the most difficult exam during the semester. During the semester, after the students took an exam on the information, I decided the exam included too large amount of pertinent information. Next semester, I am splitting the one exam into two separate exams. I believe the amount of information will be more manageable for the students and yield an overall greater understanding of material as well as retention.
CHEM G130	cSLO 1	2014 - 2015 (Fall 2014)	Generally, molarity is a hard concept for students. It is covered at the end of the semester, and students are often tired and distracted during this time. The Tuesday-Thursday evening percentages by the number of outcomes are the typical percentages I have seen in previous semesters with 83% of the students getting 3 or greater of the outcomes correct. The Monday-Wednesday section was significantly lower with 71 percent getting 3 or greater of the outcomes correct. I have identified common errors this semester which caused students to incorrectly calculate the molarity. Next semester, I will highlight these areas in the lecture and provide more practice problems in these specific areas. The areas identified were as follows: - Students do not have the correct definition of molarity- Students make calculator errors. In laboratory, I will emphasize the calculation of molarity as well as the steps to making a solution. In the future, I will collect data and do a laboratory assessment of making a solution.
CHEM G130	cSLO 4	2014 - 2015 (Summer 2014)	No improvement at this time.
CHEM G130L	cSLO 1	2014 - 2015 (Summer 2014)	The summer session is unique in that there is a beneficial instructor to student ratio. Students get a great amount of instructor time and are in a small class where personalized attention occurs daily. Additionally, students are only enrolled in one course, allowing the student complete focus. I attribute these reasons to such success over the summer 2014 semester.
CHEM G130L	cSLO 1	2013 - 2014 (Fall 2013)	When students learned these major concepts, I included it as part of a large exam. These concepts were included on the most difficult exam during the semester. During the semester, after the students took an exam on the information, I decided the exam included too large amount of pertinent information. Next semester, I am splitting the one exam into two separate exams. I believe the amount of information will be more manageable for the students and yield an overall greater understanding of material as well as retention.
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			in the lecture and provide more practice problems in these specific areas. The areas identified were as follows: - students do not have the correct definition of molarity- students make a calculator error. In laboratory, I will emphasize the calculation of molarity as well as the steps to making a solution. In the future, I will collect data and do a laboratory assessment of making a solution.
CHEM G130L	cSLO 4	2014 - 2015 (Summer 2014)	No improvements at this time.
CHEM G180	cSLO 3	2013 - 2014 (Fall 2013)	In order to determine why the result for the night section was significantly better than that for the day sections for the case of "naming a covalent compound given its chemical formula," the two instructors responsible for teaching these sections will share information about what each is doing to teach this topic. If the instructor for the night section is doing something to teach this topic that the day instructor is not, the day instructor will attempt to replicate what the night instructor is doing. A practice quiz related to naming chemical compounds will be created for students and made available on Blackboard in an effort to improve both sections' performance when it comes to "naming an ionic compound that contains a metal with a variable charge given its chemical formula."
CHEM G180	cSLO 3	2013 - 2014 (Spring 2014)	Why students in the night section perform better than students in the day sections when it comes to chemical nomenclature, despite the great similarity in instructional time and techniques, is uncertain. The instructors of the day and night sections will continue to discuss this issue and look for differences in instruction that might be its source. Students' apparent difficulty in remembering to specify the charge of the silver cation might be due to students only seeing examples of Ag ⁺ compounds in the textbook, examples where the Roman numeral I is omitted in the name. To determine whether this is the case, this question will be modified to involve a metal that is more obviously a metal with a variable charge. The practice quiz related to naming chemical compounds seems to have either improved or had no effect on student performance. Its use will be continued in future semesters.
CHEM G180	cSLO 3	2014 - 2015 (Fall 2014)	The instructor for the evening CHEM 180 section is different than the instructor for the two CHEM 180 daytime sections. It's possible that a difference in instruction is responsible for the significantly smaller percentage of students in the evening section who successfully satisfied the SLO. The two CHEM instructors will compare methods of instruction to determine if there are any significant differences in their teaching of this skill. Additionally, audio-visual (AV) presentations that demonstrate how to perform the five-step procedure used to determine the empirical formula of a compound from combustion analysis data will be posted on the Blackboard sites of all three sections. These AV presentations will consist of PowerPoint slides that detail the necessary calculations coupled with recorded explanations of how to perform the calculations.
CHEM G180	cSLO 3	2014 - 2015 (Summer 2014)	Students demonstrated that they are proficient at naming chemical compounds. There is no need to assess this SLO again. The changes made over the past semesters- the guide to decision making on nomenclature questions,- the practice quiz related to naming chemical compounds, and - the use of less obscure compounds that helped to bring about this state of proficiency will maintained in the future.
CHEM G180	cSLO 3	2013 - 2014	In general, it is my feeling that the current performance on this topic is

Courses Assessed and their Action Plans

Course Name	cSLO #	Semester Assessed	Action Plans
		(Fall 2013)	acceptable. Nevertheless, the time spent during lecture on this topic will be expanded in the next semester and more emphasis will be placed on dealing with ionic compounds having metal ions that may have different charges in different compounds.
CHEM G180	cSLO 3 *Historical*	2014 - 2015 (Summer 2014)	The general finding was that 91% of students performed very well to excellently. Students demonstrated that they are very capable at performing titrations. Given this high level of accomplishment, there is no need to assess this SLO again.
CHEM G180L	cSLO 3	2013 - 2014 (Spring 2014)	Why students in the night section perform better than students in the day sections when it comes to chemical nomenclature, despite the great similarity in instructional time and techniques, is uncertain. The instructors of the day and night sections will continue to discuss this issue and look for differences in instruction that might be its source. Students' apparent difficulty in remembering to specify the charge of the silver cation might be due to students only seeing examples of Ag ⁺ compounds in the textbook, examples where the Roman numeral I is omitted in the name. To determine whether this is the case, this question will be modified to involve a metal that is more obviously a metal with a variable charge. The practice quiz related to naming chemical compounds seems to have either improved or had no affect on student performance. Its use will be continued in future semesters.
CHEM G180L	cSLO 3	2013 - 2014 (Fall 2013)	In general, it is my feeling that the current performance on this topic is acceptable. Nevertheless, the time spent during lecture on this topic will be expanded in the next semester and more emphasis will be placed on dealing with ionic compounds having metal ions that may have different charges in different compounds.
CHEM G180L	cSLO 3	2013 - 2014 (Fall 2013)	In order to determine why the result for the night section was significantly better than that for the day sections for the case of "naming a covalent compound given its chemical formula," the two instructors responsible for teaching these sections will share information about what each is doing to teach this topic. If the instructor for the night section is doing something to teach this topic that the day instructor is not, the day instructor will attempt to replicate what the night instructor is doing. A practice quiz related to naming chemical compounds will be created for students and made available on Blackboard in an effort to improve both sections' performance when it comes to "naming an ionic compound that contains a metal with a variable charge given its chemical formula."
CHEM G180L	cSLO 3	2014 - 2015 (Fall 2014)	The instructor for the evening CHEM 180 section is different than the instructor for the two CHEM 180 daytime sections. It's possible that a difference in instruction is responsible for the significantly smaller percentage of students in the evening section who successfully satisfied the SLO. The two CHEM instructors will compare methods of instruction to determine if there are any significant differences in their teaching of this skill. Additionally, audio-visual (AV) presentations that demonstrate how to perform the five-step procedure used to determine the empirical formula of a compound from combustion analysis data will be posted on the Blackboard sites of all three sections. These AV presentations will consist of PowerPoint slides that detail the necessary calculations coupled with recorded explanations of how to perform the calculations.
CHEM G180L	cSLO 3	2014 - 2015 (Summer 2014)	Students demonstrated that they are proficient at naming chemical compounds. There is no need to assess this SLO again. The changes made over

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Course Name	cSLO #	Semester Assessed	Action Plans
			the past six semester- the guide to decision making on nomenclature questions, - the practice quiz related to naming chemical compounds, and- the use of less obscure compounds that helped to bring about this state of proficiency will be maintained in the future.
CHEM G180L	cSLO 3 *Historical*	2014 - 2015 (Summer 2014)	The general finding was that 91% of students performed very well to excellently. Students demonstrated that they are very capable at performing titrations. Given this high level of accomplishment, there is no need to assess this SLO again.
CHEM G185	cSLO 2	2013 - 2014 (Fall 2013)	95% of students can correctly identify the 3rd Law of Thermodynamics, while 73% can correctly apply the 3rd law of Thermodynamics to compounds, reactions, and reaction variables. This is a reasonable result because application of a law is harder than the simple identification of the Law. This chapter is taught in the 8th week of a 16 week class, and the students are showing good retention. I will focus my efforts on improving other chapters, as this one seems to be working.
CHEM G185	cSLO 4	2014 - 2015 (Summer 2014)	In order to try and improve student performance of these two topics to 100%, one extra handout will be given for each of these topics in addition to the one given in class. This will be given as a take home assignment.
CHEM G185	cSLO 4	2014 - 2015 (Fall 2014)	We cover electrochemistry 8 weeks before the final. I will add more electrochemistry review material to the final study packet.
CHEM G185	cSLO 5	2014 - 2015 (Fall 2014)	This was a new lab. The results show there is room for improvement. I will emphasize the cation identification steps as I go through the next semester, to ensure that students recognize the difference between separation steps and identification steps.
CHEM G185L	cSLO 2	2013 - 2014 (Fall 2013)	95% of students can correctly identify the 3rd Law of Thermodynamics, while 73% can correctly apply the 3rd law of Thermodynamics to compounds, reactions, and reaction variables. This is a reasonable result because application of a law is harder than the simple identification of the Law. This chapter is taught in the 8th week of a 16 week class, and the students are showing good retention. I will focus my efforts on improving other chapters, as this one seems to be working.
CHEM G185L	cSLO 4	2014 - 2015 (Fall 2014)	We cover electrochemistry 8 weeks before the final. I will add more electrochemistry review material to the final study packet.
CHEM G185L	cSLO 4	2014 - 2015 (Summer 2014)	In order to try and improve student performance of these two topics to 100%, one extra handout will be given for each of these topics in addition to the one given in class. This will be given as a take home assignment.
CHEM G185L	cSLO 5	2014 - 2015 (Fall 2014)	This was a new lab. The results show there is room for improvement. I will emphasize the cation identification steps as I go through the next semester, to ensure that students recognize the difference between separation steps and identification steps.
CHEM G220	cSLO 2	2013 - 2014 (Spring 2014)	According to feedback from the students, it wasn't so much the difficulty of the problem but many reactions to memorize. This particular SLO can be improved by repetition. I saw this last year and in an attempt to improve it, I made some practice worksheets similar to the exam questions where they are required to either predict products, predict reactants or predict reagents. I did emphasize flashcards as I said that I would do the last time I taught this class. It is a particular learning objective that really required work on the part of the student. I included more practice and more worksheets but students did not do them. Some even admitted that they do not go on Blackboard site. The only thing I can think of is making these worksheets a grade requirement

Courses Assessed and their Action Plans

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CHEM G220	cSLO 2	2014 - 2015 (Fall 2014)	rather than an option. About ¾ of the students did an adequate job of being able to predict the products of the reactions tested. There are a very large number of reactions learned over the course of the semester, and some of them have considerations of regiochemistry and stereochemistry which make them more complex. Many students try to memorize rather than understand why the reactions occur the way they do, and then have trouble reproducing the product on a different compound than the ones in the homework problems. I encourage them to do many problems, as this is the best way to understand the material and remember the reactions, but homework is not graded, so some of the less motivated students do not spend enough time on this. I also encourage them to make flashcards and their workbook has a compendium of the reactions at the back of the book for them to refer to. Other than making graded homework a part of their grade, which I am very reluctant to do, as it is very time consuming to grade, I'm not sure what else I can do to encourage them to practice the reactions more. There are online homework programs which could be used, but this would be an additional cost for the students on top of a very expensive textbook, a workbook, lab materials and a clicker. I really hesitate to ask them to spend any more money – many of them don't even buy the required books, but photocopy or borrow materials.
CHEM G220	cSLO 5	2014 - 2015 (Fall 2014)	Melting Point: Most students performed adequately on this practical portion of the lab exam. They obtained melting points on several early experiments in the semester, but had little practice during the second half of the semester. A review of proper technique would probably be helpful toward the end of the semester. Calculations: The calculations for percent recovery and solvent requirements reflect a high level of proficiency. These calculations are based on material learned in general chemistry and it appears that most students successfully retained this knowledge. The gas chromatography calculations are new to them in organic chemistry, so students were less proficient. This instrument is used twice during the semester – more practice would probably improve their performance, but it is quite time consuming and adding it to another experiment is probably not very feasible at this point.
CHEM G220	cSLO 5	2013 - 2014 (Spring 2014)	From the analysis of the other laboratory section which also seems to have similar difficulties: we have recently been able to purchase an nmr which seems to be the more difficult of the spectroscopic methods for the students to understand. The labs are set up now that we are able to incorporate infrared spectroscopy into most of the experiments so they have a much better understanding of it. I feel that as we do the same with the nmr spectroscopy, incorporate it into more labs, they will get more practice and end up with a better understanding of it. I will also add to this that more practice of analyzing the IR spectra in the classroom setting should be incorporated. I am aware that many students have online sources that they refer to when analyzing their spectra for their laboratory reports. If we give more time to a lab where they are unable to use this resource, it may help improve their comprehension and analysis of the IR as well as NMR spectra.
CHEM G220	cSLO 5	2013 - 2014 (Spring 2014)	We have recently been able to purchase nmr which seems to be the more difficult of the spectroscopic methods for students to understand. The labs are set up now that we are able to incorporate infrared spectroscopy into most of the experiments so they have a much better understanding of it. I feel that as we do the same with the nmr spectroscopy, incorporate it into more of the

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CHEM G220	cSLO 5	2013 - 2014 (Fall 2013)	<p>labs, they will get more practice and end up with a better understanding of it.</p> <p>IR Spectroscopy: An 85% satisfactory rate is quite good for a chemistry topic. Infrared Spectroscopy is used repeatedly throughout the semester and the students have many opportunities to take their own spectra and analyze them, which I think is reflected in the good success rate. Most students provide good analysis of their IRs in their lab reports, but less confident students may obtain help from a friend for their lab report. Then when they are on their own for the lab exam, their weakness on this topic is exposed. I will continue to emphasize to students that they will be tested on this on the lab exam and that they need to be sure they understand the analysis on their own. Thin Layer Chromatography: Most students demonstrated confusion about the effect of the polarity of the solvent on the results of the TLC. This topic clearly needs to be clarified in both the lab manual and the pre-lab lecture. Also, this technique was used only once during the semester. It might be worthwhile to try to incorporate it into an additional experiment so the students will get more practice with the interpretation. NMR Spectroscopy: There was a great deal of variability in students' ability to predict an NMR spectrum. I suspect some of the less successful students didn't read the question completely, as they didn't answer part of it. One trend I noticed was that the students who were in the one lab section not taught by me were less successful on this topic. The college does not have an NMR instrument, so this topic is taught as lecture/group work/paper and pencil exercises. The part-time faculty member teaching the less successful section was teaching this subject for the first time and was not very prepared. Subsequently, we had a long talk about it, and I think he will do better next semester. We have asked for purchase of an NMR spectrometer through program review – having an actual instrument for students to use and being able to incorporate the interpretation of NMR spectra into multiple experiments should increase their comfort with the spectra, as seen by the results above for IR spectroscopy.</p>
CHEM G220L	cSLO 2	2013 - 2014 (Spring 2014)	<p>According to the feedback from the student, it wasn't so much the difficulty of the problem but the many reactions to memorize. This particular SLO can be improved by repetition. I saw this last year and in an attempt to improve it, I made some practice worksheets similar to the exam questions where they are required to either predict the products, predict reactants or predict reagents. I did emphasize flashcards as I said that I would do the last time I taught this class. However, it has not seemed to increase the student's success. It is a particular learning objective that really requires work on the part of the student. I included more practice and more worksheets but students did not do them. Some even admitted that they do not go only my Blackboard site. The only thing I can think of is making these worksheets a grade requirement rather than an option.</p>
CHEM G220L	cSLO 2	2014 - 2015 (Fall 2014)	<p>About ¾ of the students did an adequate job of being able to predict the products of the reactions tested. There are a very large number of reactions learned over the course of the semester, and some of them have considerations of regiochemistry and stereochemistry which make them more complex. Many students try to memorize rather than understand why the reactions occur the way they do, and then have trouble reproducing the product on a different compound than the ones in the homework problems. I encourage them to do many problems, as this is the best way to understand the material and remember the reactions, but homework is not graded, so some of the less motivated students do not spend enough time on this. I also</p>

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			encourage them to make flashcards and their workbook has a compendium of the reactions at the back of the book for them to refer to. Other than making graded homework a part of their grade, which I am very reluctant to do, as it is very time consuming to grade, I'm not sure what else I can do to encourage them to practice the reactions more. There are online homework programs which could be used, but this would be an additional cost for the students on top of a very expensive textbook, a workbook, lab materials and a clicker. I really hesitate to ask them to spend any more money – many of them don't even buy the required books, but photocopy or borrow materials.
CHEM G220L	cSLO 5	2014 - 2015 (Fall 2014)	Melting Point: Most students performed adequately on this practical portion of the lab exam. They obtained melting points on several early experiments in the semester, but had little practice during the second half of the semester. A review of proper technique would probably be helpful toward the end of the semester. Calculations: The calculations for percent recovery and solvent requirements reflect a high level of proficiency. These calculations are based on material learned in general chemistry and it appears that most students successfully retained this knowledge. The gas chromatography calculations are new to them in organic chemistry, so students were less proficient. This instrument is used twice during the semester – more practice would probably improve their performance, but it is quite time consuming and adding it to another experiment is probably not very feasible at this point.
CHEM G220L	cSLO 5	2013 - 2014 (Fall 2013)	IR Spectroscopy: An 85% satisfactory rate is quite good for a chemistry topic. Infrared Spectroscopy is used repeatedly throughout the semester and the students have many opportunities to take their own spectra and analyze them, which I think is reflected in the good success rate. Most students provide good analysis of their IRs in their lab reports, but less confident students may obtain help from a friend for their lab report. Then when they are on their own for the lab exam, their weakness on this topic is exposed. I will continue to emphasize to students that they will be tested on this on the lab exam and that they need to be sure they understand the analysis on their own. Thin Layer Chromatography: Most students demonstrated confusion about the effect of the polarity of the solvent on the results of the TLC. This topic clearly needs to be clarified in both the lab manual and the pre-lab lecture. Also, this technique was used only once during the semester. It might be worthwhile to try to incorporate it into an additional experiment so the students will get more practice with the interpretation. NMR Spectroscopy: There was a great deal of variability in students' ability to predict an NMR spectrum. I suspect some of the less successful students didn't read the question completely, as they didn't answer part of it. One trend I noticed was that the students who were in the one lab section not taught by me were less successful on this topic. The college does not have an NMR instrument, so this topic is taught as lecture/group work/paper and pencil exercises. The part-time faculty member teaching the less successful section was teaching this subject for the first time and was not very prepared. Subsequently, we had a long talk about it, and I think he will do better next semester. We have asked for purchase of an NMR spectrometer through program review – having an actual instrument for students to use and being able to incorporate the interpretation of NMR spectra into multiple experiments should increase their comfort with the spectra, as seen by the results above for IR spectroscopy.
CHEM G220L	cSLO 5	2013 - 2014 (Spring 2014)	From the analysis of the other laboratory section which also seems to have similar difficulties: we have recently been able to purchase an nmr which

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			seems to be the more difficult of the spectroscopic methods for the students to understand. The labs are set up now that we are able to incorporate infrared spectroscopy into most of the experiments so they have a much better understanding of it. I feel that as we do the same with the nmr spectroscopy, incorporate it into more labs, they will get more practice and end up with a better understanding of it. I will also add to this that more practice of analyzing the IR spectra in the classroom setting should be incorporated. I am aware that many students have online sources that they refer to when analyzing their spectra for their laboratory reports. If we give more time to a lab where they are unable to use this resource, it may help improve their comprehension and analysis of the IR as well as NMR spectra.
CHEM G220L	cSLO 5	2013 - 2014 (Spring 2014)	We have recently been able to purchase nmr which seems to be the more difficult of the spectroscopic methods for students to understand. The labs are set up now that we are able to incorporate infrared spectroscopy into most of the experiments so they have a much better understanding of it. I feel that as we do the same with the nmr spectroscopy, incorporate it into more of the labs, they will get more practice and end up with a better understanding of it.
CHEM G225	cSLO 2	2014 - 2015 (Fall 2014)	At this stage in the semester, there is a very large set of reactions for students to memorize. I feel that the flashcards that I recommend are helpful and will continue to highly recommend. However, I feel that I need to do something more. I think that putting together practice worksheets with answer keys that they can look at periodically through the semester will help greatly. In question 10, after speaking with the students, they didn't remember what the Stork enamine reaction was called so didn't know how to answer that question. I will definitely do that one differently next time but also incorporate the names of the reactions in the practice worksheets. I know, through discussing with the students, that many did not read the adjoining textbook and work on the homework problems that I assigned. This greatly affected their success rate. I tried to emphasize that the book work was extremely important and started to incorporate homework problems into the quizzes so they can see that. They have the solutions manual to the textbook so they have many predicting products with answers already given but I think, having worksheets where they are all mixed up from different chapters may be helpful with this SLO.
CHEM G225L	cSLO 2	2014 - 2015 (Fall 2014)	At this stage in the semester, there is a very large set of reactions for students to memorize. I feel that the flashcards that I recommend are helpful and will continue to highly recommend. However, I feel that I need to do something more. I think that putting together practice worksheets with answer keys that they can look at periodically through the semester will help greatly. In question 10, after speaking with the students, they didn't remember what the Stork enamine reaction was called so didn't know how to answer that question. I will definitely do that one differently next time but also incorporate the names of the reactions in the practice worksheets. I know, through discussing with the students, that many did not read the adjoining textbook and work on the homework problems that I assigned. This greatly affected their success rate. I tried to emphasize that the book work was extremely important and started to incorporate homework problems into the quizzes so they can see that. They have the solutions manual to the textbook so they have many predicting products with answers already given but I think, having worksheets where they are all mixed up from different chapters may be helpful with this SLO.