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I. Educational & Professional Background

Brief Resume

*Redacted for publication.*
II. Individualized Learning Plan

Year – 1
Individualized Learning Plan (ILP) Submission Form

<table>
<thead>
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<th>Candidate’s Name</th>
<th>Laura B. Sessions, Ph.D.</th>
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<tr>
<td>Dean’s Name</td>
<td>Robert Gessner, D.V.M.</td>
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Candidate Context

Educational & Professional Background (Brief Resume):

*please see page 4 of the portfolio (I. Educational & Professional Background)*

Candidate’s Workload:

Number of credit hours/contact hours per semester:
- 12 credit hours
- 18 contact hours

Number of preparations: 2-3 per semester varying between
- Organic Chemistry I (with laboratory)
- Organic Chemistry II (with laboratory)
- Introduction to Chemistry (with laboratory)
- General Chemistry II (with laboratory)

Other professional commitments:
- Participated in TLA seminars/roundtables, meetings, classes
- Coordinated organic chemistry laboratory schedule (with Ms. Davila-Aponte) and chemistry laboratory schedules (with Ms. Frieda Lambert)
- Served on hiring committees for Instructional Assistant, Sr. for chemistry labs (fall 2011) and for chemistry adjunct faculty (spring 2013, fall 2013)
- Founded and advised the student club American Chemical Society Valencia Chapter (fall 2011-spring 2013 with Prof. Diaz-Lopez)
- Lab manual selection for Organic Chemistry courses: examined 12 available lab manuals; prepared a custom lab manual that is re-saleable at cost savings of $59 for our students
- Headed campus-wide organic chemistry textbook adoption committee (summer/fall 2012)
- Participated in chemistry committee to write/re-write Common Course Outlines for all chemistry courses; authored Organic Chemistry I and II Outlines (fall 2012-fall 2013)
- Observed adjunct faculty in the classroom at Lake Nona Campus and provided other guidance and coordination for them as needed (fall 2013)
- Served on Pathways Pre-Nursing Advisory Team, Title III grant (fall 2013)

Professional Strengths:

**Teaching Competencies (Learning-centered Teaching Strategies, Scholarship of Teaching and Learning):** From 2007-2009, I taught in and eventually led the education and exhibits department at a science museum, where I had the opportunity to spend several years investigating, implementing, assessing, and disseminating information about the most dynamic and exciting teaching methods for the K-12 system. Transitioning to teaching full-time in college, I now have the opportunity to adapt and carry out these best practices in my classroom. I look forward to increasing the variety of learning methods in my classroom to make chemistry accessible to all students with an emphasis on active learning and engaging activities. I also feel that my interactions with the general public have given me perspective on what students will find interesting. I take care to integrate ‘everyday-life’ applications into each lecture to impart the relevance of each topic to students and create connections to what they already know and to their future activities.

**Engagement with students (LifeMap):** I have initiated formation of a chemistry club (American Chemical Society Valencia Chapter) on campus to aid students in exploring their educational and career interests. As an advisor to students outside the classroom, this activity has increased my awareness of students’ greater educational needs as they progress through their studies at Valencia College. In the fall of 2011, I also succeeded in getting a $500 start-up grant for the Valencia Chapter.

**Professional Commitment:** I have always enjoyed contributing to a learning community and evaluating and creating innovative new processes and tools. I have been a member of the American Chemical Society since 2001 and the National Science Teachers Association since 2007. I intend to serve on committees that will advance Valencia College in its mission to serve students as well as attend and contribute to conferences that improve the larger educational community.

**Philosophy of Teaching, Counseling or Librarianship (1-2 pages):**

As a professor of chemistry, I view myself as an experienced facilitator for student learning. My goal is for students to learn the core curriculum for chemistry (for example in organic chemistry, the relationship of structure to properties and reactivity) and the skills that come from application of this knowledge – skills such as critical thinking, analysis, and communication that can be applied across disciplines and throughout life. I strive to be knowledgeable, relevant, caring, and passionate in order to perform these roles.

My goal is to meet students where they are in scholarship and skills, and build upon their knowledge base by providing meaningful experiences to challenge, engage, and prepare them for their future. Meeting students where they are begins by creating a safe and encouraging environment. Subsequently, student interest can be generated by linking what students know already to what they want to know and understand. The key to learning is to create connections between course curricula, all the sciences, and everyday life; to show the interconnectedness of science and life; and to paint the
big picture. To this end, I offer significant real-life examples that aid students’ memory of concepts and expand learning to the world outside of the classroom.

My goal is also to create a student-centered learning environment where students must take responsibility by contributing to the process. They must think about why they are taking the class and what they want to know, and then work toward it. Developing a safe and encouraging environment in the classroom allows students to participate and make themselves responsible for their learning. Students should feel comfortable asking questions especially when they do not understand. They should also take a role in their classmates’ learning by explaining what they do understand.

My instructional strategies in this learner-centered environment include lecture, punctuated by discussion and group work, and laboratory. Lecture is a useful method for communicating a lot of information quickly, and it can be made more effective across learning styles in several ways. Utilization of technology allows inclusion of dynamic visual aids such as graphic depictions of concepts, interesting images and videos, and connections to the world outside the classroom. Additionally, my lectures have been divided into short presentations, followed by conceptual and problem-solving questions to be solved in small groups. These activities vary from short discussions (think-pair-share, for example) to formal collaborative learning groups, taking anywhere from five minutes to an hour. These questions integrated into the lecture with active discussion establish critical thinking skills. By having students solve problems in small groups after each concept is introduced in lecture, the students can ensure they understand the idea before they leave the classroom. Student work in small groups allows peer instruction; students hear one another express concepts and ideas in new ways, increasing learning and the diversity of perspectives in the classroom. It enables students to contribute to the classroom community, increasing their sense of responsibility and empowerment for their own learning. Meanwhile, the laboratory provides opportunities to observe ideas and concepts in action, a hands-on method especially beneficial to kinesthetic learners. Students lead their own experiments and can synthesize and apply the ideas learned in lecture. Formal laboratory reports that include a research component allow students to further investigate topics in which they are interested while reinforcing core class content and increasing their written communication skills.

Finally, having set forth all these grand ideas of my roles and methods, how will I know that they’re working? Assessment allows me to gauge success, but it is also a critical part of the learning process. On a daily basis, I utilize formative assessment in class and laboratory discussions and group work so that the students and I can immediately identify specific concepts that require more investigation and explanation. Summative assessment for class content occurs through homework, laboratory reports, and examinations that include many styles of questions including multiple choice (in preparation for graduate school entrance examinations), short answer, essays, conceptual and critical-thinking (synthesis) questions. Some of the most rewarding assessment comes from conversations and surveys with students at the end of the class when they describe how much they have learned and how they enjoyed the class (usually, a drastic change in attitude toward the subject). Then, it is clear that I have met their needs as students and learners, and hopefully, given them knowledge and skills that will translate beyond the classroom.
**Faculty Learning Outcome & Implementation Plan #1: Action Research Project**

### Needs Assessment for Faculty Learning Outcome #1 Action Research Project: *(needs are based on what the faculty member wants to learn to improve student learning)*

Organic Chemistry I Review Activity for Organic Chemistry II Students:

Many students beginning Organic Chemistry II lack basic knowledge and skills from General Chemistry and their Organic Chemistry I course. This discrepancy is to be expected given the differences in classes from professor to professor and the interval in time that often occurs between Organic Chemistry I and Organic Chemistry II. However, students need to have competency in certain key concepts and skills before beginning Organic Chemistry II. Specifically, students should know how to draw and recognize Lewis structures and resonance structures including geometrical shape (with an understanding of hybridization), draw simple mechanisms, and understand acid-base chemistry since these skills are important to investigating the dependence of properties and reaction mechanisms upon structure. Because it is the students’ first impression of the class, review of these topics needs to be engaging, challenging, and an introduction to working with their classmates.

### Faculty Learning Outcome and, if developed at this point, Research Question:

**FLO:** Develop a learning-centered group activity and associated pre- and post-quiz to improve Organic Chemistry II students’ ability to employ some key concepts from General Chemistry and Organic Chemistry I (namely Lewis structures and resonance structures including geometrical shape with an understanding of hybridization, mechanisms, and acid-base chemistry).

**RQ:** Will a learning-centered group activity and associated pre- and post-quiz increase students’ ability to employ General Chemistry and Organic Chemistry I concepts (namely to draw Lewis structures and resonance structures including geometrical shape with an understanding of hybridization, to draw mechanisms, and to predict acid-base chemistry reactions)?

**SLO:** Students will be able to employ some key concepts (namely to draw Lewis structures and resonance structures including geometrical shape with an understanding of hybridization, to draw mechanisms, and to predict acid-base chemistry reactions).

### Essential Competencies Addressed:

**Assessment**
- employ formative feedback loops to assess student learning
- employ formative feedback loops to inform students of their learning progress
- give timely feedback on class activities, exams and papers

**Inclusion and Diversity**
- develop reciprocity and cooperation among students (interdependence and teamwork)
- create learning atmospheres that encourage all students to share viewpoints

**Learning-Centered Teaching**
- employ strategies that guide students to become more active learners (e.g., reference interview, counseling inquiry, engaging lectures, discussion, experiential learning, scenarios, role-play,
case study, problem-based learning, inquiry-based learning, manipulatives, etc.)

- use cooperative/collaborative learning strategies

Outcomes-based Practice

- construct measurable learning outcomes (this performance indicator must be used in conjunction with at least one other Outcomes-based Practice indicator for demonstration in faculty portfolios)
- align learning opportunities and assessments of course learning outcomes and program learning outcomes, with the student core competencies (Think, Value, Communicate & Act)
- sequence learning opportunities and assessments throughout courses, programs, and developmental advising to build student understanding and knowledge

Scholarship of Teaching and Learning

- produce professional work (action research or traditional research) that meets the Valencia Standards of Scholarship
- build upon the work of others (consult experts, peers, self, students)
- be open to constructive critique (by both peers and students)
- make work public to college and broader audiences
- demonstrate relationship of SoTL to improved teaching and learning processes
- demonstrate current teaching and learning theory & practice

**Conditions:**

This FLO will apply to CHM2211C Organic Chemistry II.

In the spring of Year 1:

- The key concepts (Lewis structures and resonance structures including geometrical shape with an understanding of hybridization, mechanisms, and acid-base chemistry) in need of review will be confirmed.
- A corresponding learning-centered group activity will be developed utilizing best practices from education literature.
- An assessment (quiz) that is currently in use will be evaluated for suitability based upon the activity and re-developed, if needed, for use as a pre- and post-quiz for the activity.
- Additionally, a student survey soliciting feedback about the activity will be developed to be administered after the activity.

In the summer of Year 1:

- The activity will be piloted.

In the fall of Year 2:

- The activity will be modified as needed based upon pre- and post-quiz results, and student feedback via survey.

In the spring of Year 2:

- The project will be analyzed, written, and shared with the ILP panel.
Products/Evidence of Learning:

The product will be the learning-centered group activity with the associated Action Research Project results. Performance indicators will be student scores on a quiz covering the key concepts: 1) compared within a class as pre- and post-quizzes, and 2) compared with previous semesters where lecture was used to cover remedial topics rather than the group activity (as long as the currently used quiz is suitable). Additionally, a survey of student feedback on use of the activity will be evaluated.

Faculty Learning Outcome Statement (FLO) & Implementation Plan for FLO #2

Needs Assessment for Faculty Learning Outcome # 2: (needs are based on what the faculty member wants to learn to improve student learning)

Relevance of an Organic Chemistry Course to Students:

Some students in organic chemistry courses feel that the class material is not directly relevant to their educational and career goals. This feeling is detrimental because students do not invest their time to succeed in the class, fail to examine their career goals in light of new information from the course, and generally do not utilize the course to its fullest value. Interestingly, this feeling persists despite my inclusion of ‘application’ slides in every PowerPoint lecture with corresponding test questions such as why we can digest glucose, but not cellulose; that S-ibuprofen is an effective NSAID, but R-ibuprofen is not and why it is still sold as a racemic mixture; how aspirin works in the body; how gasoline is made; etc. It seems that a more focused activity is needed.

Many students are very engaged with online resources and technology for their educational advancement. Since this medium is where students spend much of their time (personal as well as educational), we as educators should be prepared to exploit this focus for our courses. I am interested in better utilization of online resources in my classes, specifically Blackboard. Keeping current in this technology will improve me as an educator and prepare me for the future. I will complete a Blackboard Course for Professional Development and use a Blackboard discussion forum as the student small group activity for exploration of the link between career and organic chemistry.

Faculty Learning Outcome Statement # 2:

Create a small group activity that will improve Organic Chemistry I students’ ability to investigate application of one course concept in a career function that interests them.
### Essential Competencies Addressed:

**LifeMap**
- help students to continue clarifying and developing purpose (attention to life, career, education goals)
- help students identify where academic behaviors can be adapted as life skills (e.g., library search skills, decision-making, communication skills, scientific understanding, etc.)

**Professional Commitment**
- stay current in discipline/academic field (e.g., professional organizations, conferences, journals and other literature, etc.)
- access faculty development programs and resources

### Conditions:

This FLO will apply to CHM2210C Organic Chemistry I.

In the spring of Year 1:
- A survey of student attitude and outcome toward organic chemistry and careers will be developed to be used as a pre- and post-activity performance indicator.
- An activity gauging student professional interests and linking course material to these interests will be created utilizing best practices from the educational literature. A list of organic chemistry-related career informational sources (for example, case studies, videos, current scientific articles, etc.) will be built. A small group activity utilizing the Organic Chemistry I students’ choice of one of these will encourage students to examine the connections between organic chemistry concepts and the career informational source.
- A student survey soliciting feedback about the activity will be developed to be administered after the activity.

In the summer of Year 1:
- I will take a Blackboard course.
- The activity will be piloted.

In the fall of Year 2:
- The activity will be modified as needed based upon student attitude survey results and student feedback via survey.

In the spring of Year 2:
- The project will be analyzed, written, and shared with the ILP panel.

### Products/Evidence of Learning:

The product will be the activity and examples of student work related to the activity. Performance indicators will be the pre- and post-survey of student attitude and student feedback on use of the activity.
### Faculty Learning Outcome Statement (FLO) & Implementation Plan for FLO #3

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### Professional Development

**Professional Development Transcripts (seminars, courses completed, etc.)**

**Term: Professional Development 1314**

- LTAD 3400 PD Using Interactive Whiteboard (1.000 credit hour)
- PRFC 3220 PD Lab Safety and Awareness (4.000)
- LCTS 3242 Dev Interactive Web-Based Courses (2.000)

**Term: Professional Development 1213**

- SOTL 2910 PD IRB for the TLA (1.000 credit hour)

**Term: Professional Development 1112**

- PRCF 2263 PD Creating An Evidence-Based Portfolio (20.000 credit hours)
- ASMT 2121 PD Assessment as a Tool for Learning (2.000)
- INDV 2151 PD Inclusion and Diversity (2.000)
- LCTS 2111 PD L-C Teaching Strategies (2.000)
- LFMP 2141 PD LifeMap (2.000)
- LOBP 2131 PD Learning Outcomes-based Practice (2.000)
- PRFC 2161 PD Creating an ILP (20.000)
- SOTL 2171 PD Scholarship of Teaching/Learning (2.000)
- SOTL 2271 PD Learning to Use the ARP Builder (2.000)
- SOTL 2272 PD Creating Effective Surveys (2.000)
- LTAD 3282 PD Blackboard Essentials (10.000)
Describe any other professional development activities, such as graduate courses completed, conferences attended, books read, and/or journal articles read in the space provided below.

- Conferences attended:
  - 193rd Two Year College Chemistry Consortium (2YC) Conference, Brevard Community College, September 17, 2011
  - 2nd Annual Central Florida Regional Curriculum Alignment Conference, Valencia College, October 28, 2011

- Key books read:

- Key journal articles read:
List/describe your Professional Development plans for Year-2 in the space below.

I will take the Year 2 TLA course ‘Creating an Evidence-Based Portfolio.’ I will investigate the utility of additional Year 2 Teaching and Learning Academy courses such as ‘Learning to Use the ARP Builder’ and ‘Creating Effective Surveys’ in order to complete my tenure process. I will continue professional development by reading books and articles about best practices related to my tenure projects and by taking classes such as the Blackboard training course.

Y-1 and Y-2 Review Panel Reports

Redacted for publication.
This is NOT an official transcript. Courses which are in progress are included on this transcript. Please note that your overall GPA includes preparatory courses that will not apply toward your degree and degree GPA.

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Laura B. Sessions, Ph.D. Faculty Portfolio
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#### Unofficial Transcript

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<td>75.000</td>
<td>75.000</td>
<td>75.000</td>
<td>0.000</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>Overall:</strong></td>
<td>75.000</td>
<td>75.000</td>
<td>75.000</td>
<td>0.000</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Laura B. Sessions, Ph.D. Faculty Portfolio
III. Faculty Learning Outcome #1

Action Research Project

Faculty Learning Outcome #1

Develop a learning-centered group activity and associated pre- and post-quiz to improve Organic Chemistry II students’ ability to employ some key concepts from General Chemistry and Organic Chemistry I (namely, Lewis structures and resonance structures including geometrical shape with an understanding of hybridization, mechanisms, and acid-base chemistry).

Essential Competencies and Indicators Addressed:

1) Assessment
   - employ formative feedback loops to assess student learning
   - employ formative feedback loops to inform students of their learning progress
   - give timely feedback on class activities, exams and papers
2) Inclusion and Diversity
   - develop reciprocity and cooperation among students (interdependence and teamwork)
   - create learning atmospheres that encourage all students to share viewpoints
3) Learning-Centered Teaching
   - employ strategies that guide students to become more active learners (e.g., reference interview, counseling inquiry, engaging lectures, discussion, experiential learning, scenarios, role-play, case study, problem-based learning, inquiry-based learning, manipulatives, etc.)
   - use cooperative/collaborative learning strategies
4) Outcomes-based Practice
   - construct measurable learning outcomes (this performance indicator must be used in conjunction with at least one other Outcomes-based Practice indicator for demonstration in faculty portfolios)
   - align learning opportunities and assessments of course learning outcomes and program learning outcomes, with the student core competencies (Think, Value, Communicate & Act)
   - sequence learning opportunities and assessments throughout courses, programs, and developmental advising to build student understanding and knowledge
5) Scholarship of Teaching and Learning
   - produce professional work (action research or traditional research) that meets the Valencia Standards of Scholarship
   - build upon the work of others (consult experts, peers, self, students)
   - be open to constructive critique (by both peers and students)
   - make work public to college and broader audiences
   - demonstrate relationship of SoTL to improved teaching and learning processes
   - demonstrate current teaching and learning theory & practice
Clear Goals

A. Abstract

Many students beginning Organic Chemistry II lack basic knowledge and skills from General Chemistry and Organic Chemistry I. As the students’ first impression of the class, review of these concepts needs to be engaging, challenging, and an introduction to working with their classmates. In this action research project, a collaborative learning activity and associated pre- and post-quiz was developed as review. Success was determined by: a) 20.7% average increase on pre- to post-quiz score measuring student abilities on the key concepts; b) 18.8% average increase of post-quiz scores over previous semesters that utilized lecture to review the key concepts; c) very positive student feedback on the activity. These results encourage me to continue this activity and add more learning-centered techniques to my future teaching practice.

B. Research Question

Will a learning-centered group activity and associated pre- and post-quiz increase students’ ability to employ General Chemistry and Organic Chemistry I concepts (namely Lewis structures and resonance structures including geometrical shape with an understanding of hybridization, mechanisms, and acid-base chemistry)?

Adequate Preparation

Background from Multiple Perspectives

1. Student Perspective

Student feedback is extremely important to me. I examined student perspective on the key concepts that need to be reviewed as well as on the teaching methodology that could be used to do so. In my organic chemistry classes, students frequently mention that they did not learn or did not remember learning hybridization, resonance structures, and mechanisms. From their comments, most seem to think that they understand Lewis structures and acid-base theory; however test scores do not bear that out. To further characterize students’ views, I utilized a survey. In addition to survey results mentioned here, my self-perspective below includes more observations of students.

As a regular part of my courses, I ask students to fill out surveys after the mid-term on various aspects of the class such as course tools, the most difficult concepts (muddiest points), and attitude toward the subject (FLO 1, Artifact 1: Resource Utilization Survey). In reviewing surveys from fall 2011 and spring 2012 courses of Organic Chemistry I and II, I found the following responses valuable in preparing for this project. In response to ‘topics that have been particularly unclear so far that you would like to spend more time on,’ 8% of Organic Chemistry II and 26% of Organic Chemistry I respondents listed mechanisms or basic organic I concepts (Table 1). These are high percentages considering that the most frequently listed topics were simply the most recently covered topics prior
to survey administration. This information suggests that many students recognize the importance of understanding the basics for success in the courses.

Table 1. Excerpts of Student Responses from Surveys of Organic Chemistry I and II, fall 2011 and spring 2012 (FLO 1, Artifact 1: Resource Utilization Survey).

| Please list any topics that have been particularly unclear so far that you would like to spend more time on. | % of respondents |
|---|---|---|
| | Organic I | Organic II |
| Mechanisms/Organic I basics | 26 | 8 |
| Substitution and elimination reactions | 9 | 8 |
| Alkene/alkyne addition reactions | 9 | 0 |
| Stereochemistry | 22 | 0 |
| Spectroscopy/spectrometry | 0 | 25 |
| Carbonyl chemistry | 0 | 25 |
| Multistep and retrosynthesis | 13 | 8 |

| Please list any tools that you feel would be interesting or that you would like to see more of. | % of respondents |
|---|---|---|
| | Organic I | Organic II |
| More problems/group work | 38 | 67 |
| Videos/online resources | 25 | 22 |
| Real-life examples | 13 | 11 |

<table>
<thead>
<tr>
<th>Please rate the following tools for generating interest in organic chemistry.</th>
<th>Average rating out of 6 (Organic I and II)</th>
<th>Median rating out of 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic Chemistry by Bruice (textbook)</td>
<td>4.1</td>
<td>4.0</td>
</tr>
<tr>
<td>Real-life examples</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Group work</td>
<td>5.0</td>
<td>5.0</td>
</tr>
</tbody>
</table>

When considering methodology for this project, in response to ‘tools that you feel would be interesting or that you would like to see more of,’ 38% of Organic Chemistry I respondents and 67% of Organic Chemistry II respondents listed more example problems or more group work (which in my classes consists of problems) (Table 1). When asked to rate tools for generating interest in organic chemistry, students ranked group work on average as 5.0 out of 6. For comparison, the textbook was rated on average as 4.1 out of 6. While students listed videos, online resources, and real-life examples often as well, the student perspective on group work conforms to best practices in the field of education on cooperative and collaborative learning (vide infra) and so was strongly considered.

2. Colleague Perspective

I solicited the opinions of three fellow organic chemistry professors on defining key concepts as well as how they addressed them in their course. After having identified the problem of inadequate basic knowledge for Organic Chemistry II students, I defined the key concepts for basic knowledge as:
Lewis structures and resonance structures including geometrical shape with an understanding of hybridization, mechanisms, and acid-base chemistry (see Expert Perspective below for detail on how these topics were chosen). Professors Eric Crumpler, Renee Becker, and an anonymous colleague at Valencia College were kind enough to share their opinions with me. The consensus amongst these colleagues was that the topics listed above were important concepts, but that these topics were reviewed in Organic Chemistry I.

Renee Becker stated that, ‘I do not review Lewis Dot, hybridization, mechanisms and acid-base because if they don't know that they shouldn't have passed CHM 2210. I do review those topics (except mech) the first day of CHM 2210.’ Although she does not use group work to review these concepts in Organic Chemistry II, Renee Becker’s Tenure Portfolio demonstrates that she effectively uses this methodology to teach organic chemistry, specifically for a molecular model building activity. Eric Crumpler agreed that he did not review these topics. He reminds students that knowledge of General Chemistry and Organic Chemistry I are required and tested on the first exam. He expects them to review on their own the first week of class.

Another colleague brought up the idea that students might not be prepared in the key concepts of General Chemistry and Organic Chemistry I because they simply had not invested the time of studying and were not likely to begin now. Hence, it was possible that my result might still be no improvement after the group learning activity. These perspectives from experienced colleagues were difficult to digest in light of the apparent need. I hoped that implementing this project would provide me with first-hand information on the subject.

3. Expert Perspective

Again, to verify my choice of key concepts and my choice of teaching methodology and best practices for executing it, I looked to the experts.

After having decided the basics in need of review: (a) Lewis structures and resonance structures, (b) geometrical shape, (c) hybridization, (d) mechanisms, and (e) acid-base chemistry, I confirmed their status as the five key concepts through many sources. The vast majority of organic textbooks cover the following concepts in Chapters 1 or 2: atomic structure, bonding (Lewis structures), orbitals and molecular orbital theory, hybridization, dipole moments, and acid-base theories. These textbooks go on to cover resonance structures and mechanisms in the first half of the books, generally covered in Organic Chemistry I. The classic graduate-level text, The Art of Writing Reasonable Organic Reaction Mechanisms, also mentions specifically these five concepts as necessary for understanding organic chemistry, corroborating their importance to students continuing on as chemistry majors. The American Chemical Society includes the five topics as conceptual topics that should be covered in the organic chemistry sequence, listing them as: bonding (Lewis structures); electronic, steric, and

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* Molecular orbital theory was omitted from review because of recent discussion that it was not as necessary and perhaps in error (see for a start: Pritchard, H.O. J. Chem. Ed. 2012, 89 (3), pp. 301-303.) and because it was not a necessary concept in every chapter as the others were.
orbital interactions on behavior and properties (hybridization and shape); Lewis and Brønsted acid chemistry; and addition, elimination, substitution, and rearrangement mechanisms. Lastly, these five concepts have been identified by organic chemistry instructors in a noteworthy study reported in the *Journal of Chemical Education* as: general chemistry concepts required to be reviewed; fundamental concepts for organic chemistry; difficult concepts; and concepts important for later chemistry learning. Under general chemistry concepts required to be reviewed, 70% of instructors interviewed in this study reported reviewing reaction mechanisms, 48% hybridization, 39% acid-base chemistry, 39% structure and bonding, and 22% resonance structures. Consequently, my interpretation of all these sources is that these concepts are worthy of focused review each semester.

Even though these concepts are agreed upon as key, there are not a lot of good resources for teaching them outside of the traditional textbook (or a good workbook that I regularly reference to students). For example, an internet search of ‘resonance structures’ leads to eleven first page hits – eleven of which are narrative or videos, only four of which have example problems, only two of which have organic chemistry problems. Similar experiences were found with the other topics. The lack of readily accessible resources for students reinforced the need for in-class time on the concepts.

Given students’ propensity for group learning (see student survey in Student Perspective), I investigated group work, formally known as cooperative or collaborative learning, as the methodology for reviewing these topics. I attended the following seminars at Valencia College: Learning-Centered Teaching Strategies (An Introduction to Cooperative Learning) by Dr. Susan Ledlow and Inclusion and Diversity by Michele Lima as excellent introductions to the topic. Educational literature is rife with studies on the value of cooperative or collaborative learning. Most often, I referenced the seminal book on the topic by Johnson, Johnson, and Smith and another by Millis and Cotrell however, several shorter summaries lend slightly new perspectives to the topic as well as discipline-specific tips.

Best practices in collaborative learning include the following ideas. Generally, collaborative learning is the structured use of small group work toward a common learning objective that maximizes learning through the participation of each member of the group. As the most studied instructional method, it has been shown to be an effective tool that leads to higher achievement and productivity by all levels of students, positive relationships amongst students, and greater psychological health. It transfers the responsibility and process of learning to the students, following the new paradigm of student-centered or active-learning instruction. It requires a common task or activity for the group and the following team traits: appropriate small groupings; belief that success depends upon each member (positive interdependence); individual accountability; cooperative face-to-face interactions; and group processing (to improve the group dynamic). All of these traits were carefully considered when developing the project.

Additionally, collaborative learning methodology builds important student competencies. Collaborative learning acknowledges learning as a ‘social enterprise’ - building team skills and allowing for student experience and knowledge to be heard. Therefore, the use of collaborative learning methodology improves student communication skills. The Florida Community College General
Education Student Learning Outcome Categories and the Valencia General Education Student Learning Outcomes both list communication skills. Also, the *Development of Student Skills in a Chemistry Curriculum* by the American Chemical Society lists group experiences as important for developing communication and team skills. In summary, collaborative learning is an important teaching methodology to be included in the classroom for many reasons.

In final preparation for this project, I attended the following seminars at Valencia College: Outcomes-based Practice by Helen Clarke and Wendi Dew to assist in writing learning outcomes and aligning learning opportunities with outcomes; Scholarship of Teaching and Learning by Dr. Lisa Armour to learn how to do action research; Assessment as a Tool for Learning by Dr. Melissa Pedone to advance my assessment strategies; and Developing Effective Surveys by Marcelle Cohen to help refine my student opinion surveys.

### 4. Self Perspective

The first semester that I taught Organic Chemistry II (spring 2011), I realized very quickly that students were having exceptional difficulties with new reactions. It became apparent to me that they were lacking adequate background in the basics such as Lewis structures, resonance structures, and mechanisms. Evidence of this deficiency included transcription errors of Lewis structures in mechanisms and predict-the-product problems that we worked in class (and difficulty recognizing the errors when pointed out); inability to follow curved arrows to draw products or resonance structures; and, on occasion, *actual groans* when I drew mechanisms on the board! Many stated that they had not drawn structures or mechanisms before and a few stated that my approach to the class was ‘too hard’.

This feedback from students did not mesh with my teaching philosophy of making the subject accessible by first meeting students where they are in knowledge and skills and then building upon that base. My first method of improvement (summer 2011) was to add more to the review lecture at the beginning of the term and an associated quiz on these review topics including hybridization with geometry, resonance structures, acid-base reactions, and mechanism arrows. During the review lecture, many students nodded in understanding, but still performed poorly on in-class problems and on the quiz, confirming my initial hypothesis and also suggesting that lecture was not a sufficient method of review. It became apparent that a stronger intervention was needed on these topics, thus the development of this action research project.

### Appropriate Methods – Methods & Assessment Plan

After considering student thoughts on course material, tools, and methodology (*FLO 1, Artifact 1: Resource Utilization Survey*), I verified the key concepts in need of review. Then, I created a collaborative learning activity for the first week of class that gave students very brief concept overviews and the opportunity to solve problems on these topics. Strategies to collect student input on this project (and also to identify if the activity worked) included administration of a pre- and post-quiz.
The post-quiz results were also compared to semesters when lecture was used to review rather than the activity. To obtain student opinions on the activity itself, I administered a post-survey soliciting their opinions.

A. Methods

1. Student Learning Outcomes

Students will be able to employ some key concepts from General Chemistry and Organic Chemistry I (namely, Lewis structures and resonance structures including geometrical shape with an understanding of hybridization, mechanisms, and acid-base chemistry).

2. Performance Indictors of Student Learning Outcomes

a. Students will accurately use key concepts from General Chemistry and Organic Chemistry I in the collaborative learning activity as demonstrated by my observations of groups and worksheet grades. Namely, students will identify atoms in a Lewis/line structure and recognize their hybridization and geometry, draw resonance structures for a Lewis/line structure, employ reaction mechanisms, and predict acid-base reaction products.

b. Students will improve abilities to employ key concepts as shown by increased scores from pre- to post-quiz.

c. Students who participated in the learning-centered group activity will show improved abilities over students who participated in lecture (comparison from previous semesters) as shown by higher scores on post-quiz comparison of the two groups.

d. Students will indicate on a survey that they found the collaborative learning activity useful in learning the key concepts.

3. Teaching Strategies of Student Learning Outcomes

a. On the first day of class, students took a pre-quiz (diagnostic) on the key concepts.

   FLO 1, Artifact 2: Key Concepts Pre-Quiz

   This formative assessment allowed me to gauge the baseline of student knowledge and divide the students into collaborative groups according to their abilities. This assessment also gave students a preview of their current abilities in the class and if they would need to review to get up to speed.

b. The same day, students participated in the learning-centered group activity. This activity consisted of several parts:

   ○ Students were placed in groups with heterogeneous pre-quiz scores to ensure diversity of perspectives on the topics (stratified random assignment). Following best practices in collaborative learning, appropriate groupings were also followed. Just for example, combining
3-4 students maximum and avoiding isolated minorities allow all members of the group to be participatory and comfortable.\textsuperscript{10}

- Students completed an introduction activity to get to know one another, set a collegial classroom climate, and begin to build group dynamics.\textsuperscript{20}

**FLO 1, Artifact 3: Ice Breaker - Introductions**

- Students received instructions for working in collaborative learning groups, continuing climate-setting by laying out clear expectations about the activity from the start. The rules prescribed that each student takes turns as the reader, secretary, checker, and encourager to ensure that each student is participating and individually accountable throughout the activity.

**FLO 1, Artifact 4: Collaborative Activity Ground Rules**

- To encourage positive interdependence, I told students that I would award two extra points if all members of their group scored above 50\% on the post-quiz. This kind of bonus system was suggested for encouraging all group members to score well by Claudia Genovese Martinez at the Valencia LifeMap Workshop and others.\textsuperscript{10}

- In their groups, students completed the activity. First, they read summary information on each key concept. For the spring 2013 project, as a class, we discussed to introduce and do a process analysis on the problem-solving techniques for each concept. Students then completed a series of problems on each concept.

**FLO 1, Artifact 5: Key Concepts Problem Worksheet**

- I monitored the groups for progress and, as a verbal formative assessment, encouraged individual accountability by circulating to ask each student questions on the material that was covered. Students turned in their worksheets at the end of the class period. This process was continued for all classes the first week.

- Students received their graded pre-quiz and Key Concepts Problem Worksheet back by the next class. For the spring 2013 project, a few minutes were given for group processing discussion, going over missed answers, and celebration.

c. The following week (giving two days to study after having received back the graded worksheets), students took a post-quiz on the key concepts.

**FLO 1, Artifact 6: Key Concepts Post-Quiz**

Students were informed of the post-quiz on the first day and were encouraged to prepare for it. This assessment was a second chance for students to assess their standing in the class. It also provided feedback for me on the success of the activity.

d. After receiving their post-quiz back, students responded to a survey about the Key Concepts Activity.

**FLO 1, Artifact 7: Opinion Survey on Key Concepts Collaborative Learning Activity**

e. I analyzed the student work and opinions to determine the success of the project.
**B. Assessment Strategies**  
(Report Form #4)

A range of formative and summative assessments allowed both me and the students to gauge their current abilities on the key concepts at any point during the project.

- **Formative Assessments included:**
  - Key Concepts Pre-Quiz (FLO 1, Artifact 2: Key Concepts Pre-Quiz)
  - Key Concepts Problem Worksheet/Activity (FLO 1, Artifact 5: Key Concepts Problem Worksheet)
  - my observations and verbal questions (Significant Results, part a)

- **Summative Assessments included:**
  - Key Concepts Post-Quiz (FLO 1, Artifact 6: Key Concepts Post-Quiz)
  - Student Survey (FLO 1, Artifact 7: Opinion Survey on Key Concepts Collaborative Learning Activity)

**C. Action Research Methodological Design**  
(Report Form #5)

1. Sample: The experimental student sample consisted of Organic Chemistry II classes in the summer 2012 (1 section of 17 students) and spring 2013 (1 section of 17 students) semesters on West Campus at Valencia College. The pseudo-control student sample consisted of Organic Chemistry II classes in the summer 2011 (1 section of 16 students) and fall 2011 (2 sections of 8 students each) semesters on West Campus at Valencia College. The activity and pre- and post-quiz were part of regular classroom work. Completion of the activity was worth 6 points. The pre-quiz was worth 2 points (0.2% of the course grade), sufficient points to motivate students to take it seriously, but not enough to make it a penalty (and therefore still a formative assessment). The post-quiz was worth 2 points with an additional 2 points added if each member of the group scored above 50%. No points were awarded for the survey. Post-quizzes from previous semesters (defined as pseudo-control group to compare lecture versus collaborative learning activity pedagogy) were worth between 5 or 10 points (0.7 or 1.4% of the course grade at the time).

2. Data:
   - a. Comparison of average pre-quiz to post-quiz scores in summer 2012 and spring 2013
   - b. Comparison of average post-quiz scores from summer 2012 and spring 2013 (classes utilizing collaborative learning activity to review key concepts) to summer 2011 and fall 2011 (classes utilizing lecture to review key concepts)
   - c. Student survey feedback
3. Analysis: Data was analyzed after the summer 2012 term and provided feedback for modifications prepared during fall 2012 for the spring 2013 term re-implementation. Further analysis was conducted after the spring 2013 term.

**Significant Results**
Results are discussed by performance indicators.

a. During the collaborative learning activity (FLO 1, Artifact 5: Key Concepts Problem Worksheet; FLO 1, Artifact 9: Examples of Student Work from Collaborative Learning Activity), students will be able to employ key concepts from General Chemistry and Organic Chemistry I as demonstrated by my observations of groups and worksheet grades.

Worksheet grades showed that students were able to employ the key concepts. Collaborative learning groups were encouraged to ask for help from the professor or utilize any available resources, so as planned, all scored 90% or better on the Key Concepts Collaborative Learning Activity (average score = 5.88/6.0, standard deviation = 0.17). This result means that within each group, the concepts were understood. Student worksheets demonstrate this understanding as well as group dynamics (FLO 1, Artifact 9: Examples of Student Work from Collaborative Learning Activity).

My observations of the students and verbal formative assessment during the activity were very enlightening. During the activity, the majority of students were able to explain their work very well. I was pleased to see even “C” students from my Organic Chemistry I class able to explain these concepts. In spring 2013, one student approached me after the second day’s activity and thanked me for making clear resonance structures, a concept that he stated as frustrating to him throughout his Organic Chemistry I course. These conversations made the activity seem a great success.

Looking a little deeper, there were several groups who abandoned the assigned roles of the collaborative learning model. While appearing harmless since the groups continued to work well together, the lack of roles can lead to hijacking of the work by one or two students, leaving weaker team members behind. Because of this experience in summer 2012, emphasis on maintaining roles was added in spring 2013 with a stronger introduction of the ground rules (FLO 1, Artifact 4: Collaborative Activity Ground Rules). Additionally, more structured instruction to switch roles was added as part of the class discussion for introduction and process analysis of problem-solving for each concept.

In summer 2012, one group was found to have significant interpersonal conflicts that interfered with learning. A member of this group proclaimed, ‘I have never gotten along with other people.’ This attitude was credited as an outlier for this project since it was expressed by only one student. Comments from other groups were much more positive: ‘this is fun – hard, but challenging at the same time’ or ‘now I’m motivated to go home and study this weekend.’ More student perspectives will be discussed under Performance Indicator d below.
b. Students will improve abilities to employ the key concepts as shown by increased scores from pre- to post-quiz. (FLO 1, Artifact 2: Key Concepts Pre-Quiz versus FLO 1, Artifact 6: Key Concepts Post-Quiz)

Pre-quiz scores have been shown to identify strengths and weaknesses and can be used to group students by heterogeneous abilities, as done for this activity.21 The post-quiz informed me about concepts that will need more work in future classes and informed the students of their standing with regard to the class content. Moreover, the difference from pre-quiz to post-quiz scores was a major indicator of success for the project. A majority of students (82.3%) improved their scores. A small proportion of students received the same score (5.9%) or lower (11.8%) on the post-quiz compared to the pre-quiz. The four students with lower scores were mid-range performers on the quizzes. On average, students improved in abilities on the key concepts, shown by a 20.7% increase from the pre-quiz to post-quiz score (Table 2) and the grade distributions (Figure 1).

![Figure 1. Grade Distributions for Pre- and Post-Quizzes, FLO 1.](image-url)
Table 2. Pre- and Post-Quiz Score Averages for FLO 1, Pseudo-Control and Experimental Groups.

<table>
<thead>
<tr>
<th>Term</th>
<th>Number of students</th>
<th>Pre-Quiz Score</th>
<th>Post-Quiz Score</th>
<th>Average Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$\chi$</td>
<td>$s$</td>
<td>$\chi$</td>
</tr>
<tr>
<td>Lecture as review</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer 2011</td>
<td>16</td>
<td>-</td>
<td>-</td>
<td>68.8%</td>
</tr>
<tr>
<td>Fall 2011-13561</td>
<td>8</td>
<td>-</td>
<td>-</td>
<td>34.4%</td>
</tr>
<tr>
<td>Fall 2011-13497</td>
<td>8</td>
<td>-</td>
<td>-</td>
<td>43.5%</td>
</tr>
<tr>
<td>Lecture Average*</td>
<td>32</td>
<td>-</td>
<td>-</td>
<td>53.8%</td>
</tr>
<tr>
<td>Collaborative learning activity as review</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer 2012</td>
<td>17</td>
<td>55.7%</td>
<td>24.4%</td>
<td>67.5%</td>
</tr>
<tr>
<td>Spring 2013</td>
<td>17</td>
<td>48.2%</td>
<td>21.4%</td>
<td>77.9%</td>
</tr>
<tr>
<td>CL Act. Average</td>
<td>34</td>
<td>52.0%</td>
<td>22.9%</td>
<td>72.7%</td>
</tr>
</tbody>
</table>

$\chi$ is the average. $s$ is the standard deviation. *Weighted average of lecture class scores.

Statistical analysis showed that this result was significant with greater than 99% confidence (paired t-test, p<0.001), however there are several limitations to this conclusion. One limitation is that the grade distributions for the data sets were not normally distributed and the samples were not randomly assigned (see Data Analysis), requirements for t-test analysis. A second is design of the quizzes. Different questions were posited on the pre- and post-quiz intentionally. First, the pre-quiz was returned to students as feedback so the same questions repeated on a post-quiz would not have yielded real results since students might have simply remembered the answers (a lower level in Bloom’s taxonomy than desired). I believe that tests and quizzes are strong motivators so I always return them to the students to use as learning tools. This use of the quiz also led me to administer different pre- and post-quiz questions every semester. An effort was made to ensure that the level of questions was the same from class to class and the format and style of questions was always the same (FLO 1, Artifact 2: Key Concepts Pre-Quiz, FLO 1, Artifact 6: Key Concepts Post-Quiz). Second, the post-quiz questions were designed to be more difficult compared to pre-quiz questions. This design ensures that any increase in score is a real improvement and not an issue of question quality. Finally, the primary purpose for the pre-quiz was for formation of heterogeneous collaborative learning groups; comparison of pre- and post-data is an added benefit as one measure of project success. Since the pre- and post-quiz were not identical, statistical analysis is completed as an exercise for discussion.

Examination of student abilities on each individual concept showed an average increase in scores from pre- to post-quiz questions on all topics (Table 3). Statistical analysis showed that gains were significant for all concepts (see t-tests in Table 3, p<0.1) except resonance, but again, this conclusion is tempered by the limitations mentioned above. Note that high-scoring concepts like recognizing hybridization/geometry and predicting acid-base reaction products can be considered lower order skills in Bloom’s taxonomy (remember and comprehend, respectively) while low-scoring concepts like drawing structures and employing reaction mechanisms are higher level (apply). Regardless, understanding the simpler topics is foundational to the rest and a step toward the application of key concepts.
Resonance structures showed the smallest observed increase because in summer 2012, there was actually an 18% decrease in scores from pre- to post-quiz. This significant decrease likely stemmed from the quiz design, making the post-quiz more difficult than the pre-quiz to ensure that improvement was real (*vide supra*). This question differential was decreased slightly for spring 2013. Additionally, this topic was examined as follows for better implementation in the spring 2013 term. The Lewis structures were reviewed on day 1 and then, resonance was reviewed on day 2 so that students who did not recall Lewis structures could review these before resonance, since these topics are cumulative. An additional, more challenging resonance problem was also added to the worksheet. Finally, an introduction to each topic was added during which student groups completed a process analysis for each kind of problem. All of these improvements seemed to lead to a 28% increase in scores for spring 2013, which is an overall 5% increase for both experimental sections on this topic. Critical examination of my teaching methodology for resonance structures was a benefit of this action research project.

### Table 3. Pre- and Post-Quiz Scores by Concept for FLO 1, Experimental Group.

<table>
<thead>
<tr>
<th>Concept</th>
<th>Pre-Quiz Score</th>
<th>Post-Quiz Score</th>
<th>Paired t-test (p-value)</th>
<th>Average Increase</th>
<th>% of students that improved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recognize hybridization/geometry.</td>
<td>48.2% 22.4%</td>
<td>86.1% 10.7%</td>
<td>0.00002</td>
<td>+37.9</td>
<td>51%</td>
</tr>
<tr>
<td>Draw resonance structures.</td>
<td>37.8% 21.7%</td>
<td>42.8% 19.0%</td>
<td>0.549</td>
<td>+5.0</td>
<td>31%</td>
</tr>
<tr>
<td>Employ reaction mechanisms.</td>
<td>51.0% 17.3%</td>
<td>72.4% 15.1%</td>
<td>0.00116</td>
<td>+21.4</td>
<td>63%</td>
</tr>
<tr>
<td>Predict acid-base reaction products.</td>
<td>73.6% 12.8%</td>
<td>89.1% 8.2%</td>
<td>0.00160</td>
<td>+15.5</td>
<td>46%</td>
</tr>
</tbody>
</table>

χ is the average. s is the standard deviation.

The improvement within each semester of the experimental group varied, with greater improvement demonstrated by the second semester of implementation (spring 2013). I will speculate that the improvement is perhaps due to the analysis made during the fall semester that led to improvements such as greater introduction of the pedagogy and especially process analysis of each key concept in addition to decreasing the resonance question differential (Figure 2, Table 2).
Another project design aspect that warrants discussion here is that pre- and post-quiz data from students who dropped the course were not included in the analysis. This exclusion occurred for two reasons: 1) Blackboard Grade Center does not keep data from students who drop from the course; 2) students who drop may have had external effects on their course performance. This exclusion affects performance indicators b (page 28) and c (page 32). Part a data for dropped students could not be separated since it was the Key Concepts Problem Worksheet, completed as group work (FLO 1, Artifact 5: Key Concepts Problem Worksheet). Part d data for dropped students could not be separated since the student surveys were submitted anonymously (FLO 1, Artifact 7: Opinion Survey on Key Concepts Collaborative Learning Activity).

Analysis of pre- and post-quiz data from students who ended up withdrawing from the course in summer 2012 (for which data was kept outside of Blackboard) shows that these students had lower scores, both pre- and post-, on average than students who remained in the course (Table 4). This factor may have contributed to or correlated to their dropping from the course. No students dropped from my spring 2013 course.

Table 4. Average Scores of Completion/Withdrawal Students from Collaborative Learning Activity Courses for FLO 1.

<table>
<thead>
<tr>
<th>Term</th>
<th>Number of students</th>
<th>Pre-Quiz Score</th>
<th>Post-Quiz Score</th>
<th>Average Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$\chi$</td>
<td>$s$</td>
<td>$\chi$</td>
</tr>
<tr>
<td>Completed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer 2012</td>
<td>17</td>
<td>55.7%</td>
<td>24.4%</td>
<td>67.5%</td>
</tr>
<tr>
<td>Spring 2013</td>
<td>17</td>
<td>48.2%</td>
<td>21.4%</td>
<td>77.9%</td>
</tr>
<tr>
<td>Withdraw</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer 2012</td>
<td>6</td>
<td>37.5%</td>
<td>20.0%</td>
<td>53.4%</td>
</tr>
<tr>
<td>Spring 2013</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

$\chi$ is the average. $s$ is the standard deviation.
Examples of student work in the open-response style of questions from pre- to post-quiz visibly demonstrate learning as well (FLO 1, Artifact 8: Examples of Student Work from Pre- to Post-Quiz).

c. Students who participated in the learning-centered group activity will show improved abilities over students who participated in lecture (comparison from previous semesters) as shown by higher scores on post-quiz comparison of the two groups. FLO 1, Artifact 6: Key Concepts Post-Quiz, FLO 1, Artifact 10: Key Concepts Post-Quiz from Lecture Classes

This project began from my observation that my Organic Chemistry II students were missing basic skills and knowledge so I began by adding a quiz after my review lecture. I kept this quiz, same format, style, and difficulty of questions, for use in this action research project and so thought that comparison of these post-review quizzes from experimental to my previous classes (pseudo-control) might be useful as one measure of project success. Because I did not give a pre-lecture quiz to my pseudo-control group, I cannot measure learning gains from the pseudo-control group to experimental. However, I did not want to continue the lecture-style review simply for the sake of obtaining a pre- and post-quiz since students were lacking in skills and concepts following this method (Self Perspective). Keeping these limitations in mind, improvement in abilities on the key concepts can be attributed to participation the collaborative learning activity since students who participated in the activity scored 18.9% higher on average than students from previous semesters with lecture as the review method (Figure 3, Table 2). Statistical analysis showed that this result was significant with greater than 99% confidence (independent samples t-test, p=0.00146) although the limitations mentioned under performance indicator b with respect to quiz design should be considered.

![Figure 3. Comparison of Post-Quiz Scores for Lecture versus Collaborative Learning Activity (CL act.) for FLO 1.](image-url)
Scores from summer 2011 were in opposition to this proposed significance (Table 2). These very high scores may be an issue of question quality since examination of the post-quiz from summer 2011 revealed easier questions than those used in summer 2012. Additionally, the quiz was worth 10 points in summer 2011 rather than 2 points as it is currently, perhaps offering students greater incentive to study. Finally, due to lack of random sampling (which is not possible in regular class selection), this class may have been a highly motivated bunch!

Given that collaborative learning is such a well-documented improvement to student learning10,11 along with the student response to the activity (see indicator d below), I will continue to use this methodology for review of key concepts.

d. Students will indicate on a survey that they found the Key Concepts Activity useful for learning the key concepts. (FLO 1, Artifact 7: Opinion Survey on Key Concepts Collaborative Learning Activity)

Student feedback from the Opinion Survey on Key Concepts Collaborative Learning Activity was overwhelmingly positive. Students responded to statements about the activity on a forced-choice Likert scale of 1-6 with 1 being the lowest and 6 being the highest score (Table 5).

Table 5. Likert Scale Used for Student Survey for FLO 1.

<table>
<thead>
<tr>
<th>Very Strongly Agree</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
<th>Very Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

To statements that affirmed the effectiveness of the activity (statements 1,4,5), students on average responded in agreement (Table 6). For example, 92% of students agreed (rated 4-6) with statement 1 that the collaborative learning activity helped to remember and learn the key review concepts, leading to an average rating of 5.2 out of 6 (s=1.0). To statements about the enjoyment of the activity (statements 2,3), students on average agreed. This measure is important because students will be more likely to participate in an activity that they enjoy. Importantly, 97% of students responded that they felt actively engaged during the activity (χ=5.2, s=0.9). To statements that covered the effectiveness of collaborative learning as a methodology (statements 6-12), on average students agreed that their group worked well together and that working in a group helped them to review the key concepts. Students also agreed that the activity helped them to grow in Valencia’s core student competencies, communication especially being a benefit of collaborative learning (χ=5.0, s=1.0, statement 13). Lastly, 100% of students agreed that the pre- and post-quiz assessments were effective learning tools (statements 14,15). This survey overwhelmingly defines the activity as a success from the student perspective since students rated every aspect of the project positively.
Interestingly, the lowest score on the entire survey was 4.3 (Agree, s=1.3) to statement 3 “I enjoyed the activity more than a lecture”; only 77% of students responded ‘Agree’ (rated 4-6) to this statement. This score may reflect some student comments in the open response section of the survey (Please feel free to add your comments (about working in groups, the activity worksheet, etc.)). Selected representative mixed and negative comments were:

‘When you put too many strong willed people together it doesn't work out well.’

‘Working in groups is nice but also troubling because your grade is dependent upon the entire group not individually.’

‘It was a great activity. The only downside is for some groups sometimes one of the members is the only one engaged with the activity. I didn't feel this from my group, but a friend in another group did & it also happened to me in orgo I.’

---

\(^b\) All comments in this portfolio are provided unedited, as the students wrote them.
‘I think working in groups is great IF all the members of the group are cooperative’

‘Working in groups is tough when you’re assigned members because I feel as though most of the group is clueless as to what is going on and I feel as though I have to compensate for everyone else. I would like to pick my own group b/c I can ensure that the members are competent and will do their part.’

‘The activity was very helpful to remember key concepts from last semester. But I am the type of student that likes to work by myself I think I learn more and I concentrate more by reading the material.’

In addition to being required to learn how to work effectively with others, my general feeling was that students found the activity took effort on their part whereas in a lecture, they are passive participants who can just sit back and relax. This feeling is well-documented in collaborative learning as students adjust to an active-learning classroom environment. Spending more time explaining the methodology of collaborative learning and why it is used to the students would help to alleviate some of these problems. This methodology includes the importance of student roles discussed in the Significant Results part a above. That students did not maintain their roles was the next lowest scoring area in the survey (statement 9). Emphasis of student roles will be considered for future improvements on the project and may help to increase enjoyment. This emphasis could be provided by even more discussion about collaborative learning methodology at the start of the activity or by reinforcement on an individual level within each group. Given the difficulties reported in the literature, these are small problems. Overall, student feedback was fantastic!

Positive comments included:

‘I thought that working as a group, we were able to show each other what we know and share info.’

‘Sometimes it’s good to work in groups because you may not understand something that your group members do understand, or vice versa.’

‘I enjoy working in groups. It helps make the problems easier to understand in case you do not remember cause a team member can help to explain it.’

‘I really like working in groups. It helps me to learn more and be more active in the class.’

‘I really enjoyed working in groups for the in class activities. I felt I learned the concepts a lot better when talking through them in a group. I really liked how the prof walked around and helped answer questions, so we weren't sitting around and going through problems incorrectly.’
‘The groups were small which was great! The nice thing about group work in a class level this high is that everyone contributed, instead of one person doing all the work. We were able to check each other’s understanding and to show our own personal methods for remembering how to do things.’

‘I felt the group work helped me understand concepts I had forgotten via the collaborative knowledge of my group members. It helped greatly.’

‘The group learning activities help to reinforce key concepts covered in the lectures. It would be helpful to have one for each chapter.’

‘The activity assignments were perfect for working in groups and were a good review of the key concepts from Organic Chemistry I. It seemed like our group was well chosen because one person's weak spot was another person's strength. Therefore we could effectively communicate and learn, as well as ensure we all participated.’

One student comment was informative in re-designing the methodology for the spring 2013 classes.

‘I would have preferred doing it individually or even better, as a homework assignment. Coming in cold and doing it only tells you whether you remember it from previous semester or not. You don't learn or refresh concepts.’

This comment related to my observations that students sometimes did not take the time to read each topic introduction thoroughly in order to refresh the whole group’s knowledge and put them on the same page. Feedback from another student in office hours later in the semester revealed that his group had disagreement about hybridization of allenes, despite reading the topic introduction. For spring 2013, I added a class discussion to introduce each topic in which students came to consensus on the definition or did a process analysis on the problem-solving techniques for each concept. This addition better paced the activity to give students a break between topics and change their assigned roles. Student feedback from the survey turned out to be an incredibly valuable tool for improving the activity.

**Reflective Critique**

**A. General Reflection**

This project has given me the opportunity to learn about best practices in collaborative learning and action research. Additionally, I had the opportunity to discuss teaching practice with colleagues throughout Valencia as well as my ILP committee members. These resources have given me insight into my teaching and I will continue to use them in the future. The action research nature of this project enabled me to be very methodical, circumspect, and inquiring in my approach to the classroom, something that I will carry over to all major changes that I make in my teaching in the future. Overall, the observed results of data and student feedback lead to characterization of this project as a success.
Post-quiz results showed that a large majority of students improved in their knowledge of the key concepts. Student feedback confirmed that the activity was successful for teaching the topics as well. Additionally, student feedback on the extensive use of formative assessments was highly positive. My formal inquiries into the students’ opinions on the project are another tool that I will carry over throughout my practice as it led to specific feedback about opportunities for improvement. I was pleasantly surprised at how well the review activity worked. It was painless to implement despite the fact that group work is notoriously tricky. I attribute this success to reading and utilizing best practices from the literature before beginning the project. I was thrilled to have so many students show such fast improvement, whether from a jogged memory or a different explanation of the concepts. I intend to continue using the activity and also expand the use of collaborative learning groups and formative assessments in my classes. This project will be improved by increasing even further the focus on the collaborative learning methodology such as student roles in the activity. This will lead to better student feelings on the idea of group work. Moreover, based upon feedback from my students to add more group work and on the need to review all the reactions from Organic Chemistry I, I eventually will extend the group review activity to cover alkene addition reactions and substitution and elimination reactions.

B. Critical Evaluation of Each Essential Competency in this FLO

1. Assessment
   - employ formative feedback loops to assess student learning
   - employ formative feedback loops to inform students of their learning progress
   - give timely feedback on class activities, exams and papers

Reflection:

The purpose of assessment is to improve student learning through student awareness of strengths and weaknesses and through faculty awareness of content and instructional design to improve courses.\(^{22}\) I have found that extensive formative assessment not only helps me to assess student learning, but also informs students of their learning progress, meeting my teaching philosophy goal of student involvement in the learning process.

- The feedback loop of pre-quiz (diagnostic) followed by collaborative learning activity followed by post-quiz was useful in determining whether the project had succeeded, i.e. whether students had learned the key concepts as evidenced by the Significant Results (Table 7). This loop did allow me to document student improvement (or lack thereof), and use this information to help students individually as well as to improve the activity.

<table>
<thead>
<tr>
<th>Table 7. Formative Feedback Loop of Assessments Used in FLO 1.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-quiz → collaborative learning activity → post-quiz</td>
</tr>
</tbody>
</table>

Laura B. Sessions, Ph.D. Faculty Portfolio
• Students also found the feedback loop useful as indicated by the Student Survey (FLO 1, Artifact 7: Opinion Survey on Key Concepts Collaborative Learning Activity). 100% of responding students found that ‘The diagnostic quiz/post-quiz helped me to recognize how well I understood the concepts,’ ranking its utility as 5.5 out of 6 on a Likert scale (s=0.6, Table 6). Additionally, 92% of the students agreed that the collaborative learning activity was helpful in learning the key concepts, ranking it as 5.2 out of 6 (s=1.0, Table 6). This kind of feedback was really useful to me. While I have frequently utilized formative assessments, I had not asked for such formal student feedback on them. The results were quite gratifying. I feel that students had an idea of their preparation level for the entire class after the activity. Because of this result, I classified the pre- and post-quiz as part of the activity in the research question since students continued to learn even from the post-quiz.

• Finally, I have always made timely return of assessments a priority in my teaching practice since it gives students feedback while the information is fresh in their minds. In this project, 100% of responding students agreed that the assessments were returned in a timely manner (χ=5.9, s=0.3, Table 6).

Personally, I feel that the assessment part of this project has been the most informative and enlightening to me as an instructor since it has given me feedback for action research and the students rated it highly. I will continue to use the same assessment feedback loop for this activity in the future. One area for improvement is to ‘talk up’ the importance of the post-quiz and preparing for it so that every student spends the time to learn the concepts right at the beginning of the class. Peer evaluation also might be a tool to improve student participation. I also intend to increase the use of formative assessments in my courses in the future.

2. Inclusion and Diversity

• develop reciprocity and cooperation among students (interdependence and teamwork)
• create learning atmospheres that encourage all students to share viewpoints

Reflection:

A big part of my teaching philosophy is creating a safe and encouraging learning environment, making students comfortable in the classroom so that they can learn. Students will feel safe when a diversity of perspectives is included and respected. Additionally, the structured setup of a collaborative learning group with introductions and ground rules that encourage cooperation and respect contributes to the classroom environment. This methodology increased student learning in my project. It also made me a better instructor because I had to be focused not only on the group dynamics of the class but also on individual student interactions within each group. This attention to individuals made me more
aware of common difficulties in the concepts and also of student tricks for remembering and explaining the concepts.

- Because of the nature of the active-learning teaching methodology - collaborative learning - reciprocity, cooperation, and an atmosphere encouraging of student sharing were all built in to the activity. Students enjoyed these features as indicated by the Student Survey (FLO 1, Artifact 7: Opinion Survey on Key Concepts Collaborative Learning Activity). To the statement ‘I felt cooperation and helpfulness among my group,’ 92% of students agreed with an average rating of 5.1 out of 6 (s=1.1, Table 6). It is important to me that students feel a collegial atmosphere since this feeling extends to me as well. We are all on the same team and ‘in this together.’ This kind of attitude is a recipe for success in the classroom.

- To the statement ‘I felt that I could share my viewpoint in my group,’ 95% of students agreed with an average rating of 5.3 out of 6 (s=1.1). This result likely stems from the ground rules for working in groups in which respect of fellow classmates is a basic requirement.

In the summer term 2012, only 3 out of the 22 students in the class disagreed with the effectiveness of the group activity and its nature, perhaps pointing to one group that had difficulties working together (see the details of this group’s problems in Significant Results, Indicator d).

While overall highly positive, this result does leave room for improvements in future classes. This was improved in spring 2013 by adding to the introduction and rules of the methodology of collaborative learning. Greater time spent introducing the methodology of collaborative learning should lead to even more appreciation of working in groups and developing reciprocity and cooperation. Monitoring the groups even more closely for following the ground rules of collaborative learning (FLO 1, Artifact 4: Collaborative Activity Ground Rules) should lead to a comfortable atmosphere for every student, a very important trait of a good learning environment. Additionally, more time will be given for group processing and for celebration at the end of the activity. It should be noted that, given the steep learning curve usually associated with introduction of collaborative learning into the classroom, this project was an amazing success the first time.

3. Learning-centered Teaching Strategies
   - employ strategies that guide students to become more active learners (e.g., reference interview, counseling inquiry, engaging lectures, discussion, experiential learning, scenarios, role-play, case study, problem-based learning, inquiry-based learning, manipulatives, etc.)
   - use cooperative/collaborative learning strategies

Reflection:

- Learning-centered teaching strategies reflect the current paradigm in education of the learner as active and at the center of the education process. These can be incorporated across many
teaching methodologies. As indicated by the Student Survey (FLO 1, Artifact 7: Opinion Survey on Key Concepts Collaborative Learning Activity), the most delightful result for me from this activity was that 97% of students reported feeling actively engaged in the activity ($\chi^2=5.2, \, s=0.9, \text{ Table 6}$). I think that this feeling of empowerment was the driving force for their improved performance on the post-quiz.

- Because of the nature of the collaborative learning teaching methodology, active learning on the part of the students was built in to the activity. Working problems based on the key concepts allowed students to construct their own knowledge rather than memorize lecture information, a huge improvement in student learning. This kind of learning process is considered to be the best practice in the field of education today.

The challenge here is to catch and engage every single student actively. This involves strict adherence to the collaborative learning methodology, where each member has a defined role. This role will require each student to participate. Perhaps an improvement here is to create a larger discussion about the roles amongst the groups during the introduction to collaborative learning; are they helpful, or cheesy, or a waste of time? Having the students construct the importance of the roles for themselves may lead to better compliance with them during the activity.

4. Outcomes-based Practice

- construct measurable learning outcomes (this performance indicator must be used in conjunction with at least one other Outcomes-based Practice indicator for demonstration in faculty portfolios)
- align learning opportunities and assessments of course learning outcomes and program learning outcomes, with the student core competencies (Think, Value, Communicate & Act)
- sequence learning opportunities and assessments throughout courses, programs, and developmental advising to build student understanding and knowledge

Reflection:

The goal of outcomes-based practice is student learning. Evidence of student learning is presented in the Significant Results section. However, the appropriate design of the action research project was critical to be able to demonstrate the student learning.

- The faculty learning outcome (FLO) and student learning outcome (SLO) written for this project were demonstrated to be measurable from the results of the action research discussed in the Significant Results section utilizing pre- and post-quiz data, the collaborative learning activity data, my observations, and student surveys. It was an enjoyable process to develop the action research methodology and associated data to measure, since it was much like the scientific method. Taking considerable amounts of time to appropriately design the project before implementing in the classroom ensured that the results would inform my teaching practice. This kind of careful and detailed
planning process will be conscientiously implemented in further improvements to this project as well as across the board in development of my courses.

- Again, due to the nature of collaborative learning in which students are actively engaged in thinking (think), appraising and constructing knowledge (value), communicating with other members of their group (communicate), and completing the problems in the activity (act), the student core competencies were all addressed. Students recognized this fact as evidenced by the Student Survey (FLO 1, Artifact 7: Opinion Survey on Key Concepts Collaborative Learning Activity) since 90% of them agreed that ‘This activity helped me to grow in Valencia’s core competencies (Think, Value, Communicate, and Act),’ rating the statement an average of 5.0 out of 6 (s=1.0). Opportunity for improvement exists here and can be accomplished by having students realize the value of team work and communication for their future careers. I might consider addition of a student discussion of why think, value, communicate, and act are core competencies and how they might be practiced in the activity.

- I had to include the indicator ‘sequence learning opportunities.’ It is significant that the entire goal of this project was to prepare students for Organic Chemistry II by reviewing concepts that are fundamental for understanding the course material. By putting this activity at the beginning of the class and ensuring that the large majority of students could employ the concepts - that is, creating the proper sequence of learning opportunities and assessments - students should have the knowledge base to succeed at Organic Chemistry II. This is the crucial point of the project.

5. Scholarship of Teaching and Learning

- Produce professional work (action research or traditional research) that meets the Valencia Standards of Scholarship
- Build upon the work of others (consult experts, peers, self, students)
- Be open to constructive critique (by both peers and students)
- Make work public to college and broader audiences
- Demonstrate relationship of SoTL to improved teaching and learning processes
- Demonstrate current teaching and learning theory & practice

Reflection:

Action research is a support tool that arranges the scholarship of teaching and learning as the foundation for all classroom work: continuous and concerted examination of the effectiveness of teaching and assessment with adaptation of best practices from the current education literature.

- This action research project has demonstrated that I have continuously examined the effectiveness of my teaching strategies by using and writing clear goals, adequate
preparation, appropriate methods, significant results, and reflective critique, all of the Valencia Standards of Scholarship.

- I have applied the opinions of students, peers, and myself as well as literature from the experts in design of this project (see Adequate Preparation).

- I have always prided myself on taking advice to heart and so enjoyed researching the ideas of experts and colleagues and studying the feedback from students and my Individualized Learning Plan (ILP) committee. I am especially grateful for input from my ILP committee and the Teaching and Learning Academy in completion of this project.

- As required, this work will be available on the Action Research Builder on Atlas. I hope that others will benefit from presentation of this project there.

- The Scholarship of Teaching and Learning is built into the action research project format and so has been demonstrated here. Action research is an iterative process of planning, acting, observing, and reflecting that continues in cycles to improve teaching. Utilizing the principles of the scholarship of teaching and learning through action research has allowed me to improve my teaching practice by creating a comprehensive and effective review of key concepts for my Organic Chemistry II students. The cycle of action research (plan, act, observe, and reflect back to plan again) leads to informative feedback and a concerted effort to improve my teaching practice, something that I really enjoy.

- In this project, I have researched and demonstrated a current and accepted teaching practice: collaborative learning.

Opportunities for improvement include continued use of feedback from students, colleagues, and experts in my teaching practice, continued reading of journals and trade magazines on education, and attending conferences. It could also be interesting, now that some time has passed and student test banks may be defunct, to recycle the pre- and post-quizzes from summer 2011 and fall 2011 (lecture review classes) for comparison with the collaborative learning activity review. This comparison, using the same post-quiz questions for lecture versus collaborative learning activity, would eliminate one limitation of the statistical analysis. The same quiz questions could also be used for pre-quiz, again strengthening the statistical analysis for valid comparison of pre- to post-quiz, however this change would weaken the teaching aspect of the project, since I could not return the pre-quiz as an added learning tool.

**Plan for Dissemination**

This project will be presented to my Individualized Learning Plan committee. This work will be available on the Action Research Builder on Atlas.
Supporting Artifacts for FLO#1

FLO 1, Artifact 1: Resource Utilization Survey
Resource Utilization Survey

Please take a few moments to share your opinion on various tools and resources that we use in the organic chemistry courses. Your thoughts will be anonymous and will help to shape the class for future students.

Please rate the value of the following tools for learning/studying organic chemistry:

<table>
<thead>
<tr>
<th>Resource</th>
<th>Extremely helpful</th>
<th>Very helpful</th>
<th>Helpful</th>
<th>Not helpful</th>
<th>Very unhelpful</th>
<th>Extremely unhelpful</th>
<th>Have not used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sapling Learning online homework</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>N/A</td>
</tr>
<tr>
<td>Organic Chemistry textbook by Bruice</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>N/A</td>
</tr>
<tr>
<td>Operational Organic Chemistry lab manual</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>N/A</td>
</tr>
<tr>
<td>PowerPoint lecture notes</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>N/A</td>
</tr>
<tr>
<td>Review homework (practice test)</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>N/A</td>
</tr>
<tr>
<td>Lab reports</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>N/A</td>
</tr>
<tr>
<td>Formal lab reports (CHM2211 only)</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>N/A</td>
</tr>
<tr>
<td>Tests</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>N/A</td>
</tr>
<tr>
<td>Online resources</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>N/A</td>
</tr>
<tr>
<td>Valencia College Tutoring Center</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Please list any online resources or resources of any type that have been particularly helpful to you:

Please list any topics that have been particularly unclear so far that you would like to spend more time on:
Please respond to the following statements as honestly as possible:

<table>
<thead>
<tr>
<th>Statement</th>
<th>Very strongly agree</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
<th>Very strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I generally enjoy science classes.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>I generally enjoy humanities classes.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>I generally enjoy math classes.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>I enjoyed general chemistry classes.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>I look forward to organic chemistry classes.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>I would rather find out about things by asking an expert than by doing an experiment.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>The material covered in organic chemistry classes is uninteresting.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Organic chemistry helps make life better.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Talking to friends about organic chemistry outside of school would be boring.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>I feel that organic chemistry classes will be helpful in my future studies/career.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Please rate the value of the following tools for generating interest in organic chemistry:

<table>
<thead>
<tr>
<th>Tool</th>
<th>Extremely interesting</th>
<th>Very interesting</th>
<th>Interesting</th>
<th>Boring</th>
<th>Very boring</th>
<th>Extremely boring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic Chemistry textbook by Bruice</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>PowerPoint lecture real-life applications (slides about ibuprofen, sugars vs. cellulose, Nobel prize, green tea free radicals, etc.)</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Group activities (naming models extra credit, alkene worksheet, etc.)</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Laboratory/ Operational Organic Chemistry lab book</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Formal lab reports (CHM2211 only)</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Please list any tools that you feel would be interesting or that you would like to see more of:

Please turn over.
FLO 1, Artifact 2: Key Concepts Pre-Quiz
Key Concepts Pre-Quiz

Name: ________________________________

Directions: Tests are to be completed on your own. If you need to leave the exam room, check out and
then back in with the professor. Phone calls, electronic devices, and conversation are prohibited at all
times. Turn in all papers with the test questions, periodic table, and any scratch paper.

Answer the following questions about the structure of dicyclohexylurea, shown below.

1a) Indicate the hybridization of each carbon atom on the structure above.

1b) The predicted N-C-O bond angle (indicated by arrows in the structure above) in
dicyclohexylurea is:
   a) 90°  b) 109.5°  c) 120°  d) 180°

2) Draw all significant resonance structures for dicyclohexylurea. Include formal charges and
   lone pairs.
Draw a reaction arrow to indicate the direction that the reaction will proceed. Label each species as acid or base in the blanks below.

3a)

\[
\text{CO}_3^{\text{Na}^+} + \text{HCl} \xrightarrow{?} \text{HCO}_2^- + \text{NaCl}
\]

\[pK_a = 7.0 \quad pK_a = 4.76\]

3b)

\[
\text{C}_{6}^\text{H}_{5}^\text{O}^- + \text{HN(H}_2\text{C}_2\text{H}_2\text{CH}_3}^\text{CH}_2\text{CH}_3 \xrightarrow{?} \text{C}_{6}^\text{H}_{5}^\text{OH} + \text{HN(CH}_2\text{H}_2\text{CH}_3)_{2}
\]

\[pK_a = 10.98 \quad pK_a = 9.89\]

For each reaction shown below, identify the nucleophile (with \text{Nu}) and the electrophile (with \text{E}). Draw arrows showing the movement of electrons for each reaction. Draw in lone pairs of electrons where necessary.

4)

\[
\text{C}_{6}^\text{H}_{5}^\text{C}O + \text{HCl} \rightarrow \text{C}_{6}^\text{H}_{5}^\text{C}O^+ + \text{Cl}^-
\]

5)

\[
\text{C}_{6}^\text{H}_{6} + \text{HBr} \rightarrow \text{C}_{6}^\text{H}_{6}^+ + \text{Br}^-
\]

\[pK_a = 2\]

page total: ________
Key Concepts Pre-Quiz

Name: ____________________________

Directions: Tests are to be completed on your own. If you need to leave the exam room, check out and then back in with the professor. Phone calls, electronic devices, and conversation are prohibited at all times. Turn in all papers with the test questions, periodic table, and any scratch paper.

Answer the following questions about the structure of formic acid, shown below.

\[
\begin{align*}
\text{O} & \quad \text{H} \\
\text{H} & \quad \text{C} \quad \text{O} \\
\end{align*}
\]

1a) Indicate the hybridization of each carbon atom on the structure above.

1b) The predicted O-C-O bond angle (indicated by arrows in the structure above) in formic acid is:

a) 90°  
   b) 109.5°  
   c) 120°  
   d) 180°

2) Draw all significant resonance structures for formic acid. Include formal charges and lone pairs.
- Draw a reaction arrow to indicate the direction that the reaction will proceed.
- Label each species as acid or base in the blanks below.

3a)

\[
\begin{align*}
\text{H}_2\text{CO}_2\text{H} & + \Theta\text{C}_2\text{N} & \text{?} & \Theta\text{C}_2\text{O} & + \text{H-C}_2\text{N} \\
pK_a = 3.78 & & & pK_a = 9.22
\end{align*}
\]

- -

3b)

\[
\begin{align*}
\text{HO-C}_2\text{OH} & + \text{H}_2\text{O} & \text{?} & \text{HO-C}_2\text{O} & + \Theta\text{H}_2\text{O} \\
pK_a = 6.35 & & & pK_a = -1.74
\end{align*}
\]

- -

For each reaction shown below, identify the nucleophile (with Nu) and the electrophile (with E). Draw arrows showing the movement of electrons for each reaction. Draw in lone pairs of electrons where necessary.

4)

\[
\begin{align*}
\text{C}_2\text{H}_4 & + \text{H-Cl} & \rightarrow & \Theta\text{H} & + \Theta\text{Cl} \\

\end{align*}
\]

- -

5)

\[
\begin{align*}
\text{H}_3\text{C-NH}_2 & + \text{H}_3\text{C-Cl} & \rightarrow & \text{H}_3\text{C-N-CH}_3 & + \Theta\text{Cl} \\

\end{align*}
\]

- -

2

Page total: ______
FLO 1, Artifact 3: Ice Breaker - Introductions
Orgo II Class Participation Activity – “Introductions”

**Directions:** To facilitate your introduction to your classmates and to Dr. Sessions, choose a partner sitting near you. Interview your partner by recording his/her answers to the questions below. When finished, your partner should ask you these same questions. Pay close attention to your partner’s answers; later you may spend one to two minutes introducing your partner to the rest of the class. Do not share anything you don’t want the rest of the class to know.

(Interviewer: Please print the answers neatly. These will be collected and kept by Dr. Sessions.)

**Interviewer Name:** __________________________________________

1. What is your name? (Last name, First name)
2. What high school did you attend (in what city, state)?
3. Who was your professor for CHM2210?
4. What is your major? What is your planned career? Which school are you affiliated with?
5. Briefly share one thing about yourself such as a hobby, personal preference, or a unique quality.
6. Why are you taking this course?
7. How does this course fit into your plans (major, career, etc.)?
8. How do you think organic chemistry is related to your future career?
9. Any concerns/fears about taking this course?
10. Name one thing that you would like to learn from the class. Be specific.
FLO 1, Artifact 4: Collaborative Activity Ground Rules
Collaborative Learning Activity Ground Rules

About 35 points in the class will come from group work activities since cooperative learning has been proven to be a valuable learning method. Working in a group with other people can sometimes be challenging so it helps to set the ground rules, putting everyone on the same page before even starting the activity. These same rules can also apply to laboratory partners. Learning to work well with others is part of your Valencia core competencies as well as a valued skill for employers!

Roles

Each person in the group should take a specific role. I know these roles seem cheesy at first, but it’s good to know exactly what you are expected to do. These roles should also prevent one person from dominating the conversation and others from not participating.

- **Reader** – reads and interprets the assignment to the group
- **Secretary** – writes down the consensus answer of the group
- **Checker** – makes sure that all members can explain how to solve the assigned problem or generate the appropriate report material; also acts as timekeeper
- **Encourager** – prods all members to participate in information gathering and discussion; also acts as devil’s advocate or skeptic to review ideas for potential problems

In a group of 3, the reader should also act as checker. In a group of 5, the encourager and the skeptic are two separate roles.

Rules

1. Listen actively.
2. Ask questions.
3. Give constructive feedback:
   - Don't express an opinion as a fact
   - Explain your reasons
   - Restate the original idea to be sure it's understood
   - Compliment another's idea
   - Respond, don't react
   - Don't interrupt
   - Critique the idea, not the person
   - Be courteous
   - Avoid jargon
   - Have awareness of body language and tone
   - Maintain appropriate humor
   - Expect some chit-chat in meetings
4. Have patience.
FLO 1, Artifact 5: Key Concepts Problem Worksheet
Organic Chemistry II Collaborative Learning Activity: Key Concepts

Ground Rules

About 35 points in the class will come from group work activities since collaborative learning has been proven to be a valuable learning method. Working in a group with other people can sometimes be challenging so it helps to set the ground rules, putting everyone on the same page before even starting the activity. These same rules can also apply to laboratory partners. Learning to work well with others is part of your Valencia core competencies as well as a valued skill for employers!

Roles

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In a group of 3, the reader should also act as checker. In a group of 5, the encourager and the skeptic are two separate roles.

Rules

1. Listen actively.
2. Ask questions.
3. Give constructive feedback.
4. Have patience.

In your group, answer the questions, alternating the reader, secretary, checker, and encourager for each section. The numbers in parentheses after each title indicate the textbook section (Bruice 6th ed.) to read for more detail. The Ch. 1-10 Review Powerpoint lecture notes and associated problems may also be useful. Also, feel free to ask me questions!
1) Lewis structures, line structures, and condensed formulas (1.4, 2.3)

Reader: ________, Secretary: ________, Checker: ________, Encourager: ________.

Molecules are held together by covalent bonds created by sharing electrons between two atoms. This is the driving force for all of chemistry: atoms undergo reactions to get 8 valence electrons! Only electrons in valence orbitals can bond. Reader: have someone explain how to determine the number of valence electrons (or read Section 1.2 of Bruice). Lewis structures illustrate all valence electrons surrounding an atom and how bonding occurs between atoms (Figure 1).

![Figure 1. Lewis structures for chlorine gas (Cl₂). Each chlorine atom has 7 valence electrons for a total of 14 in the whole molecule. When the shared electrons (bonding pair) are double-counted, each atom has the desired 8 electrons. Lone pair electrons are non-bonding, but still important.](image)

Line structures, a.k.a. skeletal structures, are simplified Lewis structures in which carbon and the hydrogens directly attached to it are hidden. This is important because organic chemicals are often large molecules that make it difficult and time-consuming to draw every single atom. Carbons are recognized simply as being at the end of a bond or at the joint of a bond. One then assumes that the hydrogens necessary to give carbon 8 electrons (4 bonds) are also there. The nice thing about molecular formulas in organic chemistry is that they are usually written in the same order that atoms are attached together and called condensed structures (Figure 2).

<table>
<thead>
<tr>
<th>Condensed Structure</th>
<th>Lewis Structure</th>
<th>Line Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH₃CH₂CH₂CH₃</td>
<td><img src="image" alt="Lewis Structure" /></td>
<td><img src="image" alt="Line Structure" /></td>
</tr>
<tr>
<td>CH₃CH₂CH₂OH</td>
<td><img src="image" alt="Lewis Structure" /></td>
<td><img src="image" alt="Line Structure" /></td>
</tr>
<tr>
<td>CH₃COCH₂CH₃</td>
<td><img src="image" alt="Lewis Structure" /></td>
<td><img src="image" alt="Line Structure" /></td>
</tr>
</tbody>
</table>

Figure 2. Structures for some organic molecules. Note that hydrogens attached to atoms other than carbon are shown.
Fill in the table with the missing condensed, Lewis (showing all lone pair electrons), or line structure. Hint: double-check your answer with total electron count and formal charges (Bruice, Section 1.4).

<table>
<thead>
<tr>
<th>Condensed Structure</th>
<th>Lewis structure</th>
<th>Line Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ( \text{CH}_3\text{CO}_2\text{H} )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. ( \text{CH}_2\text{CH}_3\text{CH}_2\text{NH}_3 )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. ( \text{H}_2\text{CO} )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. ( \text{CH}_2\text{CHCH}_2\text{NO}_3 )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. ( \text{(CH}_3\text{)}_2\text{CHSeCl} )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td>( \text{\c{=}O} )</td>
</tr>
</tbody>
</table>
2) Hybridization and molecular shape (1.7-1.14)


Recall that carbon has 4 valence electrons in 2s and 2p orbitals. Based on ground-state electron configuration, carbon should have only two bonds since it has two unpaired electrons:

$$[\text{He}] \quad \begin{array}{c}
\uparrow \\
2s \\
\downarrow \\
\uparrow \\
2p \\
\uparrow \\
\downarrow \\
\end{array}$$

In order to explain why carbon forms four equal bonds, chemists invented hybrid orbitals. If a 2s electron is promoted to an empty 2p orbital, then four unpaired electrons can give rise to four bonds,

$$[\text{He}] \quad \begin{array}{c}
\uparrow \\
2s \\
\uparrow \\
2p \\
\uparrow \\
\end{array} \text{ and then, create four equal hybrid orbitals:} \quad [\text{He}] \quad \begin{array}{c}
\uparrow \\
sp^3 \\
\uparrow \\
\uparrow \\
\downarrow \\
\uparrow \\
\downarrow \\
\end{array}$$

If three hybrid orbitals are made, then three equal bonds can be formed and one p orbital is left (to form a double bond):

$$[\text{He}] \quad \begin{array}{c}
\uparrow \\
sp^2 \\
\uparrow \\
2p \\
\uparrow \\
\downarrow \\
\end{array}$$

If two hybrid orbitals are made, then two equal bonds can be formed and two p orbitals are left (to form double and triple bonds):

$$[\text{He}] \quad \begin{array}{c}
\uparrow \\
sp \\
\uparrow \\
\downarrow \\
\uparrow \\
\downarrow \\
\end{array}$$

The molecular shape of the molecule is determined by how each of these orbitals can be separated from the other due to electron repulsion (since electrons have -1 charge) (Table 1). Remember VSEPR? An electron group is any collection of valence electrons, localized in a region around a central atom, that repels other groups of valence electrons. An electron group can be a lone pair, a single bond, a double bond, or a triple bond.

Table 1. The number of electron groups surrounding the central atom determines the shape of that piece of the molecule.

<table>
<thead>
<tr>
<th>e- groups</th>
<th>lone pairs</th>
<th>Hybridization</th>
<th>orbitals</th>
<th>bond angles</th>
<th>geometry</th>
<th>examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0</td>
<td>$sp^3$</td>
<td></td>
<td>109.5°</td>
<td>Tetrahedral</td>
<td>CH₄</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>$sp^3$</td>
<td></td>
<td></td>
<td>Trigonal pyramidal</td>
<td>NH₃</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>Bent</td>
<td>H₂O</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>$sp^3$</td>
<td></td>
<td>120°</td>
<td>Trigonal planar</td>
<td>BF₃</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>Bent</td>
<td>SO₃</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>Sp</td>
<td></td>
<td>180°</td>
<td>Linear</td>
<td>CO₂</td>
</tr>
</tbody>
</table>
CHM2211C  

Spring 2013  

Sessions

a) Re-draw the six molecules from the table in section 1 below with correct molecular geometry.
b) Label each atom with its hybridization (it’s ok if it’s messy). Hint: draw out all lone pairs to see the electron groups.

1) 

2) 

3) 

4) 

5) 

6)
3) Resonance structures (electron delocalization) (7.3-7.6)


Some molecules have structures that cannot be shown with a single representation. Instead, we draw multiple structures, resonance contributors or structures, that contribute to the final structure but which differ in the position of the π bond(s) or lone pair(s).

<table>
<thead>
<tr>
<th>Resonance Structure Rules</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Identify the resonance donor atom: one with lone pair or π electrons.</td>
</tr>
<tr>
<td>- Identify the resonance acceptor atom: one with an open octet (less than 8e⁻) or an electron pair that can be displaced (a π bond can be displaced so the atom must be sp³ or sp hybridized).</td>
</tr>
<tr>
<td>- Push the electrons from donor to acceptor using a curved arrow.</td>
</tr>
<tr>
<td>- Check:</td>
</tr>
<tr>
<td>- All resonance structures must have the same number of valence electrons and total formal charge as the original Lewis structure.</td>
</tr>
<tr>
<td>- The octet rule must be obeyed.</td>
</tr>
<tr>
<td>- Atoms do not change positions in space between resonance structures.</td>
</tr>
<tr>
<td>- Do not move electrons to an sp³ carbon; it already has an octet.</td>
</tr>
<tr>
<td>- Connect the resonance forms by a double-headed arrow (not an equilibrium arrow!).</td>
</tr>
</tbody>
</table>

Resonance structures are incredibly important because they show the reactive sites of a molecule. A resonance structure can be drawn by using curved arrows to show where electrons move. Just remember that these arrows really mean that you are moving electrons from point A to point B (wherever your arrows are drawn) so make sure that movement is allowed (Figures 3 and 4).

**Figure 3.** Push lone pair on the negative oxygen toward the nitrogen and then oxygen with π bond (both sp³ hybridized).

**Figure 4.** Push lone pair electrons toward the sp³ hybridized carbons.
Draw all significant resonance structures for the molecules below. Hint: move the fewest electron pairs at a time to make sure that you draw all significant structures. Draw in lone pairs!

1) 
\[
\begin{align*}
\text{H-} & \text{C=O} \quad \text{N} \\
\text{H} & \text{C-} \quad \text{N} \quad \text{H}
\end{align*}
\]

2) 
\[
\begin{align*}
\text{O} & \text{H} \\
\end{align*}
\]

3) 
\[
\begin{align*}
\text{O} & \text{H} \\
\end{align*}
\]

4) 
\[
\begin{align*}
\text{N} \\
\end{align*}
\]

5) 
\[
\begin{align*}
\text{N} & \text{S} \\
\text{CH}_3 & \text{N} \\
\end{align*}
\]
4) Organic Acids and Bases

Reader: _______, Secretary: _______, Checker: _______, Encourager: _______.

For the dissociation of an acidic proton H⁺ from compound AH, equilibrium can be expressed mathematically:

$$K_a = \frac{[H_3O^+][A^-]}{[H_2O][AH]}$$  \quad -\log K_a = pK_a$$

This means:

a) The stronger the acid, the larger its $K_a$ value, and the smaller its $pK_a$ value... more $H^+$ will be dissociated and complexed with water (H₂O').

b) A strong acid will have a weak conjugate base. For example, HCl is a very strong acid, but Cl⁻ is a very weak base. These are physical properties of a compound and do not change.

c) In solution, if the pH of the solution is more basic than the $pK_a$ of the compound, the acidic hydrogen of the compound will be dissociated. In other words, there are less $H^+$ floating around in solution so the compound loses its acidic proton to maintain the equilibrium ($K_a$).

The reverse is also true for each one of these statements. **Answer the following questions.**

1) Formic acid, HCOOH, has $pK_a$ = 3.7, and picric acid, HCl₃H₃N₃O₁₀₃, has $pK_a$ = 0.3. Which is the stronger acid?

2) Ammonia, NH₃, has $pK_a$ = 34 and water has $pK_a$ = 15. Which do you expect to be a stronger base: amide (‘NH₃) or hydroxide (‘OH)?

3) Which direction do you expect the equilibrium to lie for the following equations (fill in the arrow)? Label each species as acid or base in the blanks below.

\[ \text{NH}_3 + \Theta \text{OH} \xrightarrow{?} \Theta \text{NH}_2 + \Theta \text{H}_2\text{O} \]

$pK_a = 34$ \quad $pK_a = 15$
b. \[
\begin{align*}
\text{CH}_3\text{CHOH}^+ & + \text{H}_2\text{CO}_3^- & \rightleftharpoons & \text{CH}_3\text{CO}^- \\
pK_a = 15.7 & & pK_a = 60
\end{align*}
\]

c. \[
\begin{align*}
\text{phenol} & + \text{amine} & \rightleftharpoons & \text{phenolate} + \text{amine} \\
pK_a = 9.95 & & pK_a = 10.75
\end{align*}
\]

4) **Draw the structure of the amino acid serine at pH = 3 and at pH = 14.**

\[
\begin{align*}
\text{pK}_a = 2.21 & & \text{pK}_a = 9.15 \\
\text{serine}
\end{align*}
\]
5) Reaction Mechanisms

Reader: _______  Secretary: _______  Checker: _______  Encourager: _______

Reaction mechanisms are the mathematical equations of organic chemistry. Each curved arrow describes precisely where two electrons move! Since electrons have a -1 charge, they are attracted to positive areas of the molecule. Here is the secret to organic chemistry: 1) Find the electron dense areas of a molecule (look for negative charges or lone pairs), called the nucleophile. 2) Use electronegativity differences to discover the positive areas in the other molecule, called the electrophile. 3) Draw an arrow from the negative to positive and move the electrons accordingly. See Figure 5 for a familiar example.

\[ \text{Figure 5. Mechanism for the alkene addition reaction. Notice the colors of the new bonds correspond to the electrons that formed them. Step 1) Alkene double bond electrons form a bond to hydrogen. Since hydrogen already had two electrons (bond to bromine), that bond must be broken with those two electrons going to make bromide anion. Step 2) Bromide uses two lone pair electrons to form a bond to the electron deficient carbocation.} \]

Remember that each species is a Lewis structure so all the usual rules must be obeyed.

Draw the curved arrows to form the product shown. Label each species as nucleophile or electrophile in the blanks.

1) \[ \text{[Diagram]} \]

2) \[ \text{[Diagram]} \]
3)

\[
\begin{align*}
\text{HO}^- & + \text{HO}^-\text{Cr}^{VI}\text{O}_2\text{H}_2 & \rightleftharpoons & \text{HO}^-\text{Cr}^{VI}\text{O}_2\text{H}_2^- + \text{H}_2\text{O} \\
\end{align*}
\]

\[\text{CO}_2^- \quad \text{H}_2\text{CrO}_3 \quad \text{H}_3\text{O}^+ \]

*Draw the product of the curved arrows in each equation. Label each species as nucleophile or electrophile in the blanks.*

4)

\[
\begin{align*}
\text{O}^-\text{H} & + \text{EtOH} & \rightarrow & \text{EtO}^-\text{H} \\
\end{align*}
\]

5)

\[
\begin{align*}
\text{CH}_2=\text{CH} & + \text{HCl} & \rightarrow & \text{CH}_3\text{CH}_2\text{Cl} \\
\end{align*}
\]
FLO 1, Artifact 6: Key Concepts Post-Quiz
Key Concepts Post-Quiz

Name: ________________________________

Directions: Tests are to be completed on your own. If you need to leave the exam room, check out and then back in with the professor. Phone calls, electronic devices, and conversation are prohibited at all times. Turn in all papers with the test questions, periodic table, and any scratch paper.

Answer the following questions about the structure of the thiazolium salt shown below.

\[
\begin{array}{c}
\text{CH}_3 \\
\text{N} \\
\text{S}
\end{array}
\]

1a) Indicate the hybridization of each carbon atom on the structure above.

1b) The predicted C-N-C bond angle (indicated by arrows in the structure above) in the thiazolium salt is:

a) 90°   b) 109.5°   c) 120°   d) 180°

2) Draw all significant resonance structures for the thiazolium salt shown above. Include formal charges and lone pairs.
Draw a reaction arrow to indicate the direction that the reaction will proceed. Label each species as acid or base in the blanks below.

3a)  
\[ \text{Ph}\text{N}^+\text{OH}\text{O} + \text{H}_3\text{C}\text{C}\text{O}^- \quad ? \quad \text{Ph}\text{N}^+\text{O}^- + \text{H}_3\text{C}\text{C}\text{OH} \]
\[ p\text{Ka} = -12.4 \quad\text{and}\quad p\text{Ka} = -4.76 \]

3b)  
\[ \text{O}^-\text{H} + \text{NH}_2 \quad ? \quad \text{O}^- + \text{NH}_2^+ \]
\[ p\text{Ka} = -2.05 \quad\text{and}\quad p\text{Ka} = 10.75 \]

For each reaction shown below, identify the nucleophile (with Nu) and the electrophile (with E). Draw arrows showing the movement of electrons for each reaction. Draw in lone pairs of electrons where necessary.

4)  
\[ \text{CH}_3\text{C}^+\text{H}_2\text{CH}_3 \quad \rightarrow \quad \text{CH}_2\text{C} \quad + \quad \text{CH}_3\text{C}^-\text{H}_2\text{CH}_3 \]

5)  
\[ \text{O}^-\text{H} + \text{Br}^-\text{Br} \quad \rightarrow \quad \text{O}^\text{Br} \text{C} \text{H} \quad + \quad \text{Br}^-\text{H} \text{C} \text{H}_3 \]

2  

page total: _______
Key Concepts Post-Quiz

Name: _____________________________________________

Directions: Tests are to be completed on your own. If you need to leave the exam room, check out and then back in with the professor. Phone calls, electronic devices, and conversation are prohibited at all times. Turn in all papers with the test questions, periodic table, and any scratch paper.

Answer the following questions about the structure of nitroethene shown below.

\[
\begin{array}{c}
  \text{O}_2^+ \\
  \text{N} \equiv \\
  \text{O} \\
\end{array}
\]

1a) Indicate the hybridization of each carbon atom on the structure above.

1b) The predicted C-C-C bond angle (indicated by arrows in the structure above) in nitroethene is:

   a) 90°  b) 109.5°  c) 120°  d) 180°

2) Draw all significant resonance structures for nitroethene shown above. Include formal charges and lone pairs.
• Draw a reaction arrow to indicate the direction that the reaction will proceed.
• Label each species as acid or base in the blanks below.

3a)

\[ \text{CH}_3\text{CH}_2\text{OH} + \Theta\text{CH}_3 \rightleftharpoons \text{CH}_3\text{CH}_2\Theta \rightleftharpoons \text{CH}_3\text{CH}_2\Theta + \text{CH}_4 \]

\[ pK_a = 15.9 \quad pK_a = 40 \]

3b)

\[ \Theta\text{CH}_3\text{NH}_3 + \Theta\text{H}_3\text{C}_2\Theta \rightleftharpoons \text{CH}_3\text{NH}_2 + \text{H}_3\text{C}_2\Theta \]

\[ pK_a = 38 \quad pK_a = 4.74 \]

For each reaction shown below, identify the nucleophile (with \text{Nu}) and the electrophile (with \text{E}). Draw arrows showing the movement of electrons for each reaction. Draw in lone pairs of electrons where necessary.

4)

\[ \Theta\text{SH} + \Theta\text{OH} \rightarrow \Theta\text{S} + \Theta\text{H}_2\text{O} \]

5)

\[ \Theta\text{OH} + \Theta\text{OH} \rightarrow \Theta\text{OH} \]

\[ \text{page total: } \]
FLO 1, Artifact 7: Opinion Survey on Key Concepts Collaborative Learning Activity
## Opinion Survey on Key Concepts Collaborative Learning Activity

**Directions:** Please take the time to answer the following questions. Your opinion will shape the class for future students. Thank you.

1. Please respond to the following statements as honestly as possible.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Very strongly agree</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
<th>Very strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>The collaborative learning activity helped me to remember/learn the key review concepts.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>I felt actively engaged in learning during the activity.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>I enjoyed the activity more than a lecture.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>The activity questions were an appropriate level of difficulty.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>I understand why the questions covered are key concepts for organic chemistry.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>My group worked well together.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>I felt cooperation and helpfulness among my group.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>All members of my group contributed to the activity.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Members of my group adhered to their assigned roles during the activity.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>I felt that I could share my viewpoint in my group.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>I felt that my success was linked to the success of my group.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Working in a group is an effective method for remembering/learning the concepts.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>This activity helped me to grow in Valencia’s core competencies (Think, Value, Communicate, and Act).</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>The diagnostic quiz/post-quiz helped me to recognize how well I understood the concepts.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>The diagnostic quiz and post-quiz were graded and returned in a timely manner.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

*please turn over*
2. Please feel free to add your comments (about working in groups, the activity worksheet, etc.).

3. Having completed this review activity, is there anything that your Organic Chemistry 1 course could have done to better prepare you for Organic Chemistry 2?
FLO 1, Artifact 8: Examples of Student Work from Pre- to Post-Quiz
Examples of Student Work from Pre- to Post-Quiz for FLO 1

Examples of student responses from the pre- and post-quiz are included for the open-response questions to show improvement in knowledge for specific concepts.

Student no. S13ZA (Example of 100% increase on resonance question)

This piece of student work appears to demonstrate increase in knowledge on Lewis structures, formal charges, and resonance structures (see correct use of resonance arrows, discontinuation of ‘major and minor product’ in the post-quiz).

PRE-QUIZ:

2) Draw all significant resonance structures for formic acid. Include formal charges and lone pairs.

POST-QUIZ:

2) Draw all significant resonance structures for nitroethene shown above. Include formal charges and lone pairs.
Student no. S13WE (Example of 68% increase on resonance question)

This piece of student work appears to demonstrate increase in confidence of knowledge on resonance structures (student comment on pre-quiz is ‘not comfortable with drawing this resonance structure’). The fact that the student missed the octet on oxygen and nitrogen will lead me to add more discussion of this detail for future review activities.

PRE-QUIZ:

2) Draw all significant resonance structures for formic acid. Include formal charges and lone pairs.

![Image of formic acid resonance structure]

POST-QUIZ:

2) Draw all significant resonance structures for nitroethene shown above. Include formal charges and lone pairs.

![Image of nitroethene resonance structures]
Student no. C12CR (Example of 50% increase on mechanism question)

This piece of student work appears to demonstrate increase in knowledge on definition of electrophile versus nucleophile.

PRE-QUIZ:

For each reaction shown below, identify the nucleophile (with Nu) and the electrophile (with E). Draw arrows showing the movement of electrons for each reaction. Draw lone pairs of electrons where necessary.

POST-QUIZ:
Student no. C12ML (example of 45% increase on mechanism question)

This piece of student work appears to demonstrate some increase in knowledge in use of curved arrows.

PRE-QUIZ:

![Diagram of chemical reactions with curved arrows]

POST-QUIZ:

![Diagram of chemical reactions with curved arrows]
FLO 1, Artifact 9: Examples of Student Work from Collaborative Learning Activity
Examples of Student Work from Collaborative Learning Activity for FLO 1

Examples of student responses from the Collaborative Learning Activity Worksheet are included to help demonstrate success of the activity.

For spring 2013, I added an introduction emphasizing the importance of group work and the roles with the group. As part of the activity, I asked students to discuss amongst the group an advantage and disadvantage of group learning. Even though it was short and casual, students took the time to consider the method. Here are a few of their notes on the worksheets regarding the discussion:

Student no. S13CG

Group work

Advantage: pool resources, share knowledge ✓

Disadvantage: possibility of conflict ✓

Student no. S13JM

Pros ✓
Multiple opinions

Cons ✓
Easy to distract (off-track)

Rule of behavior: Participation
Some groups had worksheet responses that were very neat and comprehensive as a result of scratch paper, which all members felt free to draw on. The secretary would then transcribe the agreed upon response. For example, Student no. S13ZA

CHM2211C  Spring 2013  Sessions

a) Re-draw the six molecules from the table in section 1 below with correct molecular geometry.
b) Label each atom with its hybridization (it’s ok if it’s messy). Hint: draw out all lone pairs to see the electron groups.

1)  

2)  

3)  

4)  

5)  

6)  

Laura B. Sessions, Ph.D. Faculty Portfolio  Page 82
Often, there was evidence of working the problems out on the paper (scribbles in margins).

Student no. S13JM

1) Formic acid, HCOOH, has pKₐ = 3.7, and picric acid, H₃C₆H₂N₂O₇, has pKₐ = 0.3. Which is the stronger acid?
   Picric acid is the stronger acid because has the smaller pKₐ meaning it has a larger $K_a$.

2) Ammonia, NH₃, has pKₐ = 34 and water has pKₐ = 15. Which do you expect to be a stronger base:
   amide (NH₂) or hydroxide (OH)?
   Amide is weaker acid which means it has a stronger conjugate base.

3) Which direction do you expect the equilibrium to lie for the following equations (fill in the arrow)?
   Label each species as acid or base in the blanks below.
   a. $\text{H}_2\text{O} + \text{NH}_3 + \text{OH}^- \rightarrow \text{NH}_2^- + \text{H}_2\text{O}$
      $\text{pK}_a = 34$
   b. $\text{H}_2\text{O} + \text{H}_3\text{O}^+ \rightarrow \text{H}_3\text{O}^+$
      $\text{pK}_a = 15$

(redundant information added: H₂O, H₃O⁺)
FLO 1, Artifact 10: Key Concepts Post-Quiz from Lecture Classes
Diagnostic Test

Name: ________________________________

Directions: Tests are to be completed on your own. If you need to leave the exam room, check out and then back in with the professor. Phone calls, electronic devices, and conversation are prohibited at all times. Turn in all papers with the test questions, periodic table, and any scratch paper.

Answer the following questions about the structure of dicyclohexylurea, shown below.

\[
\begin{array}{c}
\text{N} \\
\text{O}
\end{array}
\begin{array}{c}
\text{N} \\
\text{O}
\end{array}
\]

1) Indicate the hybridization of each carbon atom on the structure above.

2) The predicted N-C-O bond angle in dicyclohexylurea is:
   a) 90°    b) 109.5°    c) 120°    d) 180°

3) Draw all significant resonance structures for dicyclohexylurea. Rank them according to stability. Include formal charges and lone pairs.
For which of the reactions shown below will the equilibrium not lie in direction shown by the arrow? (Circle the question number.) Label each species as acid or base in the blanks.

(Relevant $pK_a$ values: $H_2O$, 15.7; $Et_3NH^+$, 10.98; $PhOH$, 9.89; CH$_3$COOH, 4.76; HCl, -7.0)

4) 
\[ \text{CH}_3\text{CO}^- + \text{Na}^+ + \text{H}^+ \rightarrow \text{CH}_3\text{OH} + \text{Na}^+ \text{Cl}^- \]

5) 
\[ \text{PhOH} + \text{NaOH} \rightarrow \text{PhO}^- + \text{H}_2\text{O} \]

6) 
\[ \text{PhO}^- + \text{H}^+\text{CH}_3\text{CH}_3 \rightarrow \text{PhOH} + \text{HN(CH}_2\text{CH}_3)_2 \]

For each reaction shown below, identify the nucleophile (with $\text{Nu}$) and the electrophile (with $\text{E}$). Draw arrows showing the movement of electrons for each reaction. Draw in lone pairs of electrons where necessary.

7) 
\[ \text{Cl}^- + \text{C}_6\text{H}_11 \rightarrow \text{Cl}^- + \text{C}_6\text{H}_11 \]

8) 
\[ \text{H}_2\text{C} = \text{C} + \text{H}_2\text{Br} \rightarrow \text{H}_2\text{C} = \text{C} + \text{H}_2\text{Br} \]

9) 
\[ \text{C}_6\text{H}_11\text{O} + \text{H}_2\text{Cl} \rightarrow \text{C}_6\text{H}_11\text{OH} + \text{H}_2\text{Cl} \]
Diagnostic Test

Name: ____________________________

Directions: Tests are to be completed on your own. If you need to leave the exam room, check out and then back in with the professor. Phone calls, electronic devices, and conversation are prohibited at all times. Turn in all papers with the test questions, periodic table, and any scratch paper.

Answer the following questions about the structure of 1-cyclohexylbut-2-yn-1-one, shown below.

1a) Indicate the hybridization of each carbon atom on the structure above.

1b) The predicted C-C-O bond angle (indicated by arrows in the structure above) is:
   a) 90°   b) 109.5°   c) 120°   d) 180°

2) Draw all significant resonance structures for 1-cyclohexylbut-2-yn-1-one. Rank them according to stability. Include formal charges and lone pairs.

SCORE: _____/5

page total: _____
Draw a reaction arrow to indicate the direction that the reaction will proceed. Label each species as acid or base in the blanks below.

3a)

\[
\begin{aligned}
\text{Ph}^+ \text{N}^+ \text{O}^- \text{OH} + \text{H}_3\text{C}^+ \text{C}^- \text{O}^- & \quad \xrightarrow{?} \quad \text{Ph}^+ \text{N}^+ \text{O}^- + \text{H}_3\text{C}^+ \text{C}^- \text{OH} \\
p\text{Ka} = -12.4 & \quad \text{p\text{Ka}} = -4.76
\end{aligned}
\]

3b)

\[
\begin{aligned}
\text{Ph}^- \text{OH} + \quad \text{N}^- \text{H} & \quad \xrightarrow{?} \quad \text{Ph}^- \text{O}^- + \quad \text{N}^- \text{H}^+ \\
p\text{Ka} = 9.95 & \quad \text{p\text{Ka}} = 10.75
\end{aligned}
\]

For each reaction shown below, identify the nucleophile (with Nu) and the electrophile (with E). Draw arrows showing the movement of electrons for each reaction. Draw in lone pairs of electrons where necessary.

4)

\[
\begin{aligned}
\text{Br^- C}^- \text{H} & \quad \xrightarrow{\text{H}^+} \quad \text{C}^- \text{H} + \quad \text{Br}^- \\
\end{aligned}
\]

5)

\[
\begin{aligned}
\text{Cl^- CO} & \quad \xrightarrow{\text{NH}3} \quad \text{NH}_3\text{CO}^- \\
\end{aligned}
\]
Data Analysis

The nature of action research is to examine and improve teaching practice based upon active cycles of simultaneous change and research upon student subjects. The statistical analysis for the action research project, FLO 1, was completed to corroborate observed differences, not as a statement of real statistical significance due to the following limitations.

- Different questions were posited on the pre- and post-quiz intentionally.

First, the pre-quiz was returned to students as feedback so the same questions repeated on a post-quiz would not have yielded real results since students might have simply remembered the answers (a lower level in Bloom's taxonomy than desired). I believe that tests and quizzes are strong motivators so I always return them to the students to use as learning tools. This use of the quiz also led me to administer different pre- and post-quiz questions every semester. An effort was made to ensure that the level of questions was the same from class to class and the format and style of questions was the same (FLO 1, Artifact 2: Key Concepts Pre-Quiz, FLO 1, Artifact 6: Key Concepts Post-Quiz, FLO 1, Artifact 10: Key Concepts Post-Quiz from Lecture Classes). Second, the post-quiz questions were designed to be more difficult compared to pre-quiz questions. This design ensures that any increase in score is a real improvement and not an issue of question quality.

- Quiz grade distributions for FLO 1 were not normally distributed (Figure 4, Figure 5, Figure 6).

![Figure 4. Collaborative learning activity pre-quiz grade distribution.](image-url)
The class populations are subject to random sampling errors since classes were chosen by the students based upon class time, semester, and other factors.
The measures of center (averages) and spread (standard deviations) were calculated using Excel. The t-tests were performed using StatCrunch by Pearson, a free online tool for educators (www.statcrunch.com).

- FLO 1, performance indicator b: Students will improve abilities to employ the key concepts as shown by increased scores from pre- to post-quiz.

For comparison of pre- to post-quiz scores, a paired t-test was used. The analysis produced a significant t value ($t_{33} = -5.60$, $p<0.001$) as shown in Table 8.

**Hypothesis test results:**

$\mu_1 - \mu_2$: mean of the paired difference between pre-quiz scores and post-quiz scores

$H_0: \mu_1 - \mu_2 = 0$ (null hypothesis is that there will be no statistical difference between pre- and post-quiz scores)

$H_A: \mu_1 - \mu_2 \neq 0$ (alternate hypothesis is that there will be a difference between pre- and post-quiz scores)

Table 8. Paired t-statistic for FLO 1 pre- to post-quiz comparison (performance indicator b).

<table>
<thead>
<tr>
<th>Pre-quiz average</th>
<th>Post-quiz average</th>
<th>t-statistic</th>
<th>Degrees of freedom</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>52.0%</td>
<td>72.7%</td>
<td>-5.60</td>
<td>33</td>
<td>0.000003</td>
</tr>
</tbody>
</table>

- FLO 1, performance indicator c: Students who participated in the learning-centered group activity will show improved abilities over students who participated in lecture (comparison from previous semesters) as shown by higher scores on post-quiz comparison of the two groups.

For comparison of post-lecture quiz to post-collaborative-learning-activity quiz, an independent samples t-test was used. The analysis produced a significant t value ($t_{64} = 3.32$, $p=0.00147$) as shown in Table 9.

**Hypothesis test results:**

$\mu_1$: mean of post-collaborative-learning-activity quiz

$\mu_2$: mean of post-lecture quiz

$\mu_1 - \mu_2$: mean difference

$H_0: \mu_1 - \mu_2 = 0$

$H_A: \mu_1 - \mu_2 \neq 0$

(with pooled variances)

Table 9. Independent samples t-statistic for FLO 1 post- to post-quiz comparison (performance indicator c).

<table>
<thead>
<tr>
<th>Post-lecture quiz average</th>
<th>Post-CL Act quiz average</th>
<th>t-statistic</th>
<th>Degrees of freedom</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>53.8%</td>
<td>72.7%</td>
<td>3.32</td>
<td>64</td>
<td>0.00147</td>
</tr>
</tbody>
</table>
IV. Faculty Learning Outcome #2

Faculty Learning Outcome #2

Create a small group activity that will improve Organic Chemistry I students’ ability to investigate application of one course concept in a career function that interests them.

Essential Competencies and Indicators Addressed:
1) LifeMap
   - help students to continue clarifying and developing purpose (attention to life, career, education goals)
   - help students identify where academic behaviors can be adapted as life skills (e.g., library search skills, decision-making, communication skills, scientific understanding, etc.)

2) Professional Commitment
   - stay current in discipline/academic field (e.g., professional organizations, conferences, journals and other literature, etc.)
   - access faculty development programs and resources

Adequate Preparation

Two frequently overheard sentiments in my classes are: 1) that organic chemistry is a ‘weed-out’ course for pre-medical, pre-pharmacy, and other pre-professional students and, 2) that students will never need the information again after their pre-professional exam. From speaking to my colleagues, these are common student sentiments in undergraduate organic chemistry courses. This attitude is detrimental because students do not invest their time to succeed in the class, fail to examine their career goals in light of new information from the course, and generally do not utilize the course to its fullest value.

To further examine this issue, I looked at student surveys that I administer as a regular part of my courses. In reviewing surveys from fall 2011 and spring 2012 courses of Organic Chemistry I and II (FLO 1, Artifact 1: Resource Utilization Survey), I found the following responses valuable in preparing for this project. When asked to rate course ‘tools for generating interest in organic chemistry,’ students on average rated real-life examples that I currently use as 5.0 out of 6.0 (Table 1). These real-life examples consist of slides within regular class PowerPoint presentations that relate the coursework to an application of interest. A few examples are saturated, unsaturated, and trans fat structures when discussing alkenes; different biological activity of R and S enantiomers of ibuprofen when introducing stereochemistry; table sugar versus cellulose when covering chair conformers; the Nobel Prize; etc. On the survey, only 13% and 11% of responding Organic Chemistry I and II students, respectively, would like to see more of these real-life examples in the class (Table 1). Since students do not seem to care about the application of the course materials to everyday life it is no wonder that they do not think they will need the information again. With this faculty learning
outcome, I hope to develop a more in-depth activity for exploration of organic chemistry in everyday life. Linking the course material to students’ personal goals and career aspirations should make the course material even more relevant and therefore, interesting to them.

In preparing for this project, I consulted my colleagues both for the topic and the methodology used. Many professors that I spoke with at Valencia use some real-life examples in teaching organic chemistry. Most simply incorporate these into regular lectures as the topic comes up as I have done to this point. Dr. Tim Barnett seems to have a more concerted approach. He shared that, ‘One of the things that I do in my organic chem classes is to show them that bridge, primarily to healthcare fields! All of my PowerPoint lectures, exams, and quizzes show some relevance to future careers. In addition, I have written a number of labs (mostly for Organic-2) that center around 1) multistep synthesis of biologically important molecules or drugs and 2) green chemistry.’ He also uses his Organic Chemistry II course as a model of a pharmaceutical research lab and has students go through levels modeling the career of a chemistry researcher.

While not wanting to take that much time from traditional core course material, I felt that giving students resources (news articles, case studies, video lectures, etc.) and asking open-ended application questions might encourage students’ interest and critical thinking skills. I shall loosely label all the resources offered in this learning outcome as case studies, since Clyde Herreid defines case studies as ‘stories with an educational message.’ Further, he says, ‘Stories put learning into context. Lectures often don’t do this. They are abstract mountains of facts.’ Good case studies center on an interesting issue and are thought-provoking. By teaching through stories and open-ended questions, the effort of learning comes from the students rather than the professor.

There are also additional benefits - case studies give students examples from outside the classroom to discuss chemistry with those not in their class. This furthers the spread of scientific literacy and also puts the students in the position of instructor, which further solidifies the concepts and ideas in their minds.

Given the potentially broad range of career aspirations in an organic chemistry class, I would like to allow students to choose a topic close to their interests. Therefore, I envisioned a database of case studies, current news articles, educational videos, and the like. However, using these kinds of resources as a deeper examination of a specific topic seems to be a rare occurrence in the field. For example, when searching for case studies, I found only about a dozen actual case studies for organic chemistry written at various levels, some too simple and some too advanced. Inquiries about resources in online discussion forums with chemistry colleagues were not very helpful either so it seems that this endeavor is rather unique in organic chemistry. Finally, very recently efforts have been reported to collect case studies for chemical education purposes by Herreid. However, I did not find a lot of succinct, yet pertinent and challenging resources, especially related to careers. Finally, I ended up writing two review articles myself to give sufficient background on a topic with an appropriate level of discussion about the organic chemistry involved.
In thinking about the implementation of this project, I wanted students to have the opportunity to discuss their investigation with one another. The current paradigm of teaching (constructivism) describes learning as a social enterprise in which relationships create motivation to learn and construct and provide support for learning difficult concepts. However, beginning the project in a summer term (twelve weeks compared to the usual fifteen) and not wanting to take away significant time from the class, I decided that a discussion forum on Blackboard would still allow interaction and opinion sharing amongst classmates. Online discussions utilize many of the same elements as collaborative learning when structured correctly and can have an even greater effect than classroom discussions since it creates an even platform for all participants (does not allow quieter students to remain unheard), and allows extra time for reflection (being asynchronous). Furthermore, many students are very engaged with online resources and technology for their educational advancement. Since this media is where students spend much of their time (personal as well as educational), we as educators should be prepared to exploit this focus for our courses. I am interested in better utilization of online resources in my classes, specifically Blackboard. Keeping current in this technology will improve me as an educator and prepare me for the future. While taking the Blackboard course (LTAD 3282, Blackboard Essentials), I had the opportunity to learn about Blackboard discussion forums in more detail. I decided that this project would be a good opportunity to try this new teaching method in my courses.

As one of a few chemistry professors that teaches online or hybrid courses, Wanda Davila spoke with me about her use of discussion forums. She uses them primarily as attendance verification for online courses, but has found that they can help students with course content as well. She frequently asks students to explain a certain concept, solve a certain question, or answer questions related to application of the course material. Since students must respond to one another’s posts, she has found that a meaningful discussion and elaboration on course content frequently occurs. One downside that she mentioned was low participation of students. This lack was attributed to the low point score of this activity (being attendance). This downside was taken into consideration when setting points values for the activity. Otherwise, it seems that online discussions will make a good forum for small group reflection.

I took the professional development course, Blackboard Essentials (LTAD 3282), which added many best practices to my development of the discussion forum. For example, questions must be thought-provoking and not allow for a yes or no response in order to encourage discussion. It is important that the professor participates in the discussions, emphasizing exemplary posts. In online discussion forums, it is important to create boundaries and guidelines, just as in face-to-face courses. Blackboard provides etiquette guidelines for online courses, which I modified to suit the discussion forum (FLO 2, Artifact 2, Discussion Forum Grading Rubric and Rules). Since giving students the metrics and resources to understand how they will be graded is imperative in teaching, I adapted Bill Pelz’s grading rubric, which describes knowledge construction as the primary goal (FLO 2, Artifact 2, Discussion Forum Grading Rubric and Rules).
Additionally, the Valencia College professional development course Developing Effective Surveys by Marcelle Cohen helped to refine my student opinion surveys.

**Appropriate Methods**

The experimental student sample consisted of Organic Chemistry I classes in the summer 2012 (1 section of 16 students) and spring 2013 (1 section of 22 students) semesters on West Campus at Valencia College.

At the beginning of each semester, I administered an ice breaker or introduction of the students to one another as well as to me (FLO 1, Artifact 3: Ice Breaker - Introductions). As part of this exercise, students discuss their career aspirations (Questions 4 and 7) and a question that reveals their attitude toward the class (Question 8):

- (Question 4) What is your major? What is your planned career?
- (Question 7) How does this course fit into your plans (major, career, etc.)?
- (Question 8) How do you think organic chemistry is related to your future career?

In my summer 2012 and spring 2013 Organic Chemistry I courses, I found thirteen different majors and twelve career goals in response to Question 4 (Table 10).

### Table 10. Self-reported Majors and Careers for Organic Chemistry I Students, Summer 2012 and Spring 2013.

<table>
<thead>
<tr>
<th>Major</th>
<th>No. of Students</th>
<th>Career</th>
<th>No. of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology</td>
<td>17</td>
<td>Doctor</td>
<td>11</td>
</tr>
<tr>
<td>Health science/pre-clinical</td>
<td>6</td>
<td>Physician’s assistant</td>
<td>6</td>
</tr>
<tr>
<td>Pre-pharmacy</td>
<td>3</td>
<td>Pharmacist</td>
<td>5</td>
</tr>
<tr>
<td>Biomedical science</td>
<td>3</td>
<td>Dentist</td>
<td>4</td>
</tr>
<tr>
<td>Pre-med</td>
<td>3</td>
<td>Veterinarian/animal care</td>
<td>4</td>
</tr>
<tr>
<td>Chemistry</td>
<td>2</td>
<td>Researcher</td>
<td>2</td>
</tr>
<tr>
<td>Microbiology</td>
<td>1</td>
<td>Optometrist</td>
<td>2</td>
</tr>
<tr>
<td>Nursing</td>
<td>1</td>
<td>Undecided</td>
<td>2</td>
</tr>
<tr>
<td>Forensic science</td>
<td>1</td>
<td>Chemical engineer</td>
<td>1</td>
</tr>
<tr>
<td>Chemical engineering</td>
<td>1</td>
<td>Nurse</td>
<td>1</td>
</tr>
<tr>
<td>Engineering</td>
<td>1</td>
<td>Forensic scientist</td>
<td>1</td>
</tr>
<tr>
<td>Political science</td>
<td>1</td>
<td>Air force</td>
<td>1</td>
</tr>
<tr>
<td>Psychology</td>
<td>1</td>
<td>Physical therapist</td>
<td>1</td>
</tr>
</tbody>
</table>

After investigation of student interests, resources were chosen based on career interests and also media types (case studies, video, news articles, etc.). In this way, students have options to choose topics and
methods of studying the topic that interests them (FLO 2, Artifact 1, Relevance of Organic Chemistry). Possible topics and activities were:

1. Vioxx (medical/pharmacy) – read a review on non-steroidal anti-inflammatory drugs (NSAIDs) and four current news articles; answer fact and opinion questions.

2. Thalidomide (medical/pharmacy) – read a summary article and a case study; answer fact and opinion questions.

3. Minamata Disease (chemical engineering/environmental) – read three articles; answer fact and opinion questions.

4. Bioethanol (environmental) – read a review and six current news and government informational web pages; answer fact and opinion questions.

5. Molecular gastronomy (food science) – read a summary article and watch video segments; answer fact and opinion questions.

An online discussion forum was created to allow students to reflect on their studies and share their thoughts with their peers. The Blackboard discussion forum was set up in a way that encouraged student interaction (FLO 2, Artifact 3, Student Discussion Forums) based upon best practices in online teaching and collaborative learning (see Adequate Preparation for more detail).

The activity schedule follows:

1. Guidelines for online discussion and the grading rubric were posted (FLO 2, Artifact 2, Discussion Forum Grading Rubric and Rules).
2. Week 1: Students read brief summaries of each possible topic. They chose one topic and posted to a discussion forum on that topic, explaining why they chose the topic. (Worth 3 points.)
3. I graded student responses to topic choice and added comments to encourage good discussion.
4. Week 2: Students completed the activity. They posted to the discussion forum their answers to the fact and opinion questions about the topic. (Worth 7 points.)
5. Week 3: Students read and responded to two classmates’ posts about the topic. (Worth 5 points.)
6. The activity student posts and responses were graded according to a rubric (FLO 2, Artifact 2, Discussion Forum Grading Rubric and Rules).
7. Students took a survey about the activity (FLO 2, Artifact 4, Opinion Survey on Career Group Activity).
The assessment strategies were:

- **Formative assessment:** After students’ initial posts, I left many comments in the discussion forum. This allowed me to encourage thoughtful responses and also correct any major misconceptions or rule violations.
- **Summative assessment:** A grading rubric was used to grade students’ participation in the discussion forum.
- **A survey was administered to students after the activity.**

I analyzed the student work and survey opinions to determine the success of the project.

**Significant Results**

The activity and small group discussion forum was created (FLO 2, Artifact 1, Relevance of Organic Chemistry). Finding information at an appropriate level was the most challenging part of this project. As mentioned in the Adequate Preparation, there were **not** a lot of readily available, pre-existing case studies or discussions available. Because of this, I ended up writing two of the reviews myself (for the Vioxx discussion and for the bioethanol discussion). I wanted the organic chemistry of each topic to really stand out to the students and be highlighted as concretely as possible.

One improvement made for the spring 2013 semester discussion forum was requiring two responses to other students’ posts rather than only one as done in summer 2012. This change responded to some student feedback from the summer 2012 surveys that the activity did not feel like group work. For example,

‘This didn’t feel like a “group” activity. We each submitted our answered individually. It was still very informative.’

‘I am not sure exactly how this activity had much group work besides reading another post and responding. I don’t really consider that group work, because we didn't work together to come up with a product or one post. People in a group voiced their opinions and by responding to their post just really served as a discussion in my opinion, not so much as a group project.’

Requiring two responses to classmates’ posts made the activity slightly more discussion and less solo reading and writing work.

For the most part, I found student discussions and responses were very thoughtful and lucid. Students stayed on task in discussions, prepared well-written arguments, and even frequently added extensive

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*All students comments in this portfolio are provided unedited, as they were written.*

Laura B. Sessions, Ph.D. Faculty Portfolio
research and references to their posts. Examples are provided (FLO 2, Artifact 3, Student Discussion Forums).

For the spring 2013 semester, I added a discussion question regarding the necessity of organic chemistry knowledge and skills for the people working in the case study and for students’ own future careers: ‘What skills or facts from organic chemistry would be useful to [insert discussion topic here] (or it is not necessary)? Does any of this apply to your personal career goals? Explain.’ Although the essence of these questions was contained in the survey for summer 2012 and spring 2013 (‘How do you think organic chemistry is related to your future career?’), allowing students to post their answers in the discussion forum and read their classmates’ responses simply gave more opportunity for exploration. Many students took the time to consider how the activity applied to organic chemistry and envision the researchers or scientists involved in the process, which was the goal of this project. From most student discussions, the relation of organic chemistry to their careers was examined and found to be positive. Selected responses included:

‘Organic chemistry is paramount to understanding drugs and their effects. Drugs are synthesized using principles of organic chemistry. For example, Vioxx was synthesized using Friedel-Crafts acylations, S$_2$N$_2$ Substitution and Dieckman condensation and elimination, to name a few. The chirality of the drug is also important. For example, the R enantiomer in ibuprofen is inactive but the body is able to convert it to the S enantiomer. The presence of these R enantiomers slows down the effects of ibuprofen. These ideas are very relevant to my career plan. As a nurse anesthetist, I need to have a solid understanding of how drugs effect the human body.’

‘a strong understanding of organic chemistry and biochemistry are necessary in order to be an effective researcher. We learned about how he enantiomer of thalidomide had completely different effects in people, other drugs would be no different. I’m pursuing a career in pharmacy, so understanding these topics is of the utmost importance to me.’

‘I feel that the organic chemistry can help in finding a new sort of drugs that may have similar effects with less harmful consequences by studying how the organic properties of this drug reacts with the body and what kind of chemical properties can be added to it so that it reacts with the body in a more efficient and safer manner.’

‘Skills or facts from organic chemistry that are useful for cooking are, measuring out ingredients, mixing, heating, monitoring how things progress over time and then making a decision about when everything has finished reacting/cooking. These skills are always necessary and helpful when cooking. These skills do also apply to my personal career goals. I plan to be a dentist and dentists have to be able to measure out stuff, heat stuff, and use these different skills too.’
‘Using organic chemistry for cooking is very important; it is a subject that we all apply to our daily lives, though it most definitely is not used consciously. While cooking, knowing principles such as hydrophobic and hydrophilic substances help determine what certain products are soluble or insoluble in. Consistencies, boiling points, acidities of ingredients, and many other organic chemistry facts and skills are also used in the kitchen on a daily basis. Pertaining to food, no it does not relate to my personal career goal though I have no doubt chemistry is a major part of learning about the field I have chosen.’

The survey administered after the activity was a forced choice Likert scale response to statements about the activity (Table 11). Several open response questions were provided as well (FLO 2, Artifact 4, Opinion Survey on Career Group Activity).

Table 11. Likert Scale Responses for Student Survey for FLO 2.

<table>
<thead>
<tr>
<th>Very Strongly Agree</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
<th>Very Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

The main goal of this project was to allow students to explore the application and relevance of organic chemistry in their futures. On the survey (FLO 2, Artifact 4, Opinion Survey on Career Group Activity), students agreed that the activity allowed them to investigate application of course concepts in a career function that interests them. This result was measured through several statements to ensure accuracy. I created survey questions with outcome-based statements for students to respond to. Outcome is a measure of what benefits the students feel the course has for them, again important since this can affect effort and performance. These survey questions were based upon several recently tested surveys on attitude, outcome, and other learning-related measures in science. 33,34,35,36

First, 94.1% of responding students agreed that ‘This activity helped me to see how organic chemistry is used in a profession (statement 1, Table 12).’ The average rating was 5.2 out of 6.0 (s=0.9). The second statement that measures whether the activity helped students explore a career option with respect to organic chemistry is ‘This activity helped me clarify and develop my professional/career goals (statement 2, Table 12).’ 85.3% of students agreed with the average response of 4.6 out of 6.0 (s=1.0).

Some comments from the open response question were:

‘Being a student who aspires to become a neurological physician, I’ve slowly noticed more and more classes helping me to achieve an understanding of what it means to understand what my role will be in the world. When I took anatomy, I was fascinated in learning the different parts of the body and how they function. When I took nutrition, I learned how different hormones and nutrients interact with the functions of the body. Now, in organic chemistry, I’m noticing the trends in the molecular interactions that occur within the body from nutrients as well as
man-made drugs. I know that this is all going to tie in together during my career path to help me be the best doctor I could hope to be.

‘The thing that I enjoyed most about this activity is that it allows me to have a real life assessment of the pros and cons of certain drugs which I will be doing in my career.’

Table 12. Results from Student Opinion Survey on FLO 2 (FLO 2, Artifact 4, Opinion Survey on Career Group Activity).

Students found that course skills apply to life (Table 12) based upon the fact that 94.1% of students agreed that ‘Reasoning skills used to understand chemistry can be helpful to me in everyday life’ (statement 3, Table 12). The average response was 4.9 out of 6.0 (s=0.9). Students responded positively to ‘The activity made clear the importance of organic chemistry to me’ (statement 4, Table 12) with 91.2% agreeing (average (χ)=4.9, standard deviation (s)=1.0). 100% of students agreed that ‘I could see the link between organic chemistry and the activity’ (statement 5, Table 12) (χ=5.1, s=1.0). One final statement that measures students’ perception of outcomes is ‘A good understanding of chemistry is necessary for me to achieve my career goals. A good grade in this course is not enough.’ (statement 12, Table 12) 91.2% of students agreed with this statement (χ=5.2, s=1.0).

Selected positive responses from the open response question that apply to these statements were:
‘Organic chemistry is all around us. The chemical reactions through cooking, the flow of electrons through lightening strikes and something simply as drying your hair has some bases to organic chemistry. Understanding how organic chemistry works will allow you as the individual to see the world through a different lens. Normally, students take organic chemistry to enter a science and/or healthcare field. Knowing organic chemistry allows a student to see view their particular field on another dimension.’

‘This assignment help me to learn more about organic chemistry and how it is apply in many different fields in the modern world. I really enjoy learning about bio-ethanol and its uses.’

‘Reading about a real life topic, that helped me better understand mercury poisioning.’

‘I liked how we were able to pick a topic that interested us most instead of having no choice. That being said I really enjoyed having a further look into biofuels and learning some information that could certainly affect my future.’

‘What I enjoyed most about the activity was the fact that I learned more about bioethanol and how it may be a better source for our environment. I learned also the advantages and disadvantages that it has and how Organic Chemistry relates to it.’

‘I enjoyed having the ability to read about a topic and then finding the answers to questions on my own. It was a lot more fun than listening to a lecture. I also liked the fact that this activity showed us how organic chemistry is related to things outside just the class and the lab.’

‘I enjoyed being able to pick a topic that I had a bit of previous knowledge of, so that I could further my understanding of a topic that already interested me.’

‘Learning a new topic. Learning new topics will facilitate your knowledge base and it helps you become more aware of what is actually going on in the world today.’

There was only one negative response about the activity from the two classes and it still acknowledged that the course applied to many topics, if not life:

‘Did not really like this activity though, I see how useful organic chemistry is in relation to many topics.’

The major area for improvement here is to add more varied case studies so that students with nearly every career choice will have an option related to them.
As one last measure of student exploration of organic chemistry and their careers, I analyzed the student ice breaker responses (FLO 1, Artifact 3: Ice Breaker - Introductions).20 As part of this exercise, students discuss their career aspirations (see Appropriate Methods). On this survey, when asked ‘How do you think organic chemistry is related to your future career?’ (Question 8), there were three responses (8.1% of responders) that I would characterize as negative:

‘Requirement.’

‘I don’t think it’s related much, but it will give me a good background for the GRE.’

‘Weed-out class.’

Many students beginning organic chemistry told me that they had ‘no idea’ what the course was about and so could not answer the question (‘not sure’ was the response from two students).

After the activity, there were three negative responses (8.8% of responders) to ‘How do you think organic chemistry is related to your future career?’ (FLO 1, Artifact 3: Ice Breaker - Introductions). It should be noted that because this question was first administered the first day of class, the course itself in addition to the activity should have an effect. For example, students no longer responded that they were ‘not sure’ or ‘had no idea’ what organic chemistry was. It should also be noted that not all students completed the activity and survey (four out of thirty-eight did not). Most likely though, this response rate could mean that there was not much influence from the activity on student attitude for the few whose minds could not be changed. However, since many responses mentioned topics and scenarios specifically from the activity, I tend to think the activity did have an effect for the large majority of students (vide supra: ‘This activity helped me to see how organic chemistry is used in a profession’ results and comments). Importantly, the majority of student responses were eloquent and expansive upon the idea. Here are a few representative examples:

‘I am pursuing in a pharmaceutical career, either in development or retail. Organic chemistry is one of the key concepts to understand how drugs can be used to contribute in an individual's health. Understanding the characteristics of chemicals and the ability to synthesis products is a skill that anyone in the science field should have.’

‘Organic chemistry is related to my future career because it is all around us. Everything we deal with has a chemical structure so it is helpful to know how substances react with each other.’

‘As a PA, I must be aware of chemical composition, interaction and processes within medication and the human body. Without this knowledge, medical error could occur at the patient's expense. As discussed in class, many important medications are of organic
composition, therefore understanding how they work within the body is essential for effective treatment of a patient.’

‘In the field that I attend to enter organic chemistry will play a big part of it. In the medical field, many cases and study are base on organic chemistry. In a sense, organic chemistry is very important in my future career.’

‘Even in present, I am surrounded with chemicals. I work in Pharmacy and I see chemicals around me. I see different type of drugs working same on our body. And also in future, If I decide to join medical, organic chemistry will help me learn the effects of chemical isomers on our body and that will help me understand the good combination of drug to be prescribed to my patients.’

‘People couldn't create the drugs I'll be working with as a pharmacist if they didn't have a strong knowledge of organic chemistry. It's my responsibility to understand what the drugs do, how they do it, and what they're made of.’

‘I want to become a Dentist therefore not only will I use the critical thinking required of me in Organic Chemistry but i will also be using a lot of the actual material in this class for knowing the appropriate ph of a healthy gum tissue and or the medication my patient might need.’

‘Well, in my opinion Organic Chemistry (and Organic Chemistry 2 reaction groups, will help me memorize the steps better for Biochem) will prepare me for biochemistry (how enzymes act on substrates etc), and biochemistry will prepare me for pharmacology, which is more concerned with Pharmacokinetics and a lot memorization of drugs and their interactions, side effects, therapeutic thresh holds and how they're broken down. And this is not only important for my future career in Dentistry, but also important to know how Organic Chemistry works so I can understand better how molecules form, interact, etc. Very interesting class for sure.’

‘I plan to be a doctor, precisely a pedratrician, that's why i was interested to this topic of Thalidomide and its risks on the unborn child. Now I know that I am not only learning Organic chemistry for my major but I will need to work also. It can help to decide which product to prescribe to the patients.’

‘Organic chemistry is the backbone to Biochemistry, which I can then link to nutrition and food science. I need to understand Organic if i wish to be successful in my future research/studies.’

The three negative responses were:
‘I do not think organic chemistry is related to my future career.’

‘I think understanding molecules are somewhat important for physicians when it comes to medications but I don't think it is a high priority. Most doctors that I have spoken to from shadowing opportunities have plain out told me that they do not use organic chemistry at all in their field when I have asked them in the past. In fact, recently one of the doctors I am shadowing in my internship told me he doesn't even know how to do a simple organic chemistry problem. So to answer your question, I don't think organic chemistry has much importance when it comes to my future career.’

‘I plan on being an optometrist. I do not see organic chemistry relating to this career. If I was working with the chemicals involved in the medication used on eyes then I'd see the connection, but not for my career.’

Clearly, improving this area will require more exploration of the medical fields or of day-to-day life applications to try to reach these last few students. It might be that these students are not reachable. It might be that a very specific case study showing organic chemistry saving the life of a patient would work. The next step for improvement here is more investigation of these students’ viewpoints.

Finally, students rated and commented on the online discussion format of the activity as well (FLO 2, Artifact 4, Opinion Survey on Career Group Activity). 100% of students responded positively to ‘I felt that I could share my viewpoint in my group’ and ‘Discussion in a group is an effective method for investigating this topic’ with average ratings of 5.3 and 5.1 out of 6, respectively (s=0.8 and 0.8, Table 12). Selected relevant positive comments to the open response question, ‘What did you enjoy most about the activity?’ were:

‘I enjoyed most discussing the topic.’

‘I enjoyed being able to read other peoples thought on the same subject that I might have had a completely different opinion on. It's interesting to see how people can think so differently.’

‘The group discussion gave me an idea on how others students approach this kind of subjects.’

‘I like working in groups it is a good way to learn from other students also other students can learn from you it is a win-win situation.’

Other relevant general comments regarding the format of the discussion are:

‘Great activity. loved working on it and being able to express what i believe and want to see happen.’
‘I liked that the activity was random in the sense that there were no groups assigned and one was able to choose whichever topic was most interesting based on personal beliefs. It was very interesting to see who in the class shares the same point of views as you.’

‘I was able to choose a topic was interested in, as well share my viewpoint with other students interested in the same subject.’

‘I enjoyed most that it gave the whole class an opportunity to do some research rather than follow an instruction list of how to do a lab and bring about more interaction with one another.’

‘I liked how we were able to pick a topic that interested us most instead of having no choice. That being said I really enjoyed having a further look into biofuels and learning some information that could certainly affect my future.’

**Reflective Critique**

**A. General Reflection**

I define this project a success in light of the depth of student discussion on the topics and the student comments in the survey. Of responding students, 91.2% agreed that they felt actively engaged during the activity with an average response of 4.9 out of 6 (Table 12). Interestingly, only 61.8% felt that they enjoyed the activity more than a lecture. I would like to posit that this latter result could stem from the fact that students can sit passively during a lecture while in this activity, students were required to learn, digest, and apply the information (to work!). In spring 2013, a student excitedly approached me to say that he really enjoyed the activity since it gave him an outlet to discuss his coursework, something that he could not do with his family or friends. Giving students a new experience is the most gratifying activity that a teacher can do!

Furthermore, the format of the activity is a success based upon student comments. Student responses to the question ‘What did you enjoy most about the activity?’ or ‘Please add any other comments.’ included a 41.2% that stated some form of enjoying discussing in groups and hearing the opinions and ideas of their classmates, a high number for an open response question. The group discussion would seem to be fundamental in this activity. Students stated that they enjoyed being able to select a topic that they were personally interested in. Finally, I strongly feel that since students spend so much time online, if we can meet them there, we will maximize their learning opportunities. In this project, I also had the opportunity to hear a lot more from my quieter students in the classes, a benefit of the online, asynchronous format.

I have learned that overall students really enjoyed learning from an activity that is different from the traditional content material of the course such as lecture and homework. They also really enjoyed
being able to give their opinions and to debate with their classmates. I intend to continue using this project in my classes. Eventually, writing my own case studies to be brief, pertinent to the practical application, and current will be the biggest future improvement to this particular project.

B. Critical Evaluation of Essential Competencies & Indicators in this FLO

1. LifeMap

- help students to continue clarifying and developing purpose (attention to life, career, education goals)
- help students identify where academic behaviors can be adapted as life skills (e.g., library search skills, decision-making, communication skills, scientific understanding, etc.)

Reflection:

Student responses certainly showed that the two LifeMap indicators were met in this activity since: 1) of responding students, 85.3% rated positively (rated 4-6, Table 12) to ‘This activity helped me clarify and develop my professional/career goals.’; 2) of responding students, 94.1% of students rated positively (rated 4-6) to ‘Reasoning skills used to understand chemistry can be helpful to me in everyday life.’; and 3) 100% of students responded positively (rated 4-6) to ‘Learning chemistry requires that I substantially rethink, restructure, and reorganize the information that I am given in class/read in the textbook.’. The latter two statements are outcome statements that measure students’ perceptions of what the course will do for them.\textsuperscript{33,34,35} More corroborating details can be read in the Significant Results section with regard to student comments on the activity.

I felt that exposing students to organic chemistry stories in the real world would help them to recognize the usefulness of organic chemistry. Further, I added two questions to the spring 2013 discussion for each topic: ‘What skills or facts from organic chemistry would be useful to [insert discussion topic here] (or it is not necessary)? Does any of this apply to your personal career goals? Explain.’ Having the opportunity to consider and discuss the professions in each story allows them to reflect on their own careers. Just being given the time in the class to stop and consider their futures in light of new information is a valuable exercise accomplished with this activity.

There is an opportunity for improvement by adding more discussion questions related to this project goal. I could add more discussion questions that pinpoint relevant reasoning skills from the coursework that are used in each case study. I would also like to explore students’ understanding of facts versus skills with respect to the course. Many students listed specific reactions or facts from the course, but did not list skills such as problem-solving skills, communication skills, laboratory safety skills, observation skills, research skills, etc. Lastly, as mentioned before, another future improvement would be to write my own case studies. This would also allow me to focus more on the career aspects and skills aspects of the case as related to organic chemistry.
2. **Professional Commitment**

- stay current in discipline/academic field (e.g., professional organizations, conferences, journals and other literature, etc.)
- access faculty development programs and resources

**Reflection:**

This project allowed me to stay current in the field of education by learning more about online tools in teaching through access of journals that were new to me, for example, *Journal of Asynchronous Learning Networks*. Despite being a relatively new branch of education, there are best practices in this area. One key example is to encourage instructor-student contact since the online text-based environment can be isolating. It is important in this environment to communicate frequently with students and to give expectations for response time to emails. As with face-to-face classes, advanced planning and well-defined guidelines create an environment for successful teaching and learning online. This structure is even more important in online teaching due to the asynchronous and impersonal barriers to communication. I have just skimmed the surface of online learning in using a discussion forum for this one project.

This project allowed me to take a professional development course at Valencia College, Blackboard Essentials (LTAD 3282). This course helped me to refine my use of Blackboard, an important tool even in face-to-face courses. Specifically, for this project, I learned best practices for setting up and facilitating online discussion forums (see Adequate Preparation for more detail). According to the course facilitator, online discussions are an extremely popular tool for professors to use.

An area for improvement is pursuing more professional development on this increasingly valuable and fast-evolving topic. For example, given students’ enjoyment of sharing their opinions, should I expand these open discussion forums to other areas of the course? Would students benefit from ongoing question-and-answer forums in Blackboard while working on homework?
Supporting Artifacts for FLO#2

FLO 2, Artifact 1, Relevance of Organic Chemistry
See separate document.
FLO 2, Artifact 2, Discussion Forum Grading Rubric and Rules
Discussion Forum Grading Rubric and Rules

‘No lab’ Lab Discussion Points and Due Dates

<table>
<thead>
<tr>
<th>Discussion Grade</th>
<th>Number of points</th>
<th>Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1: pre-survey and choosing a topic</td>
<td>3</td>
<td>July 1 10pm</td>
</tr>
<tr>
<td>#2: answer your questions on the discussion post</td>
<td>7</td>
<td>Available July 2, due July 9 10pm</td>
</tr>
<tr>
<td>#3: responding to 1 classmate’s post and post-survey</td>
<td>5</td>
<td>July 16 10pm</td>
</tr>
</tbody>
</table>

Discussion Posting Points

1. Is the comment accurate?
2. Is it relevant to the issue under discussion?
3. Have you taught us anything new?
4. Have you added to the academic atmosphere of this course?

<table>
<thead>
<tr>
<th>Points</th>
<th>Interpretation</th>
<th>Grading Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>Excellent (A)</td>
<td>The comment is accurate, original, and relevant. Teaches us something new, and is well written. Full credit comments add substantial teaching presence to the course, and stimulate additional thought about the issue under discussion.</td>
</tr>
<tr>
<td>75%</td>
<td>Above Average (B)</td>
<td>The comment lacks at least one of the above qualities, but is above average in quality. A 75% comment makes a significant contribution to our understanding of the issue being discussed.</td>
</tr>
<tr>
<td>50%</td>
<td>Average (C)</td>
<td>The comment lacks two or three of the required qualities. Comments which are based upon personal opinion or personal experience often fall within this category.</td>
</tr>
<tr>
<td>25%</td>
<td>Minimal (D)</td>
<td>The comment presents little or no new information. However, 25% comments may provide important social presence and contribute to a collegial atmosphere.</td>
</tr>
<tr>
<td>0</td>
<td>Unacceptable (F)</td>
<td>The comment adds no value to the discussion.</td>
</tr>
</tbody>
</table>
### Online Discussion Etiquette and Guidelines

<table>
<thead>
<tr>
<th>Guideline</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use descriptive subject lines</td>
<td>Make threads easy to follow and scan.</td>
</tr>
<tr>
<td>Be concise</td>
<td>Keep posts short and use uncomplicated language. Your audience is reading on-screen and may have several messages to read. Use attachments or link to Web sites for long, detailed information.</td>
</tr>
<tr>
<td>Stay on topic</td>
<td>Your message needs to adhere to the topic at hand. If it does not, find a suitable forum or start a new thread.</td>
</tr>
<tr>
<td>Make a valuable contribution</td>
<td>Simply agreeing or disagreeing with the author of a post is not considered participation in the discussion. Back up statements, such as &quot;I do not agree&quot; or &quot;Good point&quot; with rationale or evidence.</td>
</tr>
<tr>
<td>Respect others</td>
<td>Be respectful of others' opinions and remember the golden rule—to treat others as you want to be treated.</td>
</tr>
<tr>
<td>Be professional</td>
<td>Use professional language, including proper grammar, in academic-related posts. No slang, emoticons, or chat acronyms allowed.</td>
</tr>
</tbody>
</table>

See also Valencia’s rule on netiquette: [http://learn.valenciacollege.edu/webapps/portal/frameset.jsp?tab_group=courses&url=%2Fwebapps%2Fblackboard%2Fexecute%2Fcontent%2Ffile%3Fcmd%3Dview%26content_id%3D_2251477_1%26course_id%3D_8945_1%26framesetWrapped%3Dtrue](http://learn.valenciacollege.edu/webapps/portal/frameset.jsp?tab_group=courses&url=%2Fwebapps%2Fblackboard%2Fexecute%2Fcontent%2Ffile%3Fcmd%3Dview%26content_id%3D_2251477_1%26course_id%3D_8945_1%26framesetWrapped%3Dtrue)
FLO 2, Artifact 3, Student Discussion Forums
Examples of Student Discussions

Names have been blocked out.

Selected Examples of Topic Selection Assignment:

Thread: Vioxx
Post: RE: Vioxx
Author: Laura Sess

Posted Date: June 28, 2012 6:02 PM
Status: Published
Overall Rating:

I chose the drug Vioxx as my topic because I have had first hand experience with the GI problems (irritation to the lining of the stomach) that traditional NSAIDS offer. I am interested to learn the reasons this new “wonder drug” was pulled from the market. Working in the ER I see new medications prescribed that manufacturers claim to have less or safer side effects than the medications they are meant to replace, but after they are on the market for a fairly short amount of time, these new and so called “improved” medications seem to cause even more side effects, leading to the patient or their family taking legal action against the manufacturer and the physician prescribing the med. I’m sure we’ve all seen the commercials for class action suits! I think it will be interesting to see what “effects” surfaced after Vioxx was released which caused it to be pulled from the market.

(Post is Read)

Thread: Vioxx
Post: RE: Vioxx
Author: Laura Sessions

Posted Date: July 2, 2012 10:21 AM
Status: Published
Overall Rating:

You have an interesting personal as well as professional take on the story - I look forward to your responses on the questions.

(Post is Read)

Thread: Minamata disease
Post: RE: Minamata disease
Author: Laura Sess

Posted Date: July 1, 2012 6:25 PM
Status: Published
Overall Rating:

I am choosing to do my research on the Minamata disease because as a histotechnologist I have routinely worked with aldehyde and mercuric substances yet have not taken the time to educate myself on the roles either play in disease as a result of exposure. I feel this research will help me not only for this assignment, but for future occupational precautions as well.

(Post is Read)

Thread: Minamata disease
Post: RE: Minamata disease
Author: Laura Sessions

Posted Date: July 2, 2012 10:10 AM
Status: Published
Overall Rating:

Wow - I hope this proves valuable for you and your health!
Dr. Laura Sessions
June 28, 2012

I chose the thalidomide discussion topic because I have briefly heard about it in the past, but I am curious to know the history of the drug and what makes it so controversial. Also, I am aspiring to be a pediatrician and I would like to read more about how exactly it may or may not cause birth defects. If it is a cause of birth defects, I would like to find out why some companies still sell it, and perhaps why some people may still use it. Furthermore, I am extremely curious to know how thalidomide may be used to treat certain cancers. I have never heard of that aspect of this drug prior to this assignment.

(Post is Read)

Dr. Laura Sessions
July 1, 2012

I opt for this topic because I have great interest in renewable energy sources. The conventional (non-renewable) energy sources we employ today are not infinite and it will only be so long until we run short. Moreover, the devastating environmental effects of using fossil fuels will last through many generations. The sooner we cease our dependence on these fuels, the less pollutants will be released into the earth’s biosphere. Plus, every time the gas prices increase, I die a little inside.

(Post is Read)

Dr. Laura Sessions
July 1, 2012

I have a passion for cooking because I grew up watching the Food Network channel. I have always viewed cooking as an art because of the creativity and imagination. However, now it is not hard to imagine it as science either. I can remember years ago a chef using liquid nitrogen to flash freeze ice cream. Not only was I amazed but also baffled as to how chemistry and cooking could be used in the same sentence, and yet make a comfort food such as ice cream using a chemical element. I decided to discuss the topic of Molecular Gastronomy and discover why some chefs are deciding to use this form of cooking that involves tools from a science laboratory. I am curious to know if restaurateurs would allow such peculiar style of cuisine to be served to their customers. I wonder if the average consumer would define molecular gastronomy as unhealthy and artificial or as fascinating and magical.

(Post is Read)
Interesting points about the perception of the general public on these cooking techniques!

I chose this topic because I found the molecular gastronomy interesting. I find it interesting that the flavor of food has to do with reactions. The reactions in food is unique to me because nobody expects reactions to occur in food. I usually thought of food as just adding salt, milk or whatever ingredient needed for the food. I did not know there was reactions occurring which I could not see. The information was new to me.

I chose Molecular Gastronomy to hopefully encourage me to cook. I feel that I am relying way too much on eating out lately, and hope that a little science and novelty will inspire me to cook. I remember a former Chemistry professor saying that lab would be, "just like cooking." The only problem, in my opinion, is that there is no licking the bowl in Chemistry! (Well, one could, but it would be all sorts of unsafe and unhealthy). I am hoping that the farther I get into Molecular Gastronomy, that there may be some research into how cooking affects the nutrients within foods so that I can be conscientious of my food selection with my workout regiment and health goals.
Selected Answers to Discussion Questions and Responses to Fellow Students’ Posts:

Thread: Viokxx

Poster: Viokxx

Author: 

Posted Date: July 9, 2012 2:13 PM

Edited Date: July 9, 2012 2:22 PM

Status: Published

Overall Rating:

When Viokxx was originally pulled from the market by its producing company Merck & Co, it was pulled after the company found in a study that the drug was 1.9 times more likely to cause heart disease than the placebo drug that they used. According to Knox in his article on Viokxx, he states that this could be interpreted as by taking Viokxx, your chance of a heart attack will be doubled. Merck & Co discovered the defect of the drug doing a study completely unrelated to heart disease. They were initially “looking at 2,600 patients to see if Viokxx prevented such problems as colon polyps. The findings of an increased risk for heart problems were discovered by scientists monitoring safety in the study” (Knox).

When Merck & Co decided to pull the drug, I think they were doing it as a pre-caution to what could be found after the FDA got involved. I don’t think that they had enough evidence to pull the drug initially, but I think it was a really smart choice on their behalf. According to Science News, a 13 year study and intense debate have now confirmed that Viokxx is associated with an increased risk of heart attack and stroke. I think the evidence that they found is more than enough evidence to keep the drug out of our market.

For those who don’t know, Viokxx is a type of COX-2 Inhibitor. COX-2 is an enzyme that is activated at sites of injury which manufactures hormone-like substances called prostaglandins, which trigger painful inflammation. Viokxx and other COX-2 inhibitors are drugs that are designed to block the activity of the COX-2 enzyme and relieve pain. The new study found that “COX-2 is expressed in cells lining blood vessels” (http://www.sciencedaily.com/releases/2012/05/120502143846.htm), so removing it predisposes our bodies to blood clotting and high blood pressures. It is because of these facts that I believe Viokxx should remain off the market. I don’t think we should consider the gastrointestinal effects of NSAIDs when making the decision to keep Viokxx off the market when it causes a much more serious life threatening disease.

With the serious complications of heart disease that Viokxx causes, I think all nonsteroidal anti-inflammatory drugs (NSAIDs) should be investigated to make sure that they too do not increase the risk of heart diseases. According to Landau in her article on CNN, she states that “a large meta-analysis of 31 studies has found significant risks of cardiovascular events in people” who take these kinds of drugs. For the safety of all people I think it is important to determine if these kinds of drugs will cause cardiovascular diseases in its users. Based upon my readings on aspirin, I see that it actually protects against heart attacks and strokes so I don’t think that we should spend time studying the effects of that drug.

If people are interested in finding out more information on Viokxx, I would recommend they go to sites like drugs.com or rxlist.com, which are two sites that I came across while doing research. All of
the information that I found on these websites are consistent with peer reviewed and trusted websites containing information on Vioxx. I also spoke to my local pharmacist who advised that he too uses those sites to gather information on medications.

Works Cited:


Tags: None

You have some very detailed points about the effects of these drugs. To shine some light on your observations, I completely think it's about gaining the system. Individuals (the patient), in my opinion, the majority of them are unaware of the side effects behind taking certain medications for their illness. Over the past decades, as drug after drug has been recalled after gaining FDA approval, its hard not to wonder if FDA regulators haven't yet been captured by the pharmaceutical industry. This close relationship between the drug industry and the FDA is to far fetch. The FDA is completely aware of the side effects of these approved drugs. I think it's all about keeping the public in the dark. In the next coming decades, this trend in approving new drugs is going to continue. New evidence is going to surface adding fuel to the theory that several common prescriptions may increase the risk of heart attacks and stroke. The word may is critical here, because science is constantly changing. New systems of observations and experimentations are going to continue to appear explaining a new phenomena. Similarly, new drugs is going to hit the market carrying new side effects and a new brand name for a particular illness. A wise person once told me, you only get the answers to the questions you ask. If you can't pronounce it, don't buy it!

Tags: None
I agree with all of your points made in your reply except for one, the fact that you said that there wasn't enough evidence to keep vioxx from going on the market initially. I think that the study done in the test tubes was enough of a concern to possibly at least postpone the release of the drug for further testing due to possible harm to patients. If there is even a small chance of harm to patients then the drug should not be released whatsoever.

Your reply was well thought out and extremely thorough, I like the you quoted sources and it's evident that you did your research to make valid points. I also like that you even mentioned that a pharmacist is a reliable source for information on drugs, because I think that a lot of patients forget that. That's what pharmacists are there for; to give advice about medications. Most people just go to the pharmacy, pick up their medications and whenever the pharmacy tech or pharmacists asks "do you have any questions about your medications?" most people just say no! People need to utilize the information that is cut there and take their health into their own hands, because pharmaceutical companies are just cut to make money, and the release of Vioxx on the market shows that.

In reading your response, I really appreciated that you had cited sources and also that you used other sources such as your local pharmacist. It shows that you put a lot of work into this post!

I agree that the significance of major heart problems is much greater than the risk of gastrointestinal issues. Heart problems can kill you a lot more quickly than gastrointestinal problems. I do wonder, though, how much medication the patients in the study were taking. If it was normal doses, then I can see why it should be off the market completely. If it was in larger-than-usual doses, however, I think it could possibly be studied as a medication to be taken carefully and in small doses for people who do not want hardcore pain killers (narcotics) but cannot take ibuprofen or aspirin due to gastrointestinal issues. I would want to see studies where small doses were taken first, though (assuming the original study had studied large doses). Or perhaps another form of the drug, or a similar drug, could be derived from Vioxx. I guess what I'm trying to say is that I think it may still have some potential, and we shouldn't abandon it completely, unless they've determined that the drug cannot be used safely in any quantity.

Thanks for the easy-to-understand post!
1) Are the cardiovascular risks of Vioxx strong enough to justify removal of it from the market? Should the gastrointestinal effects of NSAIDs be considered in the decision?

I think that the cardiovascular risks associated with taking Vioxx are incredibly strong enough to justify it being removed from the market. Not only does it increase the chance of a patient having a heart attack in someone with cardiac risk factors, but it also increases the risk for heart attack in people without risk factors. The drug is not safe for even the healthiest patient. Vioxx does not affect the GI tract and intestinal lining of the stomach because it is a CO-2 inhibitor not CO-1. Traditional NSAIDs that are CO-1 inhibitors do affect the GI tract and cause problems, but these problems probably won’t kill you. Having a heart attack can, so no the GI effects of NSAIDs should not be considered in the decision because Vioxx does not affect the GI tract.

2) Do you think that NSAIDs should be investigated more carefully to make sure that they don’t increase cardiovascular risk? What about aspirin?
I think there is a lot more research that needs to be done on these drugs. Treating pain for arthritis I don’t think is worth taking a medication that can cause heart attack, stroke, or death. Aspirin, Ibuprofen, and Naproxen are all CO-1 and CO-2 inhibitors. The CO-1 part is what causes the irritation to the lining of the stomach and GI problems, but the CO-2 part of these drugs like Vioxx place the patient at higher risk for heart attack by blocking CO-2 which suppresses Prostacyclin, causing platelets to stick together and blood vessels to narrow leading to strokes and heart attacks. The fact that there was evidence of these risks shown in a test tube experiment just before Vioxx and Celebrex were approved and launched but the medications were still released seems completely wrong to me. I think there has been more than enough research showing the risks associated with these drugs, so why has more not been done to deal with these risks or more measures being taken to inform the public? Doctors prescribe these medications knowing the risks but the patient is never counseled on them, and not many patients actually read the pamphlets in the prescription box stating all the side effects or risks associated with the drug. I certainly don’t read them, and I’m assuming no one else does either, until it is too late. By then the damage is already done.

3) What other articles did you come across that you found interesting? Post the link(s) here in your discussion. Are they reliable sources?

http://www.medicinenet.com/cox-2_inhibitors/article.htm

Medicinenet is a site under WebMD, which is a reliable source for medical related research. The website is accredited by URAC, which provides accreditation to health care websites.

Sources:

http://www.sciencedaily.com/releases/2012/05/120502143846.htm
http://www.time.com/time/interactive/0,31813,2106343,00.html
http://www.medicinenet.com/cox-2_inhibitors/article.htm

Tags: None (Post is Read)
I completely agree with all the points you made in your post. I also think that the evidence to pull Vioxx from the market is far too great to ignore. I know for sure that I personally wouldn't want anyone in my family nor myself to use this drug that can cause us to have a stroke or any kind of heart disease. I would prefer having the GI effects of traditional drugs used to treat inflammation rather than having a heart problem.

I also really enjoyed your point about not reading the medication labels. I do the same exact thing myself. I am actually currently on Naproxen, and now I really want to make sure I read everything on this drug to ensure that it is safe. I would really appreciate it if the drug was investigated as heavily as Vioxx to confirm that this drug is safe to use. I also wanted to say thanks for the website you provided! I am going to use it now to look up Naproxen, after all the more trusted websites I can use to research this drug, the better off I will be in the long run!
1) I feel that the side effects of Vioxx do not have consequences bad enough to remove from the market unless perhaps prescribed over a long period of time. My personal belief is that people can find alternative routes, particularly nutritionally, that may help them better for long term effects, such as osteoarthritis where a proper diet can maintain the hydroxyapatite crystals within bone better than prescription drugs can do. However, for short term use, Vioxx does not cause any particular harm among the masses given its very low increased risk of heart disease.

2) It is of course necessary that as a community of people within a society that should try their best to help and heal each other, that we should have some people at work to create a better alternative that might have less harmful side effects or even none at all. However, as I’ve previously stated, I feel that the drug is not too harmful to be used as a temporary solution until the patient can achieve another means of dealing with their health issues without using NSAIDs. I have similar feelings towards aspirin. As long as it is not overused over a long period of time, it's harmful side effects will not have a serious effect on a person’s health.

3) http://usatoday30.usatoday.com/news/health/2004-10-12-vioxx-cover_x.htm I found this article interesting in that it explains how quickly people are scrambling to take Vioxx out of the market for it's minimal effects when it fulfills it's main purpose to suppress pain in people with arthritis. Again, I feel that this drug should not be used as a long term thing in order to prevent the harmful side effects, but the people make a big deal out of the whole matter.

4) I feel that the organic chemistry can help in finding a new sort of drugs that may have similar effects with less harmful consequences by studying how the organic properties of this drug reacts with the body and what kind of chemical properties can be added to it so that it reacts with the body in a more efficient and safer manner.

Tags: None

(Post is Read)
Maybe there could be some way that we can test to see whether or not people will have an adverse reaction to vioxx, making it more commercially viable. The unfortunate thing is that when people start dying, it changes the whole dynamic of the situation. Being a corporation, and without any pressure from the outside, they'd probably just see if their profits would outweigh the hush money paid to the victims’ families and continue selling the drug anyway.

1) In our litigious society, unless it can be proven that there aren’t any permanent adverse affects (i.e. death), the drug should be taken off the market until there can be adequate testing to fully understand how it interacts with the body. Over the counter NSAIDs are more widely used than something like vioxx was. Because of this, and the fact that it’s been on the market much longer with little issues, I think it shouldn’t be pulled. Possibly a better route may be to research the drugs more so that they can be designed to not have that side effect.

2) Whenever we have advances in new research techniques, it would be advisable to try and make everything that’s currently sold in the pharmacy better. The unfortunate part is that the companies that sell these drugs make money
regardless if they’re improved or not, giving them no incentive to do so. Aspirin falls into this category as well. I think we should always try to make the good great, but corporations and money don’t allow for it all the time.


This article was probably the most informative of the business side of drug companies. I understand people have to make money and companies have to stay relevant, but what Merck did was, in my opinion, ridiculously irresponsible.

“Merck yanked Vioxx on Sept. 30 because a new study had found a higher rate of heart attacks and strokes in patients taking the drug than in those on a placebo. The move was a stunning denouement for a blockbuster drug that had been marketed in more than 80 countries with worldwide sales totaling $2.5 billion in 2003. Vioxx, hawked by the likes of Olympic gold medalists Dorothy Hamill and Bruce Jenner, had been sold in the USA for more than five years.”

This is telling that Merck knew about a possibility of the drug having serious adverse effects, but still did nothing. After all, why would they have to do a “new” test? Also, shame on the FDA for not finding these issues when phase testing the medication. It makes you wonder who’s really running the show.

4) a strong understanding of organic chemistry and biochemistry are necessary in order to be an effective researcher. We learned about how he enantiomer of thalidomide had completely different effects in people, other drugs would be no different. I’m pursuing a career in pharmacy, so understanding these topics is of the utmost importance to me.

Good point about many of the NSAIDs being on the market for so long that they shouldn’t be pulled. The mental comfort level of the consumer with the drugs plays a big role, at least until the ‘BAD DRUG’ tv commercials start.

It is always interesting to come across an argument that challenges my perspective and thought process. In my response, I was against the sale of Vioxx. After reading your response, I am inclined to take a closer look at the research findings. Perhaps, Vioxx could stay in the market and be prescribed cautiously to patients who can not tolerate conventional painkiller due to the gastrointestinal side effects that accompany the use of these drugs.
The removal of Vioxx is completely justified. Research indicates that a patient’s chance of serious heart problems significantly increases if he or she takes Vioxx. One notable study conducted in 1999, few years into the release of the drug, indicates that the risk of serious cardiovascular problems and death among consumers of Vioxx is twice as high as in consumers of Naproxen, an alternative pain killer. Not only does this illustrate the ill-effects of Vioxx, it also shows that there is a safer alternative pain medication. Indeed, Vioxx is safer on the GI tract compared to other pain killers, but this alone does not justify the use of a drug that causes serious side effects and possibly death.

Any drug, including NSAIDs, should be fully researched and tested before the FDA approves and releases the drug to the public. I suggest that the government, public and drug manufacturers be vigilant about possible side effects of drugs once it is released in the market. Aspirin, as suggested by research, has a positive effect on the patients’ heart health if taken at a low dose or a full dose every day. Patients, however, should be concerned about potential internal bleeding from taking aspirin.

http://www.ucsusa.org/scientific_integrity/abuses_of_science/vioxx.html
The first article provokes us to re-think FDA’s role in society. Is FDA looking out for the good of the public or is it influenced by drug lobbyist?

The second article provides a clear, concise timeline from the release of Vioxx to the court settlement, highlighting important research findings.

Organic chemistry is paramount to understanding drugs and their effects. Drugs are synthesized using principles of organic chemistry. For example, Vioxx was synthesized using Friedel-Crafts acylations, SN2 Substitution and Dieckman condensation and elimination, to name a few. The chirality of the drug is also important. For example, the R enantiomer in ibuprofen is inactive but the body is able to convert it to the S enantiomer. The presence of these R enantiomers slows down the effects of ibuprofen. These ideas are very relevant to my career plan. As a nurse anesthetist, I need to have a solid understanding of how drugs effect the human body.
1) I prefer chewy brownies. A recipe the will give me the desired texture is:
1 2/3 cups granulated sugar
3/4 cup baking cocoa
1 1/3 cups all-purpose flour
1/2 teaspoon baking powder
1/4 teaspoon salt
2 eggs
2 tablespoons water
3/4 cup butter or 3/4 cup margarine, melted
2 teaspoons vanilla
chocolate chips, if desired
nuts, if desired.

This recipe gives me the desired texture of chewy brownies because the more eggs and margarine and vanilla, the chewier it will be, because all of those components add to the moisture of the brownies, and more moisture creates more chewiness.

2) **Chocolate Spherical Recipe**

< ![if IsupportLists]--> Calcium Bath: 1L (0.26 gallons) water and 8g (0.28 ounces) calcium lactate

< ![if IsupportLists]--> Filling: 250ml water small pinch sodium bicarb 1.8 g (0.06 ounces) Sodium Alginate 250 g (8.82 ounces) dark chocolate

< ![if IsupportLists]--> Blend water and sodium citrate in a large bowl. Add the sodium alginate and blend again. Put in a saucepan and heat without boiling. Break the chocolate into a bowl and pour the sodium alginate mixture over the chocolate. Allow to sit and then whisk together the chocolate and liquid.

< ![if IsupportLists]--> Place spoonfuls into the calcium bath and allow to sit for 10 minutes. Remove and rinse in water bath.

< ![if IsupportLists]--> The encasing alginate gel is heat stable, so they can be coated in batter and fried. This tastes good but looses the elegant look.
The science behind this recipe is really interesting, basically all you are doing is adding sodium alginate to a container of water and then add calcium salts to the liquid that you want to make into a sphere. The two chemicals react causing the alginate to gel thus encapsulating the liquid. The reaction between the alginate and calcium is effected by the level of acid, fat and alcohol in the liquid that you use and is also variable depending on the amount of the additives.

Citation: Reardon, A. *How to Cook That.*

3) I did find Dr. Crosby’s credentials surprising. The fact that he received his degrees at different universities was interesting. He earned a B.S. in chemistry from the University of New Hampshire and a Ph.D. in organic chemistry from Brown University. Also Dr. Crosby has been a postdoctoral research associate and part-time instructor of chemistry at Stanford University and he is also a full-time associate professor in the Department of Chemistry and Food Science at Framingham State University, and he’s an adjunct associate professor of nutrition with the Harvard School of Public Health. How does he have the ability to do all of this? It seems so overwhelming!

4) Skills or facts from organic chemistry that are useful for cooking are, measuring out ingredients, mixing, heating, monitoring how things progress over time and then making a decision about when everything has finished reacting/cooking. These skills are always necessary and helpful when cooking. These skills do also apply to my personal career goals. I plan to be a dentist and dentists have to be able to measure out stuff, heat stuff, and use these different skills too.

Thread: Molecular Gastronomy  
Post: RE: Molecular Gastronomy  
Author: Laura Sessions  
Posted Date: March 21, 2013 1:47 PM  
Status: Published  
Overall Rating:

Awesome recipe. Alginate is a water-absorbing polymer...more on this in orgo !!!  
Tags: None  
(Post is Read)
I definitely agree that chewy brownies are the best. I also chose this topic and found an incredibly simple recipe for Nutella brownies. My thinking was that the type of oil used contributed to the chewiness of the brownie. Although, the consistency of Nutella as opposed to dry cocoa powder may also help them become chewier.

Love the recipe! I've always preferred chewy brownies too though I haven't found a recipe from scratch that's really giving me ideal results until now (yes, I've tried it already!) other than my usual Duncan Hines Brownie box. Great job at explaining the science behind it too! Who would've known that's what's really happening if someone doesn't research it.

I had never heard of the "chocolate spherical" dessert it sounds extremely interesting. If we weren't in this course I would be hesitant to ever try such a recipe, but now the explanation to the steps makes so much sense. I definitely want to try this recipe.
The Maillard Reaction is a non-enzymatic reaction that gives food its flavor and color during frying, roasting, and baking because of the interaction of sugars with amino acids in food. High, dry conditions are favored because browning due to the maillard reaction cannot take place at low temperatures or moist conditions. Though pH has a less dramatic effect on the smell of food than temperature, time, and water content, the rate of color formation can be reduced by decreasing the pH. The most desirable foods have a pH approximately between 5-7.

http://www.youtube.com/watch?v=KhL2Z2_KTq4
Trends in Food Science & Technology - 2001
Food-info.net
http://www.food-info.net/uk/colour/maillard.htm
Maillard Reaction mechanism attached maillard-reaction.gif

Rum Sheets
http://www.moleculargastronomynetwork.com/recipes/Rum-Sheets.html

Ingredients
3/4 cup rum

Additives
Agar-agar 1 sachet (2 g)

Steps
1. Mix and bring to a boil the rum and agar-agar.
2. Pour the rum over a plate and move it around to create a sheet.
3. Refrigerate for 15 minutes.
4. Cut and pick up the rum sheet with a knife.

Rum Sheets Science: The additive of this recipe, agar-agar, comes from the cell walls of red algae and is used to make jellified shapes and so is categorized under “gelification”. Gelification happens when a boiled solution of agar-agar cools; set the gel-like molecules to firm at temperatures approximately between 32-43 degrees Celsius.

It seems to me that Dr. Crosby had his plate full during college! It is remarkable to see his passion and dedication to food science since he has earned multiple degrees and experience from all around the country. So, to answer the question, no I was not surprised by his credentials. To be a professor at Harvard and a popular guest speaker he could not have been some mediocre man with no knowledge or experience to offer.

Using organic chemistry for cooking is very important; it is a subject that we all apply to our daily lives, though it most definitely is not used consciously. While cooking, knowing principles such as hydrophobic and hydrophilic substances help determine what certain products are soluble or insoluble in. Consistencies, boiling points, acidities of ingredients, and many other organic chemistry facts and skills are also used in the kitchen on a daily basis. Pertaining to food, no it does not relate to my personal career goal though I have no doubt chemistry is a major part of learning about the field I have chosen.
FLO 2, Artifact 4, Opinion Survey on Career Group Activity
### Post-survey questions (administered on Blackboard)

1. Please respond to the following statements as honestly as possible.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Very strongly agree</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
<th>Very strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Have you completed an online discussion for a course grade before this class?</td>
<td>4</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>This activity helped me see how organic chemistry is used in a profession.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>This activity helped me clarify and develop my educational/career goals.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>I can see how course skills apply to life.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Reasoning skills used to understand chemistry can be helpful to me in everyday life.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>The activity made clear the importance of organic chemistry to me.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>I could see the link between organic chemistry and the activity.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>All members of my group contributed to the activity.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>I felt that I could share my viewpoint in my group.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Discussion in a group is an effective method for investigating this topic.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>I felt that my success was linked to the success of my group.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>I felt actively engaged in learning during the activity.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>I enjoyed the activity more than a lecture.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>This activity helped me to grow in Valencia’s core competencies (Think, Value, Communicate, and Act).</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>I feel that organic chemistry classes will be helpful in my future studies/career.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Learning chemistry requires that I substantially rethink, restructure, and reorganize the information that I am given in class and/or read in the text.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>A good understanding of chemistry is necessary for me to achieve my career goals. A good grade in this course is not enough.</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>
3. How do you think organic chemistry is related to your future career?

4. What did you enjoy most about the activity?

5. Please feel free to add any other comments (about working in groups, the activity, etc.).
V. Acknowledgments

I would like to acknowledge the following people for their kind assistance.

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Ms. Kristin Bartholomew, Nutrition Professor, West Campus

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Ms. Kathy Hauser
Dr. Robert Gessner

My committee members for their thoughtful input:
Dr. Eileen Pérez-Obregon
Dr. Melody Boeringer-Hartnup
Dr. Lois Crichlow
VI. Works Cited


4 This colleague did not confirm permission to use their name in this document.


9 Google search of ‘resonance structures’ on April 24, 2012.


19 American Chemical Society.  ACS Guidelines and Supplements: Student Skills (*Development of Student Skills in a Chemistry Curriculum*).  
http://portal.acs.org/portal/acscorg/content?_nfpb=true&_pageLabel=PP_SUPERARTICLE&node_id=1584&use_sec=false&sec_url_var=region1&__uuid=d0949144-fd84-49d3-b542-61c8ad9777c8.  (last accessed July 16, 2012).

20 This ice breaker was adapted from Dr. Eileen Pérez.


27 Inquiries were put into iteachchemistry.com in May 2012.  Only two semi-relevant responses were obtained.


36 General science questions were adapted from a survey developed by Davis Square Associates in 2008 for Dr. Sessions’ research on ‘Anytime, Anywhere Science’ at the South Florida Science Museum, West Palm Beach, FL.