DIVISION OF SCIENCE LONG TERM ASSESSMENT PLAN

Overview
The Division of Science consists of 5 very different departments Biology, Chemistry, Earth and Atmospheric Sciences, Mathematics and Physics. Now that we have had the opportunity to conduct self-evaluation of student learning for the past two years we have begun to refocus our combined mission of education and research that will bring us back to the forefront of science education in Higher education.

Division of Science Assessment Plan at a Glance

Our first objective as a division has been to map out a logical schedule of assessment for the next 5 years (see figure 1). The main qualification is that these plans remain modifiable as we learn through the assessment process.

Schedule for Direct and Indirect Assessment of Biology Courses

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Program Missions and Goals

Each science department has created a set of program goals/outcomes based in part on the departmental mission. These missions and goals can be considered a work in progress since most science fields are continually changing especially moving towards interdisciplinary thrusts. The missions and goals are provided in their current form here.

Biology Department

Mission

In the last two decades there have been seismic changes in the Biological Sciences. The mission of the Department of Biology at The City College of New York is to conduct research in these areas, to enable students from diverse backgrounds to further their intellectual development and to prepare them to enter professions in the biological and biomedical sciences. We also
contribute to the broader community by continuing collaborations with community colleges and K-12 schools.

Consistent with recent scientific breakthroughs, we provide comprehensive biological training that focuses on core content and principles, using an array of approaches and an evolving set of intellectual tools. Our core curriculum includes cell and molecular biology, organismic biology, evolution, and ecology. Most core courses and many electives include laboratory sections, which are inquiry-based to promote learning, practicing, and refining scientific analytical skills. One of the Biology Department’s strengths is the integration of undergraduate students into faculty research programs. As biological research becomes increasingly collaborative and interdisciplinary, we endeavor to train students to apply their knowledge in new contexts.

Program Educational Goals
Students graduating with a biology degree will have been trained to:

A. analyze, critically evaluate, and draw appropriate conclusions from data
B. understand scientific texts and literature
C. design and execute experiments
D. communicate results and their implications
E. apply biological knowledge to emerging challenges
F. In addition, research students will complete independent research projects and co-author scientific publications

Chemistry Department

Mission
To provide excellent teaching to our students and to conduct top quality research, the department will:

A. educate students in the chemistry discipline at the undergraduate, and master’s levels, to prepare them for professional careers;
B. support faculty and students in performing research at the vanguard of new directions and opportunities;
C. encourage new thinking about areas of special strength, which can be cross-disciplinary;
D. maintain a scholastically excellent faculty who will be able to educate our diverse student body.

Program Educational Goals

A. demonstrate an understanding of the fundamental principles of chemistry, including atomic and molecular structure, quantum chemistry, chemical bonding, stoichiometry, kinetics and mechanism, equilibrium, thermochemistry and thermodynamics, molecular structure and function, electrochemistry, and the periodic chemical properties of the elements;
B. apply the fundamental principles of chemistry to life sciences, the environment, materials, engineering, and emerging technological fields of chemistry, as well as to everyday situations;
C. conduct experiments and learn fundamental laboratory skills;
D. analyze and interpret data;
E. apply mathematical concepts to chemical problems;
F. work as part of a problem-solving team; convey facts, theories and results about chemistry in written form;
G. present orally to convey facts, theories and results about chemistry;
H. access and utilize chemical information technology;
I. design and execute scientific research;
J. apply ethical responsibilities and professional conduct.

Earth and Atmospheric Sciences Department

Mission
The Department of Earth and Atmospheric Sciences (EAS) of the City College of New York integrates research, teaching, and service dedicated to inspire, educate and prepare students to be leaders in the field of earth systems science. Based on the emerging awareness of the interrelationships between natural and social systems EAS promotes and sustains:

A. fundamental and innovative research for the understanding of the Earth as an integrated, dynamic system,
B. the integration of earth science and science education research to promote students’ learning as well as their awareness of the obligatory role of the environmental context in all of their future endeavors.

Program Educational Goals
Program Education Goals are established to provide a quality education in Earth Systems Science:

A. Promote inquiry, analytical, technical, and communication skills necessary to succeed in the earth and atmospheric science professions.
B. Promote scientific literacy and the critical thinking skills needed for continued, lifelong learning.
C. Promote the understanding of ethical, economical and social issues as an integrated system, necessary to recognize the need to include an evaluation of societal impact and consequences of scientific development on policy matters.
D. Develop instructional and research collaborations with stakeholders.
E. Conduct research in areas of local, national, and global importance.
F. Promote a system's approach in the integration of research and teaching.
G. Serve the community and the earth science profession.
H. Improve access for an increasingly diverse student body.

Mathematics

Mission
The mission of the Department of Mathematics is to serve the present and future needs of the student body, the faculty, and the public, by contributing via teaching to the mathematical education of our students, and via research and scholarship to the body of knowledge in the discipline of mathematics.

The Department provides the mathematics education required of all students at the City College. This ranges from developing the quantitative literacy of the liberal arts graduate, to the more specialized training needed by future practitioners in such areas as teaching, architecture, science and engineering, and medicine.

The Department's introductory, service, elective, and Master's courses prepare the College's students for advanced work in science, engineering, and mathematics. This preparation is
crucial in providing New York City with a mathematically trained workforce in the twenty-first century. Our role in this area is a direct contribution to the University's mission of service to the public.

The research carried out by members of the Department contributes to the growing body of knowledge in the discipline of mathematics. Its quality and scope are congruent with the University's commitment to excellence in research and scholarship. Moreover, it enhances the excellence of teaching, thereby contributing to the academic quality of the programs offered to our students.

**Program Educational Goals**

Students completing introductory and service courses in the mathematics department will develop the abilities to:

A. understand the fundamentals ideas and applications of calculus and linear algebra;
B. employ technology to investigate mathematical concepts and applications;
C. succeed in subsequent courses (for which these courses are prerequisites) within the mathematics department or in other undergraduate departments, (especially in the Grove School of Engineering).

Students in our elective courses (including mathematics majors) will develop the ability to:

A. understand the theory of mathematical analysis as well as the theory of other major branches of mathematics such as algebra, discrete mathematics, probability and statistics, and financial mathematics;
B. understand the nature of a mathematical proof and the ideas of counterexamples, specialization and generalization;
C. communicate mathematical concepts both in writing and orally.

Additional specific objectives for mathematics majors include:

A. (for secondary education majors) the ability to pass the CST and to become effective high school teachers;
B. (for applied mathematics majors) obtaining a knowledge of advanced concepts in either statistics or financial mathematics;
C. (for pure math majors) obtaining an understanding of the role of advanced mathematics in different disciplines and preparation for graduate studies in mathematics and related disciplines, or for careers demanding a high level of analytic skills;

**Physics**

**Mission**

The mission of the Department of Physics of the City College of New York is to combine research, teaching, and service in order to inspire, educate and prepare our students to be leaders in their chosen field of physics. In addition, our mission is to inculcate in students the culture of a rational approach and analysis to any problem or situation; to provide high-quality and comprehensive undergraduate and graduate educational programs that help students acquire an appreciation of the physical world as understandable and explainable in a logical way in terms of the laws of physics; to advance the frontiers of knowledge in physics through the creative research of faculty and students; to provide educational and scientific resources to the larger community.
Program Educational Goals

The Department of Physics will endeavor to
A. enable students to acquire knowledge of the basic laws of physics and their applications;
B. help students develop the ability to use mathematics and computers as tools to analyze physical problems;
C. train students to design and conduct experiments and to analyze and interpret data;
D. help students to develop the skills to communicate their results in a professional manner, both in oral and written forms.
E. conduct research in physics with a high standard of excellence that will lead to recognition at the national and international levels
F. promote interdisciplinary and collaborative research efforts both within and outside the College.
G. prepare our students for entry into nationally-ranked graduate programs or professional schools, for careers in teaching or for employment in high-technology industry in both physics and physics-related areas;
H. serve the larger community through teaching, research and outreach Programs.

Indirect and Direct Measures

The departments in the division of science are continuing with the End of Course Surveys for all courses under examination as specified by the department Multi-year Plans. We are encouraging several modifications to existing documents.

1. Irrelevant survey questions will be removed
2. Modifications in course curriculum will be reflected with the addition of new survey questions
3. Surveys are going to be reduced to a maximum of 10 questions
4. Survey questions will be shortened and made more succinct if necessary
5. Survey questions will contain more appropriate assessment verbs (move away from assessing ‘understanding’)
6. Surveys will be modified to address higher order learning

The departments are moving away from the former method of direct assessment, i.e., using 5 representative exams in each grade category from A-F. The Physics Department has undertaken a new mode of direct that involves Professor assessment of student learning outcome achievement. This method is quantified and described by a rubric. The EAS and Chemistry departments are conducting a pilot program that uses ‘itemized’ spreadsheet data for midterm and final exams that allocates exam questions to learning outcomes and allows for the averaging of all student scores. Math and Biology are currently continuing the prior method, but will be brought on line with improved methods once these methods have been assessed. At least one improvement in Math Direct measure collection is that they will not use sample exams for students who have not elected to complete problems that are learning outcomes indicators.

The Division of Science assessment coordinator will keep hard and electronic copies of all measures and provide data and analyses to the faculty in a timely manner allowing for ‘closing the loop’ efforts.
Supporting Documentation

**Assessment reports**

Each department in the Division of Science will draft an annual assessment report to be submitted no later than July 31 of each year. The report will contain data, results and ‘closing the loop’ actions based on the prior two semesters, (fall of previous calendar year and spring of current year). End of course surveys, Direct assessment tools and grading rubrics will be attached to each report as an appendix. A section identifying and describing student successes will also be featured. The assessment coordinator will collect the reports and compile towards a divisional annual report. This report will document any changes to the department multiyear plans and provide justification for the proposed changes. Closing the loop evidence for the entire division will be extracted and outlined. The divisional report will also document the percent of compliance by individual departments relative to 1) syllabi updating and posting; 2) faculty compliance in course assessment as outlined by the multi-year plans and 3) faculty and department institution of ‘close-the-loop’ changes for course and program improvement.

All multi-year plans and reports will be posted on the Division of Science Intranet site for transparency purposes and as an aid for departments in sharing assessment information and procedures.

**Syllabi**

It is the job of the division assessment coordinator to collect and inspect all syllabi such that they meet the minimum criteria of containing the sections:

- Title of course
- Department and Course Number
- Instructor, contact information (Office location, telephone, email)
- Instructor office hours
- Course description (from Bulletin)
- Prerequisites and/or co-requisites
- Class schedule: Number of hours (lecture/lab/workshop); number of credits; day(s) of week and time that course meets
- Textbook/Course materials
- Course objectives (these are used for the direct and indirect assessment of student learning at the end of the semester)
- Course Outcomes
- Assessmentgrading/policies
- Weekly schedule and topics to be covered
- Statement of academic integrity
- Science librarian assigned to the course

The assessment coordinator will add the missing information or ask the instructor to modify and return. Then the webmaster is sent the files and asked to post the syllabi on the Division of Science website. This will be accomplished before the start of each semester, but at the latest, by the end of the first week of each semester. The Science Librarian will also receive copies of each syllabus at least two weeks in advance in order to secure textbooks and other materials to be held in reserve.

**Graduating Senior Surveys**
Graduating senior surveys will be administered through the college Assessment office. The Science Division Advising office will administer surveys for students wishing to postpone survey taking for a time other than the graduation application stage. The first trial will take place for the Sep 09 graduation. If completion rates dip below 60%, the advising office will administer online or paper surveys during the graduation check stage. This survey will contain elective questions regarding:

1) Graduate school applications
2) Graduate school acceptance
3) GRE or other standardized test taking (scores would also be nice)

Division level improvement

The Dean of Science has crafted an advisory committee on teaching and learning consisting of faculty from each department whose priorities lies foremost in education. This group will serve as a consulting and advising body for the development of a broad divisional education mission. The current charge of the committee is to:

1. Plan future teaching space in Marshak
2. Weigh in on new masters program development
3. Propose program/department curricular updates
4. Devise plans for assessing supplemental education efforts:
   a. PLTL (Peer-led-team learning; chemistry workshop)
   b. Online homework (math, chemistry, physics)
   c. Clicker usage (eclickers and iclickers)
   d. Science tutoring
5. Devise plans for assessing science division student services
   a. Undergraduate advising
   b. Job and internship placement services
   c. Job and internship satisfaction
   d. Graduate advising
   e. Masters student satisfaction

Professional Development

The Division of Science accreditation specialist will attend all relevant, local and free or low cost assessment workshops, best practice sessions and professional development programs. On schedule for the spring 2009 semester are 5 CETL workshops and ‘Assessing Student Learning and Institutional Effectiveness’ presented by Linda Suskie March 19-20, 2009 at York College. The CCNY higher administration is attending a workshop at Pace University entitled ‘Fostering a Campus Culture of Assessment’ on April 27, 2009. The Division of Science assessment coordinator will request a summary of that event. The coordinator will also continue to explore through the internet, the trials and successes of other colleges and universities to gain ideas for the Division of Science.
Assessment Plans
The Biology Department has devised a 5-year assessment plan in 2008 to cover the 5 year period from 2008 through 2013. See appendix A: Biology.Plan_0813.pdf. We have completed 3 of the 5 academic years. This report covers year 3 of 5, Academic Year Fall 2010- Spring 2011.

Suggestions from last report (pre-5-year plan).
We propose that the Curriculum Committee of the Biology Department take over the job of interpreting and acting upon assessment data and begin a discussion with individual instructors and the Department as a whole on how to use this information to improve our courses. Considering the data from Fall 2007, we believe their priorities should be:

- Monitoring the revision of our introductory courses, Bio 10100 and Bio 10200, ensuring that revision is complete in time for Fall 2008 and that additional assessment tools are put in place to examine the efficacy of these introductory courses in enhancing basic science-related skills.
- Reviewing lists of course objectives and suggesting improvements to instructors
- Examining the Direct and Indirect Course Outcomes and discussing with instructors potential course improvements.
- Review how grading is done in the Department and discussing the ways in which instructors can develop more robust and fair criteria for grading.

Policies and Guidelines
The department is following a protocol established for the 2007 middle states accreditation cycle with minor revisions. Assessment is to be guided by Assistant Professor Fardad Firooznia. He is new to the assessment process and will be taking over duties for the Fall 2011-Spring 2012 academic cycle. For the current academic year, Elizabeth Rudolph, Accreditation specialist and Deputy Dean of Science will report for the Biology Department.

Recognition and Rewards
The college continues to show weakness in this category. There are still no recognition or rewards for conducting student learning assessment except for the meager amount of workload credits (1 hour maximum) to full time faculty for helping in the dissemination, collection and analysis and synthesis of direct and indirect learning measures.

Learning Outcomes
Annual Year 2010-2011 assessment schedule per the Biology Department 5-year plan is listed in the table below.

| Undergraduate | Graduate |
Department of Biology
Report on Student Learning
AY 2010-2011
November 4, 2011

Data Collection
Two forms of assessment were undertaken as required by the Middle States Commission.

Indirect assessment of student learning is undertaken in the Division of Science through the ‘End-of-course-survey’ instrument. We have recently moved to the Scantron product, Class Climate, for survey generation and data collection.

The Science Division has adopted a new form of direct assessment based on instructor assessment of student learning on each of the listed learning outcomes for the course. The assessment is quantitative since it is to be based on exam question scores for those questions that apply to the particular learning outcome.

Assessment Tools
Appendix XX contains the indirect and direct instruments for each of the courses under examination.

Results and Discovery

Use of Assessment Results
Multi year synthesis (2008-2011)and Closing the Loop
Department of Biology  
Report on Student Learning  
AY 2010-2011  
November 4, 2011

**Syllabi**

The Biology Department posts Syllabi to the departmental website:  
http://www1.ccny.cuny.edu/prospective/science/biology/ug_courses.cfm

Postings are updated by the department administrative assistant, Christine Klusko. Biology Department faculty and instructors are now habitually presenting course learning outcomes/objectives on their syllabi.

**Faculty Professional Development**

The Divisional task force, TLAC (Teaching and Learning Advisory Committee) runs a workshop yearly on science pedagogy and/or research, entitled ‘Discussions on Student Learning’. The first event was run in January, 2010 and involved presentations on *Making Sense of How Students Make Sense of Science; Working Research Into the Classroom; How Students Do or Do Not Learn Math and Science*. The Second event took place in the reporting period, Jan, 2011 and covered a systematic review and follow-up from the 2010 event and a presentation on the *Mechanisms, Causality and Explanations in Complex Dynamic Systems -implication for teaching and learning*. In the first production, of the 25 participants, 2 were from the Biology Department, Profs Adrian Rodriguez Contreras and David Lohman. In the second production 4 biology professors participated, Ana Carnaval, Adrian Rodriguez Contreras, Kamilah Ali, and David Lohman.

**Course and Teacher Surveys (C&T)**

Two unfortunate occurrences took place in AY 2010-2011 that resulted in the lack of Course and Teacher Survey Data as of this date. Prior to the spring, 2011 semester, the Course and Teacher Survey was administered online via email to the students enrolled in each class. Historically, given no incentives or disincentives, students respond to the survey at percentages between 5 and 30%, resulting in statistically invalid and only qualitatively useful results. Furthermore, the Fall 2010 collections were corrupted due to technical problems and no collections were made. To combat all the challenges with the Course and Teacher Survey, the CCNY Office of Institutional research in collaboration with the Testing Office, reverted to paper data collection. Spring 2011 being the first run was met with different challenges, thus the data is not yet ready.

**Using results of C&T**

C&T results are used in all cases of faculty reappointments, tenure and promotion. However, since the college encountered difficulties in both fall 2010 and spring 2011 collections and analysis, these results were not available for the fall 2011 reappointment, tenure and promotion cases.
Department of Biology Multiyear Assessment Plan 2008-2013

The first year of assessment has identified the need for modification in the curriculum of the Biology Department especially in the introductory courses, Bio 10100 and Bio 10200 (see excerpt from F07 Assessment report below).

- Revision of our introductory courses, Bio 10100 and Bio 10200, ensuring that additional assessment tools are put in place to examine the efficacy of these introductory courses in enhancing basic science-related skills.

Therefore, these courses will be assessed thoroughly in the first two years and every fall semester thereafter to ensure that the courses evolve appropriately. Since Bio 20600 and Bio 20700 are also offered each semester and are considered fundamental courses for all biology majors, they too will be thoroughly assessed in years 1 and 2. Changes will be put in place and a thorough re-examination will take place in year 5. Bio 228, 229, 345, 350 and 375, which are offered at least once and sometimes twice per year will be assessed in yrs 3 and 5. The remaining 200 level and all 300 and 400 level courses will be evaluated in years 2, 4, and 5 as offered and with periodic reconsideration given to special problems that are identified along the way (contingent upon number of offerings in the 5 year period). Since the division of course evaluation is based on course level, all course outcomes will be considered for each course.

Graduate courses will be modified beginning in the spring 09 semester with the addition of course learning outcomes to the syllabi and indirect and direct assessment measures initiated. Graduate courses will be added to the grid and assessment will commence in Spring 09.

Assessment Measures

Indirect Assessment
End of Course Surveying for Biology courses have proved extremely useful. Therefore, the surveys will continue. However, all instructors will be urged to modify and/or update the Course Learning Outcomes. One key objective is to reduce the number of outcomes to a maximum number of 10-12. This can be achieved by merging similar learning outcomes or dropping less significant learning outcomes. Another objective is to reduce the complexity of the wording of the learning outcomes especially for those eliciting unusual responses from students.

The Indirect surveys will be administered for all biology classes each semester though the multi-year plan calls for periodic evaluation of courses. The goal is to use the indirect surveys to monitor the status of the course learning outcomes for all courses as a guide the curriculum committee regarding introducing changes to the multi-year plan.

Direct Assessment
The science division accreditation office is investigating alternate methods of Direct assessment particularly using Microsoft excel Instructor gradebooks. This will enable the collection of more statistically sound data since ALL student work will be considered rather than the work of 5 representatives.
During the 2008-2013 Assessment Plan, the Biology Department will also address the following ‘CLOSING-THE-LOOP’ issues revealed in the first year of assessment:

- Reviewing lists of course objectives and suggesting improvements to instructors
- Examining the Direct and Indirect Course Outcomes and discussing with instructors potential course improvements.
- Review how grading is done in the Department and discussing the ways in which instructors can develop more robust and fair criteria for grading.
Division of Science: Chemistry Department Assessment Report on Student Learning Annual Year 2011-2012

Assessment Plans
The Chemistry Department has devised a 5-year assessment plan in 2008 to cover the 5 year period from 2008 through 2013. See appendix A: Chemistry.Plan_0813.pdf. We have completed 4 of the 5 academic years. This report covers year 4 of 5, Academic Year Fall 2011-Spring 2012.

Policies and Guidelines
The department is following a protocol established for the 2007 middle states accreditation cycle with minor revisions. Assessment is to be guided by Assistant Professor Sean Boson and Professor Urs Jans. For the current academic year, Elizabeth Rudolph, Accreditation specialist and Deputy Dean of Science will report direct and indirect findings to the Chemistry Department. Upon receipt, the Departmental Coordinator and Curriculum committee reserves the right to modify the existing protocol.

Coming to the close of the 5 year plan in Dec 2013, the department and the divisional coordinator will convene to discuss a new and revised assessment plan for 2014-2019.

Recognition and Rewards
The college continues to show weakness in this category. There is still no recognition or rewards for conducting student learning assessment except for the meager amount of workload credits (1 hour maximum) to full time faculty for helping in the dissemination, collection and analysis and synthesis of direct and indirect learning measures.

Learning Outcomes
Annual Year 2011-2012 assessment schedule per the Chemistry Department 5-year plan is listed in the table 1 below. Red signifies courses that were actually examined either by direct or indirect measures or both. Courses listed in black were not examined for one of three reasons. 1) Course not offered, 2) No response to request for Direct or Indirect data gathering, or 3) instruments not drafted because of missing information, e.g. current course learning outcomes.

<table>
<thead>
<tr>
<th>CHEMISTRY</th>
<th>Fall 11</th>
<th>Spring 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNDERGRAD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10301</td>
<td>10301</td>
<td>Jans &amp; Boson</td>
</tr>
</tbody>
</table>

1
Table 1. Assessment schedule for Fall11/SP12 for the Chemistry Department

<table>
<thead>
<tr>
<th>10401</th>
<th>10401 Salame &amp; Birke</th>
</tr>
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<tbody>
<tr>
<td>26200</td>
<td>243 Bandosz</td>
</tr>
<tr>
<td>26300</td>
<td>261 Ryan &amp; Balogh-Nair</td>
</tr>
<tr>
<td></td>
<td>263</td>
</tr>
<tr>
<td></td>
<td>332 Ghose</td>
</tr>
<tr>
<td></td>
<td>335 Bu &amp; Lombardi</td>
</tr>
<tr>
<td></td>
<td>374 Boson</td>
</tr>
<tr>
<td></td>
<td>425 Kowach</td>
</tr>
<tr>
<td>33000</td>
<td>45902 Langone</td>
</tr>
<tr>
<td></td>
<td>45904 Calhoun</td>
</tr>
<tr>
<td>43400</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GRAD* DEPENDS ON OFFERINGS</td>
</tr>
<tr>
<td>A1101</td>
<td>A1400 Barnett</td>
</tr>
<tr>
<td>B5000</td>
<td>A8005 Steinberg</td>
</tr>
<tr>
<td>A1200</td>
<td>A8300 John</td>
</tr>
<tr>
<td></td>
<td>B1000 Kowach</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B5100 Lakshman</td>
</tr>
</tbody>
</table>

Data Collection
The Middle States Commission requires data assembly using a minimum of 2 assessment instruments, one of which must be a direct measure. In the Division of Science we use one of each.
Indirect evidence of student learning is measured by the ‘End-of-course-survey’ instrument administered to the students. We have recently moved to the Scantron product, Class Climate, for survey generation and data collection, however we continue to face operational challenges with the software.
The Science Division has adopted a new form of direct assessment based on instructor assessment of student learning on each of the listed learning outcomes for the course. The assessment is quantitative since it is based on exam question scores, homework assignments, lab reports and writing assignments for those questions that apply to the particular learning outcomes.
Assessment Tools
This narrative contains course and program ‘learning’ outcomes and data collected for both indirect and direct assessments for the courses under examination. Appendix A contains one sample of each of the instruments as well as the Chemistry Department multiyear assessment plan. Data is quantified on each instrument using a rating scale of 1-5, 1 representing poor agreement and 5 the strongest agreement. Prior to 2012, the rating scale was 1-4 but the categories were comparable. In the case of comparing data in mixed scale forms, all 1-4 ratings were normalized to agree with the 1-5 scale.
Data are presented in bar graphs that display the means for all learning outcome questions. In comparing and correlating direct and indirect data we encounter some problems. See the sample plot below. Therefore, in cases in which student and instructor responses are plotted together, bar graphs are utilized so individual assessments can be observed.

![Figure 1. Experimental plot showing poor correlation between student and mentor/instructor assessment of student learning.](image)

Additionally, the Chemistry Department posts program and assessment information, categories below, that can be found at the website:
http://www1.ccny.cuny.edu/prospective/science/chemistry/ug_programs.cfm

UNDERGRADUATE PROGRAMS
- Learning Outcomes
- Degree Requirements
- Courses and Syllabi
- Student Research
- Academic Support
- Career Opportunities

Results and Discovery: Program Assessment FALL 2011 & SPRING 12
The Department performed two powerful closing the loop exercises at the end of academic year 11-12. The first is a graduating senior survey which can be found as a blank form in
Appendix C and full results in Appendix D. The Second is a ‘direct’ survey completed by faculty mentors that assesses the entire chemistry program by focusing on the capstone courses Chem 30100-30400 and 31000-31400. The blank form is found in Appendix E and the complete data in Appendix F. The summary findings of both tools are found below.

**Graduating Senior Survey**
The graduating senior survey is broken into 5 general sections. Section 1 surveys student opinion about how well the program delivered **program outcomes**; Section 2 addresses the department and college facilities, faculty and staff; Section 3 covers departmental club participation and satisfaction; Section 4 deals with strengths weaknesses and areas requiring improvement; Section 5 solicits information about the student’s present and future goals such as jobs, graduate school, and etc.

As a whole graduating seniors majoring in chemistry responded quite favorably, n=9, when questioned about their acquisition of the chemistry program outcomes, Section 1 questions, at CCNY (Fig. 2). In particular questions about chemistry knowledge, analyzing and interpreting data, and ethics scored over 4 out of a maximum of 5. Standard deviations are also almost all below or just about 1 indicating a narrow range of opinion, mostly favorable. The two weakest outcomes, scoring below 3.5 are working as a problem solving team and the ability to access chemical information technology. For these outcomes to remain in the Chemistry Program list, they must be satisfactorily addressed in several courses preferably at two distinct positions in the curriculum, e.g. once at the sophomore and once at the senior level.

It is no surprise given the current financial crisis at CUNY that responses to Section 2 questions (Fig. 3) are less favorable. Only one question scored above 4 and that refers to the helpfulness of the department CLTs (lab technicians). Overall mean is 3.6. This data suggests a need for improvement in department facilities, administration and advising. It was however, reassuring to learn that despite some unhappiness with college and department resources, human and otherwise, the overall satisfaction with the CCNY experience was 3.9 out of a possible 5 (Q11 Fig.3).
Graduating Senior Survey Responses SP12

<table>
<thead>
<tr>
<th>Questions about achieving Program outcomes</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>Q5</th>
<th>Q6</th>
<th>Q7</th>
<th>Q8</th>
<th>Q9</th>
<th>Q10</th>
<th>Q11</th>
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<td>mean</td>
<td>4.22</td>
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<td>4.11</td>
<td>4.33</td>
<td>3.78</td>
<td>3.44</td>
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<td>4.00</td>
<td>3.33</td>
<td>4.00</td>
<td>4.22</td>
</tr>
<tr>
<td>stddev</td>
<td>0.83</td>
<td>1.05</td>
<td>0.93</td>
<td>0.87</td>
<td>0.97</td>
<td>0.88</td>
<td>0.93</td>
<td>1.00</td>
<td>1.12</td>
<td>1.00</td>
<td>1.09</td>
</tr>
</tbody>
</table>

Mean Q 1-11= 3.97

Figure 2. Graduating Senior Survey Section 1 responses referring to the Chemistry Program Outcome; Includes table of means and standard deviations for all questions. All questions mean=3.97.

Graduating Senior Survey Questions Part 1
1. Knowledge of the fundamental principles of chemistry
2. Application of the fundamental principles of chemistry to life sciences, the environment and other fields
3. Ability to conduct experiments and learn fundamental laboratory skills
4. Ability to analyze and interpret data
5. Ability to apply mathematical concepts to chemical problems
6. Ability to work as part of a problem solving team
7. Ability to convey facts, theories and results about chemistry in a written form
8. Ability to use oral presentation to convey facts, theories and results about chemistry
9. Ability to access and utilize chemical information technology
10. Know how to design and execute scientific research
11. Learn appropriate ethical responsibilities and professional conduct
Graduating Senior Survey Questions Part 2
1. The academic facilities of the Chemistry Department (labs, computer facilities, classrooms)
2. The Faculty of the Chemistry Department
3. The student facilities of the chem dept (copiers, society offices, phones, social support)
4. The student facilities in CCNY similar to above
5. Student/Faculty relationships in the Chem dept
6. The administration of the Chemistry department
7. The laboratory technicians in the chemistry department
8. The biochemistry option undergraduate advisor
9. The standard chemistry major undergrad advisor
10. The office staff in the chem dept
11. Your experience as a student at CCNY

Of the remaining 3 sections of the Graduating Senior Survey, Section 4 yields the most relevant information regarding student learning and the acquisition of Chemistry Program Outcomes. Below are the most telling comments.

5. Please identify areas of concern, if any, that you feel the Chemistry program should improve to provide a better education

The chemistry program should have more elective courses so students can take classes that are of their specific interest

The physical chemistry classes, particularly chem 330 should have a more integrated physical chemistry workshop in that the professors of the course should make efforts to make the workshops happen and be helpful. There either should be a good pchem student of a chem PhD to teach it.
6. Please identify the strengths of the Chemistry Program

The chemistry program has a very engaging and rigorous curriculum. I feel so well-rounded about science and chemistry as a biochem and pre-med major. The courses are phenomenal, challenging and well worth the work required to do well in that you learn so much information.

Capstone Assessment Instrument
The Capstone courses for the Chemistry Department are Chem 30100-30400, the Honors series and Chem 31000-31400, the Independent Study series and are offered to chemistry majors in their junior or senior years of study. These courses, though self-selected by students and with established academic requirements, are the best gauge the department has at this time for assessing the success of the chemistry program and curriculum. All courses are research based and culminate in written paper and oral presentation. The supervising faculty use a combination of written paper, oral presentation and day to day experiences in the research lab to provide direct evidence of student learning in this instrument.

Figure 4 presents the results of the direct evidence for student learning based on mentor assessment compared to the indirect evidence provided by the students. All varieties of capstone except the Independent study course address every learning outcome. First semester independent study courses do not require the knowledge of history and impact of chemical research in society (CLO2), oral presentations (CLO7), use of media (CLO8), or use of the chemical literature (CLO9). Therefore these outcomes should be neglected in the bottom right graph. For the most part, all overall averages are in the 4 range +/- .5. However there are some identified weaknesses that should be considered. In Chem 301 both students and mentors agree that there is a weakness in the student’s knowledge of the history and impact of chemical research on society. In Chem 30200 both students and mentors agree that there is less successful team work. This may be the nature of the project e.g. one researcher per project or position in the research, e.g. the nature of semester 2 research. In Chem 30300 both students and mentors identify weaknesses again in knowledge of the history and impact of chemical research on society. So it becomes clear that for this to remain a course outcome, a portion of one or all of the courses needs to be devoted to this theme. Also there is a disconnect in Chem 30300 between the mentors and students opinion regarding the Ethics outcome (CLO3). Students are more confident that through the research experience, they have learned and practiced the social and ethical responsibility expected of a chemist while mentors are less convinced. This study reveals a need to supply a more formalized coverage of Learning outcomes 2 and 3 in the 301 and 310 series or guarantee coverage elsewhere in the curriculum.
Chemistry Capstone Learning Outcomes
CLO1: ABILITY TO apply mathematics and science knowledge to this research project
CLO2: KNOWLEDGE OF the history and impact of the chemical research in society
CLO3: ABILITY TO practice the social and ethical responsibility expected of a chemist
CLO4: ABILITY TO design and conduct experiments.
CLO5: ABILITY TO analyze and interpret data
CLO6: ABILITY TO communicate effectively in written form.
CLO7: ABILITY TO communicate effectively in oral form.
CLO8: EXPERTISE IN the use of at least one of the modern communication media (overhead projections, PowerPoint presentations, webpage, poster presentation, etc.).
CLO9: ABILITY TO access and utilize the chemical literature.
CLO10: ABILITY TO keep accurate records of experimental or primary data.
CLO11: ABILITY to work as part of a team.
CLO12: What I learned from this course was worth the time and effort required to put into it.

Figure 4. Chemistry program assessment results using capstone courses: Chem 30100, 30200, 30300 and 31000. (blue=mentor assessment; pink=student survey results) followed by list of course outcomes

Results: Course Assessment FALL 2011 & SPRING 12

Chemistry 10301 and 10401 are foundation chemistry courses, General Chemistry I and II respectively, that serve all students in the entire Division of Science, School of Engineering in addition to being the first round of chemistry courses encountered by Chemistry majors.
Results of Direct and Indirect evaluation are shown in figure 5. There is a clear discrepancy between the perceived degree of learning by the students by the instructors’ assessment. Students scored overall learning at 4.0 out of 5 while instructors rated the class learning at 3.2. (1 sample). Though this data was derived from just one sample, results from year to year do not vary dramatically from this observation. The written comments suggest that not all students complete the survey properly which results in a ‘popularity’ assessment as opposed to an assessment of actually learning. With that understanding, there is however important information that can be extracted from the data; both faculty and students have identified weaknesses in the curriculum. Faculty find that students underperform in the subject of thermodynamics and have agreed to spend more time on that topic while students feel poorly prepared in drafting lab reports and conducting experiments. The laboratory problem is something that department can correct with improved mentoring and training of lab TAs. In the next reporting period an extensive assessment of workshop and Online homework will identify the impact of moving to a greater online approach to problem solving and away from PLTL.

<table>
<thead>
<tr>
<th>UNDERGRADUATE PROGRAM IN CHEMISTRY—Direct Assessment of Student Learning</th>
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<tbody>
<tr>
<td>COURSE</td>
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<tr>
<td>LEARNING OUTCOMES</td>
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<tr>
<td>Ability to perform unit conversions and express values with the correct number of significant figures.</td>
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<td>Ability to express and interpret atomic symbols, atomic number, mass number, and molar mass.</td>
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<td>Understanding of and ability to apply concepts of balancing chemical reactions, and be able to perform stoichiometric calculations.</td>
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<tr>
<td>Ability to define enthalpy and solve thermochemical equations.</td>
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<tr>
<td>Ability to express quantum energy levels of atoms and relate these to atomic properties.</td>
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<tr>
<td>Ability to draw and interpret Lewis-dot structures, predict three dimensional structures of simple molecules, and draw simple molecular orbital diagrams.</td>
</tr>
<tr>
<td>Ability to apply the ideal gas law to problems involving changes in moles, pressure, volume and temperature.</td>
</tr>
</tbody>
</table>
Ability to solve problems involving solution chemistry such as 
8 titrations, precipitation, and colligative properties. 3
9 Ability to write a laboratory report including data and analysis. 3
Ability to conduct a variety of experiments (titrations, spectroscopic) including accurate recording of results and preparation of calibration curves. 3
10 Increased awareness of and ability to follow the safety requirements in a chemical laboratory.
11 Ability to analyze molecular modeling and graphic plots using computers.
12 Ability to communicate concepts and problem solving of chemistry that have been presented in lecture.
13 Ability to work as part of a problem solving team to solve chemistry problems.
14 Ability to apply chemical principles to selected applications in life science or technology. 3
15

FUTURE PLANS TO IMPROVE STUDENT LEARNING
Thermochemistry was the most challenging topic for the students. I will allocate more hours to cover thermochemistry and cut other topics instead (introduction).

COURSE CONTENT CHANGES
I try to follow the book closely. So when we change the textbook, I also might slight changes to the content.

COURSE DELIVERY CHANGES
I have introduced online homework

TEXT
The current textbook is very good. The students also seem to like the online homework. The only concern they have is how time consuming the online homework systems can be. It takes some time to become familiar with the system, e.g., how to enter values, how the work is scored etc.

Table 2. Direct Instrument for Chemistry 10301


Figure 5. Student response to learning in Chem 10301. Slight improvement in overall average for all outcomes between fall and spring semesters

General Chemistry 2, Chem 10401 was assessed more completely in AY 10-11. For AY11-12 Indirect evidence from student survey responses (EOCS) suggest greater learning across all course outcomes in the fall semester (Fig. 6). We suspect that students are misguided when answering the survey and tend to ‘rate’ the instructor instead of learning which would account for this discrepancy. The department needs to conduct a thorough analysis going back 3-5 years to identify if any improvements in student success over time.

Course Learning Outcomes
1. Ability to calculate concentrations of solutions, calculate effects of colligative properties.
and the better the indirect data.

...also similar and follow similar patterns and express deficiencies in learning for the same three outcomes.

Interestingly, student's response to learning in Chem 10401 followed by a list of Course outcomes 1-14. Slight decline in perceived learning for all outcomes between fall and spring semesters

Chemistry 24300 was offered and assessed in the spring 12 semester. This course, Quantitative Analysis, covers volumetric, spectrophotometric and electrometric analyses and is the critical follow-up course to the General chemistry series and is taken by all chemistry majors. Through this assessment we learn that students perform only at average levels for 3 of the 5 outcomes, involving knowledge acquisition (CLO1), making calculations (CLO3) and thinking critically (CLO5). To address these problems, the instructor has proposed to modify instruction by encouraging homework problem solving (CLO3) … ‘Students will earn extra points for homework problem solving’ and placing more emphasis on method’s applications (CLO5). Interestingly, students agree with the direct evidence provided by the instructor and express deficiencies in learning for the same three outcomes. The overall averages for learning are also similar and follow similar patterns across outcomes. As an aside, the more advanced the course (and student for that matter) the more correctly the students complete the End Of Course Survey (EOCS) and the better the indirect data. (Table 3 and Fig. 7)

<table>
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<tr>
<th>UNDERGRADUATE PROGRAM IN CHEMISTRY</th>
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<td>COURSE</td>
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<td></td>
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<tr>
<td>LEARNING OUTCOMES</td>
</tr>
<tr>
<td>Understanding the physical basis for analytical methods discussed during the course</td>
</tr>
<tr>
<td>Increased awareness of the sources of errors and the skills to avoid them</td>
</tr>
</tbody>
</table>

Author: Elizabeth Rudolph, Deputy Dean for Assessment and Graduate Programs, Division of Science

January 14, 2013
ability to calculate the amount of an analyte in the specific application of each method 3
ability to obtain a calibration curve and use it for an analytical purpose 4
understand the criteria which are used for choosing the methods for a particular analysis 5
average 3.80

FUTURE PLANS TO IMPROVE STUDENT LEARNING
Students will earn extra points for homework problem solving
Instructor will place more emphasis on method’s applications

COURSE CONTENT CHANGES
There has been a need to decrease the amount of material covered

COURSE DELIVERY CHANGES
Reduce the experiments in the lab
introduce the problem solving opportunities during the labs (4 of them)

TEXT
Very useful textbook. Shows how to solve the representative problems

Table 3. Direct Assessment data for Chem 24300 in Spring 2012

Figure 7. Indirect evidence for student learning in Chem 24300 SP12 (overall average 3.6)

Chemistry 26100, Organic Chemistry 1 is another important course to the Chemistry program, Pre-med, Biology, Psychology and several engineering disciplines. CCNY students tend to struggle in Organic Chemistry and the pass rate has been historically low (55-57% Rudolph analysis AY2008-2009). The
following charts in Figure 8 plot student perceived learning which shows a decline over 2 years for the same instructor for all learning outcomes except CLO2 for instructor 1 and CLOs 9 & 10 for instructor 2. All outcomes are classified as ‘knowledge outcomes’ and are highly specific. Overall averages across all outcomes range from 3.8-4.3 for the 4 semesters under consideration. These numbers are above average but clearly do not align with the final grades (Liz to calculate this...11-12 average pass rate=XXXX). According to the students, workshop is an extremely important resource and almost assures improved grades. However, under the current course construction, the workshops are non-mandatory separate zero credit courses that are offered at inconvenient times that are disconnected with the remaining division offerings. The students suggest that several instead of only 1 option for workshop should be provided.

Fall 2011 Direct data (worksheet in Appendix G) suggest that all students (A-F) perform well to near perfect on questions applied to CLOs regarding Lewis Structures, orbital hybridization, IUPAC nomenclature, molecule classification, and oxidation-reduction addition products, but fall short on the remaining outcomes. The worst performance was observed in carbocation rearrangements, dehydration, dehydrohalogenation and dehalogenation reactions, 33%. In that semester, 11 students earned A, 25 earned B, 35 earned C, 15 earned D and 7 earned F grades (+ and – grades included in each category).

Spring Direct Data (Table 4) shows the disconnect between student perceived learning and actual learning as determined by the hard evidence, exams, assignments and reports used by the instructor. The instructor has identified two areas of significant weakness in student learning, CLO9 and 10, the last material covered.

Ability to perform retrosynthetic analysis to solve multistep synthesis problems

Ability to interpret simple infrared, mass, 1H NMR and 13C-NMR spectra and to use the information derived from the IR, MS and NMR spectra to propose a tentative structure for an unknown organic compound.

The instructor has also identified only two learning outcomes actually mastered by the students, CLO1 and 2.

Understanding of Lewis structures, resonance forms, acid/base theories, orbital Hybridization and geometry of molecules, functional groups, constitutional isomers, cis/trans isomers.

Understanding of IUPAC nomenclature of alkanes, Newman projection Formulas, cycloalkane conformations, cis/trans isomers of cycloalkanes.

To address some of the deficiency in student learning the professor has agreed to...

Instructor will make up more in-class practice questions for the difficult areas of retrosynthetic analyses and structural elucidation.

And will share his/her results and question sets with other faculty assigned to teach the course.

A more extensive evaluation of Chem 261 will be undertaken in SP13. In it we will ask the department to classify the outcomes by type, i.e. Knowledge, critical thinking, problem solving, etc. and try to dig to the underlying cause of the low success in this course.
Figure 8. Chemistry 26100 Indirect evidence for student learning. 2010-2012 comparisons for two instructors
LEARNING OUTCOMES

Understanding of Lewis structures, resonance forms, acid/base theories, orbital Hybridization and geometry of molecules, functional groups, constitutional isomers, cis/trans isomers.
Understanding of IUPAC nomenclature of alkanes, Newman projection Formulas, cycloalkane conformations, cis/trans isomers of cycloalkanes.
Ability to recognize and write structures for chiral and achiral molecules, (R) and (S) configurations, racemates, enantiomers, diastereomers, meso compounds, Fisher projection Formulas.
Understanding of the mechanism of SN1, SN2, E1 and E2 reactions. Predict the products of the substitution and elimination reactions including stereochemistry.
Ability to predict the products of carbocation rearrangements, dehydration, dehydrohalogenation and dehalogenation reactions.
Ability to predict the products of additions, oxidations, reductions and cleavages of alkenes, including regiochemistry and stereochemistry. Acetylide ions in the synthesis of alkynes.
Ability to predict the products of additions, oxidations, reductions and cleavages of alkynes and predict the products of hydration, hydroboration, and hydroxylation of alkenes and use Grignard and organolithium reagents for the synthesis of alcohols.
Reaction of alcohols and pinacol rearrangement of diols.
Ability to predict the mechanism and products of radical reactions.
Ability to perform retrosynthetic analysis to solve multistep synthesis problems.
Ability to interpret simple infrared, mass, 1H NMR and 13C-NMR spectra and to use the information derived from the IR, MS and NMR spectra to propose a tentative structure for an unknown organic compound.

STUDENT MASTERY 1-5

1
2
3
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average

3.00

FUTURE PLANS TO IMPROVE STUDENT LEARNING

Instructor will make up more in-class practice questions for the difficult areas of retrosynthetic analyses and structural elucidation.
Other instructors can request problems and I can provide

COURSE CONTENT CHANGES

Only at the level of illustrative examples, not the fundamentals

COURSE DELIVERY CHANGES

With 150 students, I keep it as a lecture course, but invite student discussion. Invitation is rarely accepted because class is too large. I would be able to do much more with a class size of 30-40

TEXT

Very useful textbook. We should stick with it as long as it is available
Chemistry 26200, Organic Chemistry Lab 1, is a 2credit, 4hour lab that primarily serves chemistry majors but also includes some engineering students and bio/pre-med students. This course traditionally has had a very high pass rate. Students assessed learning for outcomes 1-7 in Fall 2011 suggest above average learning (average score 3.8 out of a possible high of 4 see Fig. 9). So actual success and student perceived success match well. The only criticism is in the ‘other’ category, Prereq chem 10401 (8); coreq chem 263 (9) and textbook usefulness (10). There is no rational justification for student’s failure to connect the relevance of learning in Chem 10401 to learning in this course by this instrument. A deeper study needs to be conducted and will be suggested to the department curriculum committee. As for the textbook, most students do find problems with texts in general. More research is needed to decide whether the low score earned for this text is warranted.

### Table 4. Direct evidence for student learning in Chem 26100 determined by Instructor using exams and assignments

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### Chem 26200 Course Learning Outcomes

1. Has this course increased your understanding of fundamental principles and theory behind organic laboratory techniques commonly used for purification of compounds and separation of reaction mixtures, monitoring the course of the reactions and analyzing reaction mixtures and products?
2. Has this course increased your understanding of the mechanistic basis of the synthetic experiments performed?
3. Has this course increased your ability to execute the organic laboratory techniques?
4. Has this course increased your ability to perform in practice some of the fundamental organic reactions by synthesizing a set of compounds and to apply the techniques learned to these?
5. Has this course increased your ability to obtain information on reagents listed in the lab procedures from a number of sources and follow the necessary safety precautions that need to be addressed when using these reagents?
6. Has this course increased your ability to perform basic calculations that pertain to synthetic organic experiments, which includes: calculation of limiting reactant and theoretical yield before the reaction and actual percent yield after the reaction?
7. Has this course increased your ability to write a valid laboratory report, which includes: compiling the data on reagents, calculating limiting reactant and yields, writing the mechanism of the reaction, writing the isolation and/or the separatory scheme, concisely and faithfully reporting all the observations during the experiment and analyzing and reporting the data obtained in the course of the experiment?

### Figure 9. Chemistry 262 Indirect evidence for student learning

Organic chemistry 2, Chem 26300, is another important sophomore level course, which follows the General Chemistry series and Organic Chemistry 1 and is intended primarily for chemistry,
biochemistry and pre-med majors. The success rate in Chem 263 is also high, in the 60% pass range. One contributing factor is that the prerequisite course, Chem 26100 serves as somewhat of a filter course. Students who reach this level are almost all certain to succeed.

SP12 average across all outcomes is 4.2 of a possible 5 (average of 2 sections see Fig. 10). All learning outcomes were scored above (or very near to) 4 suggesting students feel that they are learning the key concepts in the course.

Direct evidence once again suggests something slightly different see Figure 11. According the faculty response based on exams and assignments, students do not master CLO1,2,6,9,10,12 preforming particularly poorly in CLOs 9 and 12 (full data set in Appendix G. In the Sp13 semester the department will look more carefully and completely at Chem 263 and have the instructor complete the new direct instrument so we can propose ways to improve student learning in future offerings of 26300.

Course Learning Outcomes
How well did this course prepare you to understand:
1. Unsaturated conjugated systems.
2. Orbital conjugation and molecular orbital diagrams.
3. The Diels Alder reaction mechanistically and strategically.
4. Aromatic chemistry: including MO of benzene, Huckel’s rule, nomenclature, and associated physical properties.
5. The reactions of benzene and other aromatic systems.
6. The synthesis and reactions of aldehydes, ketones, imines, and amides.
7. The properties and reactions of amines.
8. The synthesis and chemical properties of carboxylic acids and their derivatives.
10. The classification, structure, and reactions of carbohydrates.
11. The structures, properties, and reactions of amino acids, and how amino acids are used to synthesize peptides.
12. and devise a plan for retrosynthetic analysis to solve multistep synthesis problems.
13. How useful was the Prerequisite Chem 261
14. How useful was the Textbook

Figure 10. Chart showing Indirect evidence of student learning Chem 26300 and list of course learning outcomes
Figure 11. Direct evidence for student learning in Chem 26300 F11
Chem 33200, Physical Chemistry 2, the follow-up to Chem 33000, Physical Chemistry 1 was assessed in the spring semester. On average students perceive above average learning, CLO average 3.5 of a possible 4. The instructor did not provide direct evidence, but final grades for the class are high ranging from C to A+, with no failures or withdrawals. The overall class average is 3.12, a solid B.

Course Learning Outcomes
1. Has this course increased your understanding of what the wavefunction means and how to interpret it?
2. Has this course increased your understanding of the concept of quantization and how it emerges as a natural consequence of solving the Schrödinger equation and applying boundary conditions?
3. Has this course increased your ability to describe the internal states of atoms in terms of quantum numbers?
4. Has this course increased your understanding of the concepts of orbitals and how they apply to both atoms and molecules?
5. Has this course increased your understanding of the concepts of rotational and vibrational spectra in terms of their origins from solution of the quantum mechanical wave equation, also be able to apply selection rules, which specify allowed transitions between quantum mechanical states?
6. Has this course increased your ability to apply selection rules, which specify allowed transitions between quantum mechanical states?
7. Has this course increased your ability to use quantum mechanical energies as energy states in statistical thermodynamic expressions dealing with the distribution of particles over available energy states?
8. Has this course increased your ability to utilize quantum mechanical energies to define partition functions, which in turn can be used to calculate thermodynamic state functions, such as entropy, enthalpy, etc?

Figure 12. Indirect evidence for student learning for Chem 33200 followed by the list of course outcomes
Chem 37400, Organic Chemistry Lab 2 was offered and assessed in SP12. This is another course with historically high pass rates, in fact, almost all students earned an A or B in this semester. Students were very satisfied with the degree of learning especially for CLO 1-4. The average over all 10 outcomes is 3.4 out of a possible 4. In SP13 instructors will be asked to complete the new direct instrument and will propose solutions to the weaknesses in student learning that are identified.

![Chem 37400 Student Responses EOCS SP12](image)

**Course Learning Outcomes**

1. Has this course increased your understanding of the fundamental principles and theory behind organic laboratory techniques commonly used for purification of compounds and separation of reaction mixtures, monitoring the course of the reactions, and analyzing reaction mixtures and products?
2. Has this course increased your ability to use advanced techniques and equipment (e.g. flash chromatography, solid phase extraction, preparative TLC, HPLC, and GC) to isolate and purify crude product and unknown materials?
3. Has this course increased your ability to identify purified chemicals using spectroscopic methods (e.g. FTIR, FTNMR, GCMS, Optical Rotation, X-ray diffraction)?
4. Has this course increased your ability to identify purified chemicals using chemical methods (e.g. reactive indicator tests such as Tollen’s silver mirror, and derivative formation)?
5. Has this course increased your ability to perform organic reactions in different environments (e.g. air sensitive reagents, multi-step synthesis, solid-phase synthesis, “green chemistry,” combinatorial and parallel synthesis)?
6. Has this course increased your ability to demonstrate proficiency in recording and evaluating experimental data including maintaining a proper laboratory notebook?
7. Has this course increased your ability to write a proper laboratory report including abstract, introduction, experimental methods, results, discussion, and references?
8. Has this course increased your ability to follow the safety requirements of an organic chemistry laboratory?
9. Has this course increased your ability to access and utilize chemical information technology for proper experimental design and interpretation?
10. Has this course increased your understanding of ethical responsibilities and ability to apply professional conduct in the laboratory?
11. pre-req 263
12. orereq 272
13. text

*Figure 13. Indirect evidence for student learning Chem 37400 followed by the course learning outcomes*
Graduate Course Assessment

The Chem A1100-1200 series is designed for the Environmental chemistry track of the standard Chemistry degree. Indirect and direct evidence in support of student learning in Chem A1100, Environmental Chemistry, Fall 2011, are shown in Figure 14 below. Judging by both instructor and student assessment, students are mastering learning outcomes above average expectations. The only noticeable deficiencies are in CLO 7 [ability to identify and propose treatment for hazardous wastes] and to a lesser degree CLO 8 [demonstrate analytical skills used to study the pollution of the environment] as determined by the instructor. These outcomes are significant and thus these finding warrant attention in the next offering of the course. The dept will present the findings to the instructor and ask for a plan for improving student learning. The instructor will also be asked to assess the missing outcomes 4 and 6.

Course Learning Outcomes

1. Has this course increased your knowledge of the relationship between all spheres of the environment?
2. Has this course increased your knowledge of the major pollutants in all spheres, their origin and fate?
3. Has this course increased your awareness of the environmental effects of pollution?
4. Has this course improved your knowledge of the cycles of environmentally significant elements?
5. Has this course increased your awareness of the effects of pollution on humans?
6. Has this course increased your ability to link technology, resources and energy?
7. Has this course increased your ability to identify and propose treatment for hazardous wastes?
8. Has this course increased your analytical skills used to study the pollution of the environment?

Figure 14. Evidence for student learning in Chem A1100, Environmental Chemistry followed by Course learning outcomes (complete direct matrix found in appendix G)

Chem A1200, Environmental Organic Chemistry was assessed in F11. Direct and indirect results are plotted together in Fig. 15. There is somewhat of a recognizable agreement between the perceived learning of the students and the direct evidence supplied by the instructor. The instructor has identified 2 learning topics that have given the students more trouble, CLO5 and 6 [thermochemical and photochemical transformation reactions, and solving complex environmental problems]. In the next offering of the course, the instructor will be asked to
Propose ways to improve learning in these areas. Special attention will be given to teaching students to solve complex environmental problems. All students earned in the A-B range.

Course Learning Outcomes
1. Has this course increased your ability to explain how intramolecular interactions determine the chemical properties of organic compounds?
2. Has this course enabled you to connect chemical structure to chemical property (vapor pressure, air-water partitioning, octanol-water partitioning)?
3. Has this course enabled you to estimate chemical properties of contaminants?
4. Has this course increased your understanding of how chemical properties determine the distribution of a compound in the environment?
5. Has this course provided the fundamental knowledge of thermochemical and photochemical transformation reactions?
6. Has this course improved your ability to solve complex environmental problems?
7. Has this course enabled you to apply the learned tools to predict the fate of a contaminant in the environment?
8. Has this course imparted knowledge of the important classes of organic contaminants?

Figure 15. Evidence for student learning in Chem A1200, Environmental Organic Chemistry followed by Course learning outcomes (complete direct matrix found in appendix G)

Chem A1400 teaches chemistry graduate students to utilize the library and online chemical information resources and databases, an essential skill set for research based theses. Both students and instructor agree that the course as presented fulfills its learning obligation. The instructor writes that the entire format of the course has been modified to keep pace with the advances in the chemical information field and the challenge is and always will be to keep up with advancing technology. This course can only be viable if the content keeps pace with technology.
GRADUATE PROGRAM IN CHEMISTRY-Direct Instrument

COURSE  CHEM A1400

LEARNING OUTCOMES

1. Knowledge of the different types of chemistry publications and information resources.
   Know how to locate and obtain any journal article or book you need for your research.
2. Know how to obtain physical data on elements and compounds from electronic and printed sources.
3. Ability to locate information and data on inorganic compounds in the Gmelin Handbook.
4. Ability to locate specific organic compounds in the printed Beilstein Handbook, and understand the differences and similarities of the handbook and the Beilstein Online Database.
5. Ability to locate commercial sources of chemicals.
6. Knowledge of the basics principles of online searching, and how to develop proper and efficient search strategies.
7. Understand the organization, and indexing method of Chemical Abstracts, and be able to search both the Chemical Abstracts Online Database, and the SciFinder Scholar version of Chemical Abstracts for specific substances, subjects, and reactions.
8. Ability to distinguish the strengths and weaknesses of SciFinder Scholar compared to the Chemical Abstracts Online Database.
Understand the reasons for citation indexing and be able to do cited reference searching in Science Citation Index, SciFinder Scholar, and Google Scholar.  

|   |  
|---|---|
| 10 | Awareness of the leading table of contents databases. |
| 11 | Appreciation of current awareness services. |
| 12 | Understand the basics of patents. |
| 13 | Awareness of the key world wide web resources in chemistry and how they compare to the fee-based and subscription sources. |
| 14 | Familiarity with world wide web search engines, especially the ones that focus on science. |

|   |  
|---|---|
| 15 | average |
|   | 4.73 |

Regarding 13, at least several weeks would be needed to give any student a strong understanding of patents. Students only receive a brief introduction.

Regarding 15--the basis of chemistry searching has always been Chemical Abstracts and its database which I teach in depth. The world wide web search engines being so incomplete, and so poorly indexed are a poor substitute for Chemical Abstracts. While I do point out and briefly describe these substitutes, a full in-depth comparison and evaluation of these web search engines is a scholarly time-consuming research issue that is just now starting to be addressed in the literature.

**FUTURE PLANS TO IMPROVE STUDENT LEARNING**

Extensive changes: 1. All course packs have been converted to electronic form. All course materials in pdf, ppt, and word. Going paperless has allowed me to mount more material and illustrations that could previously fit into the printed course pack.

**COURSE CONTENT CHANGES**

The content has changed. Printed Chemical Abstracts has been discontinued leaving only the two databases each containing the same information but with vastly different ways of searching.

**COURSE DELIVERY CHANGES**

**TEXT**

no text; the field changes outpace the publishing ability thus, the course pack is extensive and replaces a formal text.

---

**Figure 16. Evidence for student learning in Chem A1400, Chemical Information Sources**

Chem A8005 Biochemistry 2, is a grad course designed for the Biochemistry Masters Program. Indirect evidence suggests that learning is well above average across the 10 outcomes. The
grade distribution in the course ranged from A-C with no failures and only several withdrawals. Direct evidence is necessary to identify areas of weakness. According to the indirect data, CLO7, applying biochemistry techniques to modern biomedicine, gene therapy and genetic engineering proved to garner the weakest learning. Using specific reports or assignments that deal with applying techniques to real world examples will be suggested as a means for quantifying learning in this topic and the remaining 9 learning outcomes.

Course Learning Outcomes
1. know the basic steps and important intermediates in the light and dark reactions of photosynthesis.
2. know the basic steps and important intermediates in the synthesis of complex carbohydrates.
3. distinguish between the humoral and cellular immune systems and know the basic components and the function of the components of each system.
4. outline the steps in the biotechnological approaches to genetic disease including the genetic basis of the cancers discussed in class.
5. detail the main steps and intermediates in the pathways by which hormones regulate metabolism via glycolysis and the Kreb’s cycle and carbohydrate transport.
6. describe the functions of the elements of lambda bacteriophage in the lytic cycle or lysogeny
7. describe the basic steps in the techniques of biotechnology described in class. Students should be able to provide examples of how these techniques are applied to modern biomedicine, gene therapy and genetic engineering
8. know the structure and function of the basic ion channel types involved in neural transmission and the experimental techniques used to analyze how they function in motor control, memory and sensory input.
9. outline the steps and critical enzymes involved in the generation of reactive oxygen species (ROS) in mitochondria and how mitochondrial-derived ROS activate particular signaling pathways.
10. describe the processes by which retroviral oncogenes are transduced and subsequently activated in the host. Students should know how the human homologs of the oncogenes covered in class function in cell cycle control and cancer.

Figure 17. Indirect evidence for student learning in Chem A8005, Biochemistry 2
followed by a list of course outcomes

Chem A8300, Chemistry Seminar is a 1 credit, 2 hour course open to all Chemistry, Physics and Engineering Masters students that emphasizes topics in physical, inorganic and organic chemistry and culminates in a research project. Students are satisfied with the degree of learning in this course. All students passed with either A or B grade.
Course Learning Outcomes
1. Develop the ability to survey and critically evaluate an area of research;
2. organize and prepare a formal presentation.

*Figure 18. Indirect evidence of student learning in Chem A8300 followed by Course learning outcomes*

Chem B5000, Organic Mechanisms, also a basic course for standard chemistry deals with organic reaction mechanisms and their application to specific reactions. This is a demanding 5 credit course that covers many topics, see CLO 1-14 in figure 19. Student perceived learning varies significantly from topic to topic. The weakest outcome, CLO14 is directed at using chemistry information technology. If appropriate, the department or instructor might try directing students to Chem A1400, establishing it as a prerequisite course and removing CLO14 from this course.

Course Learning Outcomes
Has this course provided the [following] fundamental principles:
Department of Chemistry
Chem-Assessment-Report-AY11-12.docx
January 14, 2013

Author: Elizabeth Rudolph, Deputy Dean for Assessment and Graduate Programs, Division of Science

1. bonding in organic compounds,
2. stereochemistry and isomerism in organic molecules,
3. determination and assignment of chirality, steric, electronic, stereoelectronic and conformational properties of organic molecules,
4. reaction kinetics,
5. linear free energy relationships,
6. isotope effects,
7. neighboring group participation,
8. the chemistry of carbanions, carbonium ions, free radicals and carbenes,
9. the basics of cycloaddition chemistry,
10. elimination and substitution at sp3 carbons and reactions of aromatic systems such as electrophilic aromatic substitution,
11. addition-elimination, elimination-addition chemistry
12. Has this course improved your ability to analyze and interpret data as related to the concepts described above?
13. Has this course enabled you to work as part of a problem-solving team or independently as occasioned?
14. Has this course improved your ability to access and utilize chemical information technology?

Figure 19. Indirect evidence for Student learning in Chem B5000 followed by the list of course learning outcomes

Chem B5100, Organic Synthesis is a 5 credit, 5 hour follow-up to Organic Mechanisms (B5000). Students also found the learning to be well above average expectations for each of the 7 CLO and final grades ranged from A to C+ with no failures and only one withdrawal. Instructor direct assessment is less favorable. The instructor recognizes weaknesses in CLO 3 and 5 and will try to improve learning through better utilization of powerpoint and group presentations.

<table>
<thead>
<tr>
<th>CLO 1-7</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
<td>4.8</td>
<td>4.6</td>
<td>4.7</td>
<td>4.6</td>
<td>4.4</td>
<td>4.6</td>
<td>4.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LEARNING OUTCOMES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Principles and concepts involved in building organic molecules</td>
</tr>
</tbody>
</table>

GRADUATE PROGRAM IN CHEMISTRY-Direct Assessment Instrument

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CHEM B5100</th>
</tr>
</thead>
<tbody>
<tr>
<td>STUDENT</td>
<td>MASTERY</td>
</tr>
<tr>
<td>(GRADIENT</td>
<td>5=STRONG--</td>
</tr>
<tr>
<td>1=WEAK)</td>
<td>4</td>
</tr>
</tbody>
</table>
Department of Chemistry
Chem-Assessment-Report-AY11-12.docx
January 14, 2013
Author: Elizabeth Rudolph, Deputy Dean for Assessment and Graduate Programs, Division of Science

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>The generation of various functional groups</td>
</tr>
<tr>
<td>3</td>
<td>Functional group interconversions</td>
</tr>
<tr>
<td>4</td>
<td>Use of Reagents for various transformations</td>
</tr>
<tr>
<td>5</td>
<td>Ability to perform retrosynthetic analysis for molecular assembly</td>
</tr>
<tr>
<td>6</td>
<td>Understand the use of various protecting groups</td>
</tr>
<tr>
<td></td>
<td>Improved understanding of the development of multi-step organic synthesis</td>
</tr>
<tr>
<td></td>
<td>average</td>
</tr>
</tbody>
</table>

FUTURE PLANS TO IMPROVE STUDENT LEARNING

This course was offered after an 8-year break. Thus, the lecture notes, content and manner in which this course was taught was completely different from when it was last offered in 2004. Thus, no major changes are envisioned also because we do not know when this course will be offered again.

COURSE DELIVERY CHANGES—PEDAGOGY

Greater use of power point and a focus on student presentations was greater

TEXT

useful text. Perhaps too sophisticated. Instructor had to sift through the rather sophisticated text

Figure 20. Evidence for student learning in Chem B5100, Organic Synthesis

Use of Assessment Results: Current and Future

2008-2011 assessment highlights

Liz to add a summary here

Summary and Closing the Loop

- Students in General Chemistry I have identified weaknesses in learning in the laboratory while instructors find students to have difficulty with a particular topic, thermodynamics.

- We plan a complete grade analysis of Gen Chem 1 and 2 for the past 5 years to see if overall pass rates have improved; we will follow a cohort beyond Chem 1 and 2 and identify the relationship between Gen Chem success and later success in advanced chemistry or science courses and in overall GPA.
• Students fail to master 3 of 5 learning outcomes in Chem 24300, Quantitative Analysis the critical follow-up course to the Gen Chem series for chemistry majors. More online homework problem solving will be added to the course to give students more practice and an opportunity to improve learning.

• Students have identified the importance of Workshop to success in Chem 261, Organic Chemistry. The department needs to rethink the scheduling of the course to enable more students to participate in workshop.

• Students do not recognize the relevance of the prerequisite course, Chem 10401, to Chem 26200. In general, students fail to value the prerequisite courses. The surveys need to elicit more specific complaints about prerequisite courses; information as to relevance will come from the instructors or the curriculum committee.

• Instructor and students opinion on student learning differs broadly in Chem 263. However, the instructor used the old direct instrument to assess the course. In the next assessment cycle the instructor will use the new direct instrument so we can identify causes for learning deficiencies and propose improvements.

• Recent graduates feel a deficiency in Chemistry Program Outcomes addressing Group work and accessing chemical information technology. The department will consider inserting group work in one or two positions in the curriculum.

• Graduates are satisfied with their learning especially with regard to acquiring knowledge, analyzing and interpreting data and practicing ethics. However students participating in capstone research felt that they needed more treatment on ethics and needed a strengthened knowledge base.

• Graduate students and the instructor report above average learning in Chem A1100 with the exception of ‘ability to identify and propose treatment for hazardous wastes and in demonstrating analytical skills used to study pollution. The new direct instrument will help the instructor propose solutions to the weaknesses in the identified areas of study.

• Graduate students in Chem A1200 also performed less strongly in two areas of study. These areas will be given more attention in the next offering.

• Graduate students in Chem A1400 rated learning well above average. Interestingly, undergraduate students have identified the material covered in this course to be absent from their curriculum and training. Therefore, it may be appropriate to add this course or an equivalent to the undergraduate curriculum.
Biochemistry Graduate students give high scores to learning in Chem A8005. Grade distribution in the course agrees with this assessment. The only difficulty that must be addressed is the ability to apply biochemistry techniques to modern biomedicine etc. Applying techniques is always a challenge and more emphasis on the steps involved will be addressed in the next offering.

Chem B5000 and B5100 are 5 credit intensive courses with very specific and technical outcomes. Interestingly, the only weakly covered outcome identified by the students in B5000 involves using chemistry technology information whereas the problem learning outcomes in B5100 are very technical topics.

Syllabi
The Chemistry Department posts Syllabi to the departmental website:
http://www1.ccny.cuny.edu/prospective/science/chemistry/ug_courseлист.cfm
Denise Addison, chemistry department administrative assistant maintains the assessment postings. Chemistry Department faculty and instructors are now routinely presenting course learning outcomes/objectives on their syllabi.

Faculty Professional Development
The Divisional task force, TLAC (Teaching and Learning Advisory Committee) runs a workshop yearly on science pedagogy and/or research, entitled ‘Discussions on Student Learning’. The first event was run in January, 2010 and involved presentations on Making Sense of How Students Make Sense of Science; Working Research Into the Classroom; How Students Do or Do Not Learn Math and Science. The Second event took place in the reporting period, Jan, 2011 and covered a systematic review and follow-up from the 2010 event and a presentation on the Mechanisms, Causality and Explanations in Complex Dynamic Systems -implication for teaching and learning. In the first production, of the 25 participants, 3 were from the Chemistry Department, Profs Stephen O’Brien, Zimei Bu and Marco Ceruso. In the second production, 4 chemistry professors participated, Issa Salame and the same 3 from the previous workshop.

Course and Teacher Surveys (C&T)
Since Spring 2011, the college has reverted to a former mode of collection of Course and Teacher survey data, paper form administered in class during the last 2 weeks of the semester. CT survey shown in Appendix C.

Using results of C&T
C&T results are used in all cases of faculty reappointments, tenure and promotion. However, since the college encountered difficulties in both fall 2010 and spring 2011 collections and analysis, these results were not available for the fall 2011 reappointment, tenure and promotion cases.
Department of Chemistry – Five Year Assessment Plan 2008-2013

Overview: To keep improving the Chemistry programs, Chemistry courses will be systematically reviewed both directly and indirectly on a regular basis. The large service courses in General Chemistry and Organic Chemistry will be assessed every semester. The other courses will be assessed once every year. The direct assessment will occur with matrices using student work (final exam, lab reports, rubrics for presentation, ...). A end of course survey (EOCS) will be used for the indirect assessment.

Indirect Assessment: The majority of the Chemistry courses will be survey for Course Knowledge Outcomes on a semesterly basis. For the typical Fall semester CHEM 10000, CHEM 10301, CHEM 10401, CHEM 24300, CHEM 26100, CHEM 26200, CHEM 26300, CHEM 31114, CHEM 31115, CHEM 33000, CHEM 42500, CHEM 43400, CHEM A1101, CHEM B5000 will be indirectly assessed. For the typical Spring semester CHEM 10100, CHEM 10301, CHEM 10401, CHEM 26100, CHEM CHEM

Direct Assessment: Course will be directly assessed at least once a year over a five year period. The four service courses with large enrollment in Chemistry will be assessed once a semester. Those courses are CHEM10301, CHEM10401, CHEM26100, and CHEM26300.

Assessment Process in the Chemistry Department: At the end of the semester, the assessment coordinator collects the data for the EOCS (indirect assessment), the matrices (direct assessment), and the grade distribution for all courses and writes an assessment report. The report is presented to the chair and approved by the faculty. The curriculum committee will then meet and discuss potential actions based on the findings in the report. These actions can lead to a change in the general syllabus for a course. If new resources for the instruction of a course are suggested a request is presented to the executive committee of the Department.
### Department of Chemistry

**Chem-Assessment-Report-AY11-12.docx**

**January 14, 2013**

**Author:** Elizabeth Rudolph, Deputy Dean for Assessment and Graduate Programs, Division of Science

<table>
<thead>
<tr>
<th>G/M</th>
<th>CHEMISTRY</th>
<th>O/CRES/CORK-133</th>
<th>MASTERS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-Science Major</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Engineering</td>
<td>Undergraduate &amp; Master's</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Field course</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.</td>
<td>Know fundamental principles</td>
<td>X X X X X X X X X X X X X X</td>
<td>X X X X X X</td>
</tr>
<tr>
<td></td>
<td>principles to life sciences,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>environment, and emerging</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>fields of diversity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.</td>
<td>Conduct experiments</td>
<td>X X X X X</td>
<td>X X X X</td>
</tr>
<tr>
<td></td>
<td>Basic concepts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.</td>
<td>Analyze and interpret</td>
<td>X X X X X X</td>
<td>X X X X</td>
</tr>
<tr>
<td></td>
<td>data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D.</td>
<td>Solve problem in a</td>
<td>X X X X X X</td>
<td>X X X X</td>
</tr>
<tr>
<td></td>
<td>team</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E.</td>
<td>Communicate in written form</td>
<td>X X X X X X</td>
<td>X X X X</td>
</tr>
<tr>
<td>F.</td>
<td>Communicate in oral form</td>
<td>X X X X X X</td>
<td>X X X X</td>
</tr>
<tr>
<td>G.</td>
<td>Use chemical information technology</td>
<td>X X X X</td>
<td>X X X X</td>
</tr>
<tr>
<td>H.</td>
<td>Design and execute research</td>
<td>X X X X</td>
<td>X X X X</td>
</tr>
<tr>
<td>I.</td>
<td>Conduct oneself</td>
<td>X X X X</td>
<td>X X X X</td>
</tr>
<tr>
<td></td>
<td>ethically and responsibly</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

32
Figure 1: Flow chart of the assessment process
APPENDIX A: SAMPLE END OF COURSE SURVEY AND DIRECT INSTRUMENT

COURSE FEEDBACK SURVEY  
(END-OF-COURSE SURVEY)  
SPRING 2012  
CHEM B5100 ORGANIC SYNTHESIS

In this survey you are asked to evaluate the course you are going to complete. Your answers provide feedback essential to the ongoing process of improving the Earth and Atmospheric Sciences program. The estimated time to complete all questions is 5 minutes. Thank you for helping us evaluate and improve this course.

What is your CHEMISTRY CONCENTRATION? ________________________

What grade do you expect? ______

<table>
<thead>
<tr>
<th>Course Outcome</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. UNDERSTAND the principles and concepts involved in building organic molecules.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. UNDERSTAND GENERATION of various functional groups.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. UNDERSTAND functional group interconversions.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. UNDERSTAND USE of reagents for various transformations.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. PERFORM retrosynthetic analysis for molecular assembly.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. UNDERSTAND USE of various protecting groups.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. BETTER UNDERSTAND the development of multi-step organic synthesis.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If you have other comments about CHEM B5100, please add them HERE:
DIRECT ASSESSMENT INSTRUMENT. LEARNING SURVEY TO BE COMPLETED BY INSTRUCTOR  
SPRING 2012 – DIVISION OF SCIENCE  CHEM B5100

1. Achievement of Learning Outcomes. Based on your in-class assessments (tests and assignments), please rate the degree to which students have grasped the course learning outcomes. (NOTE - These outcomes mirror those from the end of course survey and your syllabus.)

<table>
<thead>
<tr>
<th>LEARNING OUTCOME</th>
<th>STRONG UNDERSTANDING</th>
<th>AVERAGE UNDERSTANDING</th>
<th>WEAK UNDERSTANDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Principles and concepts involved in building organic molecules.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. The generation of various functional groups.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Functional group interconversions.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Use of reagents for various transformations.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Ability to perform retrosynthetic analysis for molecular assembly.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Understand the use of various protecting groups.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Future plans: Please respond to the following question regarding changes to improve student learning.  
2.1. Based on YOUR assessment of student learning AND your responses to question 1, list the topics and pedagogical changes that you will implement to improve student learning. (Note: if this means sharing information with other instructors, please explain)

3. IF APPLICABLE Please respond to the following questions regarding implementations since the start of learning outcomes assessment (circa 2007)
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Author: Elizabeth Rudolph, Deputy Dean for Assessment and Graduate Programs, Division of Science
DIRECT ASSESSMENT INSTRUMENT. LEARNING SURVEY TO BE COMPLETED BY INSTRUCTOR
SPRING 2012 – DIVISION OF SCIENCE  CHEM B5100

3.1 Since teaching this course, have you ever made changes in course content? If yes, please explain.

3.2 Since teaching this course have you made changes in course delivery or other pedagogy? Please explain.

4. How useful are the text and other resources assigned to this course? Please explain.
APPENDIX B. C&T SURVEY

<table>
<thead>
<tr>
<th>Class Climate</th>
<th>C&amp;T Paper version</th>
</tr>
</thead>
<tbody>
<tr>
<td>ccny-science</td>
<td>All Instructors</td>
</tr>
<tr>
<td>Science_1</td>
<td></td>
</tr>
</tbody>
</table>

Mark as shown: [ ] [ ] [ ] [ ] Please use a ballpoint pen or a felt tip. This form will be processed automatically.
Correction: [ ] [ ] [ ] [ ] Please follow the examples shown on the left-hand side to help optimize the reading results.

1. Please evaluate your instructor:

1.1 The instructor presented the course expectations clearly.
1.2 The instructor presented the course material clearly.
1.3 The instructor paid attention to whether or not students understood the material.
1.4 The assignments helped me learn the course material.
1.5 I received useful feedback on assignments.
1.6 The instructor was available outside of class, during office hours, by email, phone, or other means.
1.7 I was kept informed on how well I was doing.
1.8 The instructor fairly evaluated my knowledge of the course material.
1.9 The course stimulated my interest in the subject matter.
1.10 What I learned from the course was worth the time and effort I put into it.
1.11 I learned from this instructor [Please select one]:
   - Much more than I expected
   - Less than I expected
   - As much as I expected
1.12 Compared to other courses I have taken at CCNY, this course is [Please select one]:
   - One of the easiest
   - Easier than average
   - Average
   - One of the most difficult
   - More difficult than average
   - Cannot judge

1.13 What were the three (3) most important things you learned from the course?

1.14 Please provide your suggestions to improve the course, if any:

1.15
Class Climate

1. Please evaluate your instructor. [Continue]

1.15 What did you appreciate most about the course, if anything?

1.16 Was technology part of instruction in this course? [Check all that apply]
   - No
   - Course web pages [included Blackboard]
   - Internet [such as Google, Wikipedia]
   - PowerPoint
   - Other

1.17 To what extent did technology help you learn the course material? [Please select one]
   - Not at all
   - Much
   - Required
   - A little
   - Very much
   - An elective
   - Moderately
   - Cannot answer or N/A
   - Satisfactorily
   - C/Pass
   - Withdraw

1.18 In my major, this course is. [Please select one]
   - A or A+
   - D
   - Don't know
   - B+, B or B-
   - F or Fail
   - Never absent
   - 6 or more absences
   - 1-2 absences
   - 3-4 absences

1.19 What grade do you expect for this course?
   - A or A+
   - D
   - Don't know
   - B+, B or B-
   - F or Fail
   - Never absent
   - 6 or more absences
   - 1-2 absences
   - 3-4 absences

1.20 How often did you miss class in this course? [Please select one]
   - Yes
   - No

Thank you for completing this survey!
1. Course Learning Outcomes

1.1 This course has increased my understanding of the physical bases for analytical methods discussed during the course.

1.2 This course has increased my awareness of the sources of errors and the skills to avoid them.

1.3 This course has increased my ability to calculate the amount of analyte in the specific application of each method.

1.4 This course has enabled me to obtain a calibration curve and use it for an analytical purpose.

1.5 This course has increased my understanding of the criteria, which are used for choosing the methods for a particular analysis.

2. Other

2.1 How useful was having taken the prerequisite course Chem 10401 or equivalent to your success in this class?

2.2 How useful was the textbook?

2.3 Additional comments:
APPENDIX C: GRADUATING SENIOR SURVEY

City College of New York
Graduating Senior Survey
Chemistry

This survey provides feedback essential to the on-going assessment process of improving the Chemistry Program at the City College of New York. The estimated time to complete all questions is about 8 minutes. Thank you for your interest in and support of this effort.
If you have any questions concerning this survey, please contact the Prof. Simms, Ext. 8402, office MR1024, e-mail:

1. How strongly did the Chemistry Program educate you each of the following areas?
(Please Circle: 1 = Poorly educated or not at all, 2 = Not quite satisfactory, 3 = Adequate, 4 = Good, 5 = Excellent)

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Poor</th>
<th>Adequate</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Knowledge of the fundamental principles of chemistry</td>
<td>1</td>
<td>2</td>
<td>3 4 5</td>
</tr>
<tr>
<td>b. Application of the fundamental principles of chemistry to life sciences, the environment, and other fields</td>
<td>1</td>
<td>2</td>
<td>3 4 5</td>
</tr>
<tr>
<td>c. Ability to conduct experiments and learn fundamental laboratory skills</td>
<td>1</td>
<td>2</td>
<td>3 4 5</td>
</tr>
<tr>
<td>d. Ability to analyze and interpret data</td>
<td>1</td>
<td>2</td>
<td>3 4 5</td>
</tr>
<tr>
<td>e. Be able to apply mathematical concepts to chemical problems</td>
<td>1</td>
<td>2</td>
<td>3 4 5</td>
</tr>
<tr>
<td>f. Be able to work as part of a problem-solving team</td>
<td>1</td>
<td>2</td>
<td>3 4 5</td>
</tr>
<tr>
<td>g. Ability to convey facts, theories and results about chemistry in a written form</td>
<td>1</td>
<td>2</td>
<td>3 4 5</td>
</tr>
<tr>
<td>h. Be able to use oral presentation to convey facts, theories and results about chemistry</td>
<td>1</td>
<td>2</td>
<td>3 4 5</td>
</tr>
<tr>
<td>i. Ability to access and utilize chemical information technology</td>
<td>1</td>
<td>2</td>
<td>3 4 5</td>
</tr>
<tr>
<td>j. Know how to design and execute scientific research</td>
<td>1</td>
<td>2</td>
<td>3 4 5</td>
</tr>
<tr>
<td>k. Learn appropriate ethical responsibilities and professional conduct</td>
<td>1</td>
<td>2</td>
<td>3 4 5</td>
</tr>
</tbody>
</table>

2. Please circle the type of career that you may be interested in:
(more than one answer possible)

   Graduate Studies  Medical School  Other Professional Training  Industry  Research & Development  Other:

3. How do you rate each of the following areas?
Department of Chemistry  
Chem-Assessment-Report-AY11-12.docx  
January 14, 2013  
Author: Elizabeth Rudolph, Deputy Dean for Assessment and Graduate Programs, Division of Science

(Please Circle: 1=Poor, 2=Not quite satisfactory, 3=Adequate, 4=Good, 5=Excellent)

<table>
<thead>
<tr>
<th></th>
<th>Poor</th>
<th>Adequate</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. The academic facilities of the Chemistry Department (laboratories, computer facilities, classrooms)</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>b. The Faculty of the Chemistry Department</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>c. The student facilities of the Chemistry Department (copiers, society offices, telephones, social support)</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>d. The student facilities in the City College (similar to above)</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>e. The student/faculty relationships in the Chemistry Dept.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>f. The administration of the Chemistry Department</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>g. The laboratory technicians in the Chemistry Department</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>h. The Biochemistry option Undergraduate Advisor of the Chemistry Department</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>i. The standard Chemistry Majors Undergraduate Advisor of the Chemistry Department</td>
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<td>2</td>
<td>3</td>
</tr>
<tr>
<td>j. The office staff in the Chemistry Department</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>k. Your experience as a student at the City College of New York</td>
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<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Please circle

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Once</th>
<th>Twice</th>
<th>Often</th>
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<tbody>
<tr>
<td>k. Do you attend Baskerville Chemical Society meetings this semester?</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>k. Do you attend Cadeceus Society meetings this semester?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Would you recommend the Chemistry Department to friends or relatives?

Please Circle: Yes No Maybe/Doubt

5. Please identify any areas of concern, if any, that you feel the Chemistry program should improve to provide better education.
6. Please identify the strengths of the Chemistry program.

7. What is your present situation and what are your plans for the future? (Please Circle Yes or No)
   a. Are you employed? Yes No
      If Yes, do you have a Chemistry job? Yes No
      If Yes, which employer? Name:
      Location:
      If No, are you actively looking for employment? Yes No
   b. Are you enrolled in, accepted, or applying for, graduate School? Yes No
      If Yes, which school? Name:
      If No, are you considering graduate school in the future? Yes No
   c. Will you take, or did you, the GRE examination in Chemistry? Yes No
   d. Will you take, or did you, the general GRE examination? Yes No
   e. Will you take, or did you, the MCAT examination? Yes No
Please Detach and hand in separately

Graduating Seniors follow-up
The department would like you to provide contact information for possible follow-up purposes, e.g., asking alumni about their experiences and how their CCNY education prepared them for work, or for an exit interview.
If you have no objections being contacted, please provide your contact information below.

Confidentiality: The information asked below is strictly confidential. From reports about the survey results it can never be determined which individual gave specific answers. This information will not be filed together with your answers on the survey and will not be made available to others.

<table>
<thead>
<tr>
<th>Last Name</th>
<th>First Name and middle initial(s)</th>
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</thead>
<tbody>
<tr>
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<table>
<thead>
<tr>
<th>Current Address:</th>
<th></th>
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<tbody>
<tr>
<td>Street or PO Box</td>
<td>City</td>
</tr>
<tr>
<td>-----------------</td>
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</table>

<table>
<thead>
<tr>
<th>E-mail Address:</th>
</tr>
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</tbody>
</table>

Do you plan to keep this e-mail address in the near future? Yes No

<table>
<thead>
<tr>
<th>Phone:</th>
<th></th>
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<tbody>
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</table>

Do you plan to keep this phone number in the near future? Yes No

<table>
<thead>
<tr>
<th>Other Permanent Address:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Street or PO Box</td>
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</tr>
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</tr>
</tbody>
</table>

Other info:

4
PART D. GRADUATING SENIOR SURVEY RESULTS

Graduating Senior Survey
Chemistry Department

1. How strongly did the Chemistry Program educate you in each of the following areas? CLO (scale 1-5; poor-excellent)
   a. Knowledge of the fundamental principles of chemistry
   b. Application of the fundamental principles of chemistry to life sciences, the environment and other fields
   c. Ability to conduct experiments and learn fundamental laboratory skills
   d. Ability to analyze and interpret data
   e. Ability to apply mathematical concepts to chemical problems
   f. Ability to work as part of a problem solving team
   g. Ability to convey facts, theories and results about chemistry in a written form
   h. Ability to use oral presentation to convey facts, theories and results about chemistry
   i. Ability to access and utilize chemical information technology
   j. Know how to design and execute scientific research
   k. Learn appropriate ethical responsibilities and professional conduct

   Q1 CLO-a CLO-b CLO-c CLO-d CLO-e CLO-f CLO-g CLO-h CLO-i CLO-j CLO-k
   grad1 3 2 4 3 2 2 2 3 2 2 3
   grad2 4 4 3 5 4 3 3 4 2 3 5
   grad3 4 4 3 4 4 4 4 3 3 3 3
   grad4 5 5 5 5 4 4 5 5 4 5 4
   grad5 5 5 5 5 3 5 5 3 3 3 3
   grad6 5 5 5 5 4 4 5 4 5 5 5
   grad7 3 3 3 4 4 3 3 4 3 3 4
   grad8 4 4 4 3 3 3 4 4 3 3 4
   grad9 5 5 5 5 5 5 5 5 5 5 5
   mean 4.22 4.11 4.11 4.33 3.78 3.44 4.11 4.00 3.33 4.00 4.22
   stddev 0.83 1.05 0.93 0.87 0.97 0.88 0.93 1.00 1.12 1.00 1.09

2. What is your career interest?

   Graduate Studies 55.6
   Medical School 44.4
   Other Profession 0.0
   Industry 11.1
   Research and Development 22.2
   Other 11.1

   grad1 grad2 grad3 grad4 grad5 grad6 grad7 grad8 grad9
   X X X X X X

3. How do you rate each of the following areas?
   a. The academic facilities of the Chemistry Department (labs, computer facilities, classrooms)
   b. The Faculty of the Chemistry Department
Graduating Senior Survey
Chemistry Department

QUESTION 1 RESULTS

Knowledge of Chemistry

Team work

Ethics and prof conduct

Application of principles

Communicate in writing

Experiments & Lab skills

Oral communication

data analysis & interpretation

utilize chemical inf tech

Apply mathematics

Conduct research

QUESTION 2 RESULTS

STUDENT FUTURE PLANS IN %
Graduate Studies 55.5%
Medical School 44.4%
Other Professional 0.0%
Industry 11.1%
Research and 22.2%
Other 11.1%

January 14, 2013
Author: Elizabeth Rudolph, Deputy Dean for Assessment and Graduate Programs, Division of Science
Department of Chemistry
Chem-Assessment-Report-AY11-12.docx
January 14, 2013
Author: Elizabeth Rudolph, Deputy Dean for Assessment and Graduate Programs, Division of Science

Graduating Senior Survey
Chemistry Department

c. The student facilities of the chem dept (copiers, society offices, phones, social support)
d. The student facilities in CCNY similar to above
e. Student/Faculty relationships in the Chem dept
f. The administration of the Chemistry department
g. The laboratory technicians in the chemistry department
h. The biochemistry option undergraduate advisor
i. The standard chemistry major undergrad advisor
j. the office staff in the chem dept
k. Your experience as a student at CCNY

<table>
<thead>
<tr>
<th>Q3</th>
<th>area a</th>
<th>area b</th>
<th>area c</th>
<th>area d</th>
<th>area e</th>
<th>area f</th>
<th>area g</th>
<th>area h</th>
<th>area i</th>
<th>area j</th>
<th>area k</th>
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<td>grad9</td>
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0 2 1 0 2 1 0 2 2 2 1
5 1 2 7 2 3 1 1 1 2 0
2 5 5 2 4 3 5 4 3 2 3
2 1 0 0 1 2 3 2 1 3 4

l. Do you attend Baskerville Society meetings?
   never once twice often
   grad1 X
   grad2 X
   grad3 X
   grad4 X
   grad5 X
   grad6 X
   grad7 X
   grad8 X
   grad9 X

m. Do you attend Cadeceus Society meetings?
   never once twice often
   grad1 X
   grad2 X
   grad3 X
   grad4 X
   grad5 X
   grad6 X
   grad7 X
   grad8 X
   grad9 X

BASKERVILLE RESULTS

<table>
<thead>
<tr>
<th>BASKERVILLE SOCIETY MEETING ATTENDANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEVER 0.0%</td>
</tr>
<tr>
<td>ONCE 22.2%</td>
</tr>
<tr>
<td>TWICE 33.3%</td>
</tr>
<tr>
<td>OFTEN 44.4%</td>
</tr>
</tbody>
</table>

CADECEUS RESULTS

<table>
<thead>
<tr>
<th>CADECEUS SOCIETY MEETING ATTENDANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEVER 88.9%</td>
</tr>
<tr>
<td>ONCE 11.1%</td>
</tr>
<tr>
<td>TWICE 0.0%</td>
</tr>
<tr>
<td>OFTEN 0.0%</td>
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</tbody>
</table>
Graduating Senior Survey  
Chemistry Department

QUESTION 3 RESULTS

- **Chem Academic facilities**
- **Chem dept administration**
- **Overall CCNY experience**
- **Chem faculty**
- **Lab Technicians (CLTs)**
- **Dept facilities**
- **Biochem advisor**
- **Student facilities in dept**
- **Gen chem advisor**
- **Student/faculty rapport**
- **Office Staff in dept**
4. Would you recommend the Chemistry Department to friends or relatives?

- yes
- no
- maybe/doubtful

<table>
<thead>
<tr>
<th>grad1</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>grad2</td>
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<tr>
<td>grad3</td>
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<td>grad7</td>
<td>X</td>
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<tr>
<td>grad8</td>
<td>X</td>
</tr>
<tr>
<td>grad9</td>
<td>X</td>
</tr>
</tbody>
</table>

**WILL YOU RECOMMEND CCNY TO FRIEND OR RELATIVE?**

- YES 66.7%
- NO 0.0%
- MAYBE-DOUBTFUL 33.3%

5. Please identify areas of concern, if any, that you feel the Chemistry program should improve to provide a better education

- grad1
  - I wish that some of the faculty would be less harsh in grading. They also need to understand student's concerns better. Better exam preparation.

- grad2
  - computer lab for just chemistry majors
  - Biochem 1--the class syllabus is too encompassing. Biochem 1 should be 2 semesters and then take advanced biochem in the third semester. Biochem 1 should be a 300 level course taken before biochem. After pbiochem should be biochem II and then advanced biochem.

- grad3
  - The chemistry program should have more elective courses so students can take classes that are of their specific interest.

- grad4
  - Chem 243 and biochem class

- grad5
  - The chairman Prof Simms is very helpful and caring. I don't and can't say that for the rest of them
  - The physical chemistry classes, particularly chem 330 should have a more integrated physical chemistry workshop in that the professors of the course should make efforts to make the workshops happen and be helpful. There either should be a good pchem student of a chem PhD to teach it.

6. Please identify the strengths of the Chemistry Program

- grad1
  - good professors

- grad2
  - academic courses and faculty

- grad3
  - professors Salame, Lombardi and Ryan

- grad4
  - they are always able to reach (profs?, dept?)

- grad5
  - some faculty

- grad6
  - teaches me the fundamentals in math and science
  - The chemistry dept is a very engaging and rigorous curriculum. I feel so well-rounded about science and chemistry as a biochem and pre-med major. The courses are phenomenal, challenging and well worth the work required to do well in that you learn so much information.

7. Please answer the following
Graduating Senior Survey
Chemistry Department

Graduating Senior Survey
Chemistry Department

---

a. Are you employed
b. If yes, do you have a chemistry job?
c. If yes, which employer?
d. Are you actively looking for employment?
e. Are you enrolled in, accepted, or applying to graduate school?
f. If yes, identify schools
  g. If no, are you considering graduate school in the future?
  h. Will you take or have you taken the GRE exam in chemistry?
  i. Will you take or have you taken the General GRE exam?
j. Will you or have you taken the MCAT exam?

<table>
<thead>
<tr>
<th></th>
<th>grad1</th>
<th>grad2</th>
<th>grad3</th>
<th>grad4</th>
<th>grad5</th>
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<th>grad7</th>
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<td>MCAT</td>
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</tbody>
</table>

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**RESULTS FOR LAST SET OF QUESTIONS**

- Employed? 11.1%
- Chem Job? 11%
- Job Hunting? 44.4%
- Grad School intended 44.4%
- Grad School later 66.7%
- Chem GRE? 22.2%
- General GRE? 44.4%
- MCAT? 33.3%

---

![Chart showing percentages for each question option]
APPENDIX E: ASSESSMENT DATA FOR CHEMISTRY CAPSTONE COURSES:

1. STUDENT RESPONSES CHEM 30100 (n=5)

- Ability to apply math & science knowledge
- Appreciate chemistry research impact on society
- Ability to practice ethics in chemistry research
- Ability to design and conduct experiments

- Ability to Analyze and interpret data
- Effective written communication
- Effective oral communication
- Ability to use communication media

- Ability to assess the literature
- Ability to keep accurate records
- Effectively worked as part of a team
- Experience was worth the time and effort put in
2. **STUDENT RESPONSES CHEM 30200 (n=3)**

- **Ability to apply math & science knowledge**
- **Appreciate chemistry research impact on society**
- **Ability to practice ethics in chemistry research**
- **Ability to design and conduct experiments**
- **Ability to Analyze and interpret data**
- **Effective written communication**
- **Effective oral communication**
- **Ability to use communication media**
- **Ability to assess the literature**
- **Ability to keep accurate records**
- **Effectively worked as part of a team**
- **Experience was worth the time and effort put in**
3. STUDENT RESPONSES CHEM 30300 (n=9)

- Ability to apply math & science knowledge
- Appreciate chemistry research impact on society
- Ability to practice ethics in chemistry research
- Ability to design and conduct experiments
- Ability to Analyze and interpret data
- Effective written communication
- Effective oral communication
- Ability to use communication media
- Ability to assess the literature
- Ability to keep accurate records
- Effectively worked as part of a team
- Experience was worth the time and effort put in
4. STUDENT RESPONSES CHEM 31000 (n=4)

[Graphs showing student responses for various competencies including ability to apply math & science knowledge, appreciate chemistry research impact on society, ability to practice ethics in chemistry research, ability to design and conduct experiments, ability to analyze and interpret data, effective written communication, effective oral communication, ability to use communication media, ability to assess the literature, ability to keep accurate records, effectively worked as part of a team, and experience was worth the time and effort put in.]
5. MENTOR RESPONSES CHEM 30100 (n=4)

- **Ability to apply math & science knowledge**
- **Appreciate chemistry research impact on society**
- **Ability to practice ethics in chemistry research**
- **Ability to design and conduct experiments**
- **Ability to analyze and interpret data**
- **Effective written communication**
- **Effective oral communication**
- **Ability to use communication media**
- **Ability to assess the literature**
- **Ability to keep accurate records**
- **Effectively worked as part of a team**
- **Experience was worth the time and effort put in**
6. MENTOR RESPONSES CHEM 30200 (n=5)

- Ability to apply math & science knowledge
- Appreciate chemistry research impact on society
- Ability to practice ethics in chemistry research
- Ability to design and conduct experiments

- Ability to Analyze and interpret data
- Effective written communication
- Effective oral communication
- Ability to use communication media

- Ability to assess the literature
- Ability to keep accurate records
- Effectively worked as part of a team
- Experience was worth the time and effort put in
## 7. MENTOR RESPONSES CHEM 30300 (n=4)

<table>
<thead>
<tr>
<th>Skill</th>
<th>Rating Distribution</th>
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<tbody>
<tr>
<td>Ability to apply math &amp; science knowledge</td>
<td><img src="chart1.png" alt="Chart" /></td>
</tr>
<tr>
<td>Appreciate chemistry research impact on society</td>
<td><img src="chart2.png" alt="Chart" /></td>
</tr>
<tr>
<td>Ability to practice ethics in chemistry research</td>
<td><img src="chart3.png" alt="Chart" /></td>
</tr>
<tr>
<td>Ability to design and conduct experiments</td>
<td><img src="chart4.png" alt="Chart" /></td>
</tr>
<tr>
<td>Ability to Analyze and interpret data</td>
<td><img src="chart5.png" alt="Chart" /></td>
</tr>
<tr>
<td>Effective written communication</td>
<td><img src="chart6.png" alt="Chart" /></td>
</tr>
<tr>
<td>Effective oral communication</td>
<td><img src="chart7.png" alt="Chart" /></td>
</tr>
<tr>
<td>Ability to use communication media</td>
<td><img src="chart8.png" alt="Chart" /></td>
</tr>
<tr>
<td>Ability to assess the literature</td>
<td><img src="chart9.png" alt="Chart" /></td>
</tr>
<tr>
<td>Ability to keep accurate records</td>
<td><img src="chart10.png" alt="Chart" /></td>
</tr>
<tr>
<td>Effectively worked as part of a team</td>
<td><img src="chart11.png" alt="Chart" /></td>
</tr>
<tr>
<td>Experience was worth the time and effort put in</td>
<td><img src="chart12.png" alt="Chart" /></td>
</tr>
</tbody>
</table>
8. MENTOR RESPONSE CHEM 31000 (n=1)

- **Ability to apply math & science knowledge**
- **Appreciate chemistry research impact on society**
- **Ability to practice ethics in chemistry research**
- **Ability to design and conduct experiments**

- **Ability to Analyze and interpret data**
- **Effective written communication**
- **Effective oral communication**
- **Ability to use communication media**

- **Ability to assess the literature**
- **Ability to keep accurate records**
- **Effectively worked as part of a team**
- **Experience was worth the time and effort put in**
Appendix F: Sample Raw Data for Capstone Direct and Indirect Surveys

(chemsurveyresultssp12.xls)

<table>
<thead>
<tr>
<th>Course</th>
<th>CLO1</th>
<th>CLO2</th>
<th>CLO3</th>
<th>CLO4</th>
<th>CLO5</th>
<th>CLO6</th>
<th>CLO7</th>
<th>CLO8</th>
<th>CLO9</th>
<th>CLO10</th>
<th>CLO11</th>
<th>CLO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 30100 (HONORS)</td>
<td>4.0</td>
<td>3.0</td>
<td>4.0</td>
<td>5.0</td>
<td>5.0</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
<td>4.0</td>
<td>3.0</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>CHEM 30100 (HONORS)</td>
<td>4.0</td>
<td>3.0</td>
<td>5.0</td>
<td>4.0</td>
<td>5.0</td>
<td>4.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>CHEM 30100 (HONORS)</td>
<td>4.0</td>
<td>4.0</td>
<td>3.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>4.0</td>
</tr>
<tr>
<td>CHEM 30100 (HONORS)</td>
<td>5.0</td>
<td>4.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>4.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Mean</td>
<td>4.3</td>
<td>3.5</td>
<td>4.0</td>
<td>4.8</td>
<td>4.3</td>
<td>4.3</td>
<td>4.3</td>
<td>4.5</td>
<td>4.3</td>
<td>4.3</td>
<td>4.5</td>
<td>4.5</td>
</tr>
</tbody>
</table>

| Percentage | 25.0 | 0.0 | 25.0 | 75.0 | 100 | 50.0 | 50.0 | 50.0 | 50.0 | 50.0 | 25.0 | 50.0 |

| Percent Agreement | 4.3 | 3.5 | 4.0 | 4.8 | 5.0 | 4.3 | 4.3 | 4.3 | 4.5 | 4.3 | 4.3 | 4.5 |

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Chemistry Program Outcomes
Department of Chemistry
Chem-Assessment-Report-AY11-12.docx
January 14, 2013
Author: Elizabeth Rudolph, Deputy Dean for Assessment and Graduate Programs, Division of Science

CLO1 Ability to apply math & science knowledge
CLO2 Appreciate chemistry research impact on society
CLO3 Ability to practice ethics in chemistry research
CLO4 Ability to design and conduct experiments
CLO5 Ability to Analyze and Interpret data
CLO6 Effective written communication
CLO7 Effective oral communication
CLO8 Ability to use communication media
CLO9 Ability to assess the literature
CLO10 Ability to keep accurate records
CLO11 Effectively worked as part of a team
CLO12 Experience was worth the time and effort put in
<table>
<thead>
<tr>
<th>course</th>
<th>comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 30100 (HONORS)</td>
<td>this course helped me use what I learned in my research to share it with peers and analyze it as a chemist. Additionally, I learned how to work as part of a team. The course taught me how to work on experiments on my own and how to go about performing a different type of experiment than I am usually used to.</td>
</tr>
<tr>
<td>CHEM 30200 (HONORS)</td>
<td>I think that students should receive better preparation in terms of writing the end of the semester Research Report because it was very strictly graded and yet I had no help in completing in an orderly fashion. Paper requirement (pages) for 302 should be less than the requirement for 301, and 303 less than 302.</td>
</tr>
<tr>
<td>CHEM 30300 (HONORS)</td>
<td>NA Students should not be penalized for mentor’s mistakes. As a pre-medical student, I really enjoy conducting biochemical research involving the modification of an existing enzyme replacement treatment modality so that it can become more therapeutically beneficial to individuals who suffer from Fabry’s Disease. No comments.</td>
</tr>
<tr>
<td>CHEM 31001 (INDEPENDENT STUDY)</td>
<td>To work in a research lab is a great experience, when there is someone always available to help you learn the techniques applied based on the project. I think when students are placed in the lab they go in without knowing much of what they will be doing, but in order for them to get started it is important that they should be all the time guided and supervised by teacher and/or phd students who can help them. They should not be lost and just be capable of learning by themselves. students should also be given enough time to learn the techniques so that they dont rush and try to complete their papers at the end of the semester. It will also be great if only teacher/mentor grade our papers making sure we completed the project properly. My undergraduate research has been a wonderful experience. Personally likely the research and hands-on aspect of research. Prefer laboratory work then academics.</td>
</tr>
</tbody>
</table>
**mentor comments**

<table>
<thead>
<tr>
<th>course</th>
<th>comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem 30100</td>
<td>Independent study is highly recommended for all chemistry majors. This is the most appropriate way to learn the methods necessary to perform research</td>
</tr>
<tr>
<td>Chem 30200</td>
<td>It would be better if the students sign up for this course in the summer so that they can have a block of time for research and experiments. During the spring and fall semester, there are too many interruptions because they have to take their</td>
</tr>
<tr>
<td>Chem 30300</td>
<td>I am very happy with the performance of my students. I think they learned a lot and contributed significantly to the research of my research group</td>
</tr>
<tr>
<td>Chem 31003</td>
<td>Regarding point 8: this is the student's first semester and it is not applicable; they do not present in the first semester</td>
</tr>
</tbody>
</table>
### APPENDIX G: CHEM 26100 DIRECT ASSESSMENT WORKSHEET

<table>
<thead>
<tr>
<th>Course Objective</th>
<th>1. Understand Lewis structures, resonance forms, and the relationship between structure and chemical behavior.</th>
<th>2. Acid-base theories and their application.</th>
<th>3. Predict hybridization, shape, and geometry of covalent species, including polar covalent compounds.</th>
<th>4. Use IUPAC nomenclature, nomenclature for organic compounds, and abbreviations.</th>
<th>5. Explain the mechanism of the five radical halogenations of alkenes.</th>
<th>6. Classify molecules into primary, secondary, tertiary, and tertiary or secondary alcohols.</th>
<th>7. Use the mechanism for the addition reaction to predict the products of the substitution and elimination reactions.</th>
<th>8. Analyze and prepare the products of addition reactions, including cracking, cracking, and dehydration reactions.</th>
<th>9. Show how to use acetylions in the synthesis of aldehydes.</th>
<th>10. Demonstrate the ability to compare the reactivities of aldehydes and ketones and predict the product of addition reactions.</th>
<th>11. Predict the products of the reaction of alcohols and pinacol reagents for the synthesis of alkenes.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Points</td>
<td>1.2</td>
<td>1.6</td>
<td>2.8</td>
<td>4.6</td>
<td>4.4</td>
<td>2.7</td>
<td>3.9</td>
<td>2.5</td>
<td>3.4</td>
<td>3.9</td>
<td>4.5</td>
</tr>
<tr>
<td>Points</td>
<td>11.5</td>
<td>9.9</td>
<td>4.8</td>
<td>2.3</td>
<td>27.3</td>
<td>32</td>
<td>10.3</td>
<td>9.4</td>
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<td>3</td>
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<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Question</td>
<td>Description</td>
<td>Mean</td>
<td>Min</td>
<td>Max</td>
<td>Total</td>
<td>Percentage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
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<td>------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>retrosynthetic analysis to solve multistep synthesis problems with alkenes, alkenes or alcohols as reagents, intermediates or products</td>
<td>23</td>
<td>3</td>
<td>0</td>
<td>2.0</td>
<td>67%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>Interpret simple infrared (IR), mass (MS), proton (¹H NMR) and carbon (¹⁵C-NMR) spectra, use the information derived from the IR, MS and NMR spectra to propose a tentative structure for an unknown organic compound</td>
<td>23</td>
<td>6</td>
<td>3</td>
<td>4.2</td>
<td>70%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Grade Distribution: Note the number given of each grade (e.g., under 'A' write 3 if there were 3 'A's)

Total number of points on test: 120

Comments:
<table>
<thead>
<tr>
<th>Course Objectives to be able to understand or be able to:</th>
<th>Number of Problem or Statement (if applicable)</th>
<th>Point Value (% of total)</th>
<th>Excellent Student (A)</th>
<th>Good Student (B)</th>
<th>Fair Student (C)</th>
<th>Poor Student (D)</th>
<th>Falling Student (F)</th>
<th>AVERAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Unsaturated conjugated systems.</td>
<td>1</td>
<td>3.5 (24%)</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>0</td>
<td>0</td>
<td>2.6</td>
</tr>
<tr>
<td>2) Orbital conjugation and molecular orbital diagrams.</td>
<td>1</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>0</td>
<td>0</td>
<td>2.6</td>
</tr>
<tr>
<td>3) The Diels-Alder reaction mechanistically and</td>
<td>2</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
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<tr>
<td>strategically.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.2</td>
</tr>
<tr>
<td>4) Aromatic chemistry: including MO of benzene,</td>
<td>3</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>Huckel's rule, nomenclature, and associated physical</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.2</td>
</tr>
<tr>
<td>properties.</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>3.2</td>
</tr>
<tr>
<td>5) The reactions of benzene and other aromatic</td>
<td>4, 34</td>
<td>5.5</td>
<td>5.5</td>
<td>5.5</td>
<td>5.5</td>
<td>3.5</td>
<td>3.5</td>
<td>4.4</td>
</tr>
<tr>
<td>systems.</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.4</td>
</tr>
<tr>
<td>6) The synthesis and reactions of aldehydes, ketones,</td>
<td>10, 15</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>3.5</td>
<td>0</td>
<td>3.5</td>
<td>4.5</td>
</tr>
<tr>
<td>imines, and amides.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.5</td>
</tr>
<tr>
<td>7) The properties and reactions of amines.</td>
<td>21, 22</td>
<td>7</td>
<td>7</td>
<td>3.5</td>
<td>7</td>
<td>7</td>
<td>0</td>
<td>5.1</td>
</tr>
<tr>
<td>8) The synthesis and chemical properties of carboxylic</td>
<td>5, 16</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>3.5</td>
<td>7</td>
<td>6.4</td>
<td>73%</td>
</tr>
<tr>
<td>acids and their derivatives.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>73%</td>
</tr>
<tr>
<td>9) Enolate chemistry and its use in organic synthesis.</td>
<td>17, 19</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>3.5</td>
<td>0</td>
<td>3.5</td>
<td>3.9</td>
</tr>
<tr>
<td>10) The classification, structure, and reactions of</td>
<td>23, 32</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>4.5</td>
</tr>
<tr>
<td>carbohydrates.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.5</td>
</tr>
<tr>
<td>11) The structures, properties, and reactions of amino</td>
<td>28, 31</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>3.5</td>
<td>7</td>
<td>6.4</td>
<td>91%</td>
</tr>
<tr>
<td>acids, and how amino acids are used to synthesize</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>91%</td>
</tr>
<tr>
<td>peptides.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>91%</td>
</tr>
<tr>
<td>12) Devise a plan for retrosynthetic analysis to solve</td>
<td>6, 13</td>
<td>7</td>
<td>7</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>3.6</td>
</tr>
<tr>
<td>multistep synthesis problems.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.6</td>
</tr>
</tbody>
</table>

AVERAGE

Grade Distribution: Note the number given of each grade (e.g., under "A" write 3 if there were 3 A’s)

Total number of points on test: 120

Comments:
<table>
<thead>
<tr>
<th>Course Objectives</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Has this course increased your ability to explain how intermolecular interactions determine the chemical properties of organic compounds?</td>
<td>96%</td>
</tr>
<tr>
<td>Has this course enabled you to connect chemical structure to physical property, vapor pressure, air-water partitioning, solubility?</td>
<td>98%</td>
</tr>
<tr>
<td>Has this course increased your understanding of how chemical properties dictate the distribution of a compound in the environment?</td>
<td>91%</td>
</tr>
<tr>
<td>Has this course enabled you to estimate chemical properties?</td>
<td>87%</td>
</tr>
<tr>
<td>Has this course provided the fundamental knowledge of thermochemical and photochemical reactions?</td>
<td>93%</td>
</tr>
<tr>
<td>Has this course improved your ability to solve complex environmental problems?</td>
<td>90%</td>
</tr>
<tr>
<td>Has this course enabled you to apply the learned tools to predict the fate of a contaminant in the environment?</td>
<td>87%</td>
</tr>
<tr>
<td>Has this course imparted knowledge of the important classes of organic contaminants?</td>
<td>94%</td>
</tr>
</tbody>
</table>

Grade Distribution: Note the number given of each grade (e.g., A, S, under 'A' write 3 if there were 3 'A's.

Total number of points on test: 66
<table>
<thead>
<tr>
<th>Course Objectives</th>
<th>Number of Problem Instrument (section A)</th>
<th>Poor (0 - 5 % of total)</th>
<th>Excellent (A)</th>
<th>Good (B)</th>
<th>Fair (C)</th>
<th>Poor (D)</th>
<th>Failing (F)</th>
<th>AVERAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Describe the relationship between all spheres of the environment</td>
<td>10</td>
<td>10</td>
<td>7</td>
<td>10</td>
<td>5</td>
<td>10</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>2. Knowledge of the major pollutants in all spheres, their origin and fate</td>
<td>10</td>
<td>10</td>
<td>8</td>
<td>6</td>
<td>10</td>
<td>8.5</td>
<td>8.5</td>
<td></td>
</tr>
<tr>
<td>3. describe the environmental effects of pollution</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>9</td>
<td>5</td>
<td>8.5</td>
<td>8.5</td>
<td></td>
</tr>
<tr>
<td>4. explain the cycles of environmentally significant elements</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>5. explain the effects of pollution on humans</td>
<td>10</td>
<td>10</td>
<td>8</td>
<td>10</td>
<td>7</td>
<td>8.75</td>
<td>8.75</td>
<td></td>
</tr>
<tr>
<td>6. demonstrate the ability to link technology, resources and energy</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>7. demonstrate the ability to identify and propose treatment for hazardous wastes</td>
<td>10</td>
<td>10</td>
<td>4.5</td>
<td>355</td>
<td>4</td>
<td>5.37</td>
<td>5.37</td>
<td></td>
</tr>
<tr>
<td>8. demonstrate analytical skills used to study the pollution of the environment</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>35</td>
<td>20</td>
<td>38.75</td>
<td>38.75</td>
<td></td>
</tr>
<tr>
<td><strong>AVERAGE</strong></td>
<td><strong>100</strong></td>
<td><strong>87.5</strong></td>
<td><strong>75</strong></td>
<td><strong>51</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Grade Distribution: Note the number given of each grade (e.g., under "A" write 3 if there were 3 "A"s)

Total number of points on test: 100 --- maximum on one lab report

Comments: This evaluation is very approximate since it was done arbitrary on selected lab reports dealing with the particular environmental problems.
<table>
<thead>
<tr>
<th>Course Objectives</th>
<th>Number of Problem Instrument (section if applicable)</th>
<th>Excellent Instrument (A)</th>
<th>Excellent- Good (A-)</th>
<th>Good- Excellent (B+)</th>
<th>Good (B)</th>
<th>Good- Poor (C+)</th>
<th>Poor (C)</th>
<th>Failing Instrument (F)</th>
<th>AVERAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Has this course increased your ability to explain how intramolecular interactions determine the chemical properties of organic compounds?</td>
<td>4, 5</td>
<td>10 100%</td>
<td>10 100%</td>
<td>10 100%</td>
<td>10 100%</td>
<td>10 100%</td>
<td>100%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Has this course enabled you to connect chemical structure to chemical property (vapor pressure, air-water partitioning, octanol-water partitioning)?</td>
<td>2, 6</td>
<td>29 97%</td>
<td>28 93%</td>
<td>29 97%</td>
<td>26 86%</td>
<td>26</td>
<td>95%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has this course enabled you to estimate chemical properties of contaminants?</td>
<td>3, 5</td>
<td>25 100%</td>
<td>25 100%</td>
<td>25 100%</td>
<td>21 84%</td>
<td>21</td>
<td>97%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has this course increased your understanding of how chemical properties determine the distribution of a compound in the environment?</td>
<td>1, 5</td>
<td>15 100%</td>
<td>15 100%</td>
<td>15 100%</td>
<td>12 80%</td>
<td>12</td>
<td>86%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has this course provided the fundamental knowledge of thermochemical and photochemical transformation reactions?</td>
<td>7, 15</td>
<td>15 100%</td>
<td>13 87%</td>
<td>11 73%</td>
<td>9 60%</td>
<td>9</td>
<td>83%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has this course improved your ability to solve complex environmental problems?</td>
<td>miniproject</td>
<td>100 99</td>
<td>90 95</td>
<td>90 95</td>
<td>90 95</td>
<td>90</td>
<td>95%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade Distribution: Note the number given of each grade (e.g. under &quot;A&quot;, write 3 if there were 3 &quot;A&quot;s)</td>
<td></td>
<td>99 95 89 83</td>
<td>6 1 4 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total number of points on test:**

**Comments:**
<table>
<thead>
<tr>
<th>Course Objectives</th>
<th>Number of items</th>
<th>Part Value (N of Total)</th>
<th>Excellent (A)</th>
<th>Good (B)</th>
<th>Fair (C)</th>
<th>Poor (D)</th>
<th>Failing (F)</th>
<th>AVERAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Please provide direct data for student learning of the fundamental principles:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bonding in organic compounds,</td>
<td>1a</td>
<td>8 (7.1)</td>
<td>8</td>
<td>8</td>
<td>7</td>
<td>--</td>
<td>--</td>
<td>7.7</td>
</tr>
<tr>
<td>stereochemistry and isomerism in organic molecules,</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>determination and assignment of chirality, steric, electronic, stereoelectronic and conformational properties of organic molecules,</td>
<td>8</td>
<td>9 (8)</td>
<td>9</td>
<td>6</td>
<td>6</td>
<td>--</td>
<td>--</td>
<td>7</td>
</tr>
<tr>
<td>reaction kinetics,</td>
<td>2</td>
<td>6 (5.4)</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>--</td>
<td>--</td>
<td>5.7</td>
</tr>
<tr>
<td>liner free energy relationships,</td>
<td>9</td>
<td>8 (7.1)</td>
<td>8</td>
<td>8</td>
<td>5</td>
<td>--</td>
<td>--</td>
<td>7</td>
</tr>
<tr>
<td>isotope effects,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>neighboring group participation,</td>
<td>11</td>
<td>6 (5.4)</td>
<td>2.5</td>
<td>3</td>
<td>5</td>
<td>--</td>
<td>--</td>
<td>3.5</td>
</tr>
<tr>
<td>the chemistry of carbanions, carbonium ions, free radicals and carbenes,</td>
<td>4, 5; 6a,b; 7; bonus Q2</td>
<td>33 (29.5)</td>
<td>29</td>
<td>26.5</td>
<td>13</td>
<td>--</td>
<td>--</td>
<td>22.8</td>
</tr>
<tr>
<td>the basics of pericyclic reactions,</td>
<td>1b,c; 6c; 10b,c</td>
<td>12.5 (11.2)</td>
<td>5</td>
<td>7.5</td>
<td>5</td>
<td>--</td>
<td>--</td>
<td>5.8</td>
</tr>
<tr>
<td>substitution at sp2 carbons and reactions of aromatic systems such as electrophilic aromatic substitution,</td>
<td>3b,c,d; 10a</td>
<td>15.5 (13.8)</td>
<td>12</td>
<td>7</td>
<td>4.5</td>
<td>--</td>
<td>--</td>
<td>7.8</td>
</tr>
<tr>
<td>addition and elimination reactions</td>
<td>3a,e; bonus Q1</td>
<td>14 (12.5)</td>
<td>7</td>
<td>4</td>
<td>9</td>
<td>--</td>
<td>--</td>
<td>6.7</td>
</tr>
<tr>
<td>ability to analyze and interpret data as related to the concepts described above?</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>ability to work as part of a problem-solving team or independently as occasioned?</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>improved your ability to access and utilize chemical information technology?</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>AVERAGE</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>74</strong></td>
</tr>
</tbody>
</table>

Grade Distribution: Note the number given of each grade (e.g., under “A” write 3 if there were 3 “A”s)
Division of Science: Chemistry – Biochemistry Masters Program –
Assessment Report on Student Learning Annual Year 2011-2012

Assessment Plans
In Fall 2013, the Chemistry Department will design a separate 5-year assessment plan for the Masters Programs in Biochemistry and Chemistry. Masters courses have been added to the Undergraduate assessment plans after the 2010 Progress letter response from Middle States.

Policies and Guidelines
The department is following a protocol established for the 2007 middle states accreditation cycle with minor revisions. Assessment is to be guided by Assistant Professor Sean Boson and Professor Urs Jans. For the current academic year, Elizabeth Rudolph, Accreditation specialist and Deputy Dean of Science will report direct and indirect findings to the Chemistry Department. Upon receipt, the Departmental Coordinator and Curriculum committee reserves the right to modify the existing protocol. Coming to the close of the 5 year plan in Dec 2013, the department and the divisional coordinator will convene to discuss a new and revised assessment plan for 2014-2019.

Recognition and Rewards
The college continues to show weakness in this category. There is still no recognition or rewards for conducting student learning assessment except for the meager amount of workload credits (1 hour maximum) to full time faculty for helping in the dissemination, collection and analysis and synthesis of direct and indirect learning measures.

Learning Outcomes
Annual Year 2011-2012 Graduate Program assessment is listed in the table below. Red signifies courses that were actually examined either by direct or indirect measures or both. Courses listed in black were not examined for one of three reasons. 1) Course not offered, 2) No response to request for Direct or Indirect data gathering, or 3) instruments not drafted because of missing information, e.g. current course learning outcomes.

<table>
<thead>
<tr>
<th>Fall 11</th>
<th>Spring 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1101</td>
<td>A1400 Barnett</td>
</tr>
<tr>
<td>B5000</td>
<td>A8005 Steinberg</td>
</tr>
<tr>
<td>A1200</td>
<td>A8300 John</td>
</tr>
<tr>
<td></td>
<td>B1000 Kowach</td>
</tr>
</tbody>
</table>
Data Collection
The Middle States Commission requires data assembly using a minimum of 2 assessment instruments, one of which must be a direct measure. In the Division of Science we use one of each.
Indirect evidence of student learning is measured by the ‘End-of-course-survey’ instrument administered to the students. The Science Division has adopted a new form of direct assessment, Faculty direct, based on instructor assessment of student learning on each of the listed learning outcomes for the course. The assessment is quantitative since it is based on exam question scores, homework assignments, lab reports and writing assignments for those questions that apply to the particular learning outcomes.

Assessment Tools
This narrative contains course and program ‘learning’ outcomes and data collected for both indirect and direct assessments for the courses under examination. Appendix A contains one sample of each of the instruments as well as the Chemistry Department multiyear assessment plan. Data is quantified on each instrument using a rating scale of 1-5, 1 representing poor agreement and 5 the strongest agreement. Prior to 2012, the rating scale was 1-4 but the categories were comparable. In the case of comparing data in mixed scale forms, all 1-4 ratings were normalized to agree with the 1-5 scale.
Data are presented in bar graphs that display the means for all learning outcome questions. In comparing and correlating direct and indirect data we encounter some problems. See the sample plot below that shows little if any correlation between student and instructor rating of student learning. Therefore, in cases in which student and instructor responses are plotted together, bar graphs are utilized so individual assessments can be observed.

Figure 1. Experimental plot showing poor correlation between student and mentor/instructor assessment of student learning.
The Chemistry Department posts program and assessment information, categories below, that can be found at the website:
http://www1.ccny.cuny.edu/prospective/science/chemistry/ug_programs.cfm

UNDERGRADUATE PROGRAMS
- Learning Outcomes
- Degree Requirements
- Courses and Syllabi
- Student Research
- Academic Support
- Career Opportunities

Results and Discovery: Graduate Program Assessment FALL 2011 & SPRING 12

The Chem A1100-1200 series is designed for the Environmental chemistry track of the standard Chemistry degree. Indirect and direct evidence in support of student learning in Chem A1100, Environmental Chemistry, Fall 2011, are shown in Figure 14 below. Judging by both instructor and student assessment, students are mastering learning outcomes above average expectations. The only noticeable deficiencies are in CLO 7 [ability to identify and propose treatment for hazardous wastes] and to a lesser degree CLO 8 [demonstrate analytical skills used to study the pollution of the environment] as determined by the instructor. These outcomes are significant and thus these finding warrant attention in the next offering of the course. The dept will present the findings to the instructor and ask for a plan for improving student learning. The instructor will also be asked to assess the missing outcomes 4 and 6.

Course Learning Outcomes

1. Has this course increased your knowledge of the relationship between all spheres of the environment?
2. Has this course increased your knowledge of the major pollutants in all spheres, their origin and fate?
3. Has this course increased your awareness of the environmental effects of pollution?
4. Has this course improved your knowledge of the cycles of environmentally significant elements?
5. Has this course increased your awareness of the effects of pollution on humans?
6. Has this course increased your ability to link technology, resources and energy?
Chem A1200, Environmental Organic Chemistry was assessed in F11. Direct and indirect results are plotted together in Fig. 15. There is somewhat of a recognizable agreement between the perceived learning of the students and the direct evidence supplied by the instructor. The instructor has identified 2 learning topics that have given the students more trouble, CLO5 and 6 [thermochemical and photochemical transformation reactions, and solving complex environmental problems]. In the next offering of the course, the instructor will be asked to propose ways to improve learning in these areas. Special attention will be given to teaching students to solve complex environmental problems. All students earned in the A-B range.

---

**Course Learning Outcomes**

1. Has this course increased your ability to explain how intramolecular interactions determine the chemical properties of organic compounds?
2. Has this course enabled you to connect chemical structure to chemical property (vapor pressure, air-water partitioning, octanol-water partitioning)?
3. Has this course enabled you to estimate chemical properties of contaminants?
4. Has this course increased your understanding of how chemical properties determine the distribution of a compound in the environment?
5. Has this course provided the fundamental knowledge of thermochemical and photochemical transformation reactions?
6. Has this course improved your ability to solve complex environmental problems?
7. Has this course enabled you to apply the learned tools to predict the fate of a contaminant in the environment?
8. Has this course imparted knowledge of the important classes of organic contaminants?

---

**Figure 14. Evidence for student learning in Chem A1100, Environmental Chemistry followed by Course learning outcomes (complete direct matrix found in appendix G)**

**Figure 15. Evidence for student learning in Chem A1200, Environmental Organic Chemistry followed by Course learning outcomes (complete direct matrix found in appendix G)**
Chem A1400 teaches chemistry graduate students to utilize the library and online chemical information resources and databases, an essential skill set for research based theses. Both students and instructor agree that the course as presented fulfills its learning obligation. The instructor writes that the entire format of the course has been modified to keep pace with the advances in the chemical information field and the challenge is and always will be to keep up with advancing technology. This course can only be viable if the content keeps pace with technology.

### GRADUATE PROGRAM IN CHEMISTRY-Direct Instrument

**COURSE**  
**CHEM A1400**

**LEARNING OUTCOMES**

1. Knowledge of the different types of chemistry publications and information resources.  
   - 5
2. Know how to locate and obtain any journal article or book you need for your research.  
   - 5
3. Know how to obtain physical data on elements and compounds from electronic and printed sources.  
   - 5
4. Ability to locate information and data on inorganic compounds in the Gmelin Handbook.  
   - 5
5. Ability to locate specific organic compounds in the printed Beilstein Handbook, and understand the differences and similarities of the handbook and the Beilstein Online Database.  
   - 5
6. Ability to locate commercial sources of chemicals.  
   - 5
7. Knowledge of the basics principles of online searching, and how to develop proper and efficient search strategies.  
   - 5
Understand the organization, and indexing method of Chemical Abstracts, and be able to search both the Chemical Abstracts Online Database, and the SciFinder Scholar version of Chemical Abstracts for specific substances, subjects, and reactions.  

<table>
<thead>
<tr>
<th></th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ability to distinguish the strengths and weaknesses of SciFinder Scholar compared to the Chemical Abstracts Online Database.</td>
<td>Understand the reasons for citation indexing and be able to do cited reference searching in Science Citation Index, SciFinder Scholar, and Google Scholar.</td>
<td>Awareness of the leading table of contents databases.</td>
<td>Appreciation of current awareness services.</td>
<td>Understand the basics of patents.</td>
<td>Awareness of the key world wide web resources in chemistry and how they compare to the fee-based and subscription sources.</td>
<td>Familiarity with world wide web search engines, especially the ones that focus on science.</td>
<td>average</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>4.73</td>
</tr>
</tbody>
</table>

Regarding 13, at least several weeks would be needed to give any student a strong understanding of patents. Students only receive a brief introduction. Regarding 15--the basis of chemistry searching has always been Chemical Abstracts and its database which I teach in depth. The world wide web search engines being so incomplete, and so poorly indexed are a poor substitute for Chemical Abstracts. While I do point out and briefly describe these substitutes, a full in-depth comparison and evaluation of these web search engines is a scholarly time-consuming research issue that is just now starting to be addressed in the literature.

**FUTURE PLANS TO IMPROVE STUDENT LEARNING**

Extensive changes: 1. All course packs have been converted to electronic form. All course materials in pdf, ppt, and word. Going paperless has allowed me to mount more material and illustrations that could previously fit into the printed course pack.

**COURSE CONTENT CHANGES**

The content has changed. Printed Chemical Abstracts has been discontinued leaving only the two databases each containing the same information but with vastly different ways of searching.

**COURSE DELIVERY CHANGES**
Chem A8005 Biochemistry 2, is a grad course designed for the Biochemistry Masters Program. Indirect evidence suggests that learning is well above average across the 10 outcomes. The grade distribution in the course ranged from A-C with no failures and only several withdrawals. Direct evidence is necessary to identify areas of weakness. According to the indirect data, CLO7, applying biochemistry to modern biomedicine, gene therapy and genetic engineering proved to garner the weakest learning. Using specific reports or assignments that deal with applying techniques to real world examples will be suggested as a means for quantifying learning in this topic and the remaining 9 learning outcomes.

![Chem A8005 Student Responses EOCS -S12](image)

Course Learning Outcomes
1. know the basic steps and important intermediates in the light and dark reactions of photosynthesis.
2. know the basic steps and important intermediates in the synthesis of complex carbohydrates.
3. distinguish between the humoral and cellular immune systems and know the basic components and the function of the components of each system.
4. outline the steps in the biotechnological approaches to genetic disease including the genetic basis of the cancers discussed in class.
5. detail the main steps and intermediates in the pathways by which hormones regulate metabolism via glycolysis and the Kreb’s cycle and carbohydrate transport.
6. describe the functions of the elements of lambda bacteriophage in the lytic cycle or lysogeny
7. describe the basic steps in the techniques of biotechnology described in class. Students should be able to provide examples of how these techniques are applied to modern biomedicine, gene therapy and genetic engineering
8. know the structure and function of the basic ion channel types involved in neural transmission and the experimental techniques used to analyze how they function in motor control, memory and sensory input.
9. outline the steps and critical enzymes involved in the generation of reactive oxygen species (ROS) in mitochondria and how mitochondrial-derived ROS activate particular signaling pathways.
10. describe the processes by which retroviral oncogenes are transduced and subsequently activated in the host. Students should know how the human homologs of the oncogenes covered in class function in cell cycle control and cancer.
Chem A8300, Chemistry Seminar is a 1 credit, 2 hour course open to all Chemistry, Physics and Engineering Masters students that emphasizes topics in physical, inorganic and organic chemistry and culminates in a research project. Students are satisfied with the degree of learning in this course. All students passed with either A or B grade.

Course Learning Outcomes
1. Develop the ability to survey and critically evaluate an area of research;
2. Organize and prepare a formal presentation.

Chem B5000, Organic Mechanisms, also a basic course for standard chemistry deals with organic reaction mechanisms and their application to specific reactions. This is a demanding 5 credit course that covers many topics, see CLO 1-14 in figure 19. Student perceived learning varies significantly from topic to topic. The weakest outcome, CLO14 is directed at using chemistry information technology. If appropriate, the department or instructor might try directing students to Chem A1400, establishing it as a prerequisite course and removing CLO14 from this course.
Course Learning Outcomes

Has this course provided the following fundamental principles:
1. bonding in organic compounds,
2. stereochemistry and isomerism in organic molecules,
3. determination and assignment of chirality, steric, electronic, stereoelectronic and conformational properties of organic molecules,
4. reaction kinetics,
5. linear free energy relationships,
6. isotope effects,
7. neighboring group participation,
8. the chemistry of carbanions, carbonium ions, free radicals and carbenes,
9. the basics of cycloaddition chemistry,
10. elimination and substitution at sp3 carbons and reactions of aromatic systems such as electrophilic aromatic substitution,
11. addition-elimination, elimination-addition chemistry
12. Has this course improved your ability to analyze and interpret data as related to the concepts described above?
13. Has this course enabled you to work as part of a problem-solving team or independently as occasioned?
14. Has this course improved your ability to access and utilize chemical information technology?

Figure 19. Indirect evidence for student learning in Chem B5000 followed by the list of course learning outcomes

Chem B5100, Organic Synthesis is a 5 credit, 5 hour follow-up to Organic Mechanisms (B5000). Students also found the learning to be well above average expectations for each of the 7 CLO and final grades ranged from A to C+ with no failures and only one withdrawal. Instructor direct assessment is less favorable. The instructor recognizes weaknesses in CLO 3 and 5 and will try to improve learning through better utilization of powerpoint and group presentations.
GRADUATE PROGRAM IN CHEMISTRY-Direct Assessment Instrument

COURSE CHEM B5100

LEARNING OUTCOMES

1. Principles and concepts involved in building organic molecules 4
2. The generation of various functional groups 4
3. Functional group interconversions 3
4. Use of Reagents for various transformations 4
5. Ability to perform retrosynthetic analysis for molecular assembly 3
6. Understand the use of various protecting groups 5
   Improved understanding of the development of multi-step organic synthesis 4

average 3.86

FUTURE PLANS TO IMPROVE STUDENT LEARNING

This course was offered after an 8-year break. Thus, the lecture notes, content and manner in which this course was taught was completely different from when it was last offered in 2004. Thus, no major changes are envisioned also because we do not know when this course will be offered again.

COURSE DELIVERY CHANGES--PEDAGOGY

Greater use of power point and a focus on student presentations was greater.
Use of Assessment Results: Current and Future

Summary and Closing the Loop

• Graduate students and the instructor report above average learning in Chem A1100 with the exception of ‘ability to identify and propose treatment for hazardous wastes and in demonstrating analytical skills used to study pollution. The new direct instrument will help the instructor propose solutions to the weaknesses in the identified areas of study.

• Graduate students in Chem A1200 also performed less strongly in two areas of study. These areas will be given more attention in the next offering.

• Graduate students in Chem A1400 rated learning well above average. Interestingly, undergraduate students have identified the material covered in this course to be absent from their curriculum and training. Therefore, it may be appropriate to add this course or an equivalent to the undergraduate curriculum.

• Biochemistry Graduate students give high scores to learning in Chem A8005. Grade distribution in the course agrees with this assessment. The only difficulty that must be addressed is the ability to apply biochemistry techniques to modern biomedicine etc. Applying techniques is always a challenge and more emphasis on the steps involved will be addressed in the next offering.

• Chem B5000 and B5100 are 5 credit intensive courses with very specific and technical outcomes. Interestingly, the only weakly covered outcome identified by the students in B5000 involves using chemistry technology information whereas the problem learning outcomes in B5100 are very technical topics.

Syllabi
The Chemistry Department posts Syllabi to the departmental website:
http://www1.ccny.cuny.edu/prospective/science/chemistry/ug_courselist.cfm
Faculty Professional Development
The Divisional task force, TLAC (Teaching and Learning Advisory Committee) runs a workshop yearly on science pedagogy and/or research, entitled ‘Discussions on Student Learning’. The first event was run in January, 2010 and involved presentations on Making Sense of How Students Make Sense of Science; Working Research Into the Classroom; How Students Do or Do Not Learn Math and Science. The Second event took place in the reporting period, Jan, 2011 and covered a systematic review and follow-up from the 2010 event and a presentation on the Mechanisms, Causality and Explanations in Complex Dynamic Systems -implication for teaching and learning. In the first production, of the 25 participants, 3 were from the Chemistry Department, Profs Stephen O’Brien, Zimei Bu and Marco Ceruso. In the second production, 4 chemistry professors participated, Issa Salame and the same 3 from the previous workshop.

Course and Teacher Surveys (C&T)
Since Spring 2011, the college has reverted to a former mode of collection of Course and Teacher survey data, paper form administered in class during the last 2 weeks of the semester. CT survey shown in Appendix C.

Using results of C&T
C&T results are used in all cases of faculty reappointments, tenure and promotion. However, since the college encountered difficulties in both fall 2010 and spring 2011 collections and analysis, these results were not available for the fall 2011 reappointment, tenure and promotion cases.
APPENDIX A. FIVE YEAR PLAN

Department of Chemistry – Five Year Assessment Plan 2008-2013

Overview: To keep improving the Chemistry programs, Chemistry courses will be systematically reviewed both directly and indirectly on a regular basis. The large service courses in General Chemistry and Organic Chemistry will be assessed every semester. The other courses will be assessed once every year. The direct assessment will occur with matrices using student work (final exam, lab reports, rubrics for presentation, ...). A end of course survey (EOCS) will be used for the indirect assessment.

Indirect Assessment: The majority of the Chemistry courses will be survey for Course Knowledge Outcomes on a semesterly basis. For the typical Fall semester CHEM 10000, CHEM 10301, CHEM 10401, CHEM 24300, CHEM 26100, CHEM 26200, CHEM 26300, CHEM 31114, CHEM 31115, CHEM 33000, CHEM 42500, CHEM 43400, CHEM A1101, CHEM B5000 will be indirectly assessed. For the typical Spring semester CHEM 10100, CHEM 10301, CHEM 10401, CHEM 26100, CHEM CHEM

Direct Assessment: Course will be directly assessed at least once a year over a five year period. The four service courses with large enrollment in Chemistry will be assessed once a semester. Those courses are CHEM10301, CHEM10401, CHEM26100, and CHEM26300.

Assessment Process in the Chemistry Department: At the end of the semester, the assessment coordinator collects the data for the EOCS (indirect assessment), the matrices (direct assessment), and the grade distribution for all courses and writes an assessment report. The report is presented to the chair and approved by the faculty. The curriculum committee will then meet and discuss potential actions based on the findings in the report. These actions can lead to a change in the general syllabus for a course. If new resources for the instruction of a course are suggested a request is presented to the executive committee of the Department.
## Department of Chemistry

Chem-Assessment-Report-AY11-12.docx

January 29, 2013

Author: Elizabeth Rudolph, Deputy Dean for Assessment and Graduate Programs, Division of Science

<table>
<thead>
<tr>
<th>Non-Science Major Engineering Undergraduate &amp; Master's level course</th>
<th>CHEMISTRY</th>
<th>COURSEWORK - UC</th>
<th>MASTER'S</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Know fundamental principles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>principles to life sciences, environment and emerging fields of diversity</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>B. Conduct experiments</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>C. Analyze and interpret data</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>D. Apply mathematical concepts</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>E. Solve problems in a team</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>F. Communicate in written form</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>G. Communicate in oral form</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>H. Use chemical information technology</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>I. Design and execute research</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>J. Communicate oneself orally and nonverbally</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
Figure 1: Flow chart of the assessment process
APPENDIX A: SAMPLE END OF COURSE SURVEY AND DIRECT INSTRUMENT

<table>
<thead>
<tr>
<th>COURSE FEEDBACK SURVEY (END-OF-COURSE SURVEY)</th>
<th>THE CITY UNIVERSITY OF NEW YORK</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPRING 2012</td>
<td>THE CITY COLLEGE DEPARTMENT OF CHEMISTRY</td>
</tr>
</tbody>
</table>

**CHEM B5100 ORGANIC SYNTHESIS**

In this survey you are asked to evaluate the course you are going to complete. Your answers provide feedback essential to the ongoing process of improving the Earth and Atmospheric Sciences program. The estimated time to complete all questions is 5 minutes.

Thank you for helping us evaluate and improve this course.

What is your CHEMISTRY CONCENTRATION?

What grade do you expect?

<table>
<thead>
<tr>
<th>Course Outcome</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. UNDERSTAND the principles and concepts involved in building organic molecules.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. UNDERSTAND GENERATION of various functional groups.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. UNDERSTAND functional group interconversions.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. UNDERSTAND USE of reagents for various transformations.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. PERFORM retrosynthetic analysis for molecular assembly.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. UNDERSTAND USE of various protecting groups.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. BETTER UNDERSTAND the development of multi-step organic synthesis.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If you have other comments about CHEM B5100, please add them HERE:
DIRECT ASSESSMENT INSTRUMENT. LEARNING SURVEY TO BE COMPLETED BY INSTRUCTOR
SPRING 2012 – DIVISION OF SCIENCE  CHEM B5100

1. Achievement of Learning Outcomes. Based on your in-class assessments (tests and assignments), please rate the degree to which students have grasped the course learning outcomes. (NOTE: These outcomes mirror those from the end of course survey and your syllabus.)

<table>
<thead>
<tr>
<th>LEARNING OUTCOME</th>
<th>STRONG UNDERSTANDING</th>
<th>AVERAGE UNDERSTANDING</th>
<th>WEAK UNDERSTANDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Principles and concepts involved in building organic molecules.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. The generation of various functional groups.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Functional group interconversions.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Use of reagents for various transformations.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Ability to perform retrosynthetic analysis for molecular assembly.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Understand the use of various protecting groups.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Future plans: Please respond to the following question regarding changes to improve student learning.

2.1. Based on YOUR assessment of student learning AND your responses to question 1, list the topics and pedagogical changes that you will implement to improve student learning. (Note: if this means sharing information with other instructors, please explain)

3. IF APPLICABLE Please respond to the following questions regarding implementations since the start of learning outcomes assessment (circa 2007)
DIRECT ASSESSMENT INSTRUMENT. LEARNING SURVEY TO BE COMPLETED BY INSTRUCTOR
SPRING 2012 – DIVISION OF SCIENCE CHEM 5100

3.1 Since teaching this course, have you ever made changes in course content? If yes, please explain.

3.2 Since teaching this course have you made changes in course delivery or other pedagogy? Please explain.

4. How useful are the text and other resources assigned to this course? Please explain.
APPENDIX B. C&T SURVEY

<table>
<thead>
<tr>
<th>Class Climate</th>
<th>C&amp;T Paper version</th>
</tr>
</thead>
<tbody>
<tr>
<td>ccny-science</td>
<td>All Instructors</td>
</tr>
<tr>
<td>Science_1</td>
<td></td>
</tr>
</tbody>
</table>

Mark as shown: ☐ X ☐ ☐ ☐ Please use a ballpoint pen or a thin felt tip. This form will be processed automatically.
Correction: ☐ ☐ ☐ X ☐ Please follow the examples shown on the left hand side to help optimize the reading results.

1. Please evaluate your instructor:

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐</td>
</tr>
</tbody>
</table>

1.1 The instructor presented the course expectations clearly.
1.2 The instructor presented the course material clearly.
1.3 The instructor paid attention to whether or not students understood the material.
1.4 The assignments helped me learn the course material.
1.5 I received useful feedback on assignments.
1.6 The instructor was available outside of class, during office hours, by email, phone or other means.
1.7 I was kept informed on how well I was doing.
1.8 The instructor fairly evaluated my knowledge of the course material.
1.9 The course stimulated my interest in the subject matter.
1.10 What I learned from the course was worth the time and effort I put into it.
1.11 I learned from this instructor [Please select one]: ☐ Much more than I expected ☐ More than I expected ☐ As much as I expected
1.12 Compared to other courses I have taken at CCNY, this course is [Please select one]: ☐ One of the easiest ☐ Easier than average ☐ Average
1.13 What were the three (3) most important things you learned from the course?

1.14 Please provide your suggestions to improve the course, if any.
Class Climate

1. Please evaluate your instructor: [Continue]

1.15 What did you appreciate most about the course, if anything?

1.16 Was technology part of instruction in this course? [Check all that apply]

- No
- Course web pages [included Blackboard]
- Internet [such as Google, Wikipedia]
- PowerPoint
- Email
- e-Portfolio
- Other

1.17 To what extent did technology help you learn the course material? [Please select one]

- Not at all
- Much
- Required
- A little
- Very much
- An elective
- Moderately
- Don't know
- Not applicable

1.18 In my major, this course is: [Please select one]

- Required
- A or A+
- B+ or B-
- D
- F
- Never absent
- 1-2 absences
- 3-4 absences
- An elective
- A little
- Very much

1.19 What grade do you expect for this course?

- F
- Withdraw
- C/Pass
- Not applicable

1.20 How often did you miss class in this course? [Please select one]

- Never absent
- 1-2 absences
- 3-4 absences
- 5 or more absences
- Not applicable

1.21 Did you miss any quiz or exam? [Please select one]

- Yes
- No

Thank you for completing this survey!
Department of Chemistry
Chem-Assessment-Report-AY11-12.docx
January 29, 2013
Author: Elizabeth Rudolph, Deputy Dean for Assessment and Graduate Programs, Division of Science
## Course Objectives

<table>
<thead>
<tr>
<th>Objective</th>
<th>Number of Problem</th>
<th>Perfect/ Ideal</th>
<th>Excellent (A)</th>
<th>Good (B)</th>
<th>Fair (C)</th>
<th>Poor (D)</th>
<th>Failing (F)</th>
<th>AVERAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Describe the relationship between all spheres of the environment</td>
<td>10</td>
<td>10</td>
<td>7</td>
<td>10</td>
<td>5</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Knowledge of the major pollutants in all spheres, their origin and fate</td>
<td>10</td>
<td>10</td>
<td>8</td>
<td>6</td>
<td>10</td>
<td>8.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Describe the environmental effects of pollution</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>9</td>
<td>5</td>
<td>8.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Explain the cycles of environmentally significant elements</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Explain the effects of pollution on humans</td>
<td>10</td>
<td>10</td>
<td>8</td>
<td>10</td>
<td>7</td>
<td>8.75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Demonstrate the ability to link technology, resources and energy</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Demonstrate the ability to identify and propose treatment for hazardous wastes</td>
<td>10</td>
<td>10</td>
<td>4.5</td>
<td>355</td>
<td>4</td>
<td>5.37</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Demonstrate analytical skills used to study the pollution of the environment</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>35</td>
<td>20</td>
<td>38.75</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**AVERAGE**

<table>
<thead>
<tr>
<th>Number of Problem</th>
<th>Excellent (A)</th>
<th>Good (B)</th>
<th>Fair (C)</th>
<th>Poor (D)</th>
<th>Failing (F)</th>
<th>AVERAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>10</td>
<td>7</td>
<td>10</td>
<td>5</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>8</td>
<td>6</td>
<td>10</td>
<td>8.5</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>10</td>
<td>9</td>
<td>5</td>
<td>8.5</td>
<td></td>
</tr>
<tr>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>8</td>
<td>10</td>
<td>7</td>
<td>8.75</td>
<td></td>
</tr>
<tr>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>4.5</td>
<td>355</td>
<td>4</td>
<td>5.37</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>50</td>
<td>50</td>
<td>35</td>
<td>20</td>
<td>38.75</td>
<td></td>
</tr>
</tbody>
</table>

**Total number of points on test: 100**

**Grade Distribution:** Note the number given of each grade (e.g., under 'A' write 3 if there were 3 'A's)

<table>
<thead>
<tr>
<th>Number of Problem</th>
<th>Excellent (A)</th>
<th>Good (B)</th>
<th>Fair (C)</th>
<th>Poor (D)</th>
<th>Failing (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>10</td>
<td>7</td>
<td>4</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

**Comments:** This evaluation is very approximate since it was done arbitrary on selected lab reports dealing with the particular environmental problems.
## Course Objectives

<table>
<thead>
<tr>
<th>Course Objective</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Has this course increased your ability to explain how intramolecular interactions determine the chemical properties of organic compounds?</td>
<td>100%</td>
</tr>
<tr>
<td>Has this course enabled you to connect chemical structure to chemical property (vapor pressure, air-water partitioning, solubility)?</td>
<td>95%</td>
</tr>
<tr>
<td>Has this course enabled you to estimate chemical properties of contaminants?</td>
<td>80%</td>
</tr>
<tr>
<td>Has this course increased your understanding of how chemical properties determine the distribution of a compound in the environment?</td>
<td>75%</td>
</tr>
<tr>
<td>Has this course provided the fundamental knowledge of thermochemical and photochemical transformation?</td>
<td>70%</td>
</tr>
<tr>
<td>Has this course improved your ability to solve complex environmental problems?</td>
<td>65%</td>
</tr>
<tr>
<td>Has this course enabled you to apply the learned tools to predict the fate of a contaminant in the environment?</td>
<td>60%</td>
</tr>
<tr>
<td>Has this course imparted knowledge of the important classes of organic contaminants?</td>
<td>55%</td>
</tr>
</tbody>
</table>

## Grade Distribution

<table>
<thead>
<tr>
<th>Grade Distribution</th>
<th>Number of Points on Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>100</td>
</tr>
<tr>
<td>B</td>
<td>85</td>
</tr>
<tr>
<td>C</td>
<td>70</td>
</tr>
<tr>
<td>D</td>
<td>55</td>
</tr>
</tbody>
</table>

Average: 80%
# Chemistry B5000 Organic Mechanisms

## Course Objectives

Please provide direct data for student learning of the fundamental principles:

<table>
<thead>
<tr>
<th>Objective</th>
<th>Number of Problems</th>
<th>Port Value (out of 100)</th>
<th>Excellent Instrument (A)</th>
<th>Good Instrument (B)</th>
<th>Fair Instrument (C)</th>
<th>Poor Instrument (D)</th>
<th>Failing Instrument (F)</th>
<th>AVERAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>bonding in organic compounds,</td>
<td>1a</td>
<td>8 (7.1)</td>
<td>8</td>
<td>8</td>
<td>7</td>
<td>--</td>
<td>--</td>
<td>7.7</td>
</tr>
<tr>
<td>stereochemistry and isomerism in organic molecules,</td>
<td></td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>determination and assignment of chirality, steric, electronic,</td>
<td>8</td>
<td>9 (8)</td>
<td>9</td>
<td>6</td>
<td>6</td>
<td>--</td>
<td>--</td>
<td>7</td>
</tr>
<tr>
<td>electronic and conformational properties of organic molecules,</td>
<td></td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>reaction kinetics,</td>
<td>2</td>
<td>6 (5.4)</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>--</td>
<td>--</td>
<td>5.7</td>
</tr>
<tr>
<td>liner free energy relationships,</td>
<td>9</td>
<td>8 (7.1)</td>
<td>8</td>
<td>8</td>
<td>5</td>
<td>--</td>
<td>--</td>
<td>7</td>
</tr>
<tr>
<td>isotope effects,</td>
<td></td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>neighboring group participation,</td>
<td>11</td>
<td>6 (5.4)</td>
<td>2.5</td>
<td>3</td>
<td>5</td>
<td>--</td>
<td>--</td>
<td>3.5</td>
</tr>
<tr>
<td>the chemistry of carbanions, carbonium ions, free radicals and carbones,</td>
<td>4, 5; 6a,b; 7; bonus Q2</td>
<td>33 (29.5)</td>
<td>29</td>
<td>26.5</td>
<td>13</td>
<td>--</td>
<td>--</td>
<td>22.8</td>
</tr>
<tr>
<td>the basics of pericyclic reactions,</td>
<td>1b,c; 6c; 10b,c</td>
<td>12.5 (11.2)</td>
<td>5</td>
<td>7.5</td>
<td>5</td>
<td>--</td>
<td>--</td>
<td>5.8</td>
</tr>
<tr>
<td>substitution at sp2 carbons and reactions of aromatic systems such as</td>
<td>3b,c,d; 10a</td>
<td>15.5 (13.8)</td>
<td>12</td>
<td>7</td>
<td>4.5</td>
<td>--</td>
<td>--</td>
<td>7.8</td>
</tr>
<tr>
<td>electrophilic aromatic substitution,</td>
<td></td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>addition and elimination reactions</td>
<td>3a,e; bonus Q1</td>
<td>14 (12.5)</td>
<td>7</td>
<td>4</td>
<td>9</td>
<td>--</td>
<td>--</td>
<td>6.7</td>
</tr>
</tbody>
</table>

**Grade Distribution:** Note the number given of each grade (e.g., under “A” write 3 if there were 3 ‘A’s.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>6</td>
</tr>
<tr>
<td>B</td>
<td>8</td>
</tr>
<tr>
<td>C</td>
<td>1</td>
</tr>
<tr>
<td>D</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td></td>
</tr>
</tbody>
</table>

**AVERAGE:** 74
Department of Chemistry – Five Year Assessment Plan 2008-2013

Overview: To keep improving the Chemistry programs, Chemistry courses will be systematically reviewed both directly and indirectly on a regular basis. The large service courses in General Chemistry and Organic Chemistry will be assessed every semester. The other courses will be assessed once every year. The direct assessment will occur with matrices using student work (final exam, lab reports, rubrics for presentation, …). A end of course survey (EOCS) will be used for the indirect assessment.

Indirect Assessment: The majority of the Chemistry courses will be surveyed for Course Knowledge Outcomes on a semesterly basis. For the typical Fall semester CHEM 10000, CHEM 10301, CHEM 10401, CHEM 24300, CHEM 26100, CHEM 26200, CHEM 26300, CHEM 31114, CHEM 31115, CHEM 33000, CHEM 42500, CHEM 43400, CHEM A1101, CHEM B5000 will be indirectly assessed. For the typical Spring semester CHEM 10100, CHEM 10301, CHEM 10401, CHEM 26100, CHEM CHEM

Direct Assessment: Course will be directly assessed at least once a year over a five year period. The four service courses with large enrollment in Chemistry will be assessed once a semester. Those courses are CHEM10301, CHEM10401, CHEM26100, and CHEM26300.

Assessment Process in the Chemistry Department: At the end of the semester, the assessment coordinator collects the data for the EOCS (indirect assessment), the matrices (direct assessment), and the grade distribution for all courses and writes an assessment report. The report is presented to the chair and approved by the faculty. The curriculum committee will then meet and discuss potential actions based on the findings in the report. These actions can lead to a change in the general syllabus for a course. If new resources for the instruction of a course are suggested a request is presented to the executive committee of the Department.
<table>
<thead>
<tr>
<th>Undergraduate &amp; Master's Level Course</th>
<th>Coursework</th>
<th>Semester (S=spring, F=fall, B=Both)</th>
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</thead>
<tbody>
<tr>
<td>A. Know fundamental principles</td>
<td>x x x x x x x x x x x x x x x x x</td>
<td>F B F F F B S F F F S S F S F S</td>
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<tr>
<td>B. Apply fundamental principles to life science, environment and emerging fields of chemistry</td>
<td>x</td>
<td>x x x x x x x x x x x x x x x</td>
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<td>C. Conduct experiments</td>
<td>x x x x x x x x x</td>
<td>x x x x x x x x</td>
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<td>D. Analyze and interpret data</td>
<td>x x x x x x x x x x</td>
<td>x x x x x x x x x x</td>
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<td>E. Apply mathematical concepts</td>
<td>x x x x x x x x x</td>
<td>x x x x x x x x x x</td>
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<td>F. Solve problems in a team</td>
<td>x x x x x x x x x</td>
<td>x x x x x x x x x x</td>
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<td>G. Communicate in written form</td>
<td>x x x x x x x x x</td>
<td>x x x x x x x x x x</td>
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<tr>
<td>H. Communicate in oral form</td>
<td>x x x x x x x x x</td>
<td>x x x x x x x x x x</td>
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<tr>
<td>I. Use chemical information technology</td>
<td>x x x x x x x x x</td>
<td>x x x x x x x x x x</td>
</tr>
<tr>
<td>J. Design and execute research</td>
<td>x x x x x x x x x</td>
<td>x x x x x x x x x x</td>
</tr>
<tr>
<td>K. Conduct oneself ethically and responsibly</td>
<td>x x x x x x x x x</td>
<td>x x x x x x x x x x</td>
</tr>
</tbody>
</table>
Figure 1: Flow chart of the assessment process
Assessment Plans
The EAS Department has devised a 5-year assessment plan in 2008 to cover the 5 year period from 2008 through 2013. See appendix A: EAS.Plan_0813.pdf. We have completed 3 of the 5 academic years. This report covers year 3 of 5, Academic Year Fall 2010- Spring 2011.

Policies and Guidelines
The department is following a protocol established for the 2007 middle states accreditation cycle with minor revisions. Assessment has been led by Professor Margie Winslow. Upon her retirement in Spring 2010, the EAS department has appointed a substitute departmental coordinator, Prof. Johnny Luo to resume duties for the Fall 2011-Spring 2012 academic cycle. For the current academic year, Elizabeth Rudolph will prepare the report and train Prof Luo in the assessment process.

Recognition and Rewards
The college continues to show weakness in this category. There is still no recognition or rewards for conducting student learning assessment except for the meager amount of workload credits (1 hour maximum) to full time faculty for helping in the dissemination, collection and analysis and synthesis of direct and indirect learning measures.

Learning Outcomes
Annual Year 2010-2011 assessment schedule per the EAS Department 5-year plan is listed in the table below.

<table>
<thead>
<tr>
<th>Fall 10</th>
<th>Spring 11</th>
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<tbody>
<tr>
<td>Undergraduate</td>
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<td>328</td>
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<td>439</td>
<td>446</td>
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</table>
Data Collection

Two forms of assessment were undertaken as required by the Middle States Commission.

Indirect assessment of student learning is undertaken in the Division of Science through the ‘End-of-course-survey’ instrument. We have recently moved to the Scantron product, Class Climate, for survey generation and data collection.

The Science Division has adopted a new form of direct assessment based on instructor assessment of student learning on each of the listed learning outcomes for the course. The assessment is quantitative since it is to be based on exam question scores for those questions that apply to the particular learning outcome.

Assessment Tools

Appendix B: contains the indirect and direct instruments for each of the courses under examination.

Additionally, the EAS Department posts program and assessment information and course syllabi at the following website:

http://www1.ccny.cuny.edu/prospective/science/eas/index.cfm

Results and Discovery

Use of Assessment Results

Multi year synthesis (2008-2011) and Closing the Loop

Syllabi

The EAS Department posts Syllabi to the departmental website:

http://www1.ccny.cuny.edu/prospective/science/eas/ug_syllabi.cfm
Faculty Professional Development
The Divisional task force, TLAC (Teaching and Learning Advisory Committee) runs a workshop yearly on science pedagogy and/or research, entitled ‘Discussions on Student Learning’. The first event was run in January, 2010 and involved presentations on Making Sense of How Students Make Sense of Science; Working Research Into the Classroom; How Students Do or Do Not Learn Math and Science. The Second event took place in the reporting period, Jan, 2011 and covered a systematic review and follow-up from the 2010 event and a presentation on the Mechanisms, Causality and Explanations in Complex Dynamic Systems -implication for teaching and learning. In the first production, of the 25 participants, 3 were from the EAS Department, Profs Federica Raia, Johnny Luo and Marco Tedesco. In the second production, the same 3 professors participated.

Course and Teacher Surveys (C&T)
Two unfortunate occurrences took place in AY 2010-2011 that resulted in the lack of Course and Teacher Survey Data as of this date. Prior to the spring, 2011 semester, the Course and Teacher Survey was administered online via email to the students enrolled in each class. Historically, given no incentives or disincentives, students respond to the survey at percentages between 5 and 30%, resulting in statistically invalid and only qualitatively useful results. Furthermore, the Fall 2010 collections were corrupted due to technical problems and no collections were made. To combat all the challenges with the Course and Teacher Survey, the CCNY Office of Institutional research in collaboration with the Testing Office, reverted to paper data collection. Spring 2011 being the first run was met with different challenges, thus the data is not yet ready.

Using results of C&T
C&T results are used in all cases of faculty reappointments, tenure and promotion. However, since the college encountered difficulties in both fall 2010 and spring 2011 collections and analysis, these results were not available for the fall 2011 reappointment, tenure and promotion cases.
Overview
To keep improving The EAS program and to insure that the Program maintains relevance to Systems Science, several key EAS offerings will be systematically reviewed both directly and indirectly on a regular basis. The pivotal courses to the EAS and new EESS/ESE majors are EAS 10600/ENGR10610, EAS 21700, EAS 30800 and EAS 41300. These courses will be assessed yearly. Since the assessment office is gearing towards 90-100% electronic administering of end of course surveys, EOCS for most EAS courses will be collected each semester. The direct assessment will be modified from assessment of every course, every semester with a small sample size to assessment of a sampling of courses each semester with a large sample size. The collections will occur such that all program outcomes and thus all courses are examined at least once over a five year assessment period. The methods of direct assessment will vary depending upon the program outcome. Some outcomes will require a score, i.e. grade for HW assignment or exam question. Others may require report grades, individual or group project results.
We are currently exploring the utilization of Excel spreadsheet grade-book data for direct assessment. Several key publications feature this method and the EAS Dept is considering adopting a modified excel approach.

INDIRECT ASSESSMENT
The majority of EAS offerings will be surveyed for Course Knowledge Outcomes, (EOCS) on a semesterly basis. For the typical fall semester this will usually include:
EAS 10600, EAS 21700, EAS 30800, EAS 41300, EAS 56500 and any irregularly offered elective or new course.

The spring semester EOCS will be conducted for:
EAS 106, EAS 217, EAS 227, EAS 31801, EAS 3300, EAS 44600, EAS 48800 and EAS 52800 and any irregularly offered elective or new course.

New language will be added to the EOCS to assess the student perception of degree to which the course addresses Earth Science with a systems approach. Students will also be asked to ‘rank’ their expertise in the subject matter relative to his/her peers.

DIRECT ASSESSMENT
Courses will be directly assessed over a 5 year period once or multiple times based on the data analysis of earlier assessment efforts. Thus far, courses under development and those moving into a more pivotal position in the degree will be examined closely and over multiple years. Courses that are more rigidly set and relatively static in design will be assessed once or twice over the 5-year period. Pivotal courses to the EAS major: EAS 10600, EAS 21700, EAS 30800, EAS 22700, EAS 41300 will be examined every time they are offered. Additional to the foregoing, courses moving into the pivotal position because of their importance to the EESS and ESE major and the Systems Science thrust: EAS 33000, EAS 42600 will also be more regularly examined. As a general rule the 10 EAS program outcomes will be assessed over the 5 year period in the following manner. Outcomes A and B will be covered in AY 08-09,
C and D in AY 09-10, E and F in AY 10-11, G and H in AY 11-12 and I and J in AY 12-13. The following table describe the Direct assessment program. Courses will be examined by direct and indirect means for a particular academic year as indicated by highlight color. As a fair representation of the entire program, each academic year’s Program outcomes will be examined in a representative lower division (Freshman/Sophomore—100 to 200 level) middle division (Junior-300 level) and upper division (400-500 level) courses. This will insure that we study the development of increasing skill level attributable to each Program outcome.

The sums shown in the far right column total the number of courses examined for a particular Program outcome. Generally speaking, this number (scoring 1-10) also reflects the relative importance of the Program outcome to the desired skill set of the typical graduate. The greater the number, the more important the outcome is to the program. The tallies along the bottom of the sheet quantify the number of times a course is examined for its program outcomes over the course of the 5-year period. The most crucial courses to the program will have a greater number of analysis points. The generic requirement is that each course/program outcome be examined at least once over the examination period (5 years). Therefore each column total should possess at a minimum the number ‘1’. Regarding the EAS program, since all courses are not regularly offered semesterly, yearly or even bi-yearly, and these courses are less crucial in providing the desired outcomes, they will be much less frequently examined. As the program evolves and course offerings shift, the assessment plan will reflect these shifts.

Tables in figure 2 show a greater detailed view of the direct assessment plan, broken down by academic year. Here the faculty members responsible are identified and there are spaces to enter information gained from this particular course. The method of direct assessment is also listed.

Tables in figure 3 outline the specific course outcomes that will be examined to satisfy the assessment of the program outline under consideration.

CLOSING THE LOOP
The initial three semester assessment results have reinforced the need to improve EAS 10600 with the goal of improving the laboratory section, better aligning lab and lecture and ensuring uniform content among sections. S09 improvements include 1) weekly instructional sessions with all teaching adjuncts in which each adjunct is assigned the task of developing a laboratory exercise that coordinates with the lecture material and, 2) developing and adopting a new text that is a compilation of the best chapters of two Prentice Hall text books, one focusing on aspects of oceanography and the other on earth system science. Over this proposed 5-year examination period, the EAS department will continuously emplace changes towards improving the curriculum as the need arises.
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<thead>
<tr>
<th>ASSESSMENT YEAR</th>
<th>COURSEWORK</th>
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<tbody>
<tr>
<td>2008-2009</td>
<td>A. Design field research programs</td>
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<td></td>
<td>B. Use computers for earth system science applications</td>
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<td>2009-2010</td>
<td>C. Perform quantitative calculations</td>
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<td></td>
<td>D. Reason scientifically in context of the earth system</td>
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<tr>
<td>2010-2011</td>
<td>E. Discuss issues and controversies in earth system science</td>
</tr>
<tr>
<td>2010-2011</td>
<td>F. Identify and work with earth materials and earth structures</td>
</tr>
<tr>
<td>2011-2012</td>
<td>G. Function well in team-coordinated activities</td>
</tr>
<tr>
<td>2011-2012</td>
<td>H. Identify, formulate and solve real world earth science problems</td>
</tr>
<tr>
<td>2012-2013</td>
<td>I. Communicate effectively at all levels, orally and in writing</td>
</tr>
<tr>
<td>2012-2013</td>
<td>J. Use earth science instruments</td>
</tr>
</tbody>
</table>

Table 1: EAS Program outcomes matrix showing in which courses each program outcome is addressed.
<table>
<thead>
<tr>
<th>Program Learning Outcome</th>
<th>Where in curriculum?</th>
<th>How will it be assessed?</th>
<th>When will it be assessed?</th>
<th>Who is involved?</th>
<th>What was learned?</th>
<th>What is the impact of findings?</th>
</tr>
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<tbody>
<tr>
<td>EAS 227 Structural Geology</td>
<td>Project Portfolios</td>
<td>S09</td>
<td>P. Winslow</td>
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<td>EAS 311 Environmental Field Methods</td>
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<td>Project Portfolios</td>
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A. Design field research projects F08-S09
<table>
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<tr>
<th>Program Learning Outcome</th>
<th>Where in curriculum?</th>
<th>How will it be assessed?</th>
<th>When will it be assessed?</th>
<th>Who is involved?</th>
<th>What was learned?</th>
<th>What is the impact of findings?</th>
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<tbody>
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<td><strong>B. Use computers for earth system science applications F08-S09</strong></td>
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<td>Lab assignment</td>
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<td>EAS 217 System analysis of earth</td>
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<td>P. Gedzelman</td>
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<td>F08</td>
<td>Ps. Luo/Block</td>
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<td>How will it be assessed?</td>
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<td>How will it be assessed?</td>
<td>When will it be assessed?</td>
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D. Reason scientifically in the context of the earth system F09-S10
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E. Discuss issues and controversies in earth system science F10-S11
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Figure 2. The 5 year assessment plan broken down by academic year
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<th>A: Design Field or Research Projects/Programs</th>
<th>B: Use Computers for Earth System Science Applications</th>
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<td>EAS 10600 Intro to Earth System Science</td>
<td>Show evidence for computing comprehension: Black Box Lab</td>
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<td>Gedzelman is identifying outcomes (previously created by Raia)</td>
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<td>EAS 22700 Structural Geology</td>
<td>1. Use basic surveying equipment and techniques 3. Design a sampling grid and collect field data</td>
<td>2. Create maps of topography, bedrock, and structures 4. Analyze field data using GIS software and present a report based on their interpretations</td>
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<td>3. Understand the distribution, formation and impacts of hurricanes</td>
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<td>10. Understand the economic and environmental advantages of developing new technologies for alternative energy sources (research papers)</td>
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<td>EAS 33000 GIS</td>
<td>The entire course. Matrix needs to be developed</td>
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<td>5. Calculate stable oxygen isotope abundance relative to SMOW.</td>
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<td>2. Design a simple survey to answer a question about the shallow subsurface 3. Correctly set up and operate the equipment covered 4. Work with a group to take geophysical data</td>
<td>5. Use simple computer programs to analyze geophysical data</td>
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<td>C: Perform quantitative calculations</td>
<td>D: Reason scientifically in the context of the earth system</td>
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<td>3. Collect data and manipulate data to recognize and describe patterns and trends 4. Interpret data</td>
<td>2. Reason scientifically by formulating a research question and testable hypothesis</td>
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<td>1. Demonstrate comprehension of atmospheric thermodynamics and apply it to explain atmospheric instability. 3. Relate atmospheric dynamics to general earth circulation patterns</td>
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<tr>
<td>EAS 33000 GIS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAS 41300 Geochem</td>
<td>3. Estimate the solubility of important compounds such as quartz. 5. Calculate stable oxygen isotope abundance relative to SMOW.</td>
<td>2. Describe element cycles of Carbon and Silicon.</td>
</tr>
<tr>
<td>EAS 42600 Remote Sensing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAS 47200 Senior Environmental Project</td>
<td>Project calculations in project report</td>
<td>Scientific systems reasoning in report and project</td>
</tr>
<tr>
<td>EAS 56500 Environmental Geophysics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAS A2300 (Subsurface remediation)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAS A3300 (Instrumentation)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>both semesters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>spring semester</td>
<td></td>
<td></td>
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<tr>
<td>fall semester</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Program Outcomes:

- **E:** discuss issues and controversies in earth system science
- **F:** Identify and work with earth materials and earth structures

### Courses

<table>
<thead>
<tr>
<th>Program Outcomes:</th>
<th>Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>E: discuss issues and controversies in earth system science</td>
<td>EAS 10600 Intro to Earth System Science, EAS 21700 Systems Analysis of Earth, EAS 22700 Structural Geology, EAS 30800 Data Analysis and ESS Modeling, EAS 31700 Atmospheric Change, EAS 31800 (new) Fundamentals of Atmospheric Science, EAS 31104 Energy and Env Constraints, EAS 33000 GIS, Interpretation of earth science issues portrayed spatially in GIS maps, EAS 41300 Geochem, EAS 42600 Remote Sensing, EAS 47200 Senior Environmental Project, The project is issue/controversy based evidence in report, Field map if appropriate, EAS 56500 Environmental Geophysics, EAS A2300 (Subsurface remediation), Field map if appropriate, EAS A3300 (Instrumentation), both semesters, spring semester, fall semester</td>
</tr>
<tr>
<td>F: Identify and work with earth materials and earth structures</td>
<td>mineral lab, rock labs, report or lab exercise</td>
</tr>
<tr>
<td>Program Outcomes:</td>
<td>G: function well in team coordinated activities</td>
</tr>
<tr>
<td>------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td><strong>Courses</strong></td>
<td></td>
</tr>
<tr>
<td>EAS 10600 Intro to Earth System Science</td>
<td></td>
</tr>
<tr>
<td>EAS 21700 Systems Analysis of Earth</td>
<td>group project</td>
</tr>
<tr>
<td>EAS 22700 Structural Geology</td>
<td>group project</td>
</tr>
<tr>
<td>EAS 30800 Data Analysis and ESS Modeling</td>
<td>group project</td>
</tr>
<tr>
<td>Field Methods (new)</td>
<td>group project</td>
</tr>
<tr>
<td>EAS 31700 Atmospheric Change</td>
<td></td>
</tr>
<tr>
<td>EAS 31800 (new) fundamentals of Atmospheric Science</td>
<td></td>
</tr>
<tr>
<td>EAS 31104 Energy and Env Constraints</td>
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</tr>
<tr>
<td>EAS 33000 GIS</td>
<td>individual project</td>
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<tr>
<td>EAS 41300 Geochem</td>
<td></td>
</tr>
<tr>
<td>EAS 42600 Remote Sensing</td>
<td></td>
</tr>
<tr>
<td>EAS 47200 Senior Environmental Project</td>
<td>group project</td>
</tr>
<tr>
<td>EAS 56500 Environmental Geophysics</td>
<td></td>
</tr>
<tr>
<td>EAS A2300 (Subsurface remediation)</td>
<td>group project</td>
</tr>
<tr>
<td>EAS A3300 (Instrumentation)</td>
<td></td>
</tr>
<tr>
<td>both semesters</td>
<td></td>
</tr>
<tr>
<td>spring semester</td>
<td></td>
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<td>fall semester</td>
<td></td>
</tr>
</tbody>
</table>
### F12-S13 Direct Assessment

**Course Knowledge outcomes related to Program Outcomes**

<table>
<thead>
<tr>
<th>Program Outcomes:</th>
<th>I: communicate effectively at all levels, orally and in writing</th>
<th>J: Use earth science instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Courses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAS 10600 Intro to Earth System Science</td>
<td>Black box laboratory experiment grade</td>
<td></td>
</tr>
<tr>
<td>EAS 21700 Systems Analysis of Earth</td>
<td>Term papers and oral reports</td>
<td>Demonstrate competency in using GIS and mapping equipment</td>
</tr>
<tr>
<td>EAS 22700 Structural Geology</td>
<td></td>
<td>Demonstrate competency in using IDL, ENVI, remote sensed data</td>
</tr>
<tr>
<td>EAS 30800 Data Analysis and ESS Modeling</td>
<td>Term papers and oral reports</td>
<td>Demonstrate competency in using GIS and mapping equipment</td>
</tr>
<tr>
<td>Field Methods (new)</td>
<td>Use exercise if offered</td>
<td></td>
</tr>
<tr>
<td>EAS 31700 Atmospheric Change</td>
<td>Term papers or oral reports for either of these two</td>
<td></td>
</tr>
<tr>
<td>EAS 31800 Fundamentals of Atmospheric Science</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAS 31104 Energy and Env Constraints</td>
<td>Term papers and oral reports</td>
<td>Demonstrate higher level competency in GIS</td>
</tr>
<tr>
<td>EAS 33000 GIS</td>
<td>Term papers and oral reports</td>
<td>Demonstrate competency in Xray methods</td>
</tr>
<tr>
<td>EAS 42600 Remote Sensing</td>
<td></td>
<td></td>
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<tr>
<td>EAS 42500 Remote Sensing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAS 47200 Senior Environmental Project</td>
<td>Evaluate term papers and oral presentations</td>
<td>Demonstrate competency in applicable project based instruments</td>
</tr>
<tr>
<td>EAS 56500 Environmental Geophysics</td>
<td></td>
<td>Demonstrate competency in applicable project based instruments</td>
</tr>
<tr>
<td>EAS A2300 (Subsurface remediation)</td>
<td></td>
<td>Demonstrate competency in applicable project based instruments</td>
</tr>
<tr>
<td>EAS A3300 (Instrumentation)</td>
<td></td>
<td>Demonstrate competency in applicable instruments</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Both semesters</th>
<th>Spring semester</th>
<th>Fall semester</th>
</tr>
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</table>

**Figure 3.** Specific course outcomes that will be evaluated to satisfy program outcomes
1. Assessment Plans
The Math Department has devised a 5-year assessment plan in 2008 to cover the 5 year period from 2008 through 2013. See appendix 1: Math.Plan_0813.pdf. We have completed 3 of the 5 academic years. This report covers year 3 of 5, Academic Year Fall 2010- Spring 2011.

2. Policies and Guidelines
The department is following a protocol established for the 2007 middle states accreditation cycle with minor revisions.

3. Recognition and Rewards
The college continues to show weakness in this category. There is still no recognition or rewards for conducting student learning assessment except for 1 hour of release time to full time faculty for helping in the dissemination, collection and analysis and synthesis of direct and indirect learning measures.

4. Learning Outcomes
The plan for 10-11 assessment is analysis of lower division courses that serve to prepare students for future science or engineering majors, Math 19000 and 19500 and upper division courses for math majors, Math 30800, 32300, 32800, 34600, and 34700.

<table>
<thead>
<tr>
<th>MATHEMATICS</th>
<th>Fall 2010-Spring 2011 Courses Assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>19000 - College Algebra &amp; Trigonometry</td>
<td>19500 - Pre-calculus</td>
</tr>
<tr>
<td>a. Perform numeric and symbolic computations</td>
<td>X</td>
</tr>
<tr>
<td>b. Construct and apply symbolic and graphical representations of functions</td>
<td>X</td>
</tr>
<tr>
<td>c. Model real-life problems mathematically</td>
<td>X</td>
</tr>
</tbody>
</table>
**d. Use technology appropriately to analyze mathematical problems**

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<td>X</td>
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**e. State and apply mathematical definitions and theorems**

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**f. Prove fundamental theorems**

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<td>X</td>
<td>X</td>
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</tbody>
</table>

**g. Construct and present a rigorous mathematical argument (written or oral)**

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<td>X</td>
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<td>X</td>
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</tr>
</tbody>
</table>

**Table 1. Fall 2010-Spring 2011 Assessment Plan**

The Program Outcomes that will be examined in this report are highlighted in yellow in table 1. These Program outcomes pertain to the student’s ability to solve problems directly (1) and also to apply problem solving skills to new unknowns (5).

Math 19000, College Algebra and Trigonometry and Math 19500, Precalculus are courses that exist to prepare students for majoring in the sciences and engineering. Both courses are designed to fill remnant high school deficiencies before a student is able to start the Calculus series for either Science/Engineering (Math 20100) or Biology majors (Math 20500). As such, these courses tend to be ‘gateway’ courses either opening or closing the ‘gate’ to the intended direction of study. Moreover, as gateway courses we expect a significant amount of filtration as not all students desiring science and engineering careers are best suited for those careers.

Almost the entire curriculum of both courses is focused on promoting PROBLEM SOLVING SKILLS particular to the themes of the courses with algebra and trigonometry and topics in pre-calculus. The CLO for each are heavily weighted in problem solving, i.e. every course outcome addresses this program outcome. The content builds; upon successful completion, students will have gained the needed problem solving skills to move on to higher order math courses.

Therefore, these courses are under examination in this report for success of PROGRAM OUTCOMES a and c, those that involve problem solving and the ultimate outcome derived from grade distribution provides a good indication as to whether students are learning.

Math 19000, Algebra and Trigonometry, is a course that has been historically adjunct taught. Figures 1 and 2 show the average pass-fail rate for each of the sections taught in both fall 10 and spring 11. The data show an extremely wide variability in pass rates, in fall 10 from 46-86% and in spring 2011 from 33-80%. This data reveals some potential problems in the way algebra and trigonometry is taught and
learned. Since there is a uniform exam that comprises 40% of the student’s grade the exhibited variability in final grades and ultimate learning can be explained by one or more of the following:

1) There is variability in teaching skill that deems some faculty better at conveying the knowledge than others.
2) There is inconsistency in grading possibly involving partial credit or some other subjective parameter(s).
3) There is inconsistency in student math preparation and study skills carried from High School.
4) There is inconsistency in student dedication to success in college (some students work full-time, support a family, have extremely long commutes and other student centered factors that might impede progress)

Figure 1. Final grades for Math 19000 for the academic year fall 2010- spring 2011. Sections show extreme variability in pass/fail percentages.

Figure 2. mean pass/fail rate in Math 19000 over Fall10-Spring11 comparison.
Figure 3. Breakdown of failing grades.

The pass-fail data can be teased out to solve a problem which CCNY is not unique in suffering, the speedy and successful progression of students through the degree. As reported in the September 2010 edition of City Facts, the division of science 6-year graduation rate hovers at just under 30%. This may be in part due to stalling or drop-out due to problems with math. To address the contribution of math the department needs to evaluate the specifics of math failures and attempt to address some ways to improve student success. Figure 3 shows the 2 semester count for all possible failures in Math 19000. As a disclaimer, the math 19000 information is less valuable to perhaps math 20100, and 20500 (Calculus I for science and engineering, and biology majors respectively) since students who take Math 19000 are not necessarily positioned for science majors. However for the sake of consistency, all ‘gateway’ courses will be examined in this way.

A total of 113 of 308 students in Fall 2010 (greater than 1/3), and 98 of 229 (almost ½) in Spring 2011 have failed with either a C-, D, F or W (includes WU). And, the data shows that almost 50% of all failures receive an F grade. This can be misleading since students often ‘request’ an F grade over other failing grades in order to benefit from the F-repeat rule. Whichever the type of failure, we must investigate ways to improve student success in math courses so that they can make a timely progression through the degree. One strategy that can be employed is to provide better advising so that students do not overwhelm themselves with coursework in any given semester. Students can also be advised to take advantage of the assistance offered by Gateway’s Advising Center and The Division of Science Math and Physics tutoring center.
Figure 4. Indirect evidence for student learning in Math 19000. Eight sections plotted. The light blue bar separated by a space is the combined average for all sections.

CLO

1. demonstrate knowledge of prerequisite concepts and skills including real numbers, algebraic expressions, factoring polynomials, and removing parentheses
2. solve linear systems in two or three variables, find determinants of 3 x 3 matrices, and apply these techniques to solving real-world problems.
3. simplify sums, products, and quotients of rational expressions
4. simplify expressions involving rational exponents and radicals
5. translate between simple equations and graphs in the x,y-plane
6. solve simple systems of equations in two real variables and use the results to find intersection points of graphs;
7. construct and evaluate functions of one variable, including those that model real life problems
8. solve problems involving right triangle trigonometry, including the Laws of Sines and Cosines
9. solve other problems appropriate for a course in college algebra and trigonometry.

Parallel indirect evidence for Math 19000 gleaned from the End of Course Survey shows a consistent opinion on student learning of course outcomes (see figure 4). Except for the score for the textbook, the average student opinion on learning seems less variable, a high of 4.5 on outcome 1-the introductory concepts and problem solving to a low of 3.1 on outcome 5, graphing expressions. The average over all sections for all learning outcomes is 3.9 in a scale of 1-5, where 5 represents the
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Greatest satisfaction with learning (excluding the textbook which always scores poorly no matter what the course or discipline). The student opinion that they have weak ability to graph expressions seems to indicate that there might be a need for reinforcing the underlying concepts. Graphing as well as other problem solving tasks in math can be handled 2 ways. The steps can be memorized and thus mechanized or the concept or logic behind the routine can be emphasized, thus cementing the ‘reasons’ for the mechanics of that particular technique. The department should plan to assess this aspect of teaching and learning more carefully and perhaps add interventions that may help students grasp the concepts in addition to solving the problems routinely.

Figure 5. Final grades for Math 19500 fall 2010. Again, sections show extreme variability in pass/fail percentages.

Math 19500, Precalculus, pass/fail rates show the same variability across the sections offered over AY10-11. In figure 5, we see pass rates ranging from 28% to 83% in fall, and 32% to 71% in the spring. Of the 29 sections 7 sections were taught by fulltime faculty (FTF), however the pass/fail rates by FTF are also quite variable and therefore instructor ‘type’ does not reflect any consistency. The same four factors can explain both the variability in student success among the sections that were named for Math 19000.

Math 19500 indirect surveys have been processed using the Scantron system, but the Division has no support to analyze the data and Thus it is omitted from the report at this time. The data will be added in late December or early January.
Figure 6 shows the instructor assessed mastery of learning outcomes extracted from in-class assessments. The CLO (program outcomes (PO) in parentheses) are shown below. From student work and in class assessments, the best performance was (1) in ‘knowledge outcomes’: being able to state and repeat theorems (CLO2 and POe) and to use them in math arguments (CLO2&POg); (2) ‘problem solving and knowledge outcomes’: constructing examples and counter examples (CLO3 & PO b and e2); and (3) constructing a rigorous math argument CLO4 (POf). The students performed less well at constructing proofs CLO5 and 1, analyzing properties of functions CLO6.

1. demonstrate proficiency in epsilon-delta and triangle inequality proofs (g)
2. state the definitions of basic terms in beginning analysis of one real variable, and use them and their negations in proofs: in particular those related to sequences and series of numbers and functions (including uniform convergence), continuity and uniform continuity, differentiation, and integration(a, b, e1, e2, g)
3. construct examples and counterexamples (b, e2)
4. state and prove: the Extreme, Intermediate Value, and Mean Value Theorems; and the Fundamental Theorem of Calculus( f)
5. construct proofs which use estimation and/or other theorems/established facts (a, b, e1, e2, g)
6. analyze the properties of given functions (a, b, e2)
Student self-rating in learning the material in Math 32300 differed slightly from their actual performance on tests. They actually performed better on CLO3 than they anticipated. Otherwise, the indirect assessment correlated rather well with the direct.
CLO (program outcomes in parentheses)

1. give examples of axiomatic systems (e1)
2. give examples of equivalence relations such as congruences and verify that they are equivalence relations (e1, e2)
3. write proofs of simple statements about groups and rings (f, e2)
4. identify hypotheses and conclusions of moderately complex statements about groups or rings (f)
5. determine whether an example satisfies a given set of axioms (a, e1, e2)
6. derive conclusions about the integers or rational numbers from general theorems about groups, rings, and fields (a, b)
7. use axiomatic properties to explain operations on polynomials (a, b)

5. Syllabi and CLO
Most Math Department Syllabi and CLO are posted on the CCNY, Math Department Website and each course has an assigned faculty supervisor. There are scattered omissions due in part to the loss of the department faculty webmaster. The postings below show the available material on the website. For the purposes of this report, I will show the course learning outcomes only. The remaining material can be viewed at the links provided.

http://math.sci.ccny.cuny.edu/courses?name=Math_19000

Math 19000: College Algebra and Trigonometry--Supervisor: Stanley Ocken

Introduction to functions, rational expressions and their applications, rational exponents, conic sections, Gaussian elimination and determinants, nonlinear systems of equations, introductions to
trigonometric functions. Prereq.: placement at college entry or by subsequent examination. 4 hr./wk.; 2 cr.

**Documents**

- [190final.doc](#): Fall 2007 final exam
- [AlgebraReview3S07.pdf](#): Algebra review for algebra and precalculus
- [math19000fall2005.pdf](#): Fall 2005 final exam
- [math19000fall2006.pdf](#): Fall 2006 final exam
- [math19000spring07.pdf](#): Spring 2007 final exam
- [math19000spring2005solutions.pdf](#): Spring 2005 final exam solutions
- [math19000spring2006.pdf](#): Spring 2006 final exam
- [math19000syllabus.pdf](#): Course syllabus for Math 19000
- [math190clo.doc](#): CLO for Math 19500

**COURSE LEARNING OUTCOMES**

**DEPARTMENT:** Mathematics

<table>
<thead>
<tr>
<th>COURSE #: 19000</th>
<th>CATALOG DESCRIPTION</th>
</tr>
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<tbody>
<tr>
<td><strong>COURSE TITLE:</strong> College Algebra and Trigonometry</td>
<td>Introduction to functions, rational expressions and their applications, rational exponents, conic sections, Gaussian elimination and determinants, nonlinear systems of equations, introduction to trigonometric functions.</td>
</tr>
<tr>
<td><strong>TERM OFFERED:</strong> Spring 2007</td>
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<tr>
<td><strong>PRE-REQUISITES:</strong> Placement at college entry or by subsequent examination.</td>
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<tr>
<td><strong>PRE/CO-REQUISITES:</strong></td>
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<tr>
<td><strong>HOURS/CREDITS:</strong> 4 hrs./ week; 2 credits.</td>
<td></td>
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<tr>
<td><strong>DATE EFFECTIVE:</strong> 1/25/07</td>
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</tr>
<tr>
<td><strong>COURSE COORDINATOR:</strong> Stanley Ocken</td>
<td></td>
</tr>
</tbody>
</table>

**COURSE LEARNING OUTCOMES**

Please describe below all learning outcomes of the course, and indicate the letter(s) of the corresponding Departmental Learning Outcome(s) (see list at bottom) in the column at right.

<table>
<thead>
<tr>
<th>After taking this course, the student should be able to:</th>
<th>Contributes to Departmental Learning Outcome(s):</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. demonstrate knowledge of prerequisite concepts and skills including real numbers, algebraic expressions, factoring polynomials, and removing parentheses</td>
<td>a</td>
</tr>
<tr>
<td>2. solve linear systems in two or three variables, find determinants of 3 x 3 matrices, and apply these techniques to solving real-world problems.</td>
<td>a, c</td>
</tr>
<tr>
<td>3. simplify sums, products, and quotients of rational expressions</td>
<td>a</td>
</tr>
</tbody>
</table>
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4. simplify expressions involving rational exponents and radicals
5. translate between simple equations and graphs in the x,y-plane
6. solve simple systems of equations in two real variables and use the results to find intersection points of graphs;
7. construct and evaluate functions of one variable, including those that model real life problems
8. solve problems involving right triangle trigonometry, including the Laws of Sines and Cosines
9. solve other problems appropriate for a course in college algebra and trigonometry.

COURSE ASSESSMENT TOOLS
Please describe below all assessment tools that are used in the course.
You may also indicate the percentage that each assessment contributes to the final grade.
1. Final exam: 40%
2. In-class exams, quizzes, homework, attendance: 60%

DEPARTMENTAL LEARNING OUTCOMES (to be filled out by departmental mentor)
The mathematics department, in its varied courses, aims to teach students to

- perform numeric and symbolic computations
- construct and apply symbolic and graphical representations of functions
- model real-life problems mathematically
- use technology appropriately to analyze mathematical problems
- state (e1) and apply (e2) mathematical definitions and theorems
- prove fundamental theorems
- construct and present (generally in writing, but, occasionally, orally) a rigorous mathematical argument.

- Testbank_for_Quiz_1.pdf: Testbank questions
- Testbank_for_Quiz_10.pdf: Testbank questions
- Testbank_for_Quiz_2.pdf: Testbank questions
- Testbank_for_Quiz_3.pdf: Testbank questions
- Testbank_for_Quiz_4.pdf: Testbank questions
- Testbank_for_Quiz_5.pdf: Testbank questions
- Testbank_for_Quiz_6.pdf: Testbank questions
- Testbank_for_Quiz_7.pdf: Testbank questions
- Testbank_for_Quiz_8.pdf: Testbank questions
- Testbank_for_Quiz_9.pdf: Testbank questions

http://math.sci.ccny.cuny.edu/courses?name=Math_19500
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Math 19500: Precalculus--Supervisor: Stanley Ocken

Intervals, inequalities, operations on functions, inverse functions, graphing polynomial functions, exponential and logarithmic functions, trigonometric functions and formulas. Prereq.: Math 19000 with an A, B, or C or placement. 4 hr./wk.; 3 cr.

MapleTA Information (selected sections only):
Click here to Login to Maple TA
Click here to download Flash Plugin

Documents

- MATH 195 TEXTBOOK INFORMATION FOR STUDENTS v2.doc: IMPORTANT!!!!!!
- AlgebraReview3S07.pdf: Algebra review for algebra and precalculus
- math19500fall2005.pdf: Fall 2005 final exam
- math19500fall2006.pdf: Fall 2006 final exam
- math19500Fall2007.doc
- math19500spring07.pdf: Spring 2007 final exam
- math19500spring2006.pdf: Spring 2006 final exam
- math195clo.doc: CLO for Math 19500

COURSE LEARNING OUTCOMES

DEPARTMENT: Mathematics

<table>
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<tr>
<th>COURSE #: 19500</th>
<th>CATALOG DESCRIPTION</th>
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<tbody>
<tr>
<td>COURSE TITLE: Pre-Calculus</td>
<td>Intervals, inequalities, operations on functions, inverse functions, graphing polynomial and rational functions, binomial theorem, exponential and logarithmic functions, trigonometric functions and formulas.</td>
</tr>
<tr>
<td>CATEGORY: Prerequisite to course required of all majors</td>
<td>Required Text: Precalculus: Mathematics for Calculus, 5th edition; by Stewart, Redlin, Watson, Brooks-Cole, ISBN# 0-495-10997-5:</td>
</tr>
<tr>
<td>TERM OFFERED: Spring 2007</td>
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<td>PRE-REQUISITES: a grade of C or higher in Mathematics 19000 or placement by the department</td>
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<td>PRE/CO-REQUISITES</td>
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<tr>
<td>HOURS/CREDITS: 4 hrs./week; 3 credits.</td>
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<td>DATE EFFECTIVE: 1/23/07</td>
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<td>COURSE COORDINATOR: Stanley Ocken</td>
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COURSE LEARNING OUTCOMES

Please describe below all learning outcomes of the course, and indicate the letter(s) of the corresponding Departmental Learning Outcome(s) (see list at bottom) in the column at right.

<table>
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<tr>
<th>After taking this course, the student should be able to:</th>
<th>Contributes to Departmental Learning Outcome(s):</th>
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</table>


1. solve rational equations and inequalities in one real variable; a
2. graph linear, polynomial, trigonometric, exponential, and logarithmic equations; a, b
3. work with transformations of, and translate between, graphs and equations; a, b
4. determine whether a graph is the graph of a function; a, b, e1
5. demonstrate fluency with function notation, including composite and inverse functions; a, b
6. construct a quadratic polynomial model of appropriate real-world problems; a, b, c
7. find maximum /minimum values for a quadratic function and apply to optimization problems; a, b, c
8. state and apply trigonometric identities; a, b
9. represent and solve real-world problems involving exponential growth and decay a, b, c
10. solve other problems appropriate for a course in pre-calculus

COURSE ASSESSMENT TOOLS
Please describe below all assessment tools that are used in the course. You may also indicate the percentage that each assessment contributes to the final grade.

1. Final exam: 40%
2. In-class exams, quizzes, homework, attendance: 60%

DEPARTMENTAL LEARNING OUTCOMES (to be filled out by departmental mentor)
The mathematics department, in its varied courses, aims to teach students to (correspond to 1-7 in table 1)

  a. perform numeric and symbolic computations
  b. construct and apply symbolic and graphical representations of functions
  c. model real-life problems mathematically
  d. use technology appropriately to analyze mathematical problems
  e. state (e1) and apply (e2) mathematical definitions and theorems
  f. prove fundamental theorems
  g. construct and present (generally in writing, but, occasionally, orally) a rigorous mathematical argument.

  - [SRW Section 4.6 Exponential growth and decay..doc](http://math.sci.ccny.cuny.edu/courses?name=Math_30800)
  - [WA interval graphing camrec swf.swf](http://math.sci.ccny.cuny.edu/courses?name=Math_30800): WebAssign Interval Grapher v2

Math 30800: Bridge to Higher math: Supervisor: Edward Grossman
This course explores the logical and foundational structures of mathematics, with an emphasis on understanding and writing proofs. Topics include set theory, logic, mathematical induction, relations and orders, functions, Cantor's theory of countability, and development of the real number system. 3 HR./WK.; 3 CR.

Course learning Outcomes

| 1. | Has this course increased your ability to construct proofs of basic set-theoretic identities involving unions, intersections, and cartesian products? |
| 2. | Has this course increased your ability to formulate the negation, converse, and contrapositive of a quantified implication, both linguistically and in symbolic form? |
| 3. | Has this course increased your ability to demonstrate an understanding of the concept of a "counterexample" and be able to provide appropriate instances? |
| 4. | Has this course increased your ability to provide written proofs of statements involving elementary divisibility properties of the integers? |
| 5. | Has this course increased your ability to demonstrate knowledge of abstract functions, including being able to state precise definitions of basic concepts? |
| 6. | Has this course increased your ability to demonstrate an understanding of the Principle of Mathematical Induction? |
| 7. | Has this course increased your ability to demonstrate knowledge of the elementary theory of cardinality, including examples and applications of the main theorems? |
| 8. | Has this course increased your ability to demonstrate an understanding of the order structure of the real numbers, and the relationship of this structure to the completeness property? |

http://math.sci.ccny.cuny.edu/courses?name=Math_32300

Math 32300: Advanced Calculus--Supervisor: Pat Hooper

Sequences, properties of continuous functions, derivatives and differentials, functions defined by series, integrability and integrals, convergence of function sequences. Prereq.: Math 30800 or departmental permission. 4 HR./WK.; 4 CR.

Documents

- math323clo.pdf: CLO for Math 323

COURSE LEARNING OUTCOMES

DEPARTMENT: Mathematics
COURSE #: 32300
COURSE TITLE: Advanced Calculus I
PRE-REQUISITES: Math 30800 or departmental permission
PRE/CO-REQUISITES: None
HOURS/CREDITS: 4/4
DATE EFFECTIVE: 1/01/11
COURSE SUPERVISOR: Pat Hooper

CATALOG DESCRIPTION: Sequences, properties of continuous functions, derivatives and differentials, functions defined by series, integrability and integrals, convergence of function sequences.

Required Text: Elementary Analysis: The Theory of Calculus by Kenneth A. Ross

COURSE LEARNING OUTCOMES
Please describe below all learning outcomes of the course, and indicate the letter(s) of the corresponding Departmental Learning Outcome(s) (see list at bottom) in the column at right.

After taking this course, the student should be able to:

Contributes to Departmental Learning Outcome(s):

1. demonstrate proficiency in epsilon-delta and triangle inequality proofs g
2. state the definitions of basic terms in beginning analysis of one real variable, and use them and their negations in proofs: in particular those related to sequences and series of numbers and functions (including uniform convergence), continuity and uniform continuity, differentiation, and integration a, b, e1, e2, g
3. construct examples and counterexamples b, e2
4. state and prove: the Extreme, Intermediate Value, and Mean Value Theorems; and the Fundamental Theorem of Calculus
5. construct proofs which use estimation and/or other theorems/established facts a, b, e1, e2, g
6. analyze the properties of given functions a, b, e2,

COURSE ASSESSMENT TOOLS
Please describe below all assessment tools that are used in the course. You may also indicate the percentage that each assessment contributes to the final grade.

1. Term Grade (60%)
2. The Final Exam (40%)

DEPARTMENTAL LEARNING OUTCOMES
The mathematics department, in its varied courses, aims to teach students to
a. perform numeric and symbolic computations
b. construct and apply symbolic and graphical representations of functions
c. model real-life problems mathematically
d. use technology appropriately to analyze mathematical problems
e. state (e1) and apply (e2) mathematical definitions and theorems
f. prove fundamental theorems
g. construct and present (generally in writing, but, occasionally, orally) a rigorous mathematical argument.

http://math.sci.ccny.cuny.edu/courses?name=Math_34600

Math 34600: Elements of Linear Algebra—Supervisor: Vladimir Shpilrain

Vector spaces, basis and dimension, matrices, linear transformations, determinants, solution of systems of linear equations, eigenvalues, and eigenvectors. Prereq.: Math 20300; coreq.: Math 20300 and departmental permission. (After completion of Math 39200 only 2 credits will be given for Math 34600.) 3 HR./WK.; 3 CR.
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Documents

- math34600fall2005.pdf: Fall 2005 final exam
- math34600fall2006.pdf: Fall 2006 final exam
- math34600spring2006.pdf: Spring 2006 final exam

Course Outcome (**not posted on web)**

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<tbody>
<tr>
<td>1.</td>
<td>Has this course increased your ability to solve systems of linear equations?</td>
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<tr>
<td>2.</td>
<td>Has this course increased your ability to evaluate determinants of square matrices?</td>
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<tr>
<td>3.</td>
<td>Has this course increased your ability to compute inverses of square matrices?</td>
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<tr>
<td>4.</td>
<td>Has this course increased your ability to demonstrate a knowledge of basic properties of vector spaces, subspaces, and their bases?</td>
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<td>5.</td>
<td>Has this course increased your ability to demonstrate a knowledge of the concepts of linear dependence and independence?</td>
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<tr>
<td>6.</td>
<td>Has this course increased your ability to compute eigenvalues and eigenvectors of square matrices?</td>
</tr>
<tr>
<td>7.</td>
<td>Has this course increased your ability to demonstrate a knowledge of basic properties of linear transformations?</td>
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</tbody>
</table>


Sets, mappings, rings, isomorphisms, integral domains, properties of integers, fields, rational numbers, complex numbers, polynomials, groups. Prereq.: Math 30800 and 34600. With departmental permission, partial credit may be given for Math 44900 after completion of Math 34700. Recommended for prospective teachers and others who want a basic course in abstract algebra. 4 HR./WK.; 4 CR.
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Documents

- **MathCLO347.doc**: Word document. Modify semester and text, as needed. Grading criteria may be modified within reason from the stated policies. Distribute to students with course syllabus.

## COURSE LEARNING OUTCOMES

**DEPARTMENT:** Mathematics

### COURSE #: 34700
**COURSE TITLE:** Elements of Modern Algebra
**CATEGORY:** TERM OFFERED: Spring 2007
**PRE-REQUISITES:** 30800, 34600
**PRE/CO-REQUISITES:**
**HOURS/CREDITS:** 4 hr., 4 cr.
**DATE EFFECTIVE:** 1/23/07
**COURSE COORDINATOR:** Hoobler

### CATALOG DESCRIPTION
Sets, mapping, rings, isomorphisms, integral domains, properties of integers, fields, rational numbers, complex numbers, polynomials, groups


### COURSE LEARNING OUTCOMES

**Please describe below all learning outcomes of the course, and indicate the letter(s) of the corresponding Departmental Learning Outcome(s) (see list at bottom) in the column at right.**

After taking this course, the student should be able to

1. give examples of axiomatic systems
   - d1
2. give examples of equivalence relations such as congruences and verify that they are equivalence relations
   - d1, d2
3. write proofs of simple statements about groups and rings
   - f, d2
4. identify hypotheses and conclusions of moderately complex statements about groups or rings
   - f
5. determine whether an example satisfies a given set of axioms
   - a, d1, d2
6. derive conclusions about the integers or rational numbers from general theorems about groups, rings, and fields
   - a, b
7. use axiomatic properties to explain operations on polynomials
   - a, b

### COURSE ASSESSMENT TOOLS

**Please describe below all assessment tools that are used in the course.**
You may also indicate the percentage that each assessment contributes to the final grade.

1. Assigned and graded problems
2. Tests
3. Final

DEPARTMENTAL LEARNING OUTCOMES (to be filled out by departmental mentor)

The mathematics department, in its varied courses, aims to teach students to

a. perform numeric and symbolic mathematical computations, and use geometric representations;
b. model a physical situation using mathematical terms;
c. use technology to help organize data and solve problems;
d. state (d1) and apply (d2) fundamental definitions and theorems;
e. prove fundamental theorems;
f. present (generally in writing but, occasionally, orally) a coherent and logical mathematical argument.

6. Faculty Professional Development

7. Assessment Tools

8. Use of Assessment Results
Some of the following results are restated from earlier chapters, but are reemphasized here in the context of closing the loop or better, proposed methods of closing the loop to improve or better understand student learning.

a. A total of 113 of 308 students in Fall 2010 (greater than 1/3), and 98 of 229 (almost ½) in Spring 2011 have failed with either a C-, D, F or W (includes WU). And, the data show that almost 50% of all failures receive an F grade. This can be misleading since students often 'request' an F grade over other failing grades in order to benefit from the F-repeat rule. Whatever the type of failure, we must investigate ways to improve student success in math courses so that they can make a timely progression through the degree. One strategy that can be employed is to provide better advising so that students do not overwhelm themselves with coursework in any given
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Students can also be advised to take advantage of the assistance offered by Gateway’s Advising Center and The Division of Science Math and Physics tutoring center.

b. indirect evidence for student learning in Math 19000 gleaned from the End of Course Survey shows a consistent opinion on student learning of course outcomes (see figure 4). Except for the score for the textbook, the average student opinion on learning seems less variable, a high of 4.5 on outcome 1-the introductory concepts and problem solving to a low of 3.1 on outcome 5, graphing expressions. The average over all sections for all learning outcomes is 3.9 in a scale of 1-5, where 5 represents the greatest satisfaction with learning (excluding the textbook which always scores poorly no matter what the course or discipline). The student opinion that they have weak ability to graph expressions seems to indicate that there might be a need for reinforcing the underlying concepts. Graphing as well as other problem solving tasks in math can be handled 2 ways. The steps can be memorized and thus mechanized or the concept or logic behind the routine can be emphasized, thus cementing the ‘reasons’ for the mechanics of that particular technique. The department should plan to assess this aspect of teaching and learning more carefully and perhaps add interventions that may help students grasp the concepts in addition to solving the problems routinely.

c. Professor Hooper keenly recognized that students in Math 32300 had shown weakness in material that should have been solidified in prior math courses, in this case, Math 30800. His solution to the problem in the next offering is ‘I will provide early emphasis on proof techniques. This material should (probably) have been learned in Math 308, but students showed weakness in applying most proof techniques. This wasn’t apparent until after the first midterm. Otherwise the course is very well organized. The students find the material difficult, because it is the first time they are exposed to difficult proofs.’

d. To better understand the depth of student learning it would be beneficial to track students from math 190-195 through the calculus series and even linear algebra and differential equations (for engineering students). Since a proposition such as this is not part of the math 5-yr assessment plan we would have to initiate a supplemental tracking study and consider the causes for findings, such as significant drop offs (withdrawals and failures). Can we identify weaknesses in acquired ‘fundamentals that support the higher level math’? If so, can we design an intervention(s) that can help fix the problem(s).

e. The math department has long been aware of the problems with pass rate in gateway courses and the resultant impact on speedy graduation. There are multiple efforts underway to address these concerns. For now, this list covers these efforts. Further elaboration will be submitted upon receipt of reports from the math department

- Hybrid courses created by Andrea Marchese in Calc 1
- Online homework in Calc 1 using Maple TA
9. Course and Teacher Surveys (C&T)

The Course and teacher survey is an instrument that the college administers and the departments use for faculty reappointment and tenure decisions. Historically, the survey has been administered online via email, pre Spring 2011. Unfortunately, the results have mostly been statistically invalid since response rates tend to be much less than the necessary 50% to insure validity. In fact, response rates in between 6-15% are common for the DoS.

Fall 2010

Fall 2010 web based C&T surveys failed so there is no data to report.

Spring 2011

In Spring 2011, the college moved back to paper administering of the C&T survey. The results came back last month. The following, figure 1, contains information that pertains to the courses under examination for this reporting cycle.

![Course and Teacher Survey results SP11](image)
Course and teacher survey (C&T) for Sp11 courses under evaluation. Note: There were no C&T administered for Fall 2010. Questions best pertaining to student learning were selected and plotted by course section. All unlabeled courses were taught by adjuncts.

Course and Teacher Survey Data provides a quantitative, indirect means of assessing student learning. To make the case, we examine the questions that most closely pertain to course learning outcomes. The most relevant questions are:

- The instructor presented the material clearly.
- The instructor presented the course expectations clearly.
- I received useful feedback on assignments.
- The assignments helped me learn the course material.
- I was kept informed of how well I was doing.
- The instructor fairly evaluated my knowledge of the course material.

Student response means are plotted in Figure 1 for 10 sections of Math 19500 and each single section of Math 32300 and 34700. All courses are adjunct taught unless identified ‘FTF’ or full-time faculty. Of the 12 sections, 8 are adjunct taught. There is no apparent correlation between average scores and FTF –v- adjunct in Math 19500, the only course that has both types of instructors. However, both upper level courses, which are taught by FTF, have the highest student satisfaction.

Figure 2, mean satisfaction derived from the 6 questions most closely pertaining to student learning, shows a decent correlation between the expected grades of A+B (in percent) –v- student learning satisfaction. Though we can’t totally rule out the impact of well executed learning outcomes, this result points to the concept that satisfaction can be closely tied to expectations of positive outcomes, i.e. good grades especially when considering indirect evidence.
Figure 2: Mean ‘learning satisfaction’ plotted against expected grade %A+B showing a decent positive correlation.

10. Using results C&T

C&T results are used in reappointment and tenure cases. Faculty also receive their results and use the information to improve their teaching.
Courses in the Department of Mathematics are unique in that many of the lower level courses serve the Division of Science and are also critical to the Grove School of Engineering as service courses. Math 150 serves BA and BFA recipients; Math 190, 195 201, 202, 203, 205, 209, 391, 392 comprise the ‘calculus series’ and are geared for Engineering and Science majors. Upper level courses, 300 or higher are dedicated to the math majors except for those few courses permitted as electives in some engineering disciplines. Introductory level math courses at least through math 201 and 205 serve in some degree as a filtering mechanism, weeding out science and engineering students who are not able to master the requisite mathematics for their desired disciplines. As a result, there are a significant number of "low-achieving" learning outcomes and the pass rate is low and drop rate high. As outlined in prior assessment reports (see F07), there are several explanations for these poor scores ranging from ill preparation of transfer students to improper time allotment for studying during final exam period. The college is currently amending its admission criteria by requiring a higher math average. This should result in an improvement in student success in early math courses. For assessment purposes and to attempt to further improve student success the following assessment schedule is proposed (table 1).

### Schedule for Direct and Indirect Assessment of Mathematics Courses

Math 150, 190, 195, 201 will be assessed twice in every 5-year cycle.
Math 150, 190, 195, 201 will also have indirect assessment done in both the indicated semester and the preceding semester.

<table>
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<tr>
<th>Fall 08</th>
<th>Spring 09</th>
<th>Fall 09</th>
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Table 1. Math course direct and indirect assessment schedule
Lower level, introductory courses that provide student access to the calculus series and calculus 1 (math 201) will be examined twice in every 5 year cycle by direct measures. Indirect assessment will be measured 4 times in every 5 year cycle. Upper level courses will be evaluated once per 5 year cycle as indicated in table 1.

Indirect assessment

The mathematics department is currently revising the end of course surveys for all math courses. The goal is to phrase the learning outcomes in a more understandable language and to critically evaluate supplemental teaching methods that are being utilized such as online homework, mathzone and other efforts that have not thus far been coordinated.

Direct Assessment

As for the other Science Division departments, the math department is exploring the use of excel gradebooks for direct assessment. As the departmental coordinators learn more about this method, protocols will be developed. Faculty are exploring the use of upper division focus groups to evaluate the successes of the lower division courses in terms of their learning outcomes. The department feels that these students are better equipped to evaluate the learning outcomes of lower level courses once they have maneuvered through the math program.
Self study assessment report for the Department of Physics Spring 2009 Semester

Background

The Physics Department developed a five-year plan for assessing the outcomes of teaching and learning. The individual academic years of the five year period focuses on a different aspect of the teaching mission of department. The five periods are:

I fall 2008 and spring 2009;
II fall 2009 and spring 2010;
III fall 2010 and spring 2011;
IV fall 2011 and spring 2012;
V fall 2012 and spring 2013.

In these periods the assessments are being performed on the following types of courses:

I Core Physics courses;
II Lower-divisional Physics courses;
III Upper-divisional Physics courses;
IV Masters-level and doctoral-level courses;
V Service courses.

In addition, whenever a major change in a course is made or a new course is introduced that course is to be assessed that semester. This will permit the department to monitor the effectiveness of the major change or establish a baseline for the performance of a new course. Since City College is now a doctoral degree granting institution the doctoral-level courses will also be assessed.

The courses included in the above categories are:

I Core courses:
   Phys 203, 204, 207, 208 (+ new courses 321, 323 and 454)
II Lower-divisional courses:
   Phys 315, 351, 353, 354, 371
III Upper-divisional courses:
   Phys 422, 451, 452, 453, 454, 471, 551, 552, 554, 556
IV Masters’ courses:
   Phys V01, V11, 715, V25/725, V26/726, V38/738, V41/741,
   V71/771, V72/772
V Service courses:
   Astr 205; Phys 219, 321, 323; Sci 101

Assessment of outcomes

The assessment of courses for the spring 2009 semester narrowed the focus of study to the following courses: Physics 20300 and 20400; 20700 and 20800; 32100 and 32300; and 45400. The rationale for the choice of these courses is that Physics 20700 and 20800 are key courses that are both entry ports for the physics majors and service courses for the School of Engineering as well as core courses for some of the other Science majors. In addition, a number of changes have been recently instituted for these courses and therefore it is important to monitor the effectiveness of these changes. Physics 20300 and 20400 are courses with sizable enrollments and are service courses for the life science students. Physics 32100 and 32300 are service courses for the School of
Engineering and have been instituted recently as required courses for their students and therefore should be monitored for some period of time. Finally, Physics 45400 is a new course for the upper-divisional physics majors and is therefore of particular importance for the Physics program.

Three assessment tools were utilized in this study: an end-of-course-survey filled out by the students, a course assessment matrix filled out by the faculty, and the grade distribution for the courses. Comments were solicited both from the faculty and the students. Both the students and the faculty were asked to assess the various course outcomes listed on the general syllabus.

The student survey was administered by the Dean’s office. Students filled out the survey. The result was that the number of students fell short of the ideal goal of a 100% response rate. Nevertheless, the data provides a good sampling of the students’ feelings about the courses.

The report is organized sequentially by course number, with the results for the three assessment tools given for each course.
Physics 20300

Three sections of Phys 20300 lecture were taught by Dr. Bidyut Das (D2), Prof. Ngee-Pong Chang (EE) and Dr. Taposh Gayen (GH).

Student assessment:
The spring 2009 assessment is given in square parentheses […] and the fall 2008 assessment is presented in rounded parentheses (…), for comparison’s sake. The students rated the course objectives on a scale from 1 to 4: (4 = a lot, 3 = some, 2 = very little, 1 = not at all). The list of questions and the statistics (mean, standard deviation, median, maximum, minimum, and number of respondents) are presented after each question.

1. Has this course increased your ability to apply kinematics to problems in one and two dimensional motion?
   [3.3, 0.8, 3, 4, 1, 22] (3.1, 0.9, 3, 4, 1, 58). (slight increase in mean)
2. Has this course increased your understanding and use of the concepts of forces and Newton’s Laws of Motion?
   [3.3, 0.7, 3, 4, 1, 22] (3.2, 0.8, 3, 4, 1, 58). (slight increase in mean)
3. Has this course increased your understanding of the dynamics of uniform circular motion?
   [3.0, 0.8, 3, 4, 1, 22] (3.0, 0.9, 3, 4, 1, 58). (no change in mean)
4. Has this course increased your understanding and use of the concepts of work and energy?
   [3.2, 0.7, 3, 4, 1, 22] (3.2, 0.8, 3, 4, 1, 58). (no change in mean)
5. Has this course increased your understanding and use of the concepts of impulse and momentum?
   [3.2, 0.8, 3, 4, 1, 21] (2.9, 0.8, 3, 4, 1, 58). (slight increase in mean)
6. Has this course increased your understanding of rotational kinematics and dynamics?
   [3.1, 0.8, 3, 4, 1, 22] (2.9, 0.9, 3, 4, 1, 58). (slight increase in mean)
7. Has this course increased your understanding of simple harmonic motion?
   [2.9, 0.9, 3, 4, 1, 22] (3.0, 0.9, 3, 4, 1, 58). (slight decrease in mean)
8. Has this course increased your understanding of the properties of fluids?
   [3.0, 0.9, 3, 4, 1, 22] (2.9, 1.0, 3, 4, 1, 58). (slight increase in mean)
9. Has this course increased your understanding of the properties of temperature, heat, the ideal gas law, kinetic theory and thermodynamics?
   [3.1, 0.7, 3, 4, 2, 21] (2.9, 0.9, 3, 4, 1, 58). (slight increase in mean)

How useful were the pre- and co-requisites in preparing you for Physics 20300? (Elementary algebra and trigonometry)
[3.0, 1.0, 3, 4, 1, 20] (2.5, 1.5, 3, 4, 0, 58). (increase in mean)
How useful were the textbook and lab manual (online)?
[3.3, 0.7, 3, 4, 2, 21] (2.9, 1.0, 3, 4, 0, 58) (increase in mean)
How useful was the drop-in tutoring this semester?
[2.2, 1.0, 2, 4, 0, 18] (1.9, 0.7, 2, 4, 1, 58) (slight increase in mean)
Was sufficient time devoted to in-class problem-solving in this course?

It is interesting that in most cases the results for the fall 2008 and spring 2009 semesters were the same. From the above answers it is clear that, on average, the students felt that they had **some increased understanding** of all the topics listed in the course objectives.

The prerequisites were rated on the scale: (4 = very useful, 3 = fairly useful, 2 = a little useful and 1 = not at all useful). The results were: [3.0, 1.0, 3, 4, 1, 20]. The students, on average, found them to be **fairly useful**.

Using the same scale, the results for the textbook and lab manual were: [3.3, 0.7, 3, 4, 2, 21]. The textbook and lab manual were found to be, on average, **fairly useful**.

The in-class problem solving was rated: [2.2, 0.9, 2, 3, 1, 21]. It was found to be **just enough**.

Using the same scale, the drop-in tutoring was found to be [2.2, 0.9, 2, 3, 1, 21]. It was, on average, **fairly useful**. Out of the 18 responding students 7 used it once a week. The rest didn’t avail themselves of this resource. Obviously, there was very little overall use of the drop-in-tutoring facility.

The in-class problem solving was rated on the scale: (3 = more than enough, 2 = just enough, and 1 = less than enough). The students felt, on average, that there was **just enough** in class problem solving.

**Student comments:**

*Student comments were edited to remove ad-hominem remarks.*

1. Not enough tutors. Hard to tell who was a tutor. Concepts appealed to everyday life. I enjoyed the content of the course. I suggest less time in class working out problem (nearly 100% time problem solving) and more time explaining the concepts and the ideas.

2. Lecture time should be expanded in order for explanation on the concepts of each chapter instead of just solving problems since textbook can sometimes be overbearing to read and learn from. Professor was open to hear from students on how to improve teaching performance.

3. There should be a physics workshop like the chemistry workshop. They are very helpful and I suggest that the workshops should be at least 2 hours per week for solving problems only. They can be led by a student who got an A in the class previously. Workshops can only help.

**Faculty assessment:**

The faculty members were asked to rate the average student performance on each course objective. The possible ratings were: (excellent, very good, good, fair, poor). This rating was based on the student performance on the examinations. The responses from the three faculty members who taught the course (Sections BB, DD, ST) are given next to each objective. Again, the spring 2009 assessment is given in square parentheses […] and the fall 2008 assessment is presented in rounded parentheses (…), for comparison’s sake.
After successfully completing this course, students should be able to

1. apply kinematics to problems in one and two dimensional motion
   [good, good, good] (very good, good, fair). (no change, on average)

2. understand and use the concepts of forces and Newton’s Laws of Motion
   [poor, poor, good] (good, fair, fair). (significant improvement)

3. understand the dynamics of uniform circular motion
   [fair, fair, good] (good, poor, fair). (slight improvement)

4. understand and use the concepts of work and energy
   [excellent, fair, fair] (good, good, fair). (no change, on average)

5. understand and use the concepts of impulse and momentum
   [good, poor, fair] (good, very good, fair). (decline)

6. understand rotational kinematics and dynamics
   [poor, fair, fair] (good, poor, fair). (no change, on average)

7. understand the fundamentals of simple harmonic motion
   [fair, very good, good] (good, good, fair). (slight improvement)

8. understand the properties of fluids
   [good, good, good] (good, fair, fair). (slight improvement)

9. understand the properties of temperature, heat, the ideal gas law, kinetic theory, and
    thermodynamics
   [fair, good, very good] (good, very good, fair). (no change on average)

The strongest performances for the spring 2009 semester were for objectives 1, 4, 7, 8, and 9, and the weakest performance was for objectives 5 and 6.

**Faculty comments:**
The only comments from the faculty were that the students were very reluctant to do online homework.

**Grade distribution:**
The distribution of grades for the course is presented in Table I. The mean grades for the three sections were C, C, and C+, respectively. The mean grade for the course as a whole was C, the same as for the fall 2008 semester. Of all the students who originally enrolled in the course 71% completed the course with a grade of C or better. The corresponding completion rates for the three respective sections were 71%, 35% and 53%.
Physics 20400

Two sections of Physics 20400 were taught by Prof. Hernan Makse (DD) and Dr. Taposh Gayen (ST).

**Student Assessment:**

The spring 2009 assessment is given in square parentheses […] and the fall 2008 assessment is presented in rounded parentheses (…), for comparison’s sake. The students rated the course objectives on a scale from 1 to 4: (4 = a lot, 3 = some, 2 = very little, 1 = not at all). The list of questions and the statistics (mean, standard deviation, median, maximum, minimum, and number of respondents) are presented after each question.

1. Has this course increased your understanding of the fundamentals of wave motion and sound?
   
   
   
   
   [3.3, 0.7, 3, 4, 1, 113] (2.8, 0.7, 3, 4, 2, 9).  (significant improvement)

2. Has this course increased your understanding and ability to apply the principle of linear superpositions to interference phenomena?
   
   
   
   
   [3.1, 0.9, 3, 4, 1, 113] (2.6, 0.9, 3, 4, 1, 9).  (significant improvement)

3. Has this course increased your understanding of the concepts of electric fields, electric forces and electric potential?
   
   
   
   
   [3.3, 0.8, 3, 4, 1, 113] (3.1, 0.8, 3, 4, 2, 9)  (slight improvement)

4. Has this course increased your understanding and ability to analyze electric circuits, including alternating current circuits?
   
   
   
   
   [3.3, 0.8, 3, 4, 1, 113] (3.1, 0.8, 3, 4, 2, 9)  (slight improvement)

5. Has this course increased your understanding of the concepts of magnetic forces and magnetic fields?
   
   
   
   
   [3.3, 0.8, 3, 4, 1, 113] (3.2, 0.7, 3, 4, 2, 9).  (slight improvement)

6. Has this course increased your understanding of the concept of electromagnetic induction?
   
   
   
   
   [3.2, 0.8, 3, 4, 1, 113] (2.6, 1.1, 3, 4, 1, 9).  (significant improvement)

7. Has this course increased your understanding of the concept of and phenomena associated with electromagnetic waves?
   
   
   
   
   [3.1, 0.8, 3, 4, 1, 111] (2.9, 0.9, 3, 4, 1, 9).  (slight improvement)

8. Has this course increased your understanding of the concepts of reflection and refraction of light, interference and the wave nature of light?
   
   
   
   
   [3.2, 0.8, 3, 4, 1, 111] (3.0, 1.1, 3, 4, 1, 9).  (slight improvement)

9. Has this course increased your understanding of the concepts associated with the theory of special relativity?
   
   
   
   
   [3.1, 0.9, 3, 4, 1, 111] (3.0, 0.7, 3, 4, 2, 9).  (slight improvement)

10. Has this course increased your understanding of the basic properties and phenomena associated with the atom, nuclei, radioactivity, nuclear energy, and elementary particles?
   
   
   
   
   [3.0, 0.9, 3, 4, 1, 113] (2.8, 0.7, 3, 4, 2, 9).  (slight improvement)

How useful were the pre- and co-requisites in preparing you for Physics 20400? (Elementary algebra and trigonometry)
Was sufficient time devoted to in-class problem solving this semester?

How useful were the textbook and lab manual (online)?

How useful was the drop-in tutoring this semester?

How useful was online homework?

From the above answers it is clear that, on average, the students felt that they had some increased understanding of all the topics listed in the course objectives. The strongest objectives were number 1, 3, 4 and 5. The prerequisites were on average, found to be somewhat useful. Not enough time was devoted to in-class problem solving. The textbook was found to be, on average, somewhat useful. Using the same scale, the drop-in tutoring was found, on average, to be useful. This represents a significant improvement over the fall 2008 semester where it was not found to be useful. The online homework, which was used for the first time for Phys 20400 was found to be of little use.

Student Comments:

Student comments were edited to remove ad-hominem remarks.

1. Needs more time to in class problem solving.
2. We need more in class problem solving.
3. The physics department in itself is total trash. If it was up to me I would totally reconstruct the system.
4. Too many quizzes at the end of the semester.
5. Physics is hard and this packs a lot. Class was interesting and it was great when we went into the more enigmatic questions of physics, relativity and quantum mechanics.
6. Difficult class, more time needs to be spent on the last 5 chapters than on the first 3. overall very informative.
7. Great.
8. I thought the material was at the proper level and difficulty for students in this class.
9. I wish the test answers posted was a bit easier to read.
10. Lab manual-bad.
11. Liked grading as he graded fairly based on method of getting answer.
12. Thank you for a great class.
13. Too crowded in tutoring room?
14. Very hard. Barely followed a structure and the textbook sot the tests were very difficult.

Faculty Assessment of Physics 20400

The responses to the faculty assessment questions were as follows:

After successfully completing this course, students should be able to:

1. understand the fundamentals of wave motion and sound
2. understand and apply the principle of linear superposition to interference phenomena
   [excellent, very good]  (good)  (significant improvement)
3. understand the concepts of electric fields, electric forces and electric potential
   [good, good]  (good)  (no change)
4. understand and be able to analyze electric circuits, including alternating current circuits
   [good, fair]  (fair)  (slight improvement)
5. understand the concepts of magnetic forces and magnetic fields
   [excellent, good]  (very good)  (no change on average)
6. understand the concept of electromagnetic induction
   [very good, good]  (very good)  (slight decline)
7. understand the concept of and phenomena associated with electromagnetic waves
   [very good, good]  (good)  (slight improvement)
8. understand the concepts of reflection and refraction of light, interference and the wave
   nature of light
   [excellent, very good]  (very good)  (slight improvement)
9. understand the concepts associated with the theory of special relativity
   [very good, good]  (very good)  (slight decline)
10. understand the basic properties and phenomena associated with the atom, nuclei,
    radioactivity, nuclear energy, and elementary particles
    [not given, good]  (not given)
Outcomes 1 and 2 underwent significant improvement. The other outcomes did not
change significantly. The strongest objectives were 1, 2, and 8. The weakest objectives
were 3, 4 and 10.

Faculty comments:
1. I have yet to find the ways that the students do their homework at home, rather
   than relying upon the instructors for solutions.
2. If I could use a laptop and show them a lot of physical phenomena (wave motion,
   electromagnetic induction, interference, etc.) which are available on the internet it would
   have helped them to visualize those physical phenomena.
3. I feel that students have to digest too much material in a very short span of time,
   which really does not help students to reflect on a subject deeply.

Grade distribution
The grade distribution for Phys. 20400 is presented in Table I. The mean grade
for the two sections were B+ and C+, respectively. The overall mean grade for the
course was B, an improvement over the B- for the fall 2008 semester. Of all the students
who originally enrolled in the course 87% completed the course with a grade of C or
better. The corresponding completion rates for the two respective sections were 95% and
73%.
Four sections of Physics 20700 were taught by Prof. Hal Falk (BB), Prof. Jiufeng Tu (LL) and Prof. Frederick Smith (MM) and Dr. Zinoviy Akkerman (ST). Section LL was a special honors section of the course.

Student Assessment

The spring 2009 assessment is given in square parentheses [...] and the fall 2008 assessment is presented in rounded parentheses (...), for comparison’s sake. The students rated the course objectives on a scale from 1 to 4: (4 = a lot, 3 = some, 2 = very little, 1 = not at all). The list of questions and the statistics (mean, standard deviation, median, maximum, minimum, and number of respondents) are presented after each question.

1. Has this course increased your understanding of, and ability to recognize and use SI units, and your ability to use vectors and their components?
   \[ \text{[3.4, 0.7, 3, 4, 1, 132]} \quad \text{[3.3, 0.8, 3, 4, 1, 130]} \quad \text{(slight improvement)} \]

2. Has this course increased your understanding of the relationships between position, velocity, acceleration and time in the motion of physical objects?
   \[ \text{[3.5, 0.6, 4, 4, 1]} \quad \text{[3.4, 0.8, 4, 4, 1, 130]} \quad \text{(slight improvement)} \]

3. Has this course increased your understanding of the concepts of force and equilibrium and their relation to Newton’s laws of motion?
   \[ \text{[3.5, 0.6, 4, 4, 2]} \quad \text{[3.3, 0.8, 3, 4, 1, 130]} \quad \text{(slight improvement)} \]

4. Has this course increased your understanding and use of the concepts of work and energy, including kinetic and potential energy, and your understanding and ability to use the principle of conservation of energy?
   \[ \text{[3.5, 0.7, 4, 4, 1, 131]} \quad \text{[3.2, 0.8, 3, 4, 1, 129]} \quad \text{(slight improvement)} \]

5. Has this course increased your understanding and use of the concepts of momentum and impulse, and your understanding and ability to use the principle of conservation of momentum?
   \[ \text{[3.3, 0.8, 3, 4, 1, 132]} \quad \text{[3.2, 0.8, 3, 4, 1, 128]} \quad \text{(slight improvement)} \]

6. Has this course increased your ability to describe the rotation of physical objects, and your understanding of the concept of torque as applied to the equilibrium of objects?
   \[ \text{[3.1, 0.8, 3, 4, 1]} \quad \text{[3.0, 0.8, 3, 4, 1, 127]} \quad \text{(slight improvement)} \]

7. Has this course increased your understanding of gravitational interactions and their relationship to satellite motion and Kepler’s laws?
   \[ \text{[3.2, 0.8, 3, 4, 1, 131]} \quad \text{[2.9, 0.9, 3, 4, 0, 129]} \quad \text{(slight improvement)} \]

8. Has this course increased your understanding of the phenomenon of simple harmonic motion?
   \[ \text{[3.1, 0.9, 3, 4, 1, 131]} \quad \text{[2.9, 0.9, 3, 4, 0, 129]} \quad \text{(slight improvement)} \]

9. Has this course increased your understanding and use of the basic principles of fluid mechanics as applied to buoyancy and fluid flow?
   \[ \text{[3.3, 0.7, 3, 4, 1, 130]} \quad \text{[2.9, 0.9, 3, 4, 0, 128]} \quad \text{(significant improvement)} \]

10. Has this course increased your understanding of the properties of temperature and heat?
    \[ \text{[3.4, 0.7, 3, 4, 1, 131]} \quad \text{[3.0, 1.0, 3, 4, 0, 128]} \quad \text{(significant improvement)} \]
11. Has this course increased your understanding and use of the first and second laws of thermodynamics involving work, heat and internal energy?

   \[ [3.3, 0.8, 3, 4, 1, 131] \quad (2.9, 0.9, 3, 4, 0, 119) \text{ (significant improvement)} \]

How useful were the pre- and co-requisites in preparing you for Physics 20700? Pre- or co-requisite: Math 20200

   \[ [2.7, 0.9, 3, 4, 1, 123] \quad (2.6, 1.0, 3, 4, 0, 112) \text{ (slight increase)} \]

How useful were the textbook and lab manual (online)?

   \[ [3.1, 0.9, 3, 4, 1, 121] \quad (2.8, 1.1, 3, 4, 0, 109) \text{ (slight increase)} \]

How useful was the drop-in tutoring this semester?

   \[ [2.4, 1.0, 2, 4, 1, 121] \quad (1.7, 1.5, 2, 4, 0, 109) \text{ (significant increase)} \]

Was sufficient time devoted to in-class problem-solving in this course?

   \[ [2.0, 0.7, 2, 4, 0, 120] \quad (1.8, 0.7, 2, 3, 1, 109) \text{ (slight increase)} \]

How useful was the online homework this semester?

   \[ [2.7, 1.0, 3, 4, 1, 35] \quad (1.5, 1.7, 0, 4, 0, 91) \text{ (significant increase)} \]

Looking at these ratings one sees that all the course objectives are being met and that the average student felt that he or she has some increased understanding of all the course objectives. The strongest objectives were 2, 3 and 4.

The prerequisites seem to be well matched to the course. The textbook and lab manual were also acceptable to the students. The drop-in tutoring was found somewhat useful, an improvement over the rating given in the fall 2008 semester. There was insufficient time devoted to in-class problem solving. The online homework was better rated by the students than in the fall semester.

**Student comments:**

*Student comments were edited to remove ad-hominem remarks.*

1. Add extra course materials, textbooks. Also perhaps a recitation to this course.
2. Good good.
3. I also wish that the professors be willing to do problems in class and make exams a bit easier.
4. It would have been useful to have in info sheet at the beginning of class w/all the trig and basics needed.
5. This course bears an ill reputation for a reason. Homework and lectures do not lead to increased mastery of the material.
6. Fair enough class in unerstanding physics, but students need to learn, it is up to them to understand the materials.
7. Need to visualize problem solving on blackboard, not powerpoint.
8. Tests were too tough, web assignment complicated and unnecessary.
9. Too advanced for students who never took physics before.
10. Would be better if a prof. Work out problems in class and walk us through each step, but it is sad when we just copy, it was very difficult.
11. Would be very helpful if more in class problem solving is done, also solution for web assign will be helpful.
12. Class should be longer/more problems for HW and class.
13. Final exam is too much.
14. Great class, the experiments were amazing at explaining the theory. Great class.
10/10.
15. It is a hard course.
16. It was a great class. Very detailed in his lectures and explanations.
17. Lab manual was not useful. Lab isn't really helpful to understand the materials lab manual isn't really explain the experiments very well.
18. Loved the course. Learned so much material about the natural world that I see as a large foundation to my future in civil engineering.
19. More problems in class. Have just the practice exams constantly, every week just for practice, not graded.
20. Explains each lecture in a way that you are able to understand.
21. Reviews concepts very well and his tests are fair and balanced.
22. Reviews for exams should be similar to the real exams. Good class good demonstrations.
23. The lab part does not help with the course understanding and class work should be divided because it is a lot of stuff.
24. Learned a lot overall and I just wish the pace of class could be better.
25. More in class problem solving, drop-in tutoring not helpful.
26. Think class would be more productive if there were more problem solving done in class.

Faculty Assessment of Physics 20700
After successfully completing this course, students should be able to:

1. recognize and use SI units and be able to use vectors and their components.
   [poor, good, fair, vacant]  (good, good, vacant, fair)  (slight decline)
2. understand the relationships between position, velocity, acceleration and time in the motion of physical objects
   [fair, fair, fair, vacant]  (fair, good, vacant, fair)  (slight decline)
3. understand the concepts of force and equilibrium and their relation to Newton’s laws of motion.
   [poor, good, fair, vacant]  (fair, good, vacant, good)  (decline)
4. understand and use the concepts of work and energy, including kinetic and potential energy; understand and be able to use the principle of conservation of energy.
   [poor, fair, poor, vacant]  (fair, good, vacant, good)  (decline)
5. understand and use the concepts of momentum and impulse; understand and be able to use the principle of conservation of momentum.
   [very poor, good, poor, vacant] (poor, good, vacant, good)  (decline)
6. understand how to describe the rotation of physical objects; understand the concept of torque as applied to the equilibrium of objects.
   [very poor, fair, poor, vacant] (poor, poor, vacant, very good)  (decline)
7. understand gravitational interactions and their relationship to satellite motion and Kepler’s laws.
   [fair, fair, fair, vacant]  (poor, good, vacant, very good)  (decline)
8. understand the phenomenon of simple harmonic motion.
   [very poor, fair, fair, vacant] (poor, good, vacant, very good)  (decline)
9. understand and use the basic principles of fluid mechanics as applied to buoyancy and fluid flow.
   [fair, fair, fair, vacant] (poor, poor, vacant, very good) (no change)
10. understand the properties of temperature and heat.
    [fair, good, poor, vacant] (fair, fair, vacant, very good) (decline)
11. understand and use the first and second laws of thermodynamics involving work, heat and internal energy.
    [very poor, good, poor, vacant] (poor, good, vacant, not covered) (decline)

On average, even the strongest objectives (1, 2, 3, 7, 9, and 10) are rated only as fair. The weakest objective (6) scores very poorly and the others (4, 5, 8, and 11) score in the less than poor range.

Faculty comments:
1. Prof. Smith commented that a well-structured physics course in high school should be available and required for any student considering a major in science or engineering in college. Online homework was optional. Hardly any students attempted to use it. He did assign, collected, and graded about ten homework assignments.
2. Dr. Akkerman commented that this semester the students’ level is lower than it was previously. Since he has been teaching for several years he has established reference points. He has a strong feeling that the students come completely unprepared for calculus-based physics and, for that matter, algebra-based physics. Most are unable to take a simple derivative, let alone doing integration. Solving a system of a pair of algebraic equation proves to be an obstacle that most can’t overcome. Apparently, their expectations are that a physics course provides them with a number of formulas and solving problems means plugging in numbers. If a problem uses the symbol T for the period of an oscillator they interpret T as the temperature, etc. He suspects that they are getting a free ride in their math courses. He didn’t make use of online homework.
3. It has been suggested that there should be a uniform final exam for the course. It has also been suggested that there should be a course coordinator for each of multi-section courses.

Grade distribution:
The grade distribution for Phys. 20700 is presented in Table I. The mean grade for the four sections were C-, B-, C-, and C-/D+, respectively. The overall mean grade for the course was C-, a significant decline from the grade of C for the fall 2008 semester. Of all the students who originally enrolled in the course only 41% completed the course with a grade of C or better. The corresponding completion rates for the four respective sections varied widely and were 25%, 63%, 45%, and 45%, respectively. This wide disparity warrants further study and, perhaps, remedial steps to homogenize the completion rates.
Physics 20800

There were four lecture sections of Physics 20800 taught by Prof. Hernan Makse (CC), Prof. Matthias Lenzner (GH), Prof. Carlos Meriles (LL) and Prof. Harold Falk (PP). Section LL was a special honors section.

Student Assessment:

There was no student assessment done for Physics 208 for the fall 2008 semester, so only the results for the spring 2009 semester are recorded below. The students rated the course objectives on a scale from 1 to 4: (4 = a lot, 3 = some, 2 = very little, 1 = not at all). The list of questions and the statistics (mean, standard deviation, median, maximum, minimum, and number of respondents) are presented after each question.

1. Has this course increased your understanding of the properties of mechanical waves, including longitudinal and transverse waves, standing waves and normal modes? (1 = not at all, 2 = very little, 3 = some, 4 = a lot)
   
   [3.5, 0.6, 4, 4, 2, 105]

2. Has this course increased your understanding of the properties of sound waves, including the fall-off of intensity for a point source, the decibel scale, the resonant frequencies of stretched strings and waves in pipes, and the Doppler effect?
   
   [3.4, 0.6, 3, 4, 2, 105]

3. Has this course increased your understanding of the properties of plane and spherical mirrors and thin lenses and the ability to locate the images they produce?
   
   [3.6, 0.6, 4, 4, 1, 105]

4. Has this course increased your understanding of single- and double-slit diffraction and ability to calculate the positions of minima and maxima on a distant screen?
   
   [3.3, 0.7, 3, 4, 1, 103]

5. Has this course increased your ability to calculate the electric fields and forces as well as electric potentials and potential energies associated with simple point-charge configurations or charge configurations with planar, cylindrical, or spherical?
   
   [3.6, 0.6, 4, 4, 2, 105]

6. Has this course increased your ability to calculate the capacitance and stored energy for simple conductor arrangements?
   
   [3.4, 0.6, 3, 4, 2, 102]

7. Has this course increased your ability to solve simple direct-current circuits by combining series and parallel resistors and by using Kirchoff’s laws, and your ability to calculate the behavior of simple R-C, L-R, and L-C circuits?
   
   [3.5, 0.7, 4, 4, 1, 105]

8. Has this course increased your ability to calculate the magnetic force on a point charge moving in a magnetic field?
   
   [3.5, 0.6, 4, 4, 2, 105]

9. Has this course increased your ability to calculate the magnetic fields associated with simple current-carrying configurations?
   
   [3.4, 0.7, 4, 4, 1, 103]
10. Has this course increased your ability to calculate the induced emf due to changing magnetic fields and motion of a wire through a magnetic field and ability to apply Lenz’s law to determine the direction of induced current flow?
   [3.2, 0.9, 3, 4, 1, 105]

11. Has this course increased your ability to calculate mutual and self-inductances for simple coil configurations?
   [2.9, 1.0, 3, 4, 1, 103]

12. Has this course increased your ability to calculate the voltages, currents, phases, and powers associated with an R-L-C series AC circuit?
   [3.0, 0.9, 3, 4, 1, 105]

How useful were the prerequisite PHYS 20700 in preparing you for Physics 20800
   [3.0, 0.9, 3, 4, 1, 80]

How useful was the co-requisite MATH 20300 in preparing you for Physics 20800?
   [3.0, 0.8, 3, 4, 1, 80]

How useful were the textbook and study materials
   [3.1, 0.8, 3, 4, 0, 78]

How useful was the drop-in tutoring this semester
   [1.6, 1.2, 1, 4, 0, 79]

How often did you use the drop-in tutoring?
   [0.6, 0.9, 0, 3, 0, 17] times

How useful was the online homework this semester
   [1.9, 1.5, 2, 4, 0, 69]

Was sufficient time devoted to in-class problem-solving in this course?
   (3 = More than enough time, 2 =Just enough, 1 = Not enough time).
   [2.0, 0.7, 2, 3, 0, 77] (just enough).

Overall, the students felt that they learned the material somewhat. The strongest objectives were 3 and 5. The weakest objective is 11.

**Student comments:**
*Student comments were edited to remove ad-hominem remarks.*

1. Too much material covered; not enough concentration on key concepts. Hence I would have preferred quality as opposed to quantity
2. Co-req should be math 39200.
3. The lectures were always behind the schedule. The prof did not cover everything that was listed on the syllabus.
4. Please incorporate more problem solving for the class. We didn't see any TA so we did no problem solving. We did not cover all of the material; we stopped at chapter 31. Consider shortening the amount of chapters to cover.
5. Should contain modern physics--general relativity and quantum mechanics as part of the curriculum.
6. Shouldn't be required for CE majors since electrical circuits course is also required and it covers the same topics which by the way don't have anything to do with CE.
7. Caring instructor but he has to learn to be a bit mean and more onto another topic even if a few students are confused. By catering to the few students the majority is left out.
8. Should include a physics class other than lecture to help students more directly than a professor can during lecture.
9. Quite abstract but very interesting
10. I understand very well how to calculate the current using Kuckoff’s (sic) law.
11. It is a good class that should not be a mandate for CE majors. This course is definitely more oriented for EE majors. CE in my opinion would tend to focus on physics 207 more in dealing with stress and strain of materials.
12. My prof is a good teacher because he does not only explain is good enough but he makes me easy to understand math 392 he is awesome
13. I had a good time learning from the prof, also his ability to mix math and physics was essential to my overall performance.
14. I wish there was a workshop for physics. I really don't appreciate how much of 208 covers electricity.
15. My unsolicited opinion on educational practices: Outcome based learning is far inferior to process oriented learning. It is better to know how to think and what to think about than it is to know a certain body of facts. I feel strongly that the curriculum is too expansive. It is not possible for me to spend adequate time mastering any subject before we have moved to the next thing. I feel that as a result my understanding of everything in the course is shallow and I have merely memorized formulas instead of having learned any of the real physical science behind the formulas.

Faculty Assessment:
After successfully completing this course, students should be able to:
1. understand the properties of mechanical waves, including longitudinal and transverse waves, standing waves and normal modes
   [excellent, very good, fair] (very good, very good, fair) (slight improvement)
2. understand the properties of sound waves, including the fall-off of intensity for a point source, the decibel scale, the resonant frequencies of stretched strings and waves in pipes, and the Doppler effect
   [very good, not covered, fair] (poor, good, poor) (slight improvement)
3. understand the properties of plane and spherical mirrors and thin lenses and be able to locate the images they produce
   [fair, good/very good, fair] (poor, good, good) (no change)
4. understand single- and double-slit diffraction and be able to calculate the positions of minima and maxima on a distant screen
   [poor, very good, poor] (poor, fair, poor) (slight improvement)
5. calculate electric fields and forces as well as electric potentials and potential energies associated with simple point-charge configurations or charge configurations with planar, cylindrical, or spherical symmetry
   [good, good, poor] (poor, very good, good) (slight decline)
6. calculate the capacitance and stored energy for simple conductor arrangements.
   [very good, good, very poor] (poor, good, fair) (no change)
7. solve simple direct-current circuits by combining series and parallel resistors and by using Kirchoff’s laws and be able to calculate the behavior of simple R-C, L-R, and L-C circuits.
   [good, good/very good, good] (fair, fair, poor) (significant improvement)
8. calculate the magnetic force on a point charge moving in a magnetic field.
   [very good, good, poor] (fair, good, good) (no change)

9. calculate the magnetic fields associated with simple current-carrying configurations.
   [very good, fair/good, poor] (fair, fair, fair) (slight improvement)

10. calculate the induced emf due to changing magnetic fields and motion of a wire through a magnetic field and apply Lenz’s law to determine the direction of induced current flow.
    [very good, fair/good, fair] (fair, fair, poor) (significant improvement)

11. calculate mutual and self-inductances for simple coil configurations.
    [not tested, fair/good, not covered] (poor, not tested, poor) (improvement?)

12. calculate the voltages, currents, phases, and powers associated with an R-L-C series AC circuit
    [good, not covered, very poor] (poor, not tested, fair) (no change)

Pretty much across the board the faculty evaluation of students’ performance was in the fair to poor range. The strongest objectives were 1, 2, and 7, which were in the good range. The weakest objectives were 12, 4, 5, and 6, which were in the poor range.

**Faculty comments:**
There were no detailed faculty comments.

**Grade distribution**

The distribution of grades for the course is presented in Table I. The mean grades for the four sections were B, C, C and C-/D+, respectively. The mean grade for the course as a whole was C+/B-, a significant improvement over the grade of C for the fall 2008 semester. Of all the students who originally enrolled in the course 64% completed the course with a grade of C or better. The corresponding completion rates for the four respective sections were 89%, 49%, 57%, and 29%. This wide disparity warrants further study and remediation.
Physics 32100

One section of Physics 32100 (S) was offered and it was taught by Prof. Sarachik.

Student Assessment

The spring 2009 assessment is given in square parentheses […] and the fall 2008 assessment is presented in rounded parentheses (…), for comparison’s sake. The students rated the course objectives on a scale from 1 to 4: (4 = a lot, 3 = some, 2 = very little, 1 = not at all). The list of questions and the statistics (mean, standard deviation, median, maximum, minimum, and number of respondents) are presented after each question.

1. Has this course increased your understanding and ability to apply Einstein’s theory of special relativity to relativistic mechanics?
   
   [3.6, 0.5, 4, 3, 14]  (3.6, 0.5, 4, 4, 3, 27) (no change)

2. Has this course increased your understanding of the significance of the important experiments leading to our understanding of the nature of atoms and of light?
   
   [3.1, 0.7, 3, 4, 2, 14]  (3.5, 0.6, 4, 4, 2, 27) (significant decline)

3. Has this course increased your understanding of the Bohr model of the hydrogen atom and the quantization of atomic energy levels?
   
   [3.4, 0.5, 3, 4, 3, 14]  (3.7, 0.5, 4, 4, 3, 26) (slight decline)

4. Has this course increased your understanding of the elements of quantum mechanics: matter waves and wave functions, uncertainty relations, Schrodinger equation, etc.?
   
   [3.3, 0.8, 4, 4, 2, 14]  (3.6, 0.6, 4, 4, 2, 27) (slight decline)

5. Has this course increased your familiarity with important examples of quantized systems: quantum well, wire and dot, harmonic oscillator, hydrogen atom again, etc.
   
   [3.1, 0.8, 3, 4, 2, 14]  (3.2, 0.8, 3, 4, 1, 27) slight decline.

6. Has this course increased your understanding of the significance of the Pauli exclusion principle and the periodic table?
   
   [3.3, 0.5, 3, 4, 3, 14]  (3.6, 0.6, 4, 4, 2, 27) (slight decline)

7. Has this course increased your understanding of how quantum mechanics is applied in various fields: lasers, physics of solids, etc.?
   
   [3.1, 0.9, 3, 4, 2, 14]  (3.3, 0.7, 3, 4, 2, 27) (slight decline)

8. Has this course increased your understanding of the phenomena associated with the structure of nuclei and radioactivity?
   
   [3.1, 0.8, 3, 4, 2, 14]  (3.4, 0.8, 4, 4, 2, 27) (slight decline)

9. Has this course increased your understanding of the nature of the currently-known elementary particles?
   
   [3.4, 0.5, 3, 4, 3, 14]  (3.4, 0.7, 4, 4, 0, 24) (no change)

How useful were the pre- and co-requisites in preparing you for Physics 32100? Physics 20800?

   [2.8, 0.7, 3, 4, 2, 13]  (3.2, 0.9, 3, 4, 1, 24) (significant decline)

How useful were the pre- and co-requisites in preparing you for Physics 32100? Math 39100

   [2.6, 0.7, 3, 4, 2, 13]  (3.3, 0.8, 3, 4, 1, 24) (significant decline!)

How useful was the textbook?
The student assessment is good with particular strengths for objectives 1, 3, and 9. None of the objectives are deficient. The students appear satisfied with the prerequisites and the textbook, although there is some concern about Math 391.

**Student comments:**
*Student comments were edited to remove ad-hominem remarks.*

1. More examples could be provided to enhance better understanding of the concepts being taught.
2. Great professor. Thank you for caring about us students.

**Faculty Assessment of Physics 32100**

After successfully completing this course, students should be able to:

1. understand and apply Einstein’s theory of special relativity to relativistic mechanics.
   - [very good] (very good) (no change)
2. understand the significance of the important experiments leading to our understanding of the nature of atoms and of light.
   - [excellent] (good) (significant improvement)
3. understand the Bohr model of the hydrogen atom and the quantization of atomic energy levels.
   - [excellent] (very good) (improvement)
4. understand the elements of quantum mechanics: matter waves and wave functions, uncertainty relations, Schrodinger equation, etc.
   - [good] (very good) (decline)
5. be familiar with important examples of quantized systems: quantum well, wire and dot, harmonic oscillator, hydrogen atom again, etc.
   - [very good] (excellent) (decline)
6. understand the significance of the Pauli exclusion principle and the periodic table.
   - [very good] (excellent) (decline)
7. understand how quantum mechanics is applied in various fields: lasers, physics of solids, etc.
   - [not tested] (fair)
8. understand the phenomena associated with the structure of nuclei and radioactivity.
   - [excellent] (not tested)
9. understand the nature of the currently-known elementary particles.
   - [not tested] (not tested)

**Faculty comments:**
The professor did not cover applications of objective 7 or elementary particles, objective 9.

**Grade distribution:**
See Table I. The mean grade for the course was B, a slight improvement over the grade of B- for the fall 2008 semester. Of all the students who originally enrolled in the course 74% completed the course with a grade of C or better.
Physics 32300

Two sections of Physics 32300 were taught. Section G was taught by Prof. Swapan Gayen and Section M was taught by Prof. Alexios Polychronakos.

Student Assessment
The spring 2009 assessment is given in square parentheses [...] and the fall 2008 assessment is presented in rounded parentheses (…), for comparison's sake. The students rated the course objectives on a scale from 1 to 4: (4 = a lot, 3 = some, 2 = very little, 1 = not at all). The list of questions and the statistics (mean, standard deviation, median, maximum, minimum, and number of respondents) are presented after each question.

1. Has this course increased your understanding of the nature of quantum mechanical states?
   \[3.4, 0.5, 3, 4, 2, 35\] \(3.3, 0.9, 4, 4, 1, 13\) slight improvement.
2. Has this course increased your ability to solve 1-d barrier problems?
   \[3.2, 0.7, 3, 4, 1, 35\] \(3.5, 0.8, 4, 4, 2, 13\) slight decline.
3. Has this course increased your ability to use the creation/annihilation operator formalism?
   \[2.9, 1.0, 3, 4, 1, 35\] \(2.8, 0.8, 3, 4, 1, 13\) slight improvement.
4. Has this course increased your understanding of the spectrum of hydrogenic atoms?
   \[3.1, 0.8, 3, 4, 1, 35\] \(3.2, 0.9, 3, 4, 2, 13\) slight decline.
5. Has this course increased your understanding of the distinction between boson and fermions?
   \[2.9, 0.8, 3, 4, 1, 35\] \(2.8, 0.8, 3, 4, 2, 13\) slight improvement.
6. Has this course increased your ability to perform simple perturbation calculations?
   \[3.1, 0.8, 3, 4, 2, 35\] \(2.3, 0.9, 2, 4, 1, 13\) significant improvement.
7. Has this course increased your appreciation of the significance of Bell's theorem?
   \[2.8, 0.9, 3, 4, 1, 34\] \(1.7, 0.8, 2, 3, 1, 13\) significant improvement.

How useful were the pre- and co-requisites in preparing you for Physics 32300? PHYS 20700 and 20800
\[2.4, 1.0, 2, 4, 1, 33\] \(2.5, 0.8, 3, 4, 1, 11\) slight decline.

How useful was the textbook?
\[3.0, 1.0, 3, 4, 1, 32\] \(2.7, 1.1, 3, 4, 1, 10\) slight improvement.

Student comments:
Student comments were edited to remove ad-hominem remarks.
1. There is a need of a good background
2. This class is extremely difficult...very difficult however, the instructor makes it possible to understand.
3. This class was way above my head. It seems that we should concentrate only on the first half of class. That would be plenty and more interesting

Faculty Assessment:
After successfully completing this course, students should be able to:
1. Understand the nature of quantum mechanical states.
2. Solve one-dimensional barrier problems.
   [very good, fair]  (good)  no change

3. Use the creation/annihilation operator formalism.
   [fair, poor]  (poor)  slight improvement.

4. Understand the spectrum of hydrogenic atoms.
   [fair, good]  (fair)  slight improvement.

5. Understand the distinction between bosons and fermions.
   [good, good]  (good)  no change.

6. Perform simple perturbation calculations.
   [not tested, fair]  (not tested)

7. Appreciate the significance of Bell’s theorem.
   [very good, fair]  (good)  no change.

**Faculty comments:**

Prof. Gayen stated that: Material pertaining to objective 6 was not covered in one of the sections. In informal discussions he related that there is a need to revise the course objectives to more accurately describe what is covered in the course.

Prof. Polychronakos stated that: Students were clearly unprepared for the material, in both their mathematics and physics background. Students were returning (usually correct) homework weekly, but their performance in exams was completely inconsistent, evidencing widespread copying or using solution manuals for homework. Many engineering students left this course as one of the last courses they took before graduation, transferring pressure that “their lives would be destroyed if they did not pass/get a good grade” on the instructor. Evidence of cheating in the final exam was noticed, in spite of increased vigilance, in the form of completely nonsensical solutions that somehow magically materialized the correct answer at the end. A large class (38 students) crammed into one room with only the instructor as the proctor made this possible.

**Grade distribution:**

See Table I. The mean grade for the course was C+, a significant improvement over the C- grade for the fall 2008 semester. The performance in the two sections was essentially identical. 54% of the students originally enrolled in the course finished with a grade of C or better.
Physics 45400

One section of Physics 45400 (P) was taught by Prof. Daniel Greenberger. This was the first time that the course was offered so it warranted an out-of-sequence assessment of outcomes, according to the policies laid out in the departmental five-year plan.

Student Assessment

The spring 2009 assessment is given in square parentheses [...]. The students rated the course objectives on a scale from 1 to 4: (4 = a lot, 3 = some, 2 = very little, 1 = not at all). The list of questions and the statistics (mean, standard deviation, median, maximum, minimum, and number of respondents) are presented after each question.

1. Has the course increased your understanding of Newton’s laws and orbital mechanics?
   
   \[3.6, 0.9, 4, 4, 2, 9\] (a lot).

2. Has the course increased your ability to describe the formation of the solar system, the inner and outer planets?
   
   \[3.9, 0.3, 4, 4, 3, 9\] (a lot!)

3. Has the course increased your ability to explain atoms and quanta and define blackbody radiation?
   
   \[3.6, 0.5, 4, 4, 3, 9\] (a lot)

4. Has the course increased your ability to describe and distinguish between general and special relativity?
   
   \[3.3, 0.7, 3, 4, 2, 9\] (somewhat)

5. Has the course increased your ability to describe star types, star processes and the life and death of stars?
   
   \[3.7, 0.7, 4, 4, 2, 9\] (a lot)

6. Has the course increased your ability to describe supernovae and black holes?
   
   \[3.8, 0.4, 4, 4, 3, 9\] (a lot!)

7. Has the course increased your ability to explain general cosmological processes?
   
   \[3.8, 0.4, 4, 4, 3, 9\] (a lot!)

8. Has the course increased your ability to describe dark matter, dark energy, and elements of astrobiology?
   
   \[3.8, 0.4, 4, 4, 3, 9\] (a lot!)

How useful was the textbook?

\[2.3, 1.0, 2, 4, 1, 9\] (a little)

Student comments:

Student comments were edited to remove ad-hominem remarks.

1. Two hour meetings instead of hour lecture would be great. Hard to cover so much in just a semester with meeting an hour 2X a week. Should be 3X or 2hr/2X a week.
2. Much theory about modern physics was taught and it was fun.
3. Great course.
4. Great professor.
Faculty Assessment:

Prof. Greenberger didn’t have the assessment questions for Phys. 45400 that were given to the students by Liz Rudolph (which were not written by him). Here is a list of the objectives used by him. He gave his own evaluation of how well they learned each of the subjects on a 1-5 basis, with 5 being very good. Nevertheless, it is informative to get two different perspectives for the same course.

1. Did the students learn about what the Greeks accomplished in astronomy, and the Ptolemaic system?  
   [4] (good)
2. Did the students learn about how the Copernican system was superior to the Ptolemaic one, and what the specific differences were?  
   [4] (good)
3. Did the students learn about the contributions of other Renaissance astronomers and how it contributed to the rise of science?  
   [4] (good)
4. Did the students learn about Newton’s theory of gravity, and how ellipses and Kepler’s laws are derived from them? Also did they learn about eclipses, tides, precession of the equinoxes, etc.?  
   [4] (good)
5. Did the students learn about the different major types of telescopes, and their specific advantages?  
   [3.5] (fair/good)
6. Did the students learn about the solar system, the inner and outer planets, asteroids, comets, the Kuiper belt, and the Oort cloud?  
   [4] (good)
7. Did the students learn about the composition and geology of the earth, and the compositions of the planets, and the sun?  
   [3] (fair)
8. Did the students learn about the uncertainty principle, the Pauli principle, the causes of spectra, the spectra of stars, black body radiation, nuclear reactions in the sun?  
   [3.5] (fair/good)
9. Did the students learn about the life history of stars, how we determine stellar properties (temp., distances, etc.), the H-R diagram, white dwarfs, neutron stars, black holes?  
   [4] (good)
10. Did the students learn about the properties of our galaxy, the formation of the galaxy, and the structure of other galaxies and the history of how this was determined?  
    [3.5] (fair/good)
11. Did the students learn about the ideas of special and general relativity, cosmology, the expansion of the universe, the red shift, the CBR, dark matter, and dark energy?  
    [3] (fair)
Faculty Comments:

The last two questions were covered more quickly than he had hoped they would be. When the course is given again, it should be a 4 hr. course, and not 3. He didn’t have enough time to explore in any depth a lot of important topics.

Grade distribution:

See Table I. The mean grade for the course was B+. Of the students originally enrolled in the course 75% completed it with a grade of C or better.
## Table I. Grade Distribution Spring 2009

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Avg

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| Course | 43  | 82  | 57  | 72  | 58  | 52  | 46  | 91  | 28  | 33  | 127 | 12  | 0  | 2  | 14 | 8  | 872 | 2.3  | C   |
|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|----|----|---|----|-----|-----|---------|
| 203    | 3   | 9   | 5   | 9   | 5   | 1   | 3   | 16  | 3   | 5   | 15  | 0   | 6   | 0   | 0  | 25  | 1   | 106  | 2.0  | C   |
| 204    | 11  | 21  | 17  | 16  | 20  | 15  | 9   | 16  | 4   | 2   | 7   | 0   | 3   | 0   | 0  | 2   | 1   | 144  | 2.9  | B   |
| 207    | 12  | 8   | 12  | 17  | 14  | 9   | 10  | 38  | 5   | 13  | 62  | 10  | 1   | 0   | 2  | 81  | 2   | 296  | 1.7  | C-  |
| 210    | 10  | 31  | 17  | 14  | 12  | 20  | 14  | 10  | 7   | 6   | 35  | 0   | 0   | 0   | 0  | 20  | 3   | 199  | 2.5  | C+/B-|
| 321    | 4   | 2   | 3   | 5   | 1   | 2   | 4   | 2   | 0   | 0   | 0   | 1   | 0   | 0   | 0  | 7   | 0   | 31   | 3.1  | B   |
| 323    | 2   | 8   | 2   | 7   | 6   | 5   | 6   | 9   | 9   | 7   | 8   | 0   | 2   | 0   | 0  | 12  | 1   | 84   | 2.2  | C+  |
| 454    | 1   | 3   | 1   | 4   | 0   | 0   | 0   | 0   | 0   | 0   | 1   | 0   | 0   | 0   | 0  | 2   | 0   | 12   | 3.3  | B+  |

Avg

 Avg

Avg Grd

| Course | 43  | 82  | 57  | 72  | 58  | 52  | 46  | 91  | 28  | 33  | 127 | 12  | 0  | 2  | 14 | 8  | 872 | 2.3  | C   |

Grade
Five Year Plan for Assessment of Outcomes for the Physics Department

The physics department is committed to its mission of providing a first-class education for its majors and for the client programs that it services. To this end a five-year plan is being presented.

Timeline

The five year plan for the assessment of outcomes in teaching for the Physics Department covers the following academic years:

I Fall 2008 and Spring 2009
II Fall 2009 and Spring 2010
III Fall 2010 and Spring 2011
IV Fall 2011 and Spring 2012
V Fall 2012 and Spring 2013

The summer sessions will not be included in the assessment plan. This follows previous assessments that were made in the Spring 2007, Fall 2007, Spring 2008 and Fall 2008 periods.

The assessment will be performed on the following courses:

I Core Physics courses
II Lower-divisional Physics courses
III Upper-divisional Physics courses
IV Masters’ courses
V Service courses

In addition, whenever a major change in a course is made or a new course is introduced that course will be assessed that semester. This will permit the department to monitor the effectiveness of the major change or establish a baseline for the performance of a new course.

The courses included in the above categories are:

I Core courses:
Phys 203, 204, 207, 208 (+ new courses 321, 323 and 454)

II Lower-divisional courses:
Phys 351, 353, 354, 371

III Upper-divisional courses:
Phys 422, 451, 452, 453, 454, 471, 551, 552, 554, 556

IV Masters’ courses:
Phys V01, V11, V15, V25, V26, V38, V41, V71, V72

V Service courses:
Astr 205; Phys 219, 321, 323; Sci 101

Thus, in a five-year period a full overview of the teaching effort in the Physics Department will have been completed. This five-year plan can serve as a model for future five-year plans. The relationship of the courses to the program learning outcomes is summarized in Table I. Thus, over a five-year period all of the program learning outcomes will be assessed, with the exception of outcome E, research.
Assessment tools

Three primary assessment tools will be used:

a) Indirect assessment: A student end-of-course survey;

b) Direct assessment: A faculty end-of-course assessment report;

c) Correlation: A study of the grade distributions for the courses.

The indirect assessment consists of a questionnaire that is filled out online or on paper. The students are asked to rate the effectiveness of each course objective on a scale of 1 to 4 (not at all, very little, some, a lot). These objectives are enumerated in the course syllabus and span the topics covered in the course. In addition, the student is asked to rate various facets of the course, such as the textbook, prerequisites, tutorials, online homework, problem sessions, etc. Comments and suggestions for course improvement are solicited from the students. The survey is administered during the last week of the semester, but before the final examination.

The direct assessment consists of a questionnaire that is filled out by the lecturer after the final examination is graded and the grades are submitted. It asks them to rate the average student performance for each course objective on a scale of 1 to 5 (poor, fair, good, very good, excellent). These scores are based on the scores received on examinations during the semester, including the final exam. The faculty member is also asked questions concerning specific facets of the course and is also asked to provide comments about the course.

The study of the grade distribution for each course is meant to see how well the student grades correlate with the results of the direct and indirect assessment. It also helps the department regulate the grading standards for the various courses.

Closing the loop

The goal of the assessment of outcomes is to see if the curriculum and course delivery can be improved and to take steps to do so. Therefore it is crucial that there be a systematic dissemination of the assessment reports and plan for action by the department. Chart I. outlines the flow of information.

The first step involves generating a general syllabus for each course. This syllabus should clearly enumerate the topics to be covered and a list of course objectives. Based on the general syllabus, each instructor develops a detailed syllabus for the course he or she teaches. After the course is delivered the direct and indirect assessments are performed and grade information is collected. The departmental outcomes coordinator (DOC) incorporates this information in a semi-annual outcomes assessment report. This report is forwarded to the Chair, the faculty as a whole, and the curriculum committee. The curriculum committee decides what modifications of the curriculum are needed to improve the course. These are then given to the chair and the lecturers. The general curriculum is updated. If there is a need for funds to purchase equipment a request is put in to the executive committee for OTPS funds (other than personnel services). Such requests could include such things as added demonstration equipment or new laboratory experiments. In the case where major equipment is needed a request from the executive committee to the Dean is in order. With major renovations of the Marshak Science Building planned it is an opportune time to configure the building so as to optimize the effectiveness of the educational mission of the Physics Department.
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*Program learning outcomes:

A. Learn laws of physics and solve problems
B. Design and carry out experiments; analyze and interpret results
C. Communicate by written and oral means
D. Work cooperatively with others
E. Participate in research
F. Use computers and appropriate technology
G. Learn laws of physics and solve problems at an introductory level (for other majors)
H. Use physics to perform well in advanced courses in their own majors (for other majors)
Chart I. Closing the loop

General Syllabus
  ↓
Detailed Course Syllabus
  ↓
Course Delivery
    ↓
  Indirect  Direct  Grades
  ↓
Assessment of Outcomes Report
  ↓
Chairman
  ↓
All Physics Faculty
  ↓
Curriculum Committee
  ↓
Lecturers
  ↓
Executive Committee
  ↓
Allocation of OTPS Funds
  ↓
Dean for Major Funding
  ←