# CHEMISTRY DEPARTMENT 2012 ANNUAL ASSESSMENT UPDATE

## I. Mission Statement and Student Learning Outcomes

### Mission Statement

The mission of the chemistry department at Westmont College is to provide a nationally competitive chemistry program that helps students become competent, thoughtful, and theologically reflective scientists, teachers, health-care providers, and citizens of our world.

**Department Goals and Outcomes can be found at**
http://www.westmont.edu/_academics/departments/chemistry/goals.html

## II. Follow up on Action Items Identified in Previous Reports.

The action items from the 2011 response to our annual report are listed below as well as the steps we have taken to address them

1) **On the revising of our learning outcomes.**
   We have moved the criterion of the percentage of students who participate in summer research in second position as recommended by the PRC.
2) **On the revision of our alignment matrix**
   We have revised our alignment matrix to include the current version of our department goals and outcomes. The revised matrix is in our program review folder under guiding documents**.**
3) **On the "Closing the Loop" column in the multi-year assessment plan.** We have filled in this column in the plan. The revised plan is in our program review folder under guiding documents.

## III. 2011/2012 Focus

Our 2011/2012 focus is goal 2 which reads: Students will demonstrate a breadth and depth of knowledge in chemistry. We propose to assess this goal by using our student's performance on the American Chemical Society (ACS) National exam and on the Medical College Admission Test. The ACS exams are prepared by the American Chemical Society for many of the courses that we teach. The exams have published national normative results, which we can use to compare our students to those across the country. Similarly, we have access to our student's performance on the MCAT, which also allows us to compare our students to a national pool. Our goal is that the average performance on ACS National Exams will be at least in the 60th percentile, with 30% of the students scoring above the 80th percentile, in each course that has an exam. The average score on the MCAT will be at the 60th percentile or higher.

## A. American Chemical Society Standardized Exams

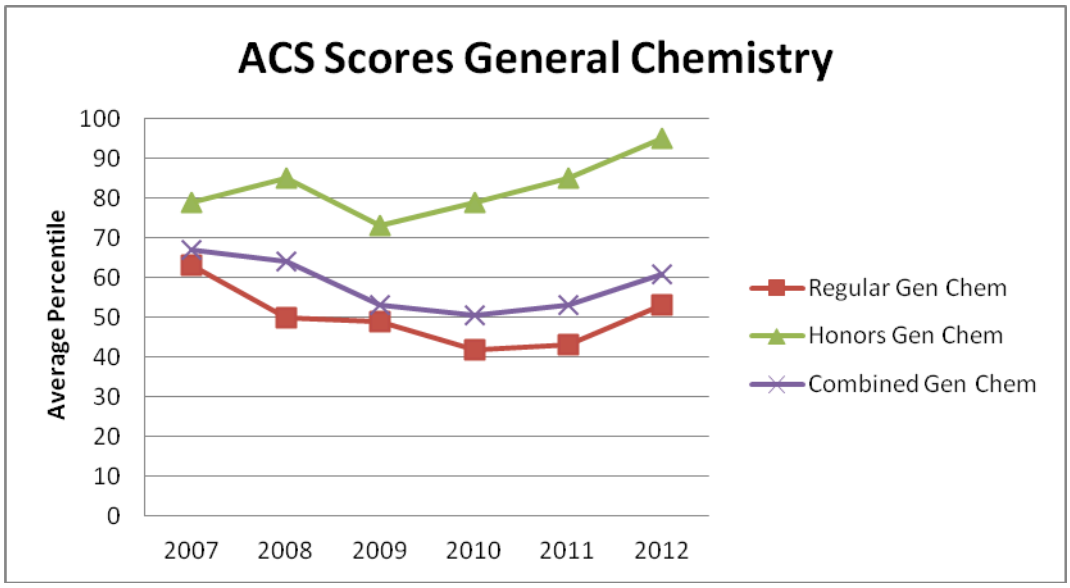
**1) Current Year (2011/2012) Results.** The data below show the performance of our students on the ACS exams in variious courses for the 2011/2012 academic year. The data in red are most pertinent to our learning outcomes.

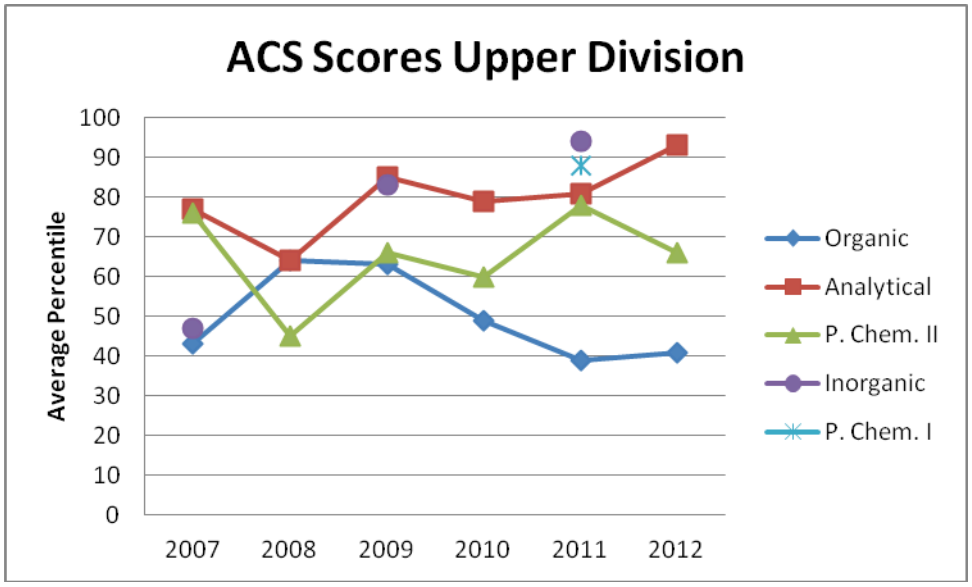
| | American Chemical Society National Exam Results | | | | | | |
|---|---|---|---|---|---|---|---|
| | Percentiles based on National Norms | | | | | | |
| **Spring 12** | **Course Number** | **Number of Students** | **Average %Tile** | **Std. Dev.** | **Range** | **Above 80%tile** | **Percent above 80%tile** |
| Gen. Chem. | 6 Honors | 18 | **85** | 15 | 45-100 | 16 | 88% |
| | 6A&B | 52 | **53.3** | 21.6 | 5-99 | 9 | 17% |
| Gen Chem | Combined | 70 | **61** | 19.9 | 5-100 | 25 | 35.7% |
| Organic I | 101 | 53 | **71** | 25 | 11-99 | 21 | 40% |
| Organic II | 102 | 48 | **41** | 29 | 2-99 | 6 | 12% |
| Analytical | 121 | 10 | **93** | 18 | 41-100 | 8 | 80% |
| P.Chem.II | 131 | 2 | **66** | 42 | 36-95 | 1 | 50% |
| Intro P. Chem. | 135 | 10 | **66** | 34 | 9-97 | 5 | 50% |

For the 2011/2012 academic year, and considering the combined General Chemistry results, the department met its goals (60$^{th}$ percentile average score and 30% of students scoring above the 80$^{th}$ percentile) in every course except Organic Chemistry II.

**2) Historical Results (2007-2012)**

**a) Average Percentile.** The graphs below show the average percentile achieved by our students in each year for our courses over the past six years. The graphs are separated into General Chemistry and Upper Division courses.





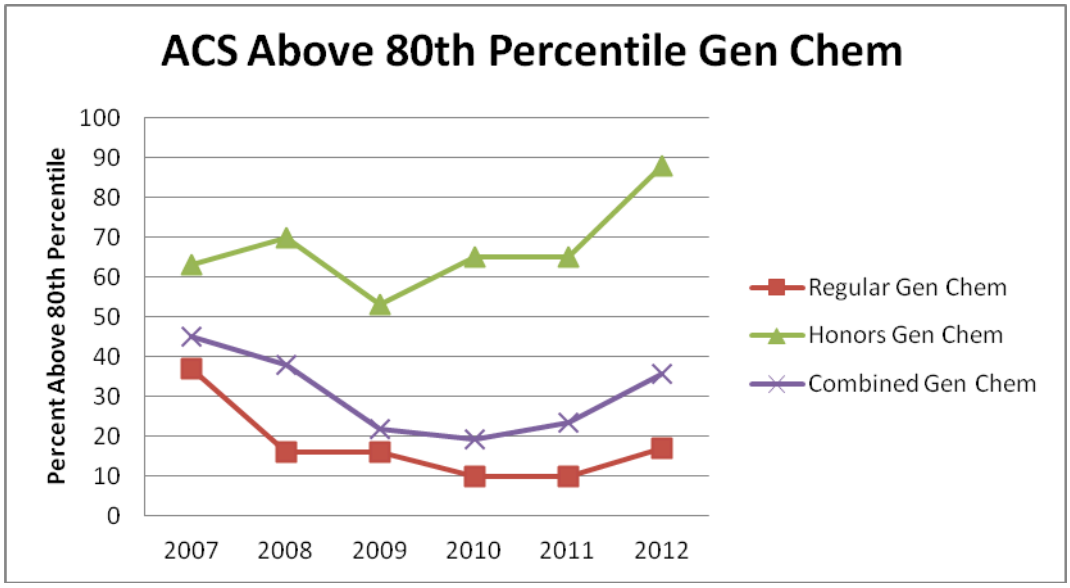

**Six Year Average of Average Percentile.** The table below shows the average percentile achieved by our students averaged over all six years displayed in the graphs above.

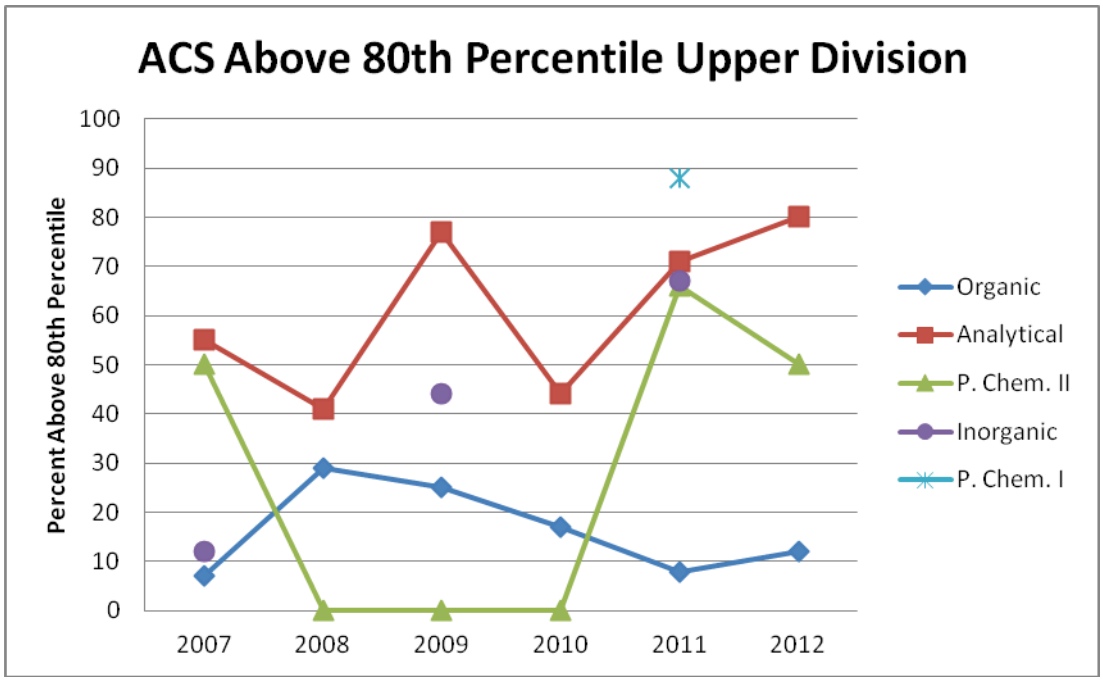
| Gen Chem | Honors Gen Chem | Combined Gen Chem | Organic | Analytical | P. Chem II | Inorganic | P. Chem I |
|---|---|---|---|---|---|---|---|
| 50.1 | 82.6 | 58.2 | 49.8 | 79.8 | 65.2 | 74.6* | 88** |

* Offered in alternating year; 3 yr. average
** Only 1 year of data available

For the six years summarized here, and considering the combined General Chemistry results, the department met its goals (60$^{th}$ percentile average score) in every course except Organic Chemistry II. (The department deemed the Combined General Chemistry Score sufficiently close to the goal to essentially meet it.)

**b) Percent Above 80th Percentile.** The graphs below show the percent of our students scoring above the 80th percentile on the ACS exam for each course over the past six years. The graphs are separated into General Chemistry and Upper Division courses.




**Six Year Average of Percent Above 80th Percentile.** The table below summarizes the percent of our students scoring above the 80th percentile averaged over all six years displayed in the graphs above.

| Gen Chem | Honors Gen Chem | Combined Gen Chem | Organic | Analytical | P. Chem II | Inorganic* | P. Chem I** |
|---|---|---|---|---|---|---|---|
| 17.7 | 67.3 | 30.6 | 16.3 | 61.3 | 27.7 | 41 | 88 |

* Offered in alternating year; 3 yr. average

** Only 1 year of data available

For the six year average, and considering the combined General Chemistry results, the department met its goals (30% of students scoring above the 80$^{th}$ percentile) in every course except Organic Chemistry II. (The department deemed the peformance of our students in P. Chem. II sufficiently close to the goal to essentially meet it, especially given the high standard deviation of the data.)

### 3) Department Discussion of ACS Exam Results

The chemistry department is overall very satisfied with the performance of our students on the ACS exams in each course over the past 6 years. We are particularly impressed that our students are performing at such a high level in comparison with their peers at colleges and universities across the country. In most of our courses, our students would rank in the top one-third of their peers.

Nonetheless, we are concerned about the continued lower performance in Organic Chemistry and our failure to meet our goals in this course. The department further investigated the low scores in Organic Chemistry by administering an intermediate ACS Exam at the one-semester mark, in addition to the normal full year exam adminsitered at the end of the year. The results of those exams for two years are shown below

.

| | | Percentiles based on National Norms | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Course Number | Number of Students | Score Ave. (70) | Average %Tile | Std. Dev. | Range | Above 80%tile | Percent above 80%tile |
| Fall 10 | 101 | 42 | 41.7 | 65 | 29 | 6-99 | 15 | 36 |
| Fall 11 | 101 | 53 | 43.2 | 71 | 25 | 11-99 | 21 | 40 |
| | | | | | | | | |
| Spring 11 | 102 | 38 | 34.6 | 39 | 28 | 3-94 | 3 | 8 |
| Spring 12 | 102 | 48 | 35.6 | 41 | 29 | 2-99 | 6 | 13 |

Notice that the results for the Fall semester exceed our departmental goals. However, the results of the Spring semesters fall short. These data indicate that our failure to meet our goals lies in the Spring semester. The department identified several possible reasons for the Spring semester shortfall. Some of these reasons are beyond our control. For example, a full week of classroom time has been cut from the Spring semester over the last decade. Students have also been encouraged to take other time intensive science courses—such as genetics—during the same semester as Organic Chemistry II. In fact, the Genetics final often falls on the same day as the Organic Chemistry II Final. Nonetheless, the department also identified a number of factors within our control. For example, for the two years summarized above, the Fall semester course had two smaller sections, while the Spring semester course had only one larger section. In fact, Organic Chemisty II is by far the largest upper division course we teach. We developed the following set of actions to improve the ACS scores in Organic Chemistry II.

| Action | Implementation Date |
|---|---|
| Yearly ACS exam item analysis to identify areas where class coverage could be improved. | Spring 2012 |
| Move at a faster pace early in the Fall semester to allow more time to cover the second semester topics earlier. | Fall 2012 |
| Increase relative weight of final exam (which is the ACS exam) in overall grade to encourage students to take it seriously. | Spring 2013 |
| Evaluate relative coverage of biochemistry during second semester. Biochemistry is typically not on the ACS exam, but is part of the MCAT, so careful balance here is important. | Spring 2013 |
| Purchase a class set of Organic Chemistry ACS exam review booklets and let students check them out to help them organize their studies for the exam. | Spring 2013 |
| Increase the amount of class time alotted to Spring Semester in class review. | Spring 2013 |
| Offer two smaller sections of Organic Chemistry II if total enrollment exceeds 40 students. | Spring 2014 |
| Evaluate the role of the second semester laboratory synthesis project. This project is extremely time intensive, which could cause students to have less time to focus on their lecture material. However, the department strongly supports the laboratory learning that occurs during this project and prefers not to diminish that aspect of the course. | Spring 2014 |
| Evaluate the effectiveness of homework in the course, and perhaps initiate a homework/quiz combination to encourage students to take the homework more seriously. | Spring 2014 |

## B. Medical College Admission Test (MCAT) Results

**1) Current Year (2011/2012) Results** The data below show the results of the 17 Westmont students who took the MCAT during the 2011/2012 academic year.

**MCAT Summary 2011-2012**

| School | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Group** Examinees - All | | **N**=17 | | | | | | | | | | |
| | | | **Percentage of Students with Scores** | | | | | | | | | |
| **MCAT Section** | **Mean** | **Std Dev** | **1-4** | **5-6** | **7** | **8** | **9** | **10-11** | **12-15** | | | |
| Verbal Reasoning | 9.1 | 1.91 | 0 | 18 | 6 | 6 | 24 | 35 | 12 | | | |
| Physical Sciences | 8.6 | 1.97 | 0 | 12 | 18 | 18 | 29 | 18 | 6 | | | |
| Biological Sciences | 9.2 | 1.21 | 0 | 0 | 6 | 29 | 18 | 47 | 0 | | | |
| **MCAT Section** | **Median** | **25th / 75th %ile** | **J-K** | **L-M** | **N** | **O** | **P** | **Q-R** | **S-T** | | | |
| Writing Sample | P | N / Q | 0 | 18 | 12 | 18 | 6 | 41 | 6 | | | |
| **MCAT Section** | **Mean** | **Std Dev** | **3-7** | **8-12** | **13-17** | **18-22** | **23-25** | **26-28** | **29-31** | **32-35** | **36-40** | **41-45** |
| Total | 27.0P | 3.91 | 0 | 0 | 0 | 18 | 18 | 29 | 24 | 6 | 6 | 0 |

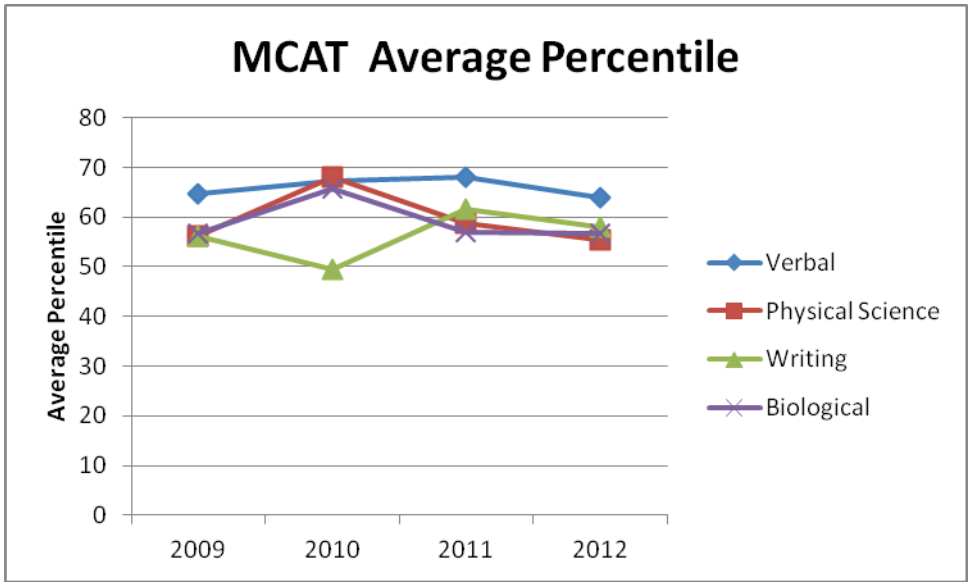
| National | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Group** Examinees - All | | **N**=89378 | | | | | | | | | | |
| | | | **Percentage of Students with Scores** | | | | | | | | | |
| **MCAT Section** | **Mean** | **Std Dev** | **1-4** | **5-6** | **7** | **8** | **9** | **10-11** | **12-15** | | | |
| Verbal Reasoning | 8.1 | 2.48 | 10 | 18 | 10 | 15 | 15 | 27 | 5 | | | |
| Physical Sciences | 8.5 | 2.52 | 5 | 18 | 16 | 14 | 12 | 23 | 12 | | | |
| Biological Sciences | 8.8 | 2.49 | 7 | 12 | 7 | 17 | 15 | 32 | 11 | | | |
| **MCAT Section** | **Median** | **25th / 75th %ile** | **J-K** | **L-M** | **N** | **O** | **P** | **Q-R** | **S-T** | | | |
| Writing Sample | O | M / Q | 4 | 28 | 9 | 13 | 10 | 32 | 4 | | | |
| **MCAT Section** | **Mean** | **Std Dev** | **3-7** | **8-12** | **13-17** | **18-22** | **23-25** | **26-28** | **29-31** | **32-35** | **36-40** | **41-45** |
| Total | 25.3O | 6.45 | 0 | 3 | 9 | 19 | 17 | 18 | 16 | 13 | 4 | 0 |

The average percentiles for our students for the 2011/2012 academic year are tabulated here:

| verbal | | Physical Sci. | Writing Sample | Biological Sci. | Total | |
|---|---|---|---|---|---|---|
| 63.9 | | 55.3 | 58.1 | 56.8 | 59.9 | |

For the 2011/2012 academic year, the department essentially met its goal (60th percentile average score) for the MCAT results.

2) **Historical Results (2009-2012)** The graph below shows the average percentile achieved by our students on the MCAT over the past four years.




**Four Year Average of MCAT percentile for Westmont Students** The table below summarizes average percentile of our students on the MCAT average over all four years displayed in the graph above.

| Verbal | Physical Science | Writing | Biological | Total |
|---|---|---|---|---|
| 66.025 | 59.575 | 56.35 | 59.075 | 63.3 |

For the period 2009-2012, the department met its goal (60th percentile average score) for the MCAT results.

3) **Department Discussion of MCAT results.**

The chemistry department is overall very satisfied with the performance of our students on the MCAT exam over the past four years. The MCAT is typically taken by the high achieving students of a college or university. The results tell us that our high achieving students are in the top 40% of their peers nationally. Nonetheless, we also discussed that the MCAT exam is changing, and we must keep up those with those changes. For now, however, no additional steps need to be take on this outcome.

## IV. Next Steps

1) Next year, we will focus on outcomes 3 (students will be skilled in working in the laboratory and will appreciate experiment design and problem solving by the time of graduation) and 4 (students will develop a love of learning and an enthusiasm for chemistry as a science and a discipline). Outcome 3 will be assessed by continuing to track participation in our summer research program (responsibility of chair and department administrative assistant), and by administering an essay lab exam to seniors taking physical chemistry (responsibility of faculty teaching Physical Chemistry). Outcome 4 will be assessed by tracking participation in the Chemistry Club (responsibility of department administrative assistant) and by polling our graduates about this issue (responsibility of chair and department administrative assistant-poll to be conducted Fall 2012).
2) Continuing yearly tasks:
    a. Each faculty member will continue to administer the ACS Exams in each of our courses where it is available, and we will also continue to track student's scores on the MCAT. These data are collected by the department chair and posted to the chemistry assessment archive website.
    b. Faculty member teaching Seminar (CHM 195) will continue to administer our yearly instrument to assess outcome 5. The current year's results based on the prompt, *Describe the relationship between scientific knowledge and the Christian Faith,* are in our assessment folder.
    c. The department as a whole will continue to track the career choices of our graduates. This file is in our department archive and will be updated every year or two as necessary.

**Appendices:**

**A) Chemistry Department Alignment Matrix (see departmental archive)**
**B) Chemistry Department Multi-Year Assessment Plan (see departmental archive)**