

Detailed Assessment Report  
2010-2011 Polymer Science BS

**Mission/Purpose**

The Polymer Science Bachelor of Science Degree in the School of Polymers and High Performance Materials is designed as a rigorous curriculum that will be the best possible preparation for graduate studies or employment in the chemical industry.

**Student Learning Outcomes, with Any Associations and Related Measures, Achievement Targets, Findings, and Action Plans**

**O 1: Understand basic language and techniques**

Students will understand the basic language of polymer chemistry, and the synthetic techniques by which polymers can be prepared. They will be expected to conceptualize polymer synthetic schemes, to analyze synthesis problems and to create theoretical solutions to the basic challenges of polymer synthesis.

**Related Measures:**

**M 3: MathCAD proficiency**

Students will be able to use MathCAD in solving real mathematical problems in polymer science given by the Polymer Science faculty. 80% of students will be able to correctly use MathCAD to create arrays of data and the appropriate graph of the data for the completion of these problem sets.

**Achievement Target:**

80% of students will be able to create arrays of data using MathCAD; 80% of students will be able to create scientific graphs using MathCAD; 80% of students will be able to solve real problems in polymer science using graphical representations of data in MathCAD.

**Findings (2010-2011) - Achievement Target: Met**

Fall 2010--100% (12 of 12) of students were able to create arrays of data in MathCAD; 100% (12 of 12) students were able to create scientific graphs in MathCAD; 100% (12 of 12) students were able to solve real problems in polymer science using MathCAD. Spring 2011--Not applicable.

**Related Action Plans (by Established cycle, then alpha):**

For full information, see the *Action Plan Details* section of this report.

**Increasing MathCAD Proficiency**

*Established in Cycle:* 2009-2010

In PSC 285, students are introduced to MathCAD for use as a tool to solve complex polymer based problems. While it appears that...

**M 4: Exit Survey-Basic Math**

The importance of mathematical problem solving will be evaluated by student questionnaire of all students who have progressed in the program, including juniors and seniors. The questionnaire will include a scale of 1-5, with 5 being very important and 1 being not important. Questions will center around how appropriate MathCAD is for solving a given problem.

**Achievement Target:**

75% of students will answer with a 4-5 on questions that refer to problems that must be solved using MathCAD

**Findings (2010-2011) - Achievement Target: Met**

Fall 2010-- Questionnaire not given until Spring; Spring 2011--88% (7 of 8) of students answered with a 4 `important` (1 student) or 5 `very important` (2 students) that MathCAD is a useful and appropriate tool for solving advanced engineering problems.

**M 5: Research Project Portfolio**

The written portfolios of the original research projects of students completing PSC 490/L or PSC 491/L (Special Projects in Polymer Science Laboratory) will be evaluated by the undergraduate committee and viewed by the entire faculty.

**Achievement Target:**

75% of these portfolios will be deemed acceptable in terms of a basic checklist used by the undergraduate committee. This checklist includes ranking of poor, acceptable, and excellent in the areas of written communication, presentation, and basic understanding of problems and techniques of polymer science.

**Findings (2010-2011) - Achievement Target: Met**

Spring 2011--88% (7 of 8) of final portfolios were deemed at least acceptable. No portfolios were deemed poor and 75% (6 of 8) were determined to be excellent. One portfolio was not turned in. \*Note: the late portfolio was turned in and was deemed acceptable.

**M 6: Alumni Survey**

An alumni survey will be issued to alumni within two years of graduation asking to rate the information received from all PSC classes as either insufficient, sufficient, excellent, or not applicable to their current careers

**Achievement Target:**

75% of alumni responding will rate the information learned from the program as at least sufficient for their current area.

**Findings (2010-2011) - Achievement Target: Met**

Fall 2010--Survey collected in the Spring; Spring 2011--Survey results indicated that 80% (4 of 5 respondents) indicated that the information learned in the program was at least sufficient for their area. The survey tool asked respondents to rate the information learned from 1 ("irrelevant") to 5 ("advanced"), with a 3 being "sufficient".

**M 8: ACS Standard Exam**

Two weeks prior to graduation, seniors will be given the Polymer Chemistry section of the American Chemical Society standard exam.

**Achievement Target:**

80% of seniors expecting to graduate will pass (as defined by the American Chemical Society) the Polymer Chemistry section of the American Chemical Society standard exam.

**Findings (2010-2011) - Achievement Target: Met**

Fall 2010- Test not given until Spring 2011--100% of seniors (8) passed the American Chemical Society Polymer Chemistry standardized ACS exam.

**O 2: Knowledge of physical aspects of polymer science**

Students will be prepared to enter the polymer science senior level curriculum with sufficient knowledge of the physical aspects of polymer science.

**Related Measures:**

**M 2: Pretest/Posttest**

Students will demonstrate an appreciation of Polymer Science in society and knowledge of the physical aspects of polymer science via an increase in scores from a pretest to a posttest

**Achievement Target:**

25% score increase between the pre-test and post-test.

**Findings (2010-2011) - Achievement Target: Met**

Fall 2010 - A 30% score increase was seen between the pre-test and post-test for students taking both tests; Spring 2011 - a 30% score increase was seen between the pre-test and post-test for students taking both tests

**M 4: Exit Survey-Basic Math**

The importance of mathematical problem solving will be evaluated by student questionnaire of all students who have progressed in the program, including juniors and seniors. The questionnaire will include a scale of 1-5, with 5 being very important and 1 being not important. Questions will center around how appropriate MathCAD is for solving a given problem.

**Achievement Target:**

75% of students will answer with a 4-5 on questions that refer to problems that must be solved using MathCAD

**Findings (2010-2011) - Achievement Target: Met**

Fall 2010-- Questionnaire not given until Spring; Spring 2011--88% (7 of 8) of students answered with a 4 `important` (1 student) or 5 `very important` (2 students) that MathCAD is a useful and appropriate tool for solving advanced engineering problems.

**M 5: Research Project Portfolio**

The written portfolios of the original research projects of students completing PSC 490/L or PSC 491/L (Special Projects in Polymer Science Laboratory) will be evaluated by the undergraduate committee and viewed by the entire faculty.

**Achievement Target:**

75% of these portfolios will be deemed acceptable in terms of a basic checklist used by the undergraduate committee. This checklist includes ranking of poor, acceptable, and excellent in the areas of written communication, presentation, and basic understanding of problems and techniques of polymer science.

**Findings (2010-2011) - Achievement Target: Met**

Spring 2011--88% (7 of 8) of final portfolios were deemed at least acceptable. No portfolios were deemed poor and 75% (6 of 8) were determined to be excellent. One

portfolio was not turned in. \*Note: the late portfolio was turned in and was deemed acceptable.

### **M 7: Self-efficacy questionnaire**

A student self-efficacy questionnaire will be given to all students at the completion of PSC 191 (Introduction to Polymers) and PSC 291 (Physical Aspects of Polymers).

#### **Achievement Target:**

90% of students will demonstrate that they have an appreciation for the role of a polymer scientist in today's society by the answers given in the questionnaire.

#### **Findings (2010-2011) - Achievement Target: Met**

Fall 2010 (PSC 191)-100% of students (36) who took the questionnaire to the questionnaire demonstrated an appreciation of the role of Polymer Scientists in society by identifying common materials and the role they play in everyday life. Spring 2011 (PSC 292) 95% of students (21 of 22) were able to demonstrate and appreciation of Polymer Science Engineering by correctly identifying different roles polymers play in daily life

### **M 8: ACS Standard Exam**

Two weeks prior to graduation, seniors will be given the Polymer Chemistry section of the American Chemical Society standard exam.

#### **Achievement Target:**

80% of seniors expecting to graduate will pass (as defined by the American Chemical Society) the Polymer Chemistry section of the American Chemical Society standard exam.

#### **Findings (2010-2011) - Achievement Target: Met**

Fall 2010- Test not given until Spring 2011--100% of seniors (8) passed the American Chemical Society Polymer Chemistry standardized ACS exam.

### **O 3: Demonstrate Basic Knowledge of Polymer Science**

Students will acquire sufficient information to ensure that they have an appreciation of polymer science and the typical role of the polymer scientist in today's society before they enter 300 level courses.

#### **Related Measures:**

### **M 2: Pretest/Posttest**

Students will demonstrate an appreciation of Polymer Science in society and knowledge of the physical aspects of polymer science via an increase in scores from a pretest to a posttest

#### **Achievement Target:**

25% score increase between the pre-test and post-test.

#### **Findings (2010-2011) - Achievement Target: Met**

Fall 2010 - A 30% score increase was seen between the pre-test and post-test for students taking both tests; Spring 2011 - a 30% score increase was seen between the pre-test and post-test for students taking both tests

### **M 5: Research Project Portfolio**

The written portfolios of the original research projects of students completing PSC 490/L or PSC 491/L (Special Projects in Polymer Science Laboratory) will be evaluated by the undergraduate committee and viewed by the entire faculty.

**Achievement Target:**

75% of these portfolios will be deemed acceptable in terms of a basic checklist used by the undergraduate committee. This checklist includes ranking of poor, acceptable, and excellent in the areas of written communication, presentation, and basic understanding of problems and techniques of polymer science.

**Findings (2010-2011) - Achievement Target: Met**

Spring 2011--88% (7 of 8) of final portfolios were deemed at least acceptable. No portfolios were deemed poor and 75% (6 of 8) were determined to be excellent. One portfolio was not turned in. \*Note: the late portfolio was turned in and was deemed acceptable.

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80% of seniors expecting to graduate will pass (as defined by the American Chemical Society) the Polymer Chemistry section of the American Chemical Society standard exam.

**Findings (2010-2011) - Achievement Target: Met**

Fall 2010- Test not given until Spring 2011--100% of seniors (8) passed the American Chemical Society Polymer Chemistry standardized ACS exam.

**O 4: Manipulate basic mathematical problems**

Students will have sufficient background to have the skills to manipulate the basic mathematical problems of polymer science.

**Related Measures:**

**M 3: MathCAD proficiency**

Students will be able to use MathCAD in solving real mathematical problems in polymer science given by the Polymer Science faculty. 80% of students will be able to correctly use MathCAD to create arrays of data and the appropriate graph of the data for the completion of these problem sets.

**Achievement Target:**

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**Related Action Plans (by Established cycle, then alpha):**

For full information, see the *Action Plan Details* section of this report.

**Increasing MathCAD Proficiency**

*Established in Cycle: 2009-2010*

In PSC 285, students are introduced to MathCAD for use as a tool to solve complex polymer based problems. While it appears that...

**M 4: Exit Survey-Basic Math**

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**Achievement Target:**

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**M 8: ACS Standard Exam**

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80% of seniors expecting to graduate will pass (as defined by the American Chemical Society) the Polymer Chemistry section of the American Chemical Society standard exam.

**Findings (2010-2011) - Achievement Target: Met**

Fall 2010- Test not given until Spring 2011--100% of seniors (8) passed the American Chemical Society Polymer Chemistry standardized ACS exam.

## **O 5: Use Knowledge Gained for Independent Research**

Apply the knowledge gained in the classroom on independent research

### **Related Measures:**

#### **M 1: Exit Survey-Graduate**

Graduating senior will complete an exit survey detailing their experience in the program and their plans after graduation.

#### **Achievement Target:**

85% of graduates will have obtained a job in a polymer related industry or will be continuing their education in graduate or professional school

#### **Findings (2010-2011) - Achievement Target: Met**

Fall 2010 - No BS Graduates; Spring 2011 - 86% (6 of 7) Polymer Science BS graduates had obtained employment (2) or had been accepted to a graduate program (4) by graduation.

#### **M 5: Research Project Portfolio**

The written portfolios of the original research projects of students completing PSC 490/L or PSC 491/L (Special Projects in Polymer Science Laboratory) will be evaluated by the undergraduate committee and viewed by the entire faculty.

#### **Achievement Target:**

75% of these portfolios will be deemed acceptable in terms of a basic checklist used by the undergraduate committee. This checklist includes ranking of poor, acceptable, and excellent in the areas of written communication, presentation, and basic understanding of problems and techniques of polymer science.

#### **Findings (2010-2011) - Achievement Target: Met**

Spring 2011--88% (7 of 8) of final portfolios were deemed at least acceptable. No portfolios were deemed poor and 75% (6 of 8) were determined to be excellent. One portfolio was not turned in. \*Note: the missing portfolio was turned in late and was deemed acceptable.

## **O 6: Characterize properties and form written reports**

Students will have the necessary practical skills to characterize the physical properties of polymers and to accurately and fully report the results of their experiments in written form through knowledge gained in polymer techniques and in the Capstone Polymer Research Courses.

### **Related Measures:**

#### **M 5: Research Project Portfolio**

The written portfolios of the original research projects of students completing PSC 490/L or PSC 491/L (Special Projects in Polymer Science Laboratory) will be evaluated by the undergraduate committee and viewed by the entire faculty.

#### **Achievement Target:**

75% of these portfolios will be deemed acceptable in terms of a basic checklist used by the undergraduate committee. This checklist includes ranking of poor, acceptable, and excellent in the areas of written communication, presentation, and basic understanding of problems and techniques of polymer science.

**Findings (2010-2011) - Achievement Target: Met**

Spring 2011--88% (7 of 8) of final portfolios were deemed at least acceptable. No portfolios were deemed poor and 75% (6 of 8) were determined to be excellent. One portfolio was not turned in. \*Note: the late portfolio was turned in and was deemed acceptable.

**O 7: Obtain employment using knowledge and skills**

Graduating students will demonstrate that they have attained a depth and breadth of chemical knowledge that is required to participate at entry level positions in a variety of polymer related industries.

**Related Measures:**

**M 1: Exit Survey-Graduate**

Graduating senior will complete and exit survey detailing their experience in the program and their plans after graduation.

**Achievement Target:**

85% of graduates will have obtained a job in a polymer related industry or will be continuing their education in graduate or professional school

**Findings (2010-2011) - Achievement Target: Met**

Fall 2010 - No BS graduates Spring 2011 - The program had 7 BS graduates; 4 students (57%) had been accepted to graduate schools, 2 students (28.5%) had accepted jobs, and 1 student was undecided about graduate school at the time of graduation, but did have a job offer.

**M 6: Alumni Survey**

An alumni survey will be issued to alumni within two years of graduation asking to rate the information received from all PSC classes as either insufficient, sufficient, excellent, or not applicable to their current careers

**Achievement Target:**

75% of alumni responding will rate the information learned from the program as at least sufficient for their current area.

**Findings (2010-2011) - Achievement Target: Met**

Fall 2010--Survey collected in the Spring; Spring 2011--Survey results indicated that 80% (4 of 5 respondents) indicated that the information learned in the program was at least sufficient for their area. The survey tool asked respondents to rate the information learned from 1 ("irrelevant") to 5 ("advanced"), with a 3 being "sufficient".

**Action Plan Details for This Cycle (by Established cycle, then alpha)**

**Understand basic industry language and techniques**

80% or greater of students will pass the Organic Chemistry section of the American Chemical Society Standardized Test on Polymer Chemistry.

**Established in Cycle:** 2005-2006

**Implementation Status:** In-Progress



**Priority:** Low

**Implementation Description:** Academic Year 06/07

**Responsible Person/Group:** Curriculum Committee

### **Increasing MathCAD Proficiency**

In PSC 285, students are introduced to MathCAD for use as a tool to solve complex polymer based problems. While it appears that a number of students did not firmly grasp MathCAD, it has been suggested by the instructor and the students that the fault lies in the problems themselves rather than the software (in other words, the students did not conceptually understand how to solve the problems asked and the use of MathCAD was not an issue). Two steps will be taken to ensure that the students understand how to correctly use the software. 1) An increased amount of time will be spent in the class providing instruction and examples of how to use MathCAD. 2) The students Proficiency on MathCAD will be determined early in the course, prior to the introduction of difficult applied problems in polymer science and engineering.

**Established in Cycle:** 2009-2010

**Implementation Status:** In-Progress

**Priority:** High

**Relationships (Measure | Outcome/Objective):**

**Measure:** MathCAD proficiency | **Outcome/Objective:** Manipulate basic mathematical problems  
| Understand basic language and techniques

### Analysis Answers

#### **What specifically did your assessments show regarding proven strengths or progress you made on outcomes/objectives?**

The BS program in Polymer Science continues to excel at placing graduates of the program in either graduate school or full time employment in the field of polymer science (Outcomes 5, 7). The strength of the program faculty has always been scholarly activity, and this is reflected in outcomes 1,2,3, 5, and 6 when examining student performance on the research portfolios. The research outcome and the job and school placement rates are related and the faculty should be encouraged to continue to utilize undergraduate students as research assistants whenever possible. The ability of our students to use mathematical software (MathCAD) greatly improved this year as well.

#### **What specifically did your assessments show regarding any outcomes/objectives that will require continued attention?**

Recently, the alumni survey response has been low. The number of responses from among the targeted cohorts is minimal, resulting in an extremely small size from which to gauge alumni opinions regarding the effectiveness of the program. The relevance of the Polymer Science curriculum is monitored in part by recent alumni surveys. This year a low percentage stated that the information learned was relevant to their current positions, although the percentage only amounted to one person. While the alumni survey is not the sole source of feedback regarding the curriculum, neutral or negative responses are worthy of close monitoring to see if a trend begins to arise.

### Annual Reports

#### **Program Summary**

During the 2010-2011 assessment cycle, the School of Polymers and High Performance Materials (SPHPM) has continued to strive to meet goals set forth by the University, especially in the area of being a premier research university. The SPHPM is a research focused program at all educational

levels. The research conducted by the faculty and students is internationally respected and renowned, as evidenced by the number of publications and invited presentations given each year (over approximately 50 in each category for the previous calendar year). The faculty have increased their effort spent in outreach activities, including Dr. Daniel Savin participating in the National Kids Science Challenge and Dr. Robert Lochhead appearing in several videos related to efforts to help clean the BP oil spill, most notably for National Geographic. Dr. Derek Patton was recently awarded a National Science Foundation Career award, a prestigious grant that allows Dr. Patton to work with several students at all levels on cutting edge ideas. The BS program in Polymer Science continues to aggressively recruit students to the program, and the recent focus has been on retention of the large cohorts that have entered the past two years. These students are high ability, and are participating in undergraduate research. The persisting students have numerous opportunities afforded to them through their research experiences at USM. Students are encouraged to begin undergraduate research as soon as they are able, and are assisted in making this decision by the faculty and staff. One of this year's graduates was a recipient of a National Science Foundation Fellowship and will attend the University of California at Santa Barbara in the fall. The School regularly hosts high school science classes of all levels and provides demonstrations and tours to students as young as 6th grade. Additionally, many of our students return to their "home" schools to speak about the program, which has proved to be a valuable recruiting tool.

### **Continuous Improvement Initiatives**

The faculty and staff of the School of Polymers and High Performance Materials are committed to providing an enriching classroom and research experience for students in the BS program in polymer science. More summer internships are being pursued with in-state and out-of-state companies, as well as with government research labs. Additionally, scholarship opportunities are being sought after by faculty and staff in order to encourage more high ability students to enroll in the program.

### **Closing the Loop**

The combining of the sophomore level courses PSC 291/292 and changing of the time offering of PSC 292 has led to increased enrollment in the course (24 students in 2011 vs. 11 in 2010) and an increase in the early enrollment for the junior level course PSC 301 (21 students enrolled). This represents a significant increase in retention of students at this level. Student involvement and is enhanced by having an accessible class at all levels, so that students do not feel distant from the faculty or program. The progression of students from their freshmen to junior year (through the sophomore level PSC 292) will continue to be monitored closely, as will the ability of students to easily enroll in required courses.