BASIC PROGRAM INFORMATION

Program Review is about documenting the discussions and plans you have for improving student success in your program and sharing that information with the college community. It is also about linking your plans to decisions about resource allocations. With that in mind, please answer the following questions.

Program/Department Name: Nanoscience

Division Name: Physical Science Mathematics and Engineering

Please list all team members who participated in this Program Review:

Name	Department	Position
Robert D. Cormia	Nanoscience	Faculty

Number of Full Time Faculty: 0.6 **Number of Part Time Faculty:** 0

Please list all existing Classified positions: *Example: Administrative Assistant I*

Ruyu Chen Administrative Assistant

SECTION 1: PROGRAM REFLECTION

1A. Program Update: Based on the program review data, please tell us how your program did last year. We are particularly interested in your proudest moments or achievements related to student success and outcomes.

Enrollments were slightly lower than 2014-15 (57 versus 64) but ~ 58% over the four year average. Enrollments in NANO10, Nanoscience, was significantly higher at Palo Alto High School (17 vs. 11) in fall 2016 vs fall 2015, a sign that the program is getting more attention in our high school venue.

1B. Program Improvement: What areas or activities are you working on this year to improve your program? Please respond to any feedback from the supervising administrator from last year's program review.

We are adding more hands on activities and laboratories to enhance the student experience at the high school level, and additionally created a new course, NANO62, and advanced nanomaterials engineering course that integrates NANO52 (Nanostructures), NANO53 (Nanocharacterization) and NANO54 (Nanofabrication).

1C. Measures of Success: What data or information will you use to measure your success (e.g. student success rates, changes in student or program learning outcomes)?

Success rates have averaged ~ 80 to 90% for both men and women, and across ethnicity (white, Asian, Latino). We have had younger students enter the program, and their success rates are similar to older (matriculated) students, although mastery of core level SLOs is slightly lower. The primary reason students don't complete the course, especially younger students, is their total class workload.

1D. EMP Goal: The 2015-2020 Educational Master Plan (EMP) includes the following goal:
"Create a culture of equity that promotes student success, particularly for underserved students."

Based on the program review data, tell us some of the things your program will be doing this year to support this goal. You will be asked to report on any accomplishments on your next comprehensive program review.

Students of all ethnicities find support in completing their homework, laboratories, etc., and special attention is given to students who may not have as strong a technical foundation entering the course. In this respect, matriculated white students have an advantage, as well as strong Asian students. We pay attention to students (of any etnicity) who may not have as strong a technical foundation, who typically struggle the most in the adavanced courses. As our institutional STEM focus increases, and especially for underserved / underrepresented populations, there will be an increasing percentage of students who lack technical experience and context, which are two success factors for this program.

SECTION 2: PROGRAM OBJECTIVES & RESOURCE REQUESTS

2A. New Program Objectives: Please list any new objectives (do not list your resource requests).

Program Objective	Implementation Timeline	Progress Measures
Example: Offer 2 New Courses to Meet Demand	*Winter 2016 Term*	*Course Enrollment*
Offer new course (NANO62) in spring 2017	Spring 2016 term	15-20
Offer electron microscopy training	Summer 2016 term	3-5
Offer internships at NASA-Ames	Fall 2017 term	1-3

2B. Resource Requests: Using the table below, summarize your program's unfunded resource requests. Refer to the Operations Planning Committee (OPC) website for current guiding principles, rubrics and resource allocation information.

Resource Request	$	Program Objective (Section 2A)	Type of Resource Request			
			Full-Time Faculty/Staff Position	One-Time B-Budget Augmentation	Ongoing B-Budget Augmentation	Facilities and Equipment
			☐	☐	☐	☐
			☐	☐	☐	☐
			☐	☐	☐	☐
			☐	☐	☐	☐
			☐	☐	☐	☐
			☐	☐	☐	☐
			☐	☐	☐	☐
			☐	☐	☐	☐
			☐	☐	☐	☐
			☐	☐	☐	☐

2C. Unbudgeted Reassigned Time: Please list and provide rationale for requested reassign time.

SWP (Strong Workforce Funding) requested for spring/summer 2017 for NASA internship program

SECTION 3: LEARNING OUTCOMES ASSESSMENT SUMMARY

3A. Attach 2015-2016 Course-Level Outcomes: Four Column Report for CL-SLO Assessment from TracDat. Please contact the Office of Instruction to assist you with this step if needed.

3B. Attach 2015-2016 Program-Level Outcomes: Four Column Report for PL-SLO Assessment from TracDat. Please contact the Office of Instruction to assist you with this step if needed.

SECTION 4: FEEDBACK AND FOLLOW-UP

This section is for the Dean/Supervising Administrator to provide feedback.

4A. Strengths and successes of the program as evidenced by the data and analysis:

As noted in previous program review, Robert Cormia is a dedicated and hard working faculty member. As a sole faculty in the department, Robert works to keep the Nano program active along with advocating for research opportunities and connections with NASA and other agencies. He is an energy champion and student champion.

The Nano Success Rate is 86% in 2015-16, much higher than the PSME division success rate of 66%.

4B. Areas of concern, if any:

As noted before, the Nanotechnology program, due to its small size and WSCH (weekly student contact hours), faces certain issues.
1. Enrollment continues to be an issue. Enrollment has decreased from 88 in 2014-15 to 73 in 2015-16. With Robert's professional development leave this academic year (2016-17), the enrollment is expected to decrease further.
2. Dual enrollment with the local high school has yielded some exposure and increase in (high school students) enrollment but the current number of students taking Nanotechnology courses cannot sustain the program.
3. Program growth continues to be an issue. There is currently no demand at the community college level for the Nanotechnology program or the reach to these students have not be advertised properly. Whatever, the case may be, the program is dwindling.

4C. Recommendations for improvement:

Changing and upgrading the current program may be an option.
The change should include internship or apprenticeship with a clear pathway for career opportunities.
The program might have to be absorbed into another department.

4D. Recommended Next Steps:

- ☒ Proceed as Planned on Program Review Schedule
- ☐ Further Review / Out-of-Cycle In-Depth Review

Upon completion of Section 4, the Program Review document should be returned to department faculty/staff for review, then submitted to the Office of Instruction and Institutional Research for public posting. Please refer to the Program Review timeline.

Unit Course Assessment Report - Four Column

Foothill College

Department - Nanotechnology (NANO)

Mission Statement: Provide technicians training for students and working professionals practicing nanomaterials engineering

Course-Level SLOs	Means of Assessment & Targets for Success / Tasks	Assessment Findings/Reflections	Action Plan & Follow-Up
Department - Nanotechnology (NANO) - NANO 10 - INTRODUCTION TO NANOTECHNOLOGY - Applications - students will describe the industrial applications of nanotechnology, with specific instances (applications) in semiconductors, high performance materials, (and suggested) energy, food, water, computing, and medicine - assessment by written evaluation. (Created By Department - Nanotechnology (NANO)) **Start Date:** 09/01/2011 **End Date:** 01/01/2013 **Course-Level SLO Status:** Active	**Assessment Method:** Students write a midterm assignment studying an application of nanotechnology including analysis of an industrial application, a company working in that area, and the technical approach taken to solve that problem. **Assessment Method Type:** Case Study/Analysis **Target for Success:** Ability to communicate a problem space (industrial application) and why it is important, the reason behind the technical approach taken, and how a company will bring this particular solution into the market place.	04/25/2016 - Case study analysis by students was excellent, far exceeding expectations **Result:** Target Met **Year This Assessment Occurred:** 2015-2016 **Resource Request:** N/A **GE/IL-SLO Reflection:** N/A	
		04/25/2016 - Students successfully completed a case study analysis of a key application in nanotechnology. Students with four-year degrees were able to complete the task with ease, while younger (typical) students struggled a bit. In addition to essays, we will consider having a final class presentation (as conducted by Jill Johnsen in winter 2011). A combination of essay and class presentation would help other students benefit from individual research. **Result:** Target Met **Year This Assessment Occurred:** 2015-2016 **Resource Request:** N/A **GE/IL-SLO Reflection:** N/A	12/16/2012 - Bring more 'current news' into the course, focus on applications and the PNPA rubric (NSF-ATE 0903316) that integrates processing => structure => properties => applications. Have more in class student presentations on writing assignments one and two, and have more in class discussions about current nanotech news.
		04/25/2016 - Students made excellent presentations about applications of nanotechnology in a class presentation that was accompanied by a written paper. This project continues to be important in developing a broader understanding of nanoscience applications. **Result:**	

Course-Level SLOs	Means of Assessment & Targets for Success / Tasks	Assessment Findings/Reflections	Action Plan & Follow-Up
		Target Met **Year This Assessment Occurred:** 2015-2016 **Resource Request:** N/A **GE/IL-SLO Reflection:** N/A	
		04/25/2015 - At both Palo Alto HS and Gunn HS, students were able to identify the applications of nanotechnology, principally through group projects. Target was met in 2014/2015. **Result:** Target Met **Year This Assessment Occurred:** 2015-2016 **Resource Request:** N/A **GE/IL-SLO Reflection:** N/A **GE/IL-SLO Reflection:** N/A	
Department - Nanotechnology (NANO) - NANO 10 - INTRODUCTION TO NANOTECHNOLOGY - Field of Nanotechnology - students will describe the field of nanotechnology from a historical perspective, and emergent / convergent from physics, materials science and engineering, semicondutors and electronics, biology and chemistry - assessment by written evaluation (Created By Department - Nanotechnology (NANO)) **Course-Level SLO Status:** Active	**Assessment Method:** Weekly writing assignment **Assessment Method Type:** Discussion/Participation **Target for Success:** Ability to communicate the history and contest of Nanotechnology, as integrative of but also distinct from chemistry, physics, and materials science		
Department - Nanotechnology (NANO) - NANO 10 - INTRODUCTION TO NANOTECHNOLOGY - Material Engineering - students will describe the material	**Assessment Method:** Weekly writing assignment **Assessment Method Type:** Discussion/Participation		

Course-Level SLOs	Means of Assessment & Targets for Success / Tasks	Assessment Findings/Reflections	Action Plan & Follow-Up
engineering and application challenges in energy, food, water, computing, and medicine - assessment by written evaluation. (Created By Department - Nanotechnology (NANO)) **Course-Level SLO Status:** Active	**Target for Success:** Ability to communicate the need for new materials and materials engineering solutions in the field of energy, food, water, computing, and medicine.		
Department - Nanotechnology (NANO) - NANO 10 - INTRODUCTION TO NANOTECHNOLOGY - Nanoengineering - students will describe how nanotechnology and nanoengineering are practiced in industry, including thin film deposition, particle size, distribution, and surface area, grain boundary engineering, lattice dimension / strain - students will describe the material engineering and application challenges in energy, food, water, computing, and medicine - assessment by written evaluation. (Created By Department - Nanotechnology (NANO)) **Course-Level SLO Status:** Active	**Assessment Method:** Weekly writing assignment **Assessment Method Type:** Discussion/Participation **Target for Success:** Ability to communicate how nanotechnology and nanomaterials engineering is used in industry, and specifically the technical approaches to solving problems in application development.		
Department - Nanotechnology (NANO) - NANO 10 - INTRODUCTION TO NANOTECHNOLOGY - Nanostructures - students will identify ten key nanostructures, how they are prepared, and why they are important in nanoscience and materials engineering - assessment by written evaluation. (Created By Department - Nanotechnology (NANO)) **Course-Level SLO Status:** Active	**Assessment Method:** Weekly writing assignment **Assessment Method Type:** Discussion/Participation **Target for Success:** Students will identify and define ten key nanostructures and why they are important in nanotechnology. Can including structure => property relationships as well as industry applications		
Department - Nanotechnology (NANO) - NANO 10 - INTRODUCTION TO NANOTECHNOLOGY - PNPA Rubric -	**Assessment Method:** Final writing assignment **Assessment Method Type:**		

Course-Level SLOs	Means of Assessment & Targets for Success / Tasks	Assessment Findings/Reflections	Action Plan & Follow-Up
students will learn and apply the PNPA rubric to key application and product engineering challenges - as a method for applying the engineering method to advanced materials engineering - assessment by written evaluation. (Created By Department - Nanotechnology (NANO)) **Course-Level SLO Status:** Active	Research Paper **Target for Success:** Ability to integrate the PNPA rubric into an industry application (nanotechnology or area of research (nanoscience). Demonstrate understanding of processing => structures => properties => applications		
Department - Nanotechnology (NANO) - NANO 10 - INTRODUCTION TO NANOTECHNOLOGY - Properties Relationships - students will apply theory of atomic, electronic, and material structure to Modeling and Simulation, Engineering, and Structure - Properties Relationships. (Created By Department - Nanotechnology (NANO)) **Course-Level SLO Status:** Active	**Assessment Method:** weekly writing assignment **Assessment Method Type:** Discussion/Participation **Target for Success:** Ability to describe how particular properties emerge from molecular/electronic structures etc., and a general understanding of structure => property relationships.		
Department - Nanotechnology (NANO) - NANO 10 - INTRODUCTION TO NANOTECHNOLOGY - Fabricating Nanostructure - students will identify the primary process tools for fabricating nanostructured materials, how they work, and where they fit into both academic research and industrial laboratories and manufacturing. (Created By Department - Nanotechnology (NANO)) **Course-Level SLO Status:** Active	**Assessment Method:** weekly writing assignments **Assessment Method Type:** Discussion/Participation **Target for Success:** Ability to identify basic approaches to nanofabrication from a tools and process perspective. May integrate a notion of key nanostructures, properties, and applications.		
Department - Nanotechnology (NANO) - NANO 10 - INTRODUCTION TO NANOTECHNOLOGY - Characterization Tools and Methods - students will identify the primary process tools for characterizing nanostructured materials, how they work,	**Assessment Method:** weekly writing assignment **Assessment Method Type:** Discussion/Participation **Target for Success:** Ability to identify typical instruments and		

Course-Level SLOs	Means of Assessment & Targets for Success / Tasks	Assessment Findings/Reflections	Action Plan & Follow-Up
and where they fit into both academic research and industrial laboratories and manufacturing (QA/QC). (Created By Department - Nanotechnology (NANO)) **Start Date:** 09/01/2011 **End Date:** 01/01/2013 **Course-Level SLO Status:** Active	methods used in characterizing nanomaterials, nanostructures, and elucidating structure property relationships.		
Department - Nanotechnology (NANO) - NANO 10 - INTRODUCTION TO NANOTECHNOLOGY - Emergent and Converget Nanotechnology - students will identify and discuss the current challenges to nanotechnology and nanoengineering in policy, education, funding, legal, and environmental applications and identify and discuss the future emergent and convergent areas of nanotechnogy, including quantum computing, synthethic biology, and IT/MEMS (nanorobotics) (Created By Department - Nanotechnology (NANO)) **Course-Level SLO Status:** Active	**Assessment Method:** weekly writing assignment **Assessment Method Type:** Discussion/Participation **Target for Success:** Describe the convergence of nanotechnology, biology, physics, etc., and the legal and policy implications of nanotechnology. Identify where funding of research is needed.		
Department - Nanotechnology (NANO) - NANO 51 - APPLICATIONS OF NANOTECHNOLOGY - Fundamental Concepts of Nanoscience - What are (some of the) fundamental tenants of nanoscience? (Emergence of properties at scale, self-assembly, surface area effects, and emergence of nanosystems). (Created By Department - Nanotechnology (NANO)) **Start Date:** 01/01/2012 **End Date:** 01/01/2013 **Course-Level SLO Status:** Active	**Assessment Method:** weekly writing assignments and midterm/final writing assignments **Assessment Method Type:** Exam - Course Test/Quiz **Target for Success:** Describe key ideas / concepts in nanoscience and how / why they are important in nanotechnology. Three key ideas are self-assembly, surfaces, and emergence of properties at scale.	04/25/2016 - Students in this class were similar to previous classes in having a diversity of knowledge and skills. This course did perform slightly better in describing the fundamental tenants of nanotechnology, especially size, surface area, and self-assembly. The class may have been more prepared. We also talked more about nanotechnology applications. **Result:** Target Met **Year This Assessment Occurred:** 2015-2016 **Resource Request:** N/A **GE/IL-SLO Reflection:**	

Course-Level SLOs	Means of Assessment & Targets for Success / Tasks	Assessment Findings/Reflections	Action Plan & Follow-Up
		N/A	
		04/25/2016 - Students used the PNPA rubric effectively in preparing final assignments, however, as noted in many other reflections, students with four-year science and engineering degrees performed far better than students with minimal science foundation. The PNPA rubric continues to be a strong pedagogical tool in NANO. **Result:** Target Met **Year This Assessment Occurred:** 2015-2016 **Resource Request:** N/A **GE/IL-SLO Reflection:** N/A	
		04/25/2016 - Students continue to do well with the fundamental concepts of nanoscience, however we see a striking difference between students that have completed a year of chemistry and physics compared to those who have not. This isn't unexpected and suggests that we should try to recruit from science courses. In fall 2016, we did notice that a number of younger and more prepared students mastered this SLO much better. **Result:** Target Met **Year This Assessment Occurred:** 2015-2016 **Resource Request:** N/A **GE/IL-SLO Reflection:** N/A	
		04/25/2016 - Students did very well with fundamental concepts of self assembly and surface area effects, however emergence of properties at scale, and emergence of nanosystems, were more difficult. As in previous classes, students who had an understanding of	12/16/2012 - Have students present and discuss a fundamental nanoscience concept as a group. For the four tenants mentioned here, group projects would likely encourage more research, and

Course-Level SLOs	Means of Assessment & Targets for Success / Tasks	Assessment Findings/Reflections	Action Plan & Follow-Up
		atomic structure and one year of physics and chemistry did much better than students who were studying nanotechnology concurrently with chemistry and physics. **Result:** Target Met **Year This Assessment Occurred:** 2015-2016 **Resource Request:** N/A **GE/IL-SLO Reflection:** connects to the four C's research and analysis (but not computation skills)	especially discussion, and ensure better understanding of each topic.
Department - Nanotechnology (NANO) - NANO 51 - APPLICATIONS OF NANOTECHNOLOGY - Key Nanostructures used in Nanotechnology - What are the 10-20 key nanostructures used in industry? (Apply PNPA to each in a top-level manner) (fullerenes, nanotubes, thin films, and dendrimers) (Created By Department - Nanotechnology (NANO)) **Start Date:** 01/01/2012 **End Date:** 01/01/2013 **Course-Level SLO Status:** Active	**Assessment Method:** weekly writing assignments and midterm/final essays **Assessment Method Type:** Exam - Course Test/Quiz **Target for Success:** Describe ten to twenty key nanostructures and how and why they are used in industry. Include a description of PNPA processing => structures => properties => applications, and how PNPA is used in industry / nanomaterials engineering.		
Department - Nanotechnology (NANO) - NANO 51 - APPLICATIONS OF NANOTECHNOLOGY - Fundamental Applications of Nanotechnology - What are the fundamental problems addressed and industries using nanoscience and nanoengineering? Use PNPA, and how does it relate to the actual hands-on practice of nanomaterials engineering? (Created By Department - Nanotechnology (NANO)) **Start Date:**	**Assessment Method:** midterm/final writing assignment **Assessment Method Type:** Case Study/Analysis **Target for Success:** Describe fundamental problems in industry requiring novel materials / properties, and how / where nanomaterials engineering is used to find solutions to those problems. Integrate PNPA: processing => structures => applications => properties into the discussion		

Course-Level SLOs	Means of Assessment & Targets for Success / Tasks	Assessment Findings/Reflections	Action Plan & Follow-Up
01/01/2012 **End Date:** 01/01/2013 **Course-Level SLO Status:** Active	of nanomaterials engineering for application development.		
Department - Nanotechnology (NANO) - NANO 52 - NANOMATERIALS & NANOSTRUCTURES - Key Nanostructures used in Nanotechnology - What are the key 10 to 12 nanostructures used in nanotechnology, and what are their composition and structure. Why are they important and what industries use them to solve what types of problems? (Created By Department - Nanotechnology (NANO)) **Start Date:** 01/01/2012 **End Date:** 01/01/2013 **Course-Level SLO Status:** Active	**Assessment Method:** weekly writing assignments and midterm/final writing assignment **Assessment Method Type:** Exam - Course Test/Quiz **Target for Success:** Describe ten to twelve key nanostructures in terms of their elemental composition, molecular and electronic structures, and how/why they are important in nanoscience and nanotechnology. Integrate PNPA (fundamental structure => properties)	07/01/2016 - Students are capable of identifying a dozen key nanostructures, the key properties and applications, and how the materials are fabricated and characterized. **Result:** Target Met **Year This Assessment Occurred:** 2015-2016 **Resource Request:** N/A **GE/IL-SLO Reflection:** N/A	
Department - Nanotechnology (NANO) - NANO 52 - NANOMATERIALS & NANOSTRUCTURES - Structure => Property Relationships - How do properties arise from key nanostructures? Using the systems archetype model: networks of atoms, systems of physics, and emergence of properties at scale. (Created By Department - Nanotechnology (NANO)) **Start Date:** 01/01/2012 **End Date:** 01/01/2013 **Course-Level SLO Status:** Active	**Assessment Method:** weekly writing assignment **Assessment Method Type:** Exam - Course Test/Quiz **Target for Success:** Ability to describe fundamental interactions (physics) at the level of molecular and electronic structure that lead to the emergence of properties, and specific structure => property relationships. Ideally integrate the nanopatterns pedagogy of networks of atoms => systems of physics => and emergence of properties at scale.	07/01/2016 - Students show through weekly assignments they understand how structure leads to properties, using the newer nanopatterns pedagogy. There is a division between younger students and students with degrees. Younger students with less materials experience have a more difficult time with this concept, while students with degrees in chemistry, physics, and engineering are more able to understand and apply this method. **Result:** Target Met **Year This Assessment Occurred:** 2015-2016 **Resource Request:** N/A **GE/IL-SLO Reflection:** N/A	

Course-Level SLOs	Means of Assessment & Targets for Success / Tasks	Assessment Findings/Reflections	Action Plan & Follow-Up
Department - Nanotechnology (NANO) - NANO 52 - NANOMATERIALS & NANOSTRUCTURES - Characterization and Fabrication of Key Nanostructures - What are the primary fabrication and characterization tools for the key 10 - 12 nanostructures used in nanotechnology? (Created By Department - Nanotechnology (NANO)) **Start Date:** 01/01/2012 **End Date:** 01/01/2013 **Course-Level SLO Status:** Active	**Assessment Method:** midterm/final writing assignments **Assessment Method Type:** Exam - Course Test/Quiz **Target for Success:** Ability to describe process and characterization tools and methods for fabricating and characterizing key nanostructures. Ideally integrate PNPA rubric: process => structures => properties => applications that tie tools to structure => properties.	07/01/2016 - Assigning fabrication and characterization techniques to each nanostructure is an advanced concept / skill and is the focus of evolving NANO52 into NANO62. Students are generally able to assign fabrication and characterization tools to a small number of nanostructures, usually nanocarbon, silicon, thin films and surfaces, and perhaps one other they make the focus of their final project. NANO62 (Advanced Materials Engineering) will be a test to see if the majority of a class can learn the fabrication and characterization tools for each structure. **Result:** Target Met **Year This Assessment Occurred:** 2015-2016 **Resource Request:** N/A **GE/IL-SLO Reflection:** N/A	
Department - Nanotechnology (NANO) - NANO 53 - NANOMATERIALS CHARACTERIZATION - Structure Characterization Tools - What combination of instruments are used to characterize the composition, chemistry, and structure of a material? (Created By Department - Nanotechnology (NANO)) **Start Date:** 09/01/2011 **End Date:** 12/30/2015 **Course-Level SLO Status:** Active	**Assessment Method:** weekly writing assignments and midterm/final writing assignment or project **Assessment Method Type:** Exam - Course Test/Quiz **Target for Success:** Describe the selection and use of characterization tools to determine composition, chemistry, structure of a material, to support process development, and FA/QA/QC of nanomaterials and devices.	01/01/2016 - We spent a LOT of time on characterization tools, using both drill and discussion, and it appears to have paid off, especially for students with some materials engineering experience, and/or a prior course (NANO52 Nanostructures) in the program sequence. That said, it appears to simply take time to absorb the various tools, and the scenario based curriculum approach appears to be effective here. In fall 2015, the students had a very strong background in materials engineering and were able to apply new knowledge of the tools to their projects and interests. **Result:** Target Met **Year This Assessment Occurred:**	

Course-Level SLOs	Means of Assessment & Targets for Success / Tasks	Assessment Findings/Reflections	Action Plan & Follow-Up
		2015-2016 **Resource Request:** N/A **GE/IL-SLO Reflection:** N/A	
		01/01/2016 - Students were able to describe the correct approach by instrument class (image, surface, structure, organic, elemental etc) but not as specific within a class of instruments (e.g. SEM/TEM, or AFM/STM) but were able to articulate why you would use a particular type of instrument, or at least why a particular tool was needed. In smaller groups where longer discussion was possible, we were able to describe the choice and approach of a particular tool in materials characterization and failure analysis. Learning the names of tools was a little cumbersome. In fall 2015 this trend continued, and but a number of more experienced students were able to apply knowledge of tools to their projects fairly well. **Result:** Target Met **Year This Assessment Occurred:** 2015-2016 **Resource Request:** N/A **GE/IL-SLO Reflection:** Critical thinking in context of an industrial problem.	
		01/01/2016 - Students were able to describe the appropriate tools for composition, chemistry, and structure, and had the ability (with notes) to align tools, nanostructures, and industry. Performance varied based on experience. This was clearly shown in both their middle term and final project assignment, especially in fall 2015. **Result:** Target Met **Year This Assessment Occurred:** 2015-2016	12/16/2012 - Do more in class drills (discussion) asking students to quickly identify the types of tools used in an industry, to look at specific materials, to solve particular types of problems. This builds on our 5-step rubric instrument => physics => information => materials => industry problems. The rubric is rigorous but intuitive in application.

Course-Level SLOs	Means of Assessment & Targets for Success / Tasks	Assessment Findings/Reflections	Action Plan & Follow-Up
		Resource Request: N/A **GE/IL-SLO Reflection:** Degree holders and especially students with industry experience were able to do this more successfully than students with minimal technician level experience. This trend continues in fall 2015 - and our workforce program has also made note of this.	
		01/01/2016 - We spent more time on this SLO in fall 2014 and fall 2015 and it paid off. We could definitely spend more time on this topic in the future, and will using more in class exercises that were very effective in helping students understand which tools are used for what types of tests, and the information gained from those analyses. Using class discussions as an instructional tool, we were able to share what other students knew about the tools, and how to use them. **Result:** Target Met **Year This Assessment Occurred:** 2015-2016 **Resource Request:** N/A **GE/IL-SLO Reflection:** N/A	
Department - Nanotechnology (NANO) - NANO 53 - NANOMATERIALS CHARACTERIZATION - Property Characterization Tools - What combination of instruments are used to characterize the physical properties of materials? How are structure-property relationships determined? (Created By Department - Nanotechnology (NANO)) **Start Date:**	**Assessment Method:** weekly writing assignments and midterm/final writing assignment or project **Assessment Method Type:** Exam - Course Test/Quiz **Target for Success:** Describe key tools and methods for determining material properties (physical, electrical, optical, magnetic, etc.) and elucidation of structure => property		

Course-Level SLOs	Means of Assessment & Targets for Success / Tasks	Assessment Findings/Reflections	Action Plan & Follow-Up
09/01/2011 **End Date:** 01/01/2013 **Course-Level SLO Status:** Active	relationships		
Department - Nanotechnology (NANO) - NANO 53 - NANOMATERIALS CHARACTERIZATION - Approaches to Failure Analysis and Materials Characterization - What are are typical approaches to failure analysis, materials characterization, and QA/QC (for nanostructures, nanomaterials, devices and industries)? (Created By Department - Nanotechnology (NANO)) **Start Date:** 09/01/2011 **End Date:** 01/01/2013 **Course-Level SLO Status:** Active	**Assessment Method:** weekly writing assignments and midterm/final writing assignment or project **Assessment Method Type:** Exam - Course Test/Quiz **Target for Success:** Describe approaches to failure analysis, materials characterization, and QA/QC using specific tools for key problems/devices in targeted industries.		
Department - Nanotechnology (NANO) - NANO 54 - NANOFABRICATION TOOLS & PROCESS - Process Tools and Techniques - What are the key process tools and techniques used to fabricate nanomaterials and nanostructures? (Created By Department - Nanotechnology (NANO)) **Start Date:** 01/01/2012 **End Date:** 01/01/2013 **Course-Level SLO Status:** Active	**Assessment Method:** weekly writing assignments and midterm/final writing assignment or project **Assessment Method Type:** Exam - Course Test/Quiz **Target for Success:** Describe key process tools and techniques for fabrication of nanomaterials and devices used in high technology industry (semiconductors, magnetic media, biomedical devices, etc). Explain why specific tools and processes are used.	04/01/2016 - Students described the use of various sputtering and process tools, but many found their description difficult because of the lack of familiarity with the vocabulary, and or needing hands-on experience. This was even more difficult in winter 2016 **Result:** Target Not Met **Year This Assessment Occurred:** 2015-2016 **Resource Request:** N/A (other than internships) **GE/IL-SLO Reflection:** N/A (other than internships) 04/01/2016 - Students have challenges with this SLO, and most likely because we don't have a hands-on component where they can see the process equipment. Students who participated in internships, and/or have work experience using	

Course-Level SLOs	Means of Assessment & Targets for Success / Tasks	Assessment Findings/Reflections	Action Plan & Follow-Up
		these tools. are able to identify two-three tools fairly well **Result:** Target Not Met **Year This Assessment Occurred:** 2015-2016 **Resource Request:** We need to fund internships at NASA-ASL (this is still a need for NANO) **Resource Request:** We need to fund (more) internships at NASA-ASL (this is still a need for NANO) **GE/IL-SLO Reflection:** N/A **GE/IL-SLO Reflection:** N/A	
		04/01/2016 - All of the students were able to identify one or more process tools associated with each type of material/structure. Interestingly students who were strong in one area, e.g. semiconductors, were not weaker in a new area, e.g. nanocarbon, ceramics, or metals and alloys. Students with a four-year degree (all of this smaller class) had a slight advantage in learning techniques, but not significantly. **Result:** Target Met **Year This Assessment Occurred:** 2015-2016 **Resource Request:** N/A **GE/IL-SLO Reflection:** N/A	12/16/2012 - Develop more tours of local industry that show students fabrication tools and process, including thin film and nanocarbon deposition, and ideally finished products, such as solar PV films, nanocarbon materials, and semiconductor (MEMS).
		04/01/2016 - Students were able to match process tools and techniques for nanostructures for general categories of materials, but not so much for specific nanomaterials. This was a particularly small class, very experienced in narrow domains, but not the larger subject area. **Result:** Target Met	

Course-Level SLOs	Means of Assessment & Targets for Success / Tasks	Assessment Findings/Reflections	Action Plan & Follow-Up
		Year This Assessment Occurred: 2015-2016 **Resource Request:** None **GE/IL-SLO Reflection:** Not applicable	
Department - Nanotechnology (NANO) - NANO 54 - NANOFABRICATION TOOLS & PROCESS - Process Optimization - What are the key methods and approaches to process optimization, including optimizing process => structure => properties (Created By Department - Nanotechnology (NANO)) **Start Date:** 01/01/2012 **End Date:** 01/01/2013 **Course-Level SLO Status:** Active	**Assessment Method:** weekly writing assignments and midterm/final writing assignment or project **Assessment Method Type:** Exam - Course Test/Quiz **Target for Success:** Describe approaches for process optimization, including diagraming process intervention points, characterization tools, and tying structure => property relationships to to process => structure relationships, and demonstrating the turnkey / interlocked relationships in the PNPA rubric.		
Department - Nanotechnology (NANO) - NANO 54 - NANOFABRICATION TOOLS & PROCESS - Process Reproducibility - What are the key methods and approaches to achieving process reproducibility, and what QA/QC methods are also employed in that process? (Created By Department - Nanotechnology (NANO)) **Start Date:** 01/01/2012 **End Date:** 01/01/2013 **Course-Level SLO Status:** Active	**Assessment Method:** weekly writing assignments and midterm/final writing assignment or project **Assessment Method Type:** Exam - Course Test/Quiz **Target for Success:** Describe methods and approaches to achieving process reproducibility, including flow charts, process diagrams, and points of intervention, for nanofabrication and processing (manufacturing) in high-tech related industries (semiconductors, thin films, magnetic media, and biomedical devices).		

Unit Assessment Report - Four Column

Foothill College

Program (PSME - NANO) - Nanoscience AS/CA

PL-SLOs	Means of Assessment & Target / Tasks	Assessment Findings/Reflections	Action Plan & Follow-Up
Program (PSME - NANO) - Nanoscience AS/CA - Nanoscience / Nanotechnology Competency - Technicians will apply foundational nanoscience principles to understanding and further learning about nanostructures, properties, and engineering solutions (read and apply literature, seminars, and webinars). Demonstrate through written assignments (diagrams etc.), term papers, and class presentations. Use PNPA as a way to read and learn from technical writing articles **Year PL-SLO implemented:** End of Quarter **Start Date:** 01/01/2012 **End Date:** 01/01/2013 **SLO Status:** Active	**Assessment Method:** Students use case studies in nanoscience (research) and nanotechnology (commercial applications) to demonstrate an understanding of the relationships between processing => structure => properties => applications, and how scientists and engineers leverage structure => property relationships for nanomaterials selection, and how new fabrication methods produce novel nanostructures with unique / tailored properties. **Assessment Method Type:** Case Study/Analysis	12/01/2016 - Students continue to use case studies effectively throughout NANO51 (applications) NANO52 (structures) NANO53 (Characterization) and NANO54 (fabrication) to describe the use of the PNPA rubric in integrated materials engineering. In NANO10 (Nanoscience) younger students have used the PNPA rubric to show the integration path from structure-properties to fabrication-structure to characterization of structure and process optimization. **Result:** Target Met **Year This Assessment Occurred:** 2015-2016 **Resource Request:** Funding of electron microscopy training at NASA-ASL (MACS facility)	
Program (PSME - NANO) - Nanoscience AS/CA - Nanomaterials Engineering - Technicians will develop effective engineering plans for developing materials engineering solutions for industrial applications (using PNPA). These include applying characterization skills to elucidating structure=> property relationships, process optimization (for desired properties) and consistent material manufacturing. Demonstrate through term projects (diagrams etc.), engineering lab experiments, and class presentations, **Year PL-SLO implemented:** End of Quarter **Start Date:**	**Assessment Method:** Students will demonstrate an understanding of effective nanomaterials engineering practice through class lab projects where they will design / describe / document a path from processing => structure => (characterization) => properties => applications. **Assessment Method Type:** Class/Lab Project	12/01/2016 - Students develop a working plan to develop an advanced material for a new application, e.g. a thin film for solar PV, or a nanoparticle for energy storage. They consider the current state of the art for a material, current fabrication methods, and design a processing path to reach a specific structure, with specific properties. This PLO is only accomplished after taking NANO54, however in spring 2016 we will be offering NANO62, advanced materials engineering, which is an integrated / advanced course comprising components from NANO52, NANO53, and NANO54. We believe the integrated pedagogy will be effective for achieving this PLO. **Result:** Target Met	

PL-SLOs	Means of Assessment & Target / Tasks	Assessment Findings/Reflections	Action Plan & Follow-Up
01/01/2012 **End Date:** 01/01/2013 **SLO Status:** Active		**Year This Assessment Occurred:** 2015-2016 **Resource Request:** Funding of electron microscopy training at NASA-ASL (MACS facility)	
Program (PSME - NANO) - Nanoscience AS/CA - Nanotechnician Competency - Technicians will support fundamental R&D, process development, characterization (including QA/QC FA etc.) and consistent / good manufacturing practice (in all sizes of high technology firms). Demonstrate through internship and work experience. **Year PL-SLO implemented:** End of Quarter **Start Date:** 01/01/2012 **End Date:** 01/01/2013 **SLO Status:** Active	**Assessment Method:** Students will demonstrate an ability to effectively practice the integrated nanomaterials engineering method (PNPA rubric) in a working / research environment. Students will practice processing/fabrication, characterization, and working to develop/optimize a fabrication/processing method. Could be capstone experience in a laboratory, internship, or incumbent working experience. **Assessment Method Type:** Field Placement/Internship	12/01/2016 - In previous years we were able to place interns at NASA-ASL (Advanced Studies Lab) where they received microscopy training, and working in advanced materials engineering. This year, with UC Santa Cruz pulling out of the ASL/MACS facility, we were only able to train three students in the use of microscopes, and additionally couldn't support the materials development (experiments) for the three students **Result:** Target Not Met **Year This Assessment Occurred:** 2015-2016 **Resource Request:** Funding of electron microscopy training at NASA-ASL (MACS facility) **Resource Request:** Funding of electron microscopy training at NASA-ASL (MACS facility)	