Hartnell College

NASA—CIPA II

Executive Summary

(draft 3/7/06)

1. INTRODUCTION

The ***Hartnell College Engineering Program Upgrade with Project Management*** project will result in: updating the college's current introductory engineering course; developing curriculum for three new, advanced engineering courses infused with project management; development of special projects and internship opportunities for students at partner institutions; funding for new engineering laboratory equipment; and a better trained, and qualified science, technology, engineering, and mathematics (STEM) faculty. NASA material and content related to project management and the agency's projects and strategic enterprises will be incorporated into the revised introductory lecture course and into the new advanced courses, and applied to student internships and special projects. The program improvements resulting from new engineering curricula will provide a significant advancement in scientific and engineering instrumentation and capacity at Hartnell College. Student-centered learning is an essential ingredient in this project and will allow students to gain experience on all aspects of an engineering project applied to real world situations.

Improvements to the engineering program will occur with the consultation of professionals from several key partner institutions. The partnerships will provide a level of expertise needed to ensure articulation of the courses, give students experience working with professionals in the field, and provide a pipeline for future internships. Due to the interdisciplinary nature of our strong partnerships, the tie between Astronomy and Engineering will be a recurring theme.

Short-term goals of the project include: upgrade and expand engineering offerings so that they correspond with NASA's needs; articulate with a four-year engineering degree; identify and create special projects, internships, and capstones with partner institutions; support faculty development; and correspond with upgrades and improvements in the College's other STEM programs; development of programs to improve minority student enrollment, persistence, retention, and transfer; and provide our underrepresented students with a historical awareness of the STEM accomplishments of the indigenous peoples of the Americas.

The project's long-term goal is to build the engineering program and create for our underrepresented students, a seamless articulation pathway into UCSC's Jack Baskin School of Engineering.

2. HISTORY OF STEM AMONG INDIGENOUS PEOPLES OF AMERICA

This project is designed to enhance engineering education at Hartnell to better serve a large population of Latino and other minority students who are eager to learn and succeed in science and related fields if given the opportunity. If large numbers of underrepresented and disadvantaged students are to have access to STEM-based postsecondary programs and careers in this vast rural region of California, Hartnell will have to provide that opportunity.

This project is based on documented experience and methods resulting in significant improvements in underrepresented student enrollment and success in current engineering courses.

There are many ways in which Hartnell students will be encouraged to take pride in their STEM knowledge, and ways to enhance the chance of their adopting that culture as their own, as opposed to sensing it as something alien that has intruded on their world and on their lives from a foreign place.

Before Europeans arrived on American shores, the indigenous peoples of the Americas had already taken significant steps in the evolution of their STEM culture. Historically, people have always looked upward to the stars for inspiration. It is there that all civilizations of the old world –along the Yangtze, Indus, Tigres-Euphrates, and the Nile rivers-- found gods and science; it was no different for the advanced peoples of the Americas—Aztecs, Toltecs, Zapotecs, Maya, Incas, etc. The celestial bodies and their relationships with the seasons have always attracted the attention of farmers and shepherds, followed by the formal and ritualistic attention of priests; globally, historically STEM was stimulated by and partly evolved from these interests. Perhaps a reason that astronomy has often led the way too is that the objects of study were available to everyone.

There will be great value in encouraging the historical awareness among the Hispanic population at Hartnell College in their joint indigenous STEM history, and there are many examples from which to choose dating back to 1000 b.c. In astronomy, extant writings and calendars show that both the Aztecs and the Maya excelled. The constructions of the Inca at Machu Picchu in Peru and of the Maya on the Yucatan Peninsula indicate sophisticated engineering. Electroplating was done by metal workers on the high plateau in Peru as early as 900 a.d. The Maya had an excellent base-20 numbering system, which is no less powerful than the European base-10 system, and the use of 0. There are many other examples. It will be possible to increase the awareness of these important facts among all students and visitors to Hartnell.

As part of attracting more Hispanic students to engineering, retaining them, and increasing their chance of success, we will consider the overall question of how to get our students to acknowledge the important history of the indigenous American peoples in these (STEM) endeavors, and to realize that progress of STEM culture belongs to them as much as to anyone.

3. CURRICULUM REVISION AND UPGRADE

This project will revise/update the introductory engineering course and create three new advanced engineering courses with lab and field activities. The curriculum developed through this project will be designed in close consultation with the College's partner U.C. Santa Cruz. The new engineering courses will articulate with both the University of California and California State University systems. The new/revised engineering courses

will be a foundation to pursue a Bachelor of Science degree program in engineering and other closely related STEM majors. Descriptions of these courses, as they are envisioned, are detailed below:

Engineering 1 – Introduction to Engineering. *(Revise: Spring 06, Implement: Fall 06)* Currently this course is a look at different areas of engineering and the day – to – day realities of a career in engineering. We would like to begin our students education in project management here. Proposed revisions and upgrades will provide engineering students with an introduction to project management. This will include:

- Project life-cycle phases
- Individual and team roles
- Work breakdown structure
- Planning and scheduling
- Reviews and success criteria
- Risk management
- Project safety
- Earned value and performance indicators
- Configuration management
- Examples of program management failure

Engineering 45 – Special Topics in Engineering. *(Design: Spring 06, Implement: Spring 07)* Special Topics courses are 1-3 units of laboratory. 1 unit of lab requires 48-54 hours of lab time. Students would be mentored by a faculty member in a research laboratory environment.

Engineering 7A – Project Management in Engineering. *(Design: Fall 06, Implement: Fall 07)* This course will be the first semester of a two semester course giving students practical experience in Project Management. Engineering 7A is designed to enable a student, acting in concert with other students, to set up a project plan and management information system for an engineering project. In the laboratory component, students must meet in small groups to develop a complete project management plan for a new product. This plan will involve all aspects of project management presented in the lecture component of the course.

Students in this course will learn both project management skills and topics in rocketry design. They will have the opportunity to learn to work together as a team as well as collaborate with professionals from outside institutions. During this course, students must organize themselves into a team to design CanSat devices and possibly the rocket to launch the CanSats. CanSats are small, self-contained devices that are launched to high altitudes, deployed by parachutes, and mimic the functions of satellites orbiting Earth.

This course will be taught by Hartnell engineering faculty with additional support from professionals at the Naval Postgraduate School, members of the Tripoli Rocket Association (Central California Branch in Fresno), and experts from NASA-Ames.

Students will work as a team to write up a detailed proposal to design the CanSat payload and launch vehicle.

Their proposal will include an introduction to the basics behind rocketry, a description of the relationship of their project to the interests of NASA and the aerospace industry, design of the payload and high-powered rocket, assignment of roles, an equipment list, a budget, plan
of action, and a timeline. During this phase, the students will be given instruction on the basics of high-powered amateur rocketry and learn key concepts in project management with the emphasis on the methods used in engineering.

Project management topics that will be covered in the course will be:

- Project selection, acquisition, and development
- Developing and following a detailed work plan
- Developing and managing a project schedule and budget
- Controlling projects for quality
- Communicating effectively with the project team, client and supervisors
- Team building
- Anticipating and avoiding potential problems
- Developing networking skills
- Proposal writing

Engineering topics that will be covered in the course will be:

- Design and structure of rockets used by NASA
- Flight mechanics
- Chemistry of fuels
- Nozzle Design
- Stress/strain
- Aerodynamics/stability control
- Heat transfer
- Fin Design
- Stress Interaction
- Flight data acquisition
- Data telemetry
- Physics of propulsion

Engineering 7B –Project Management in Engineering. *(Design: Spring 07, Implement Spring 08)* This course will be the follow-up to 7A. This semester's work will be focused on project plan execution and close out. Working in groups, students will use the tools of project management as they proceed to manufacture a new product. Students will utilize project planning guides and tools such as Microsoft Project. Each team will be responsible for reporting on their progress and challenges biweekly.

Students will work on building, operating, and testing their CanSats and high-power rocket. Students will have access to computers, modeling software such as SPLASH and RockSim, and equipment and instruments for the fabrication of the rocket. In addition to working with engineering faculty at Hartnell, students will have the opportunity to work closely with professionals from the Naval Postgraduate School, members from the Tripoli Rocketry Association, and scientists at NASA-Ames to construct a working prototype of the CanSat payload and high-power rocket. They will make regular trips to the Naval Postgraduate School and NASA-Ames to work with professionals on the design and fabrication of their rockets and Tripoli Central California Branch at Fresno to test and launch their rockets. After successful testing of their CanSat device and launch vehicle, students will enter their design in the ARLISS CanSat competition which is held yearly at the end of summer in the Black Rock Desert in Nevada. The students will also participate in the October Skies Launch event.

4. PARTNER INSTITUTIONS

The importance of the partner organizations, and particularly the people who represent them, cannot be overemphasized. NASA has particularly recognized the value of the partnerships, created with advanced institutions, by Hartnell. Under CIPA I, Hartnell established partnerships with the Center for Adaptive Optics at UCSC, NASA-Ames, and Konica Minolta. These partnerships helped to provide valuable expertise, resources, and networks, which continue to be useful in our efforts to promote the growth of the program. Under CIPA II, Hartnell will continue to build new partnerships and network with established ones.

The College will be working closely with the University of California, Santa Cruz (UCSC) Baskin School of Engineering and its affiliated research center at NASA-Ames, the Center for Adaptive Optics at UCSC, the Naval Postgraduate School, and Fremont Peak Observatory Association in developing and implementing this project. These partnerships will include, but are not limited to, cooperating on the development of curriculum for all courses, lab, and field activities; ensuring that all courses meet University of California and California State University articulation requirements; creating special projects and internship opportunities for students; providing seamless transition between the community college and the university; cooperating on minority student recruitment and support in science, technology, engineering, and math programs (using both institutions' MESA programs as links and models); and ensuring updated transfer agreements are in place.

5. SPECIAL PROJECTS AND INTERNSHIP OPPORTUNITIES

An important component of this project will be to provide motivated STEM students with opportunities to explore advanced topics of Project Management in Engineering through participation in special projects and internships with partner institutions. Some examples of these projects and/or internships are the following:

UCSC Baskin School of Engineering and the University Affiliated Research Center at NASA-Ames: Students can be apprentices to senior design projects at UC Santa Cruz on team-based projects such as:

- Technology Information Management Projects
- Air Traffic Control Systems at NASA-Ames
- Bio-Engineering and Bio-Medical Research Projects
- Micro Electronics and Nanotechnology

Students may also be placed in internships at NASA-Ames through the University Affiliated Research Center there.

Center for Adaptive Optics: Through cooperative efforts between Hartnell faculty and CfAO, students can engage in a variety of adaptive optics activities and applications such as:

- Fabrication of Adaptive Optics Demonstrator
- Activities involving the Adaptive Optics Demonstrator such as:
  - Experiment with the beam's aberration by passing distorted glass or introducing turbulence.
  - Use several computational methods and observe quickness of correction, quality of correction, and error.
  - Write new centroiding methods, reconstruction routines, and merit-figuring components.
  - Change the optical layout of the system and experiment with different input beams, lens relay configurations, etc.
- Micro Electro Mechanical Systems (MEMS) software development for fabrication of adaptive optics actuators

Naval Postgraduate School: Students will work on special projects involving solid and liquid rocket design and operation.

Fremont Peak Observatory: Students will develop a plan to operate the 30-inch telescope. After obtaining experience at an observatory, students will be involved in designing and constructing an observatory that would be used to house a telescope, CCD, and computer.

We will also explore internships and special projects with other organizations:

- Stratospheric Observatory For Infrared Astronomy (SOFIA)
- Monterey Bay Aquarium Research Institute (MBARI)
- Monterey Institute for Research in Astronomy (MIRA)
- Model rocketry companies such as Estes
- Salinas Valley Memorial Hospital Imaging Technology Department (NASA partner)
- Local companies involved with construction or fabrication

- Regional aerospace companies
- Mentoring by local project managers

Furthermore, we will brainstorm ideas for internships and special projects with the Advisory Board and the Hartnell College Foundation Board of Directors.