

ASTRONOMY DEPARTMENT PROGRAM REVIEW, 2010

By William E. Keig

Overview of the Astronomy Department

The Astronomy department offers lecture and laboratory sections in freshman-level astronomy. These courses are offered mainly to satisfy a general studies science requirement.

Two lecture courses are offered, Astronomy 20 (The Solar System) and Astronomy 25 (Stars and Galaxies). In Fall, 2009, according to grade distribution reports, enrollment totaled 32 in two sections of Astronomy 20 and 30 in one section of Astronomy 25. In Winter, 2010, enrollment was 28 students in Astronomy 20. In Spring, 2010, a total of 32 students were enrolled at the conclusion of the eight week section of Astronomy 20, and for the two sixteen week lecture sections in astronomy, 22 students were enrolled in Astronomy 20, and 30 students were enrolled in Astronomy 25. If these numbers hold up, they will represent a 35% increase from 62 students in Fall to 84 students in Spring. These classes are usually held in the Astronomy Lab, but they also make use of the computer lab to allow students individually to simulate the night sky and to visit astronomy sites on the internet.

A laboratory course (Astronomy 12) is planned to be offered in Spring, 2010, using the observatory.

The Astronomy program suffered a setback with the loss of its only faculty member in the middle of the Fall, 2007 Semester but is now stronger than ever in terms of the number of students served.

Status of previous recommendations

The Prioritized Recommendations and their current status from the 2004 Astronomy Department Program review are as follows.

1. Hire a Planetarium Manager.
 - a. Does not apply to CEC. There is no planetarium on the CEC campus.
2. The department should also try active measures to increase success and retention without sacrificing rigor. This could be done by doing more interactive activities and by coordinating and developing classroom activities together, rather than individually as is done now.
 - a. The full-time faculty member at CEC is currently involved in FIPP (Faculty Inquiry Partnership Program) and developed a space mission assignment for Astronomy 20 in cooperation with a faculty member from Human Development and the Library Staff.
3. The astronomy department should alter its schedule to offer more classes on weekends and the mornings. Perhaps include a lab course in these new/restored offerings.
 - a. A Friday section of Astronomy 25 was added, and a Saturday section of Astronomy 20 was also added in Spring, 2010. Neither was as successful as the weekday sections, and the Friday section was cancelled for lack of students. The Saturday class, though initially packed, had many no-shows.
4. Maintain current high level of instruction in Astronomy.

- a. The level of instruction has improved at CEC by the assignment of a faculty member who is actively involved in astronomical research.
5. Students should be resurveyed at the end of the semester to re-examine whether an algebra level astronomy or astrophysics class should be developed or not.
 - a. This survey has not been conducted. Given the small size of the CEC Astronomy student body, it is unlikely that there would be sufficient demand for such a course.
6. Evaluate current tutoring experiences, including the new night opportunity. Review the findings.
 - a. The CEC has made a major effort to convince strong Astronomy students to become tutors, so far without success.
7. A combined lecture-lab course should also be developed pending survey results/other data.
 - a. The CEC offered Astronomy only as a combined lecture-lab course before its merger with El Camino College. Now that lecture and lab are separate, the laboratory is usually not offered because of low enrollment. It is possible that CEC students should be required to take the lab for their own good, but to establish that would require data that is difficult to gather.
8. Develop the ability to recruit and hire outstanding astronomy instructors, both full and part-time, when they become available.
 - a. There has been no need to hire new instructors in the past 6 years. The current instructor transferred over from the Math department.
9. Full-time teachers should be more active in the night courses, either by teaching the courses or by mentoring and/or monitoring the faculty.
 - a. The CEC has one night course, which has always been taught by the same full-time faculty member since its inception.
10. Expand the public planetarium program to offer additional school shows and more evening shows.
 - a. Does not apply to CEC. See response to recommendation #1 above.
11. Develop a formal (paid) mentoring program for new instructors.
 - a. The FIPP program (see response to recommendation #2 above) serves as a voluntary paid mentoring program for faculty members who choose to take part, whether new or experienced..
12. The Astronomy department should do a survey of other schools' exams and/or course materials to determine if our lower-than-average success and retention rates are, in fact, caused by offering more rigorous courses.
 - a. No such survey was conducted.
13. Develop a science pre-requisite course and/or elementary astronomy course.
 - a. No such course has been developed. Given the small size of the CEC it is doubtful that such a course would attract enough students to be offered.
14. Find a new long-term tutor or two for the Learning Resource Center.
 - a. The CEC has continued to recommend strong students to be tutors in Astronomy, but has had as yet no success in hiring student tutors. The increase in astronomy enrollment may increase the pool of potential tutors in astronomy.

Recommendation: Continue to search for qualified student tutors.

Course grade distribution; success and retention rates

The success and retention rates for 2006-2010 were extracted from an Institutional Research-published document on that department's Academic Performance web page. [insert graphs: success-- 75.0%, 50.0%, 66.7%, 59.8%, retention—75.0%, 65.5%, 81.7%, 75.6%]. Because the CEC is a smaller institution than the main El Camino campus, there is a greater statistical variation at the CEC. However, the four year averages at the CEC are remarkably similar to those at the main campus: 63% and 74% at the CEC compared to 55% and 75% at the main campus. This puts the CEC about even with the statewide success rate and about 7% below the statewide retention rate. The current instructor is applying methods learned in the FIPP workshop to expand the active learning content of the Astronomy courses in the hopes of improving both success and retention. Because of differences in the maturity of students in different sections, it is difficult to assess the effect of new teaching methods on student success and retention. The most important change in teaching style was made in Astronomy 20.

Recommendation: Ask Institutional Research to help us compare populations in Astronomy 20 sections and compare retention and success in the evening class before and after the change in teaching style. *(No cost but uses personnel time.)*

This recommendation is based on the fact that at this writing the success and retention rates in the Saturday class seem to be lower than those of the evening class, so that comparing a population of both Saturday and evening students to a population of weekday students could be misleading. Spring, 2010 is the first semester for which we have a Saturday class. Should the total population of all sections turn out to be similar to the previous total population of all sections, then it would be appropriate to compare the two total populations.

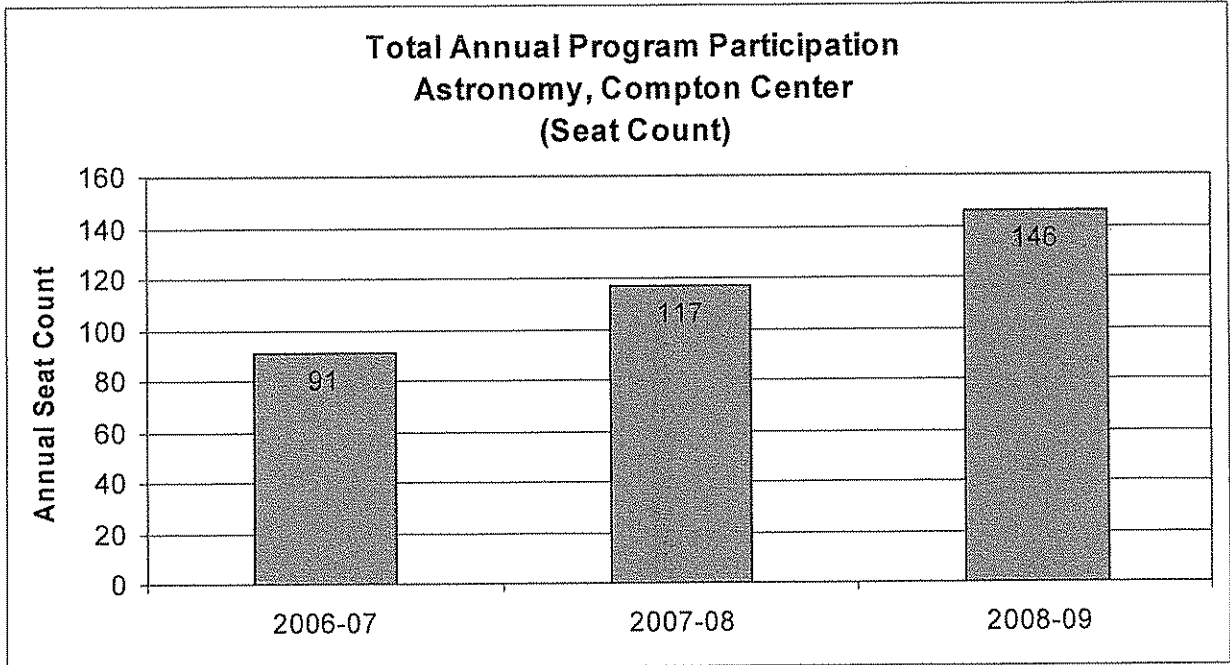
Recommendation: Consider adding an actual (rather than a recommended) prerequisite in English to Astronomy 20 and 25, if data suggest that Astronomy students are less prepared than students in other general education science classes. *(No cost.)*

Reading the text is an important part of learning the material in the class. Also, if the space mission, in cooperation with the library, is to become a permanent part of the Astronomy 20 class, then students will need to be able to read resources that are available on line and from the library. If reading and research are to become important parts of a student's astronomy experience, then communication with the library staff is vital and should be increased.

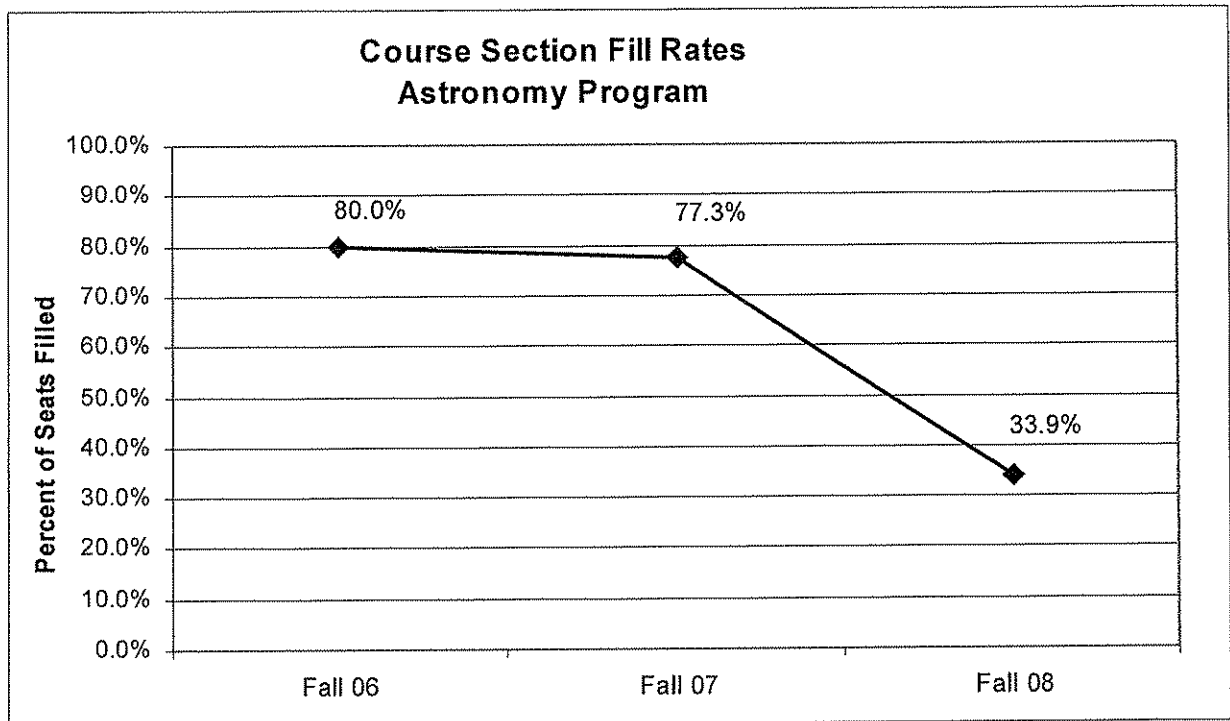
Recommendation: Astronomy faculty should increase their communication with library staff regarding instructional materials and library based education. *(No cost.)*

Enrollment statistics with section and seat counts; fill rates

As the chart below shows, enrollment in astronomy increased by 60% from the 2006-2007 academic year to the 2008-2009 academic year.



The next chart shows a decrease in fill rate. This is due to the seat limit being raised to match the limit at the ECC main campus. This seat limit is unrealistically high for the CEC, as will be discussed in the section on **Adequacy and currency of these facilities, equipment, and technology**



Curriculum—Course, Content, and Articulation

The Astronomy department submitted revised course outlines for Astronomy 13, 20, and 25 for review by the Division Curriculum Committee and College Curriculum Committee in the 2009-2010 academic year. There are no anticipated changes to any of these courses. However, new astronomical findings are constantly incorporated in these courses, and there has been some discussion of reducing some duplication of material between Astronomy 20 and 25. The CEC has no current plans to offer Astronomy 13, which is unlikely to attract enough students to allow the CEC to offer it. It would be a low priority for the CEC in any case, since it does not articulate as a science course in either the CSU or UC system.

Student Learning Outcomes (SLOs)

As of this writing, one SLO has been done and documented for each of the four astronomy courses. No official SLO report has yet been reported for CEC, but the CEC has SLO results for Astronomy 20 in the Fall Semester, 2009, and both the Winter Semester, 2010 and the eight week Spring section, which are listed below.

Astronomy 12 – Astronomy Laboratory

SLO: Using a Cassegrain reflecting telescope, students will be able to align the telescope and point it at several objects, including the Moon, planets visible to the naked eye, planets invisible to the naked eye, bright stars, faint stars, and diffuse objects (clusters, nebulae, and galaxies).

Assessment instrument: The final exam in Astronomy 12

Assessment results: To be assessed in week 16 in Spring 2010.

Astronomy 20 – The Solar System

SLO: Students will be able to explain the causes of seasonal variations in the length of the day, directions of sunrise and sunset, and the amount of solar heating on the Earth.

Assessment instrument: Given a specific month, students will diagram a path of the Sun in the sky as seen in California and estimate the hours of daylight and the amount of heat absorbed by the land.

Assessment results: The assessment results below for Fall, 2009 are designated as 12/09. Winter results are designated as 2/10. Eight week Spring Semester results are designated 4/10.

Question	% correct		
	12/09	2/10	4/10
5. match drawing with seasons	50%	71%	80%
6. match drawing with daytime length	57%	89%	73%
7. match right side drawings with hot/cold	50%	61%	70%
8. which drawing shows 12 hour days	61%	57%	73%

3B. *What were the most important findings from the data?*

Given the small sample sizes—28, 28, and 30, respectively—the improvement is barely significant, statistically, but the second and third groups fall within the 60% to 80% range reported by El Camino College. If the same questions are given to the sixteen week Saturday class, the Spring Semester percentages may come down slightly because their performance on Test 1 was not quite as good as the eight week Monday Wednesday evening class. One student gave two alternate answers to daytime being exactly 12 hours, saying maybe none of the above because the sun was never exactly east nor west. There is a surprisingly large number of students who think all days have 12 hours of daylight despite the fact was emphasized that this was only true of the Vernal and Autumnal Equinox. For the Saturday class the instructor will shrink photocopy the picture to be so close to east and west that the student will be unable to see the error.

3C. *What changes can be made to address these implications?*

The problems with 12 hour days, especially in the Winter class, which is one of the strongest ever to have taken Astronomy at CEC, may indicate the necessity of changing the teaching style. On a non-SLO test question, students were more likely to correctly state that the Sun is south of overhead at high noon after they have seen the practical connection to designing houses to be energy efficient. Something similar will be tried here. The change in day length will be related to the savings in heating and cooling costs brought about by Daylight Savings Time. This could also be a way to increase success on the hot/cold question, which also resulted in a low score.

3E. *Next time this assessment is performed, what changes need to be made to the SLO statement, assessment, rubric, or method to get better results?*

For the Saturday class the instructor will try to reduce test confusion about where the sun is rising and setting by shrink photocopying the picture to be so close to east and west that the student will be unable to see the error.

3F. *How does this SLO tie a) to any program-level SLOs or b) to institutional core competencies or c) general education outcomes?*

We recently completed a map between our course SLOs and the 6 core competencies. The course SLO most strongly emphasizes I) Content knowledge, and II) Critical and Analytical Thinking. The course SLO is also strongly related to the first and third program-level SLOs shown below.

Astronomy 25 – Star and Galaxies

SLO: Students will explain how electromagnetic radiation and astronomical instruments are used to reveal the properties of stars and planets.

Assessment instrument: Students will be given the spectrum of two stars or planets. They will then determine which star or planet has the higher temperature. Students will determine which star or planet is larger by determination of radii from relative temperatures and luminosities.

Assessment results: To be assessed in week 16 in Spring 2010.

Astronomy Program level SLOs

SLOs:

1. Students will be able to explain how the study of electromagnetic radiation and the application of the laws of physics reveal the properties of stars, planets, and galaxies. (Slightly modified from the Astronomy 25 SLO.)
2. Students will be able to apply the Scientific Method to the solution of scientific problems.
3. Students will be able to identify and appreciate ways in which astronomy affects their daily lives.
4. Students will be able to describe the structure and contents of the Universe and major events in the history of the Universe that led to the formation of the Earth.

Assessment instrument: Is under development, and will be used for the first time during the Spring 2010 semester.

Assessment results: To be assessed during Spring 2010.

Overall, the course SLOs have led to and will continue to lead to improvement in assessment of learning and the associated student and teacher activities. The SLOs themselves will likely also need to be improved, based on the analysis of the results.

Facilities, Equipment, and Technology

Facilities, equipment, and technology used by the program/department

The major facilities used by the Astronomy department are the Astronomy Lab, the Observatory, and the Math/Science Computer center. The Astronomy Lab serves also as a lab for Physics, Biology, and Health Sciences.

It has direct access to the Laboratory Storage Room, where a VCR and attached television are stored as well as optics equipment that is useful for lecture demonstrations and cloudy day astronomy labs. Because it is designed to be used as a lab it contains considerable storage space and twelve laboratory tables, eight of which seat two students each and four of which seat one student each. The Math/Science Computer center allows students individually to search the internet for important astronomical information and to use the Night Sky program to observe the apparent motion of the Sun, the other stars, the Moon and the planets. The Observatory houses the following telescopes: a sixteen inch diameter computer operated Cassegrain reflector, a twelve inch diameter equatorial mount Newtonian reflector, an eight inch diameter manually operated Cassegrain reflector, a four and one half inch diameter equatorial mount Newtonian reflector, and an eighty millimeter diameter equatorial mount refractor.

Adequacy and currency of these facilities, equipment, and technology

The enrollment cap has been set at 40 for Astronomy 25 and 45 for Astronomy 20. It has been pointed out that California state law allows that many students in a room of that size. However, as the room is now designed it cannot reasonably accommodate more than 30 students. As indicated in the above paragraph, the lab tables seat a total of 20 students. By adding five seats or desks to the left and five to the right, we can increase the number of seats to 30. If we are to increase the number of seats to 40 or 45 it will be necessary to remove the laboratory tables and replace them with an adequate number of desks. Such an action would be met by justifiable objections from other departments which use that room as a lab. In both Fall and Spring Semesters it was necessary to request a change of room. The result presented a hardship to other classes and to the Astronomy class, which was forced to meet on a different floor from where the equipment is stored. This action was taken as a result of the registration reaching 38 in one case and 36 in the other case. If the registration had reached 45 there would have been no available room in Fall, 2009, because the largest classrooms had been taken.

Recommendation: Set the enrollment cap at 30 at CEC for both Astronomy 20 and 25. (*Estimated cost: none if the number of astronomy sections is the same, but it will require paying more for faculty salaries if more sections need to be added.*)

As of this writing, the Astronomy faculty at the El Camino Torrance campus has indicated that it is studying the idea of reducing the enrollment cap of Astronomy 25 from 40 to 39 or 35.

Recommendation: El Camino faculty members in Astronomy at both the CEC and the Torrance Campus should work with each other and with Institutional Research to assess the effect of reducing the size of Astronomy 25 on Student Learning Outcomes.

The course description and SLO for Astronomy 12 requires that each student individually demonstrate the ability to point the telescope at unseen objects, using bright stars as a guide. To do this requires that the students take turns using manual telescopes. This is extremely time consuming with our small number of telescopes.

Recommendation: Buy three more telescopes with equatorial mounts. (*Estimated cost: \$1500.*)

Most of the newest available Astronomy supplemental instructional materials are now on CDs and difficult or impossible to obtain on tape.

Recommendation: Buy a CD player. (*Estimated cost: \$300.*)

Staffing

Current staffing

The Astronomy department currently has one full-time faculty member, who is able to teach most of the astronomy and physics courses, and currently (Spring 2010) only one physics course is taught by a part-time instructor. This large FT/PT ratio is possible because the full time instructor has taken 20-30% overloads routinely and because of the low physics enrollment. Professor Keig also teaches Physics classes at times as part of the teaching load. As the Astronomy and Physics programs expand it is anticipated that in the short term reliance on part-time faculty will increase. The Astronomy Department also shares with other departments the services of Ruben Valenzuela, who has expertly operated and maintained the sixteen inch Cassegrain reflector telescope and invited other members of the CEC community to attend observation sessions.

Conclusion and Summary

Prioritized recommendations and needs of your program/department.

Non-facilities needs:

1. Continue to search for qualified student tutors.
2. Astronomy faculty should increase their communication with library staff regarding instructional materials and library based education.
3. Ask Institutional Research to help us compare populations in Astronomy 20 sections and compare retention and success in the evening class before and after the change in teaching style. *(No cost but uses personnel time.)*
4. Consider adding an actual (rather than a recommended) prerequisite in English to Astronomy 20 and 25, if data suggest that Astronomy students are less prepared than students in other general education science classes. *(No cost.)*

Facilities needs:

1. Buy three more telescopes with equatorial mounts. *(Estimated cost:\$1500.)*
2. Set the enrollment cap at 30 at CEC for both Astronomy 20 and 25. *(Estimated cost: none if the number of astronomy sections is the same, but it will require paying more for faculty salaries if more sections need to be added..)*
3. El Camino faculty members in Astronomy at both the CEC and the Torrance Campus should work with each other and with Institutional Research to assess the effect of reducing the size of Astronomy 25 on Student Learning Outcomes.
4. Buy a CD player. *(Estimated cost:\$300.)*