ASTRONOMY DEPARTMENT PROGRAM REVIEW, 2010

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With comments from Leon Palmer and Jean Shankweiler

Overview of Astronomy Department

The Astronomy department offers coursework in freshman-sophomore level astronomy, in both lecture and laboratory formats. These courses are offered primarily to satisfy students' needs for a science requirement, but some students (18%, "clicker" data described below) enroll for personal enrichment.

Two lecture courses are offered exclusively in the Planetarium classroom or online. Those are Astronomy 20 (The Solar System, available online) and Astronomy 25 (Stars and Galaxies, only taught in planetarium). According to Grade Distribution reports published by Institutional Research for Fall 2009, Astronomy 20 is the most enrolled course in the entire science division, with 509 students spanning 10 sections including 2 online sections. (For reference, the second-most enrolled course in the division, Biology 10, has 499 students spanning 13 face-to-face sections.)

The astronomy department has two laboratory courses. Astronomy 12 often meets at the college observatory and the observing deck on the roof of the math building, while Astronomy 13abc meets in the telescope making laboratory.

All astronomy courses are offered in or have access to specialized classrooms that are maximized for astronomical instruction.

The Astronomy department is also involved in activities of interest to the general public. Once a month, we host meetings of a local amateur astronomy group: the South Bay Astronomical Society. As time permits, the current faculty give planetarium shows and host public sky viewings through several telescopes. These events are free, open to the public, and exhibit the wonders of the night sky, both in real and in artificial (i.e. planetarium projected) environments. All of the full-time faculty and several others in the department play an active role in the annual Onizuka Space Science Day activities, including hosting and helping out with many activities.

In the past, there were significantly more public events and there were also events coordinated with local elementary schools. Without a planetarium manager, most public events have been canceled or scaled back dramatically. The full-time faculty cannot sustain such programs without assistance.

Who are the astronomy students?

These data were taken from a clicker survey administered by Professor Vakil in his Fall 2009 and Spring 2010 Astronomy 20 sections during approximately the $5^{th}/6^{th}$ weeks. His classes were taught in the afternoons and nights. Polling results are self-reported, so there may be some minor inaccuracies.

The students in Astronomy 20, and presumably astronomy overall are:

- 53% male, 47% female
- 18-24 years old (76%) or 25-29 (10%)
- High school graduates (96%)
- 36% Hispanic, 21% White, 10% African-American, 20% Multicultural or other. (Some categories not listed, giving a total less than 100%.)
- Interested in or already teaching (44%). Specifically, "thinking about becoming a teacher" (27%), "training to be a teacher" (8%), or "already teach" (9%).
- Full-time status 59%, part-time status 34%, and 5 units or less 7%.
- Taking the class for general education (58%) or major (16%) requirement.

However, there are some noticeable differences between our night population and afternoon students. Here is a table contrasting night students with morning/afternoon students.

Description	Night Students	Morning/Afternoon students
Female	57%	50%
18-24 years old	83%	70%
Hispanic	39%	33%
White	24%	19%
Multicultural	7%	13%
Full-time students	50%	67%
Enrolled in 5 units or less	11%	3%
Work 25+ hours per week	51%	34%
Taking class for "personal enrichment"	22%	13%

Institutional Research provided data from the fall semesters from 2005-2008. Those findings showed significantly fewer full-time students (29%) than the recent (clicker) data measured and also showed fewer students 18-24 (64%), but no other significant differences. The disparity between full-time students surveyed by clicker and via Institutional Research is puzzling but may be attributed to different. Perhaps the morning students, all taught by Professor Lloyd, and those students taught by Professor Hacking (e.g. honors) have noticeably different demographic trends from the students sampled by the clickers in Professor Vakil's courses. Sample size may also explain differences.

The interest in teaching is slightly stronger than the national average. According to a national survey, 25% of students in an astronomy-for-nonscience-majors are declared education majors or have expressed an interest in the study of education. Because ECC interest appears to be above the national average and because the interest level is so strong, we write the following recommendation.

Recommendation: Based on the significant interest in teaching, the department should consider allocating at least one section of Astronomy 20 towards teachers, or possibly create or link with a course aimed at teachers.

This recommendation is contingent on the college continuing to support the Teacher Education Program.

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. There has been no progress. **This recommendation is carried forward in this program review**.
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 primarily done now.
    a. At least two of the three full-time faculty are implementing active learning techniques more than they did 6 years ago. Such activities include research-proven Lecture Tutorials, clicker questions to assess learning, and creating videos of classes for students to review classes asynchronously. However, activities and efforts are not coordinated and are still done primarily on an individual-faculty basis.
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. The morning schedule is now full, including a Friday morning 3-hour class that replaced a night section. There are no weekend courses at all, although some students work on their Astronomy 13 telescopes on weekends. The department, like the school, has had to cancel classes, so it is not possible to add weekend classes at this time.
4. Maintain current high level of instruction in Astronomy. [This language is verbatim from the last program review.]
    a. The level of the curriculum has not changed. It is not easy to assess whether the level of the instruction is “high” or otherwise.
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. In the current economic environment, it is unclear if we will be able to pursue such a course, even if a future survey is able to demonstrate demand.
6. Evaluate current tutoring experiences, including the new night opportunity. Revise according to findings.

    a. Data have been gathered regarding the night tutor and this service has been offered steadily for several years. The night tutor also has replaced Jim Lund as the primary telescope technician, and he maintains equipment on nights when few/no students show up for tutoring.
7. A combined lecture-lab course should also be developed pending survey results/other data.
    a. No survey was done, hence no class was developed. See also recommendation #5 above.
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 faculty members in the past 6 years.
9. Full-time faculty members should be more active in the night courses, either by teaching the courses or by mentoring and/or monitoring the faculty.
    a. Most of the night lecture courses have been taught by full-time faculty for several years. The lab classes, however, are taught more by part-time faculty. Success and retention rates in the night classes have increased.
10. Expand the public planetarium program to offer additional school shows and more evening shows.
    a. We have made negative process on this goal as the astronomy faculty have less time available to volunteer. **This recommendation is carried forward in this program review**. We carry this goal forward particularly because of the potential long-term recruiting effects and to help maintain an ECC presence in the community.
    b. **Recommendation**: The astronomy department should consider examining what other California Community Colleges with a planetarium do for public outreach.
11. Develop a formal (paid) mentoring program for new faculty members.
    a. ECC has developed a faculty mentor program (unpaid). The Astronomy department has not needed any mentors in 6 years because of the lack of hiring.
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. Defining "rigorous" could be difficult. However, several research-validated diagnostic exams exist and could be used, such as the Astronomy Diagnostic Test (ADT), Lunar Phase Concept Inventory, and Light and Spectroscopy Concept Test. When the ADT was given to ECC students, there was no significant difference in the entering knowledge of ECC students compared to national comparison groups.
13. Develop a science pre-requisite course and/or an elementary astronomy course.

a. No such course has been developed.

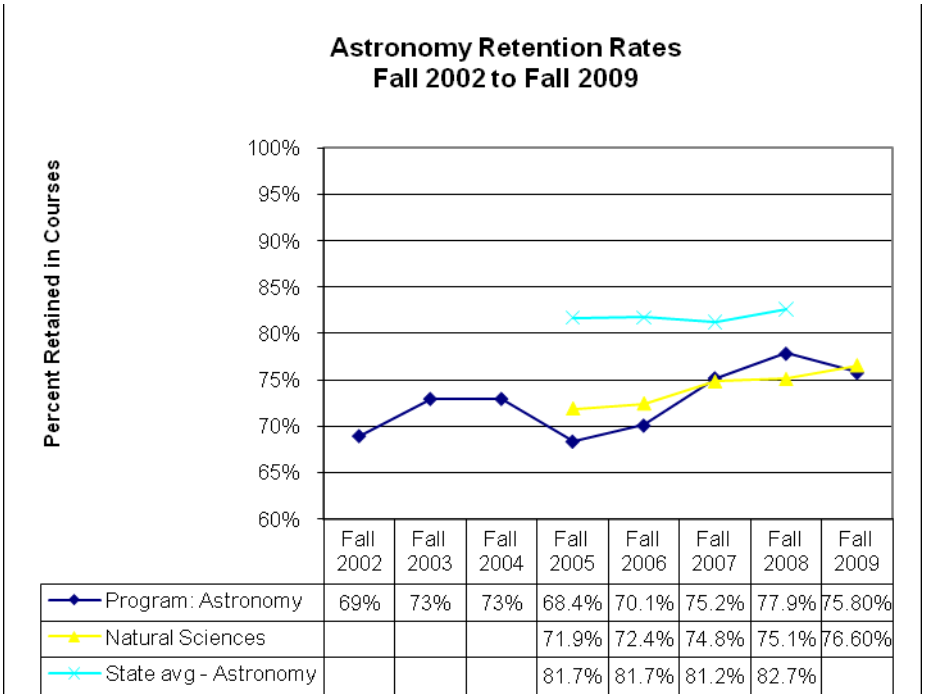
14. Find a new long-term tutor or two for the Learning Resource Center.
    a. Since the last program review, two student tutors have served. It may be difficult to recruit a long-term tutor.

Course grade distribution; success and retention rates

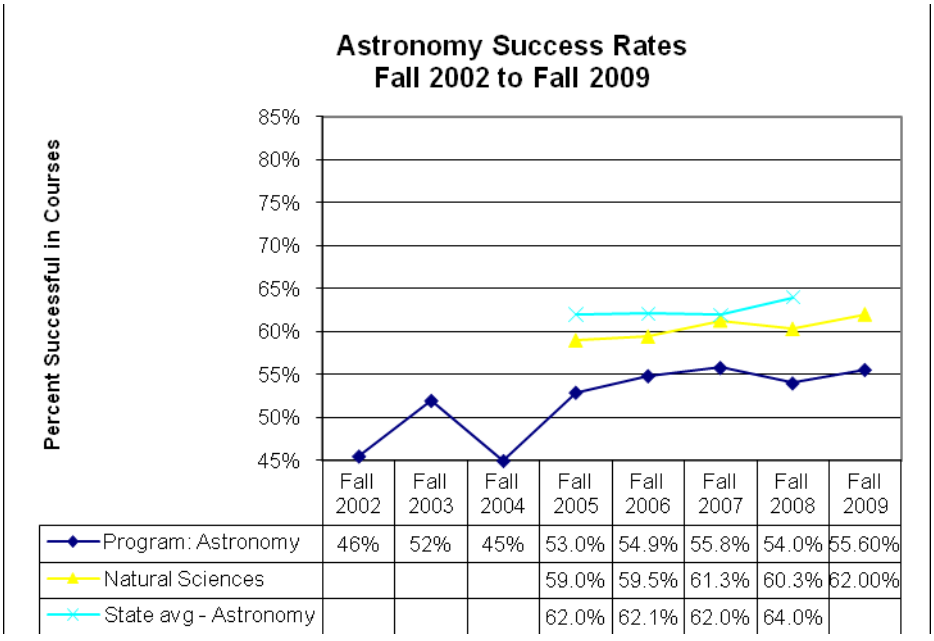
Institutional Research provided data for the Fall semesters between 2005-2008. The Fall 2009 data were extracted from an Institutional Research-published document on the Institutional Research department's Academic Performance web page. The Fall 2002-2004 data were extracted from the chancellor's office website when used as a basis in the previous Program Review. They are included here for comparison purposes.

The retention and success rates were a major concern in the previous Program Review. However, as can be seen in the data below, the Fall 2004 semester had the worst success rate in the 8 year span shown. Retention and (especially) success rates have both improved noticeably since the previous Program Review, the latter rising from 45% to 56%. The attention to the night classes may be responsible for this increase, although the data have not been examined to test this hypothesis.
While ECC's Astronomy department has improved both success and retention rates, we remain 6-7% below the statewide retention rate and 8-10% below the statewide success rate. It is not clear what might cause us to be below average. Possible explanations include: differences in the student populations at ECC vs. California as a whole, teaching styles (e.g. passive vs. active) differing from other astronomy faculty members in the state, or level of rigor vis-à-vis grading. It would be difficult to measure the second and third possibilities, although the first could be quantified. There may also be individual faculty member trends, but the past faculty member performance (e.g. success & retention rates) data are not easily available. Now that faculty can examine their individual results by course, other patterns may emerge.

Recommendation: Ask Institutional Research to help us compare the student population in astronomy classes at ECC to those across the state. (*No cost, but uses personnel time.)*

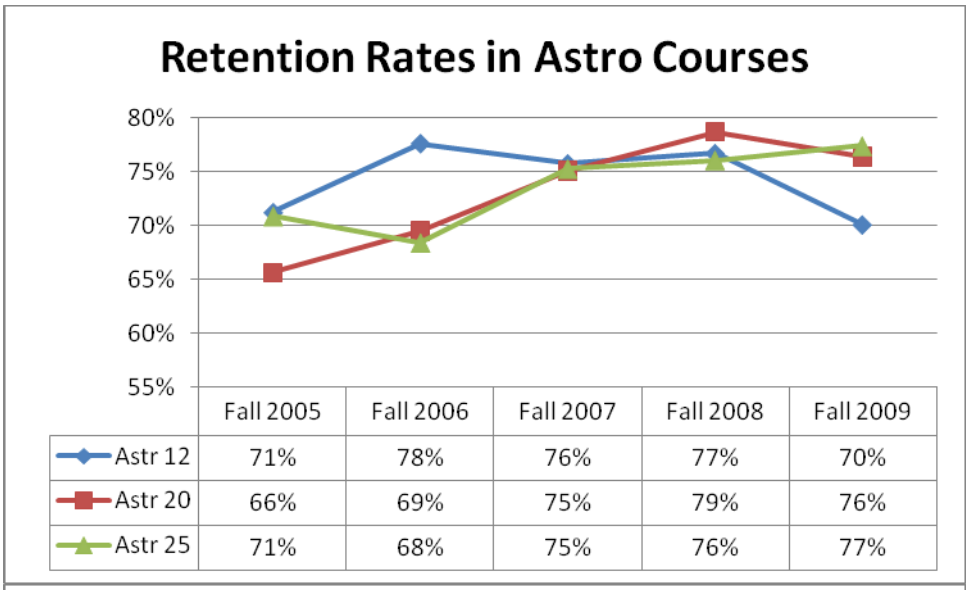


	Fall 2002	Fall 2003	Fall 2004	Fall 2005	Fall 2006	Fall 2007	Fall 2008	Fall 2009
Program: Astronomy	69%	73%	73%	68.4%	70.1%	75.2%	77.9%	75.80%
Natural Sciences				71.9%	72.4%	74.8%	75.1%	76.60%
State avg - Astronomy				81.7%	81.7%	81.2%	82.7%	

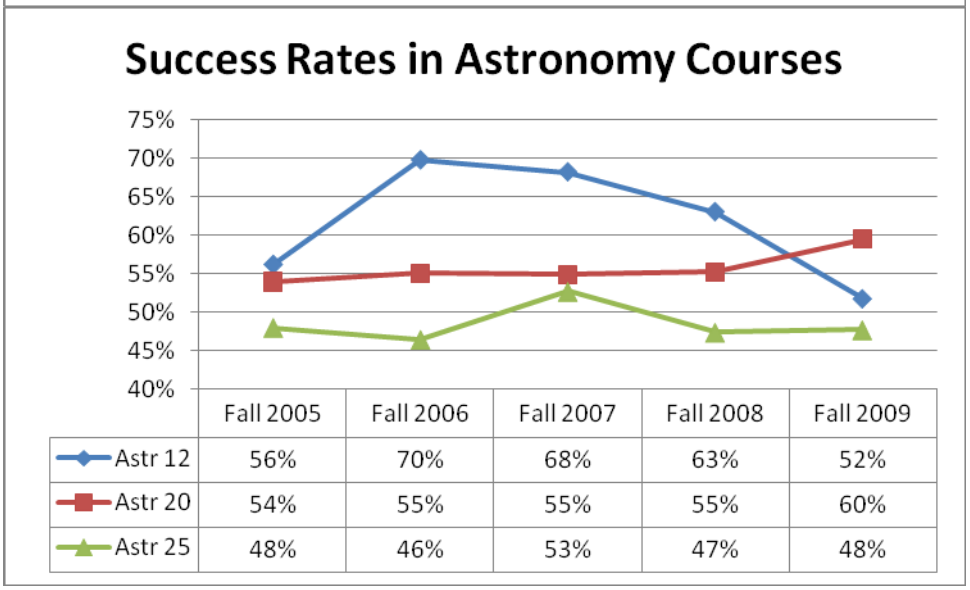


	Fall 2002	Fall 2003	Fall 2004	Fall 2005	Fall 2006	Fall 2007	Fall 2008	Fall 2009
Program: Astronomy	46%	52%	45%	53.0%	54.9%	55.8%	54.0%	55.60%
Natural Sciences				59.0%	59.5%	61.3%	60.3%	62.00%
State avg - Astronomy				62.0%	62.1%	62.0%	64.0%	

This graphs below shows the success and retention rates for the 3 general education astronomy courses:



	Fall 2005	Fall 2006	Fall 2007	Fall 2008	Fall 2009
Astr 12	71%	78%	76%	77%	70%
Astr 20	66%	69%	75%	79%	76%
Astr 25	71%	68%	75%	76%	77%



	Fall 2005	Fall 2006	Fall 2007	Fall 2008	Fall 2009
Astr 12	56%	70%	68%	63%	52%
Astr 20	54%	55%	55%	55%	60%
Astr 25	48%	46%	53%	47%	48%

Comparing the grade distributions of the lecture courses (astro 20 and 25 – data not shown here), the two courses have comparable percentages of A-grades combined with B-grades, and comparable D-grades but Astronomy 20 has more C-grades and fewer F-grades. The data clearly indicate students have more difficulty succeeding in Astronomy 25 than Astronomy 20.

Recommendation: Convert some Astronomy 25 sections to Astronomy 20. (*No cost.*)

Both courses fulfill the same student need in terms of general education and major preparation. The only people who may be impacted are students who have a strong desire to take Astronomy 25 but cannot because of possible reduced offerings. Astronomy 20 offers more seats than Astronomy 25, so Astronomy 20 is more budget-friendly while also producing higher success rates.

Recommendation: Reduce the normal class size of Astronomy 25 from forty students down to 30 or 35 students, expecting to increase student success. (*Cost is unclear, as described below.*)

This recommendation would only be effective if faculty, contrary to current practice, maintain the lower enrollment in Astronomy 25, rather than adding students until most seats are full.

Even though Astronomy 25 has a smaller class size than Astronomy 20, and therefore you might expect to see a better success rate in the smaller Astronomy 25 compared to the larger Astronomy 20, that is not the case. Astronomy 25's class size (40 students) is still one of the larger ECC courses. This may partially explain why Astronomy 25 does not produce better success than Astronomy 20. When compared to Astronomy 20, the content in Astronomy 25 is also significantly more abstract and there are fewer real-world examples available to show students from their everyday lives in Astronomy 25.

Recommendation: Purchase a set of DVDs and obtain other media to help students visualize the abstract content in astronomy 25 (and, to a lesser extent, astronomy 20). DVDs may include episodes of *Nova, The Universe,* other relevant television shows, relevant movies, etc. (Estimated cost: $1000.)

Recommendation: Have Institutional Research determine how many of our students meet the recommended preparation, and compare their outcomes to students who do not meet the recommended preparation. Pending the results, change the recommendation to a requirement.

Recommendation: Have Institutional Research determine how many of our students repeat each of the astronomy courses, and examine any patterns present in the repeating students demographics, educational background, etc.

Recommendation: Consider adding an actual (rather than a recommended) pre-requisite, either in math or 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.*)
Steps to add a Math 73 pre-requisite to astronomy 25 and as a recommended pre-requisite have begun since the first draft of this report.

This recommendation is based on the generally low success rates of astronomy students, compared to other sciences. If comparable general education science classes typically enroll better-prepared students, by adding a pre-requisite to astronomy, we could change our student population to a better-prepared set, increasing student success. Further research, as indicated above, would need to be done before implementing a pre-requisite.

Before a pre-requisite is added, the impact on and importance of enrollment would need to be estimated. Enrollment might be reduced (long-term, but probably not short-term) if

a pre-requisite is added, so perhaps we should examine Astronomy 25's readiness to accept a pre-requisite, before changing the division's biggest breadwinner, Astronomy 20.

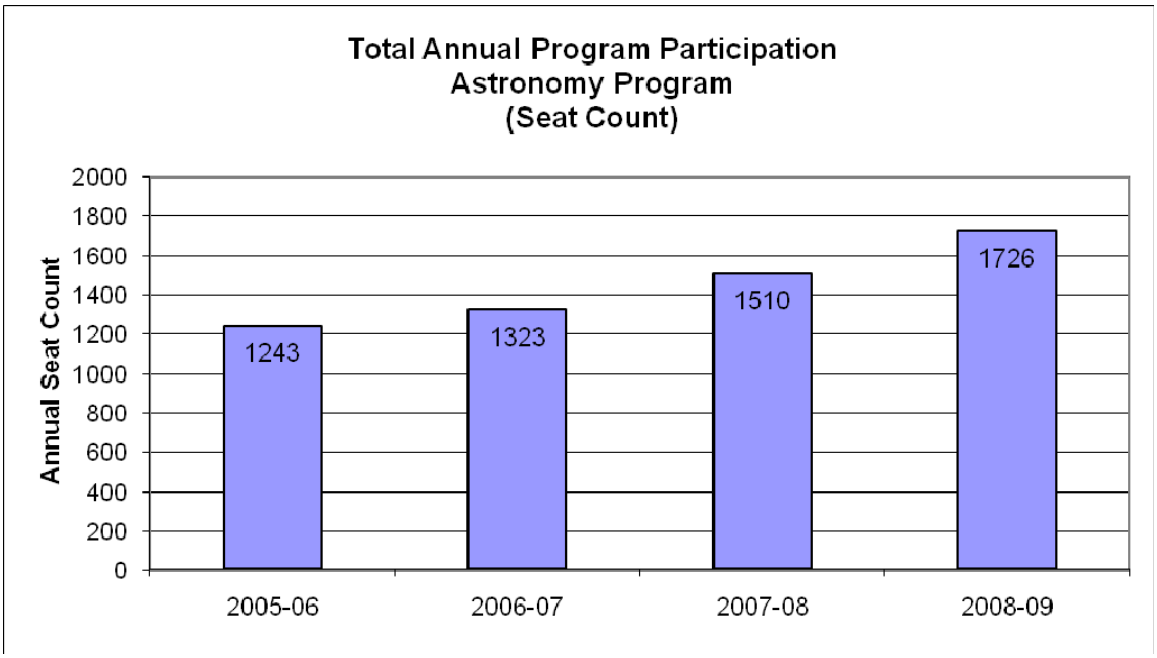
Recommendation: Explore the possibility of having Supplemental Instruction (SI) with Astronomy 25 and possibly also Astronomy 20.

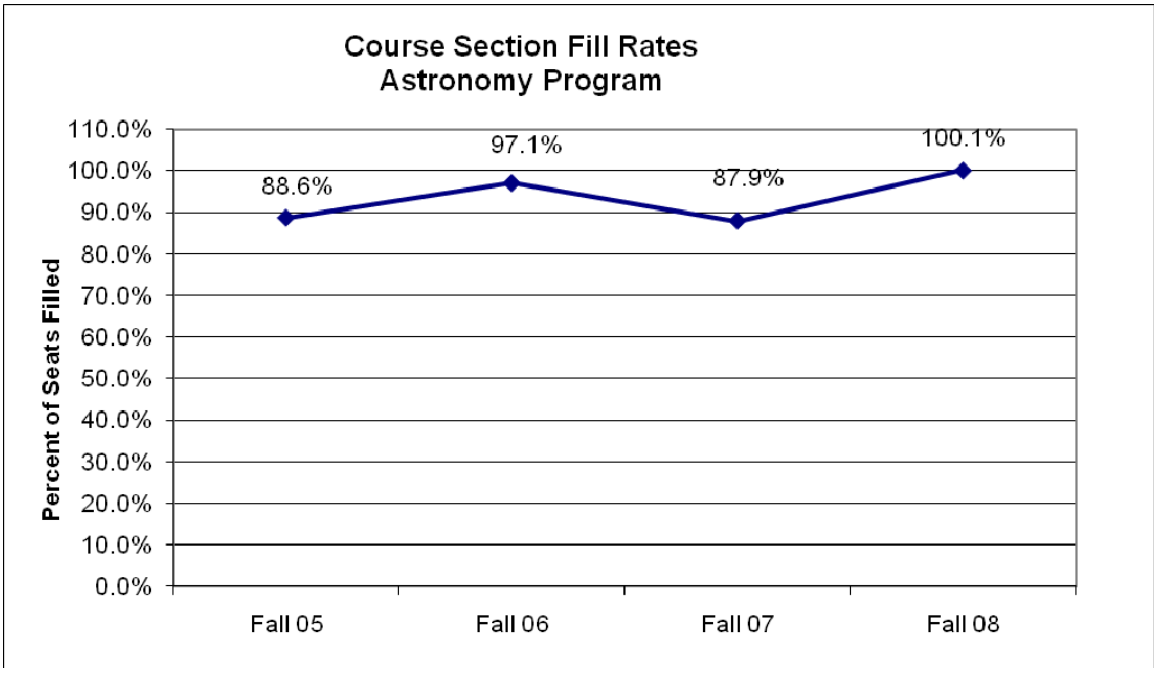
In Math (at least) SI has shown to produce noticeable increases in student success and completion rates. Astronomy, serving as the largest general education science requirement, could stand to benefit from proven student support services. (*Cost for student instructor $1,500 per section per semester*.)

Enrollment statistics with section and seat counts; fill rates

Seat counts (shown on the next page) show the Astronomy department's enrollment is growing and the participation count increased by 39%. The fill rate has also increased by 12 percentage points over 4 years. This likely will not continue with recent section cuts due to campus-wide budget reductions. If the budget climate were different, the program could probably grow.

If the recommendation to convert some Astronomy 20 sections to Astronomy 25 is fulfilled, the seat count WILL continue to increase, assuming all else remains the same. This is predicted to occur because the normal class size for Astronomy 20 is 45 students, while for Astronomy 25 it is only 40 students, producing a net gain of 5 students per section converted. (Currently, approximately 4 sections of Astronomy 25 are offered each Spring/Fall term.) However, if the recommendation to lower the class size in Astronomy 25 is also enacted, then overall seat count may remain constant if the number of sections taught is not changed.





While enrollment in astronomy is growing and strong, there is one significant weakness in the program. The one full-time astronomy faculty member who taught online has now retired and only teaches our online courses. When he chooses not to teach, there are no current faculty interested or trained in online education. We will need to: 1) train our current faculty to teach online, 2) find new faculty willing to teach online, or 3) abandon online teaching. Choice 3 is probably untenable in the long run, with the skyrocketing growth in online enrollment.

Recommendation: Work with ECC to find a way to offer faculty appropriate incentives to teach online courses OR begin to recruit currently successful online faculty from outside ECC.

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. Astronomy 12 is next scheduled for review in Spring 2012, Astronomy 13 in Spring 2012, and Astronomy 20 and 25 in Spring 2015. Astronomy 50 and 99abc are scheduled for review in Fall 2012.

When revising the Astronomy 20 and 25 course outlines, the department gave serious consideration to reactivating Astronomy 11, which serves as an overview of the universe. Much of the Astronomy 20 and 25 curriculum is common to both courses, so perhaps the common material and material that COULD be common to both courses could be switched into Astronomy 11 and then have Astronomy 20 and 25 become subject-specific courses for more interested students, perhaps more mathematical in nature. This dialog will continue.

Similarly, after discussing the first draft of this report, the department is exploring the creation of an astrobiology course which could also serve as a general education physical science requirement. This new course may be an alternative to re-activating astronomy 11 and may replace some sections of astronomy 25. Work is in progress.
Also offered in the catalog are Astronomy 50, Special Topics in Astronomy, and Astronomy 99, Independent Study. These are standard courses throughout the college curriculum. While Astronomy 50 has not been offered in many years, it is not clear if there's a benefit to deactivating the course. Astronomy 99 has had a handful of students since the last program review.

Astronomy 13 is a unique course in Southern California and it brings significant publicity to the college. The course has been showcased in several ECC newspaper articles, articles in *The Daily Breeze*, and recently in a film studying the history of buildings along Crenshaw Blvd. The fact that we offer Astronomy 13 affords us stature in the community and the course brings significant publicity which adds value to the institution. The astronomy faculty unanimously feels that the course is a valuable addition to the astronomy program. This course serves a community need, especially given the strong aerospace and astronomy base in the South Bay Area.

Astronomy 13 does not articulate in either the UC or CSU system for any science purpose, and counts only as an elective for the CSU system. It does not articulate as an elective in the UC system. With the small enrollment in the course, 15 students per section, it is a high-cost course. However, the course offering has been reduced to one section per year, which the department feels is an appropriate level at this time with the current budget constraints.

Student Learning Outcomes (SLOs)

As of this writing, one SLO has been developed for each of the four astronomy courses. Assessments have been done and documented in both lecture courses. While no official SLO report has yet been *reported* for Astronomy 12, the SLO was a mere formalization of the final exam most faculty members use; therefore minimal information extraction will help us document the results of the SLO. Astronomy 13's first SLO was written recently and will be assessed later in the Spring 2010 semester. Details follow 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 typically assesses this skill summatively. A portion of the final exam asks students to align the telescope's rotation axis with Earth's using coordinates of a few bright stars as a guide. The faculty member then gives the students celestial coordinates (RA & declination) to locate in the telescope eyepiece.

Assessment results: In process of compiling data from Fall 2009. In one of the sections assessed, 90% of students were successful.

Astronomy 13 – Astronomical Optics
SLO**:** The student will understand and apply the principles of testing optical surfaces.

Assessment instrument: Students will be given a description of an optical surface and Foucault test data measured from it. They will be asked to construct a Foucault test diagram and assess the quality of the surface.

Assessment results: To be assessed in week 10-12 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, direction 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 were submitted February 2009 and appear here without significant modifications. Only 2 faculty members (Vakil and Lloyd) have submitted data so far (as of this Program Review). Excerpts of the results follow.

Question	% correct
5. match drawing with seasons	67%
6. match drawing with daytime length	80%
7. match right side drawings with hot/cold	59%
8. which drawing shows 12 hour days	61%
Average	67%

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

Success rates for the four questions were in the range 60-80%. Vakil's students did 10-20% better than Lloyd's students. In all cases, the most common answer was the correct answer.

To answer Question 5, a student needs to know the direction of sunrise and sunset

at different times of the year. About 2/3 of the students got this concept; a little lower for Lloyd's classes. This result is disappointing to Lloyd, who had students observe the real sunset; perhaps the students who got this question wrong didn't do the sunset observation. Maybe the deeper message is that students don't understand *why* the direction of sunrise and sunset changes.

Vakil administered the assessment in both the middle and the end of the semester. Scores at the end of the semester are 5-10% higher. Vakil's results also show a small improvement between Spring 2008 and Fall 2008.

The diagrams that Lloyd uses in his instruction look different than the ones used in the assessment. That may well be one reason why his students didn't perform as well as Vakil's. Another reason may be that that he only gave the assessment once at the very end of the semester.

If we take a success rate of 80% as a reasonable goal, we are doing good on Question 6, but would like to see some improvement in the other questions. Given the large amount of classroom time is spent studying the seasons, it is disappointing that scores aren't higher. Still, the results show that a majority of students come out with a good understanding of the seasons.

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

Lloyd plans to use clicker questions or other classroom assessment techniques to check student comprehension. He also plans to devote more time to discussing the sunset observation project.

The larger lesson, perhaps, is that a deep understanding of the seasonal changes requires a significant amount of spatial and geometric reasoning. Most students will require more than one or two hours of study to really grasp the concepts. Occasional review may help students remember over the long term.

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?*

Lloyd found the diagrams slightly confusing; he wasn't quite sure himself what the answer to Question 7 is. He would like to change the diagrams to something closer to what he uses in his classes. It's hard to know whether students got a question wrong because they didn't understand the concept or because they misinterpreted the diagram.

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: The assessment results below were submitted February 2009 and appear here without significant modifications. Only 2 faculty members (Vakil and Lloyd) have submitted data so far. The results follow.
The following table is a summary of all data:

Question	% correct
1. colors, which hottest	85%
2. black body spectrum, which same temperature	61%
3. equal temp, different luminosity, which larger	40%
4. equal radius, different luminosity, which hotter	70%
Average	64%

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

Most students learned something about how the temperature, size, and luminosity of stars are related. They did better on some individual questions than on others. Question No. 1, about how the color of a star depends on its temperature, was the most basic question and most students got the concept. Question No. 2 was perhaps the hardest, as it involved the interpretation of a rather abstract graph; more than half the students got the concept, but many didn't. Questions 3 & 4 were similar in difficulty, but students did poorly on Question No. 3 and better on Question No. 4.

Questions 3 and 4 should have been answered correctly by all students who understand the relationship between temperature, size, and luminosity of a star. Perhaps a reasonable goal is that 80% of the students answer these questions correctly at the end of the semester. The results of this assessment fall considerably short of that goal. It appears that there is room for improvement.

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

In both Vakil's and Lloyd's sections, students learn these concepts through lecture-tutorials. The message is that we need to make sure that, having done the activities, they understand the concept.

Lloyd plans to use clicker questions, as Vakil does with great success, to check student comprehension.

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?*

Question 3 should be re-worded so as not to be misleading.

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

(Answer identical to the one given for Astronomy 20.) 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 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 facility used by the Astronomy department is the planetarium. The planetarium has several pieces of equipment and technology often used for instruction including: a Chronos planetarium projector, 4 LCD 32-inch high-definition televisions, an LCD projector, a 7-speaker surround sound audio system, a wireless microphone, a computer, a classroom set of 55 clickers, at least one transparency overhead projector, at least one slide projector, a DVD/VHS player, tables and chairs for approximately 55 students, and additional chairs (approximately 12) placed around the periphery of the room.

The planetarium building also has two restrooms (men and women), an office, a preparation room with a sink, a small closet, and a storage area on a second floor. In addition, the main classroom also contains a sink with a natural gas outlet (which hasn't been used in years).

The Astronomy department also maintains a telescope-making facility (in Physics 102), and an observatory with an observing deck on the roof of the math building.

Adequacy and currency of these facilities, equipment, and technology
The Goto Chronos planetarium projector is maintained professionally and annually through a professional planetarium maintenance agreement (PMA). The projector cost $400,000 to install in 2004, so the annual maintenance is necessary and prevents

significant degradation. However, according to the servicing technician, humidity in the classroom is too high and we should purchase an industrial dehumidifier to keep humidity below 50% at all times. Otherwise, parts will degrade quickly, and we may not meet the expected 25^{+}-year lifetime of the projector.

Recommendation: Purchase an industrial dehumidifier. (*Estimated cost: very uncertain, but possibly as high as $10,000.*)

The LCD televisions, while able to show JPG images, are not currently optimized for their planned use as digital posters that supplement class instruction. However, the ECC Foundation has offered to purchase the equipment necessary to convert the televisions into fully-capable digital posters. Perry Hacking has been pursuing the equipment necessary for these upgrades and is working with the dean and the Foundation to secure the funds and equipment.

Recommendation: Complete purchase of necessary equipment to fully enable the LCD televisions. (*Estimated cost: $9000, fully funded by the ECC Foundation.*)

The LCD projector currently mounted against the dome has failed. A recent attempt by ITS to repair the projector was not successful. The older, original LCD projector has been used in its place as a temporary fix. But the older projector was purchased 10-11 years ago. Replacement bulbs were costly and may no longer be available.

Recommendation: Repair/replace the LCD projector and mounting brackets. (*Estimated cost to replace: $1200.*) However, because this is a campus-wide problem for many of the campus smart classrooms, a more systematic solution should be sought by the institution.

The wireless microphone is approximately 8 years old, not fully functional, and starting to wear out. The sound technician from the Center for the Arts has examined our setup, determined our need, offered to purchase and install the replacement, and gave us a quote for a suitable replacement microphone. We need only supply the funds.

Recommendation: Replace the wireless microphone. (*Cost: $300; could be paid from the astronomy trust fund and/or from a donation by the SBAS, as was the first microphone.*)

The computer in the planetarium is also quite old. It operates on Windows XP, which will not be supported much longer. It also had a fan fail recently, though that was repaired by ITS. While currently serving our needs, it's possible the computer could fail in the near future.

Recommendation: Add the planetarium and observatory computers to the campus "replace computer" rotation, maintained by ITS. (Estimated c*ost: $2400, presumably paid by ITS.*) This item is already included in the Unit Plan.

The classroom chairs used by students in the planetarium have been in use for at least 12 years. They are showing signs of wear and tear, although only a few have failed completely. Desks are also difficult to move and do not allow for easy maneuvering around the classroom by faculty member or student.

Recommendation: Replace the tables and chairs in the planetarium with those similar to what is currently available in the Distance Education Conference Room (i.e. wheeled, easily stored). (*Estimated cost: $10,000 for 70 chairs and tables for 60.*)

The astronomy faculty, unlike most faculty in other science disciplines, do not have an easy way to post papers (e.g. homework or test solutions) in a place students can view them at their leisure.

Recommendation: Purchase and install appropriate display cases. (*Estimated cost: $2500*.)

Several planetarium building facilities are also in need of updating and repair, as one might expect for a building first constructed in the 60s with minimal updates since then. The (hot and also possibly the cold) water in the restrooms has had a significant odor (akin to sulfur) for over a year. Attempts by the campus plumbers to address the situation have not succeeded. The last explanation given was that the water heater constantly operates, and the water can heat and cool, each time leeching some chemicals from the tank and/or pipes, contributing to the smell.

Recommendation: Replace the water heater in the planetarium, perhaps with a tankless model. Replace plumbing if necessary. (*Cost: $1000, plus potential plumbing costs if replacing with tankless model. Presumably cost to be paid by maintenance and/or campus bond[s]*.)

The lighting in the planetarium had been darker than desired since the lights were replaced when we upgraded to the Goto Chronos planetarium projector. However, recent work performed on the lights may be sufficient for our needs, although the amount of light has not been measured or compared to state requirements.

Last, but not least, the temperature of the planetarium fluctuates wildly, ranging from uncomfortably cold (below 65 degrees) when the air conditioner is turned on continuously, to comfortable levels, to uncomfortably warm (over 80 degrees) when the heat is turned on continuously. The planetarium temperature does not seem to be measured or regulated according to the inside classroom, and the employees in the planetarium have no control of the heating or air conditioning. As a result, when temperatures are uncomfortable, either ALL of the doors must be propped open, hoping to replace the planetarium air with air from outside, or classes are relocated to another area on campus. No pattern has been uncovered that suggests a cause for the wild fluctuations in temperature. However, in the past, we were told that the planetarium HVAC was directly linked with the Math building, which might explain the strange times the heaters and air conditioner activated.

Recommendation: Have facilities separate the heating and cooling system of the planetarium from any other building, and have the temperature inside the classroom be the main area regulated by thermostats. (Cost: unknown.)

Recommendation: Have facilities paint the observatory dome and walls. They are beginning to show significant signs of rust.

Staffing

Current staffing

The Astronomy department currently has 3 full-time faculty devoted to the department. All three have been active in other areas of the campus, to various degrees. For example, Professor Hacking was the founder and leader of the ScienceFEST program for several years until its funding was not renewed. Professor Lloyd serves on the division council, division curriculum committee, and college curriculum committee. Professor Vakil has served on numerous campus committees and is currently the Academic Senate President; his term will expire on June 30, 2011.

The full-time faculty are able to teach most of the astronomy courses, and currently (Spring 2010) only one course is taught by a part-time faculty member. This large FT/PT ratio is possible because two faculty members have taken 20-30% overloads routinely and because of significant reductions in sections recently. Professors Hacking and Vakil also teach Physics classes at times as part of the teaching load.

The Astronomy department recently discussed the possibility of creating a department chair. The chair's duties could include coordinating SLO assessment and publication of results, planning and program review updates, supply orders, overseeing schedule development, handle student awards, coordinate student workers and lab assistants, coordinating adjunct hiring, faculty evaluations, oversee and ensure curriculum updates are performed regularly, and overseeing and/or implementing many of the recommendations in this Program Review.

Recommendation: Create an Astronomy department chair, perhaps in conjunction with one (or more) other department(s) in the science division.

Currently, the Astronomy department is the one of two science departments without a dedicated lab technician. (The other program without a technician is the much smaller Horticulture program.) Our lab facilities are currently maintained by a casual employee who doubles as our nighttime astronomy tutor. Here is a related excerpt from the previous Program Review:

> What little maintenance that is done, is currently performed by the full-time faculty during their free time and also by lab assistants, as time (or their generosity) permits. There is nobody specifically assigned to routine maintenance. This will become an increasing problem as the new planetarium projector has parts routinely wear out (e.g. fans, lights). This has been a consistent problem for our telescopes since Jim Lund retired from the planetarium manager position. For Fall

2005 & Spring 2006, one of our night assistants is maintaining our observatory facilities on Wednesday nights since the lab class for that night has been canceled.

The Astronomy department also believes that our facilities are exemplary in many ways and well-suited for a public outreach program. Currently, astronomy faculty offer occasional night sky viewing opportunities through telescopes and faculty volunteer their time to offer semi-professional (and often repeated) planetarium shows for local school children. However, the public outreach that we currently perform is not coordinated and does not sate the public's needs, as demonstrated by the numerous requests we receive for more outreach.

The department believes the addition of a full-time planetarium manager would allow us to dramatically expand our public outreach. The benefit to the institution would include:

- A greater presence in the community.
    - Currently, very few ECC facilities draw attendance from outside the student population. The dramatically-reduced Center for the Arts is probably the largest draw. We expect astronomy events to be the second largest draw, although we have not compared our statistics to photography exhibits or the Anthropology museum.
- Sustainable relationships would be forged between local schools and ECC, through coordinated K-12 planetarium shows and telescope viewing opportunities
- Long-term enrollment would increase, particularly in astronomy, as the school-age children who come to ECC would enroll here later.
    - Anecdotal evidence strongly suggests that adult students enrolled at ECC today have attended planetarium shows in the past, before Jim Lund retired in the 1990's. All 3 of the full-time faculty are routinely told "I attended a planetarium show here at ECC" when speaking with members of the community and students older than 24 years.
- Greater publicity of ECC in the community and beyond, to supplement what is currently done by the Public Information office.

Recommendation: Hire a full-time planetarium manager devoted to department maintenance and, more importantly, creating a sustained public outreach component, especially with local schools. (*Estimated cost: $90,000 per year, including benefits.*)

This need is based on the past and current facilities and equipment situation, and the significant benefits to creating a sustained public outreach and K-12 education program.

Recommendation: The astronomy department should consider examining what other California Community Colleges with a planetarium do for public outreach.

Planning

Internal and external changes or trends impacting program in the next five years
One possible trend that could affect enrollment is the recent federal initiative to increase STEM majors. This may increase demand for astronomy courses. No other external or internal trends are foreseen at this time.

Direction of program in five years
The program expects to maintain or grow in the next five years, according to demand and available funding. We also hope to offer significantly more public outreach events after we hire a planetarium manager.

Goals and objectives of program related to the college mission and strategic initiatives
Several of the Astronomy department's recommendations will help make progress on the following ECC strategic initiatives, and those recommendations are listed below underneath their associated strategic initiative:

1. Offer excellent educational and student support services:
    a. Enhance college services to support student learning using a variety of instructional delivery methods and services.

Recommendation: Convert some Astronomy 25 sections to Astronomy 20. (*No cost.*)
Recommendation: Reduce the normal class size of Astronomy 25 from forty students down to 30 or 35 students, expecting to increase student success. (*Cost is unclear, as described below.*)
Recommendation: Purchase a set of DVDs and obtain other media to help students visualize the abstract content in astronomy 25 (and, to a lesser extent, astronomy 20). DVDs may include episodes of *Nova*, *The Universe*, other relevant television shows, relevant movies, etc. (Estimated cost: depends on quantity of purchase.)
Recommendation: Explore the possibility of having Supplemental Instruction (SI) with Astronomy 25 and possibly also Astronomy 20. (*Cost for student instructor $1,500 per section per semester.*)
Recommendation: Have Institutional Research determine how many of our students meet the recommended preparation, and compare their outcomes to students who do not meet the recommended preparation. Pending the results, change the recommendation to a requirement.
Recommendation: Have Institutional Research determine how many of our students repeat each of the astronomy courses, so we can try to find any trends that may exist.
Recommendation: Work with ECC to find a way to offer faculty appropriate incentives to teach online courses OR begin to recruit currently successful online faculty from outside ECC.

    b. Maximize growth opportunities and strengthen programs and services to enhance student success.

Recommendation: Convert some Astronomy 25 sections to Astronomy 20. (*No cost.*)
Recommendation: Have Institutional Research determine how many of our students repeat each of the astronomy courses, so we can try to find any trends that may exist.
Recommendation: Have Institutional Research determine how many of our students meet the recommended preparation, and compare their outcomes to students who do not meet the recommended preparation. Pending the results, change the recommendation to a requirement.

Recommendation: Explore the possibility of having Supplemental Instruction (SI) with Astronomy 25 and possibly also Astronomy 20. (*Cost for student instructor $1,500 per section per semester*.)
Recommendation: Based on the significant interest in teaching, the department should consider allocating at least one section of Astronomy 20 towards teachers, or possibly create or link with a course aimed at teachers.
Recommendation: Create an Astronomy department chair, perhaps in conjunction with one (or more) other department(s) in the science division.
Recommendation: Work with ECC to find a way to offer faculty appropriate incentives to teach online courses OR begin to recruit currently successful online faculty from outside ECC.

c. Strengthen partnerships with schools, colleges and universities, businesses and community-based organizations to provide workforce training and economic development for our community.

3. Modernize the infrastructure to support quality programs and services:

a. Use technological advances to improve classroom instruction, services to students and employee productivity.

Recommendation: Complete purchase of necessary equipment to fully enable the LCD televisions. (*Estimated cost: $9000, fully funded by the ECC Foundation.*)

b. Improve facilities to meet the needs of students and the community for the next fifty years.

Recommendation: Purchase an industrial dehumidifier. (*Estimated cost: $10,000.*)
Recommendation: Repair/replace the LCD projector. (*Estimated cost to replace: $1000.*) However, because this is a campus-wide problem for many of the campus smart classrooms, a more systematic solution should be sought by the institution.
Recommendation: Replace the wireless microphone. (*Cost: $300; could be paid from the astronomy trust fund and/or from a donation by the SBAS, as was the first microphone.*)
Recommendation: Add the planetarium and observatory computers to the campus "replace computer" rotation, maintained by ITS. (Estimated c*ost: $2400, presumably paid by ITS.*)
Recommendation: Replace the tables and chairs in the planetarium with those similar to what is currently available in the Distance Education Conference Room. (*Estimated cost: $10,000 for 70 chairs and tables for 60.*)
Recommendation: Purchase and install appropriate display cases. (*Estimated cost: $2500*.)
Recommendation: Replace the water heater in the planetarium, perhaps with a tankless model. Replace plumbing if necessary. (*Cost: $1000, plus potential plumbing costs if replacing with tankless model. Presumably cost to be paid by maintenance and/or campus bond[s]*.)
Recommendation: Have facilities separate the heating and cooling system of the planetarium from any other building, and have the temperature inside the classroom be the main area regulated by thermostats. (Cost: unknown.)

Conclusion and Summary

Prioritized recommendations and needs of your program/department.

Non-facilities needs:

1. Hire a full-time planetarium manager devoted to department maintenance and, more importantly, creating a sustained public outreach component, especially with local schools. (*Estimated cost: $90,000 per year, including benefits.*)
    a. Related sub-recommendation: the astronomy department should consider examining what other California Community Colleges with a planetarium do for public outreach.
2. Convert some Astronomy 25 sections to Astronomy 20. (*No cost.*)
3. Explore the possibility of having Supplemental Instruction (SI) with Astronomy 25 and possibly also Astronomy 20. (*Cost for student instructor $1,500 per section per semester.*)
4. Based on the significant interest in teaching, the department should consider allocating at least one section of Astronomy 20 towards teachers, or possibly create or link with a course aimed at teachers.
5. Create an Astronomy department chair, perhaps in conjunction with one (or more) other department(s) in the science division.
6. Have Institutional Research determine how many of our students meet the recommended preparation, and compare their outcomes to students who do not meet the recommended preparation. Pending the results, change the recommendation to a requirement.
7. Consider adding an actual (rather than a recommended) pre-requisite, either in math or 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.*)
8. Purchase a set of DVDs and obtain other media to help students visualize the abstract content in astronomy 25 (and, to a lesser extent, astronomy 20).
9. Ask Institutional Research to help us compare the student population in astronomy classes at ECC to those across the state. *(No cost, but uses personnel time.)*
10. Have Institutional Research determine how many of our students repeat each of the astronomy courses, so we can try to find any trends that may exist.
11. Reduce the normal class size of Astronomy 25 from forty students down to 30 or 35 students, expecting to increase student success. (*Cost is unclear, as described below.*)
12. Work with ECC to find a way to offer faculty appropriate incentives to teach online courses OR begin to recruit currently successful online faculty from outside ECC.

Facilities Needs:

1. Purchase an industrial dehumidifier. (*Estimated cost: $10,000.*)
2. Replace the water heater in the planetarium, perhaps with a tankless model. Replace plumbing if necessary. (*Cost: $1000, plus potential plumbing costs if replacing with tankless model. Presumably cost to be paid by maintenance and/or campus bond[s].*)

3. Repair/replace the LCD projector. (*Estimated cost to replace: $1000.*) However, because this is a campus-wide problem for many of the campus smart classrooms, a more systematic solution should be sought by the institution.
4. Have facilities separate the heating and cooling system of the planetarium from any other building, and have the temperature inside the classroom be the main area regulated by thermostats. (Cost: unknown.)
5. Complete purchase of necessary equipment to fully enable the LCD televisions. (*Estimated cost: $9000, fully funded by the ECC Foundation.*)
6. Have facilities paint the observatory dome and walls. They are beginning to show significant signs of rust.
7. Purchase and install appropriate display cases. (*Estimated cost: $2500*.)
8. Replace the wireless microphone. (*Cost: $300; could be paid from the astronomy trust fund and/or from a donation by the SBAS, as was the first microphone.*)
9. Add the planetarium computer to the campus "replace computer" rotation, maintained by ITS. (Estimated c*ost: $1200, presumably paid by ITS.*)
10. Replace the tables and chairs in the planetarium with those similar to what is currently available in the Distance Education Conference Room. (*Estimated cost: $10,000 for 70 chairs and tables for 60.*)