Austin Community College
Astronomy Program Review
Self-study Report

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Compiled by John Caparusso

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Front illustration by

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ACC Graphic Design student

Back text by

James E. Heath

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PHYS 1311 (Stellar Astronomy)

and

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Syllabi by Dr. Christina Cavalli

Topics lists determined by faculty vote

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Written by Dean Becker

Austin Community College Astronomy Program Review
Section 1:

Statement of Purpose

Austin Community College
Astronomy Program
Math and Sciences Division

The goals of the astronomy program at Austin Community College are

- To provide students with classes in introductory astronomy suitable for transfer to satisfy the science requirements of four-year institutions;

- To provide students with the skills and knowledge required to understand the basic ideas of astronomy, to pursue astronomy as a hobby, and to think critically as a scientifically aware citizen.

Austin Community College Astronomy Program
Section 2:

Vision Statement

With the possible exception of agriculture, astronomy is the oldest of the sciences. Ancient cultures studied celestial phenomena to tell when to plant crops, to navigate unfamiliar territory, to secure political power, and to use as a backdrop for their mythology. Although modern tools such as the calendar, the Global Positioning System, political ideology, and the popular media have supplanted these ancient applications of astronomy, the sky continues to be a source of fascination and awe for many people. Modern science has its roots in astronomy, as a great deal of the development of the scientific method during the Renaissance was focused on determining whether the Sun or the Earth was the center of Creation.

Despite its ancient pedigree, astronomy remains a vital discipline into the modern era. New discoveries are being made literally every day in the field, as astronomers look out into space and back into time using a wide variety of observational and computational tools. This is not unusual for science in the "information age," but what sets astronomy apart from many other sciences is its accessibility to non-scientists. An alert astronomy instructor can easily weave many of the very latest astronomical discoveries into class discussions in a way students can readily grasp. By contrast, most discoveries of modern physics require years of graduate school to comprehend. The instructor of introductory physics is hard pressed to include concepts developed after 1900!

This accessibility has made astronomy a very popular science. Popular astronomy magazines and television shows keep "laymen" informed about the latest developments, and astronomy hobbyists regularly gather for all-night "star parties." Good-quality telescopes are available at reasonable prices, at least compared to a particle accelerator or electron microscope. It is this accessibility and popularity in the community at large that makes astronomy a good fit with Austin Community College. As this study demonstrates, astronomy courses are very popular at ACC, and the astronomy faculty do a fine job of instruction. There is always room for improvement, however, and as the science of astronomy moves forward, the ACC astronomy program must do likewise. To that end, here is our vision for improvements to the ACC astronomy program:

1) **We envision improved media technology in our classrooms.** Astronomy is a very visual science, and a major part of its appeal is the treasure trove of beautiful images that can supplement instruction. The World Wide Web is a nearly inexhaustible source of imagery, much of it at the cutting edge of the discipline. To bring this to our students, we envision dedicated lecture classrooms equipped with state-of-the-art media technology to allow us to call up images from the World Wide Web and show our students the stunning objects we are studying. The media technology currently available in our classrooms is of poor quality and is difficult and time-consuming to set up. This situation hampers spontaneity and creativity.

2) **We envision expansion of our course offerings, in both the geographic and curricular sense.** There is a high demand for our astronomy classes, and we could easily add more sections at all campuses. However our vision goes beyond this. We would like to expand our already diverse curriculum to bring our repertoire more in line with the tremendous number of different courses offered by the University of Texas, an important ACC transfer institution. The hiring of a full-time faculty member devoted to astronomy would help nurture this expansion of course offerings.

3) **We envision better communication among astronomy faculty at ACC.** The one-college concept has greatly facilitated interaction between faculty members, but we would like to do more. Most of our faculty are adjuncts, and the hiring of a full-time faculty devoted to astronomy would provide a unifying point for instructors. The establishment of an Astronomy Club and regular faculty workshops would also help promote unity.

4) **We envision expansion of our facilities, to better serve our students and the community.** Something as small as a central storage space for our telescopes would be a good start, but our dreams are bigger. Currently we must rely on outside agents such as the Austin Astronomical Society to provide us with facilities to observe the stars, which hampers our ability to provide students with meaningful fieldwork. We envision an outdoor facility, reasonably far from city lights but still accessible, co-owned and operated with other ACC science programs, to allow us to perform observations at any time. And our biggest dream, the far horizon of our vision, is to provide the city of Austin with a planetarium, to capture the imaginations of all members of the community.

Many elements of our vision may seem ambitious, but astronomers have a reputation for seeing farther than others. The great Russian rocket scientist Konstantin Tsilolokovsky taught us about reaching beyond when he said, “The Earth is the cradle of the mind, but one cannot stay in the cradle forever.” The Austin Community College astronomy program is one of the best in the nation among two-year colleges, but we want to go much farther.

Austin Community College Astronomy Program Review

Section 3:
Results of Strengths, Weaknesses, Opportunities, and Threats (SWOT) Brainstorming Session

October 19, 2002

Participants (in alphabetical order):

Dean Becker	Adjunct Faculty, ACC
Christina Cavalli	Adjunct Faculty, ACC
Eric Ebner	President, Austin Astronomical Society
David Fonken	Dean of Math and Sciences, ACC
James Friedrichsen	Assistant Professor of Physics, ACC
John Fulton	Adjunct Faculty, ACC
James E. Heath	Associate Professor of Physics, ACC
Mary Kay Hemenway	Research Associate, University of Texas at Austin
Kenneth Hood	Student
Ron Johns	Department Chair, Physical Sciences, ACC
Denise McClendon	Student
Elliot Richmond	Adjunct Faculty, ACC

Facilitator: John Caparusso, Austin Community College

Purpose: This meeting was a "brainstorming session" to investigate the characteristics of the Austin Community College astronomy program. A variety of participants encouraged a broad spectrum of views from both inside and outside the program. Four categories of ideas gave structure to the discussion:

1. What are the **strengths** of the program? What characteristics of the program and the College enhance the program's mission of education?
2. What are the **weaknesses** suffered by the program? What factors, inside the program and the College, inhibit the program's mission?
3. What **opportunities** present themselves to the program? What factors from outside the College could enhance the program's mission in the future?
4. What **threats** present themselves? What influences outside the college could inhibit the program's mission?

Results: The three-hour session revealed many influences in all four categories. The raw results are tabulated in Appendix A. Analysis of the results follows.

Analysis: Strengths

Quality of the faculty – The most important strength of the ACC astronomy program is clearly its faculty. The participants judged the ACC astronomy faculty to be "wonderful," "interested," "demanding," "hard-working," and "dedicated." The faculty are perceived as well educated, both in their subject matter and in techniques of pedagogy. These instructors make astronomy "real" for students. The ACC astronomy program has a solid core of committed, talented faculty, and this forms the strong backbone of the program

Quality of the curriculum – The ACC astronomy program offers a two-semester sequence of astronomy, in addition to a new lab class. This exposes students to a broader range of material than the single semester courses offered at many two-year colleges. The curriculum is parallel to that offered at the University of Texas, allowing students opportunities for transfer credit in classes taught at the University level. The ACC astronomy program allows students who might be intimidated by other science classes a chance to earn quality science credit.

Small class sizes – Many of the participants are graduates of large research institutions, so it comes as no surprise that many tout the small class sizes of ACC as a strength of the astronomy program. Small class sizes enable professors to be more accessible to students, and to give them more personal attention. While small class size is a strength of ACC in general, the participants felt it to be particularly important in science classes.

ACC students – The participants found many strengths in the students that take astronomy classes at ACC. Students frequently collaborate with other students in their learning. The students are diverse and talented.

Support from low- and mid-level administration – The participants felt that faculty received a great deal of support from members of the departmental and dean-level administration. Faculty have a strong voice at departmental meetings, and an abundance of academic freedom in the classroom. Astronomy is spread out over most major campuses, which is very convenient for faculty and students. The systems for faculty development and faculty evaluation are seen as very solid. The low- to mid-level administrations puts the emphasis on teaching, which the participants appreciated.

Facilities – By and large, the participants felt that the facilities available to the program promoted the program's mission. Computers and information technology were most often mentioned, but participants also had praise for the classroom and library facilities. The fact that the program owns some telescopes was also seen as positive, as was the working relationship that the program has with outside agencies such as the Austin Astronomical Society and the Wild Basin Wilderness Preserve.

The nature of astronomy – Participants noted that astronomy is a subject that is interesting and inspiring to students. It is a subject where, as one participant put it, "anyone can be successful."

Textbook – Participants believed that the textbook used in ACC astronomy courses was indeed a good one. The fact that the same text is used by all instructors for all classes is a plus.

Teaching methods – Participants saw astronomy as a subject that was "fun to teach," and allowed instructors to use diverse quality teaching methods, including collaborative group work.

Transferability – The fact that all ACC astronomy courses will transfer to most four-year institutions was a definite strength of the program in the eyes of participants.

Analysis: Weaknesses

Poor availability of equipment -- Whether for lecture demonstrations or hands-on student work, equipment is essential to learning in a science class. Many participants noted shortcomings in the equipment available to ACC astronomy instructors. Among the deficiencies are a lack of small telescopes for students to use, poor audio-visual equipment, and inadequate demonstration apparatus. Some participants felt that the distribution of equipment was not equitable across campuses.

Lack of facilities – In addition to the insufficient equipment, participants found the facilities lacking at ACC. From parking space to classroom space and equipment storage, many facilities fall short in the eyes of the participants.

Problems with upper administration – Many participants saw ACC's upper administration as a source of many problems. Cuts in the amount of money in the astronomy budget and in the number of sections of astronomy offered hamper the program's educational mission. Financial problems (which many participants blamed on administrative mismanagement) was seen as the root of the problem. Even something as minor as a prohibition against decorating classrooms can lower morale and be a detriment to teaching.

No dedicated area for astronomical observations – In addition to the general lack of educational facilities, participants especially noted the lack of a dedicated place to perform astronomical observations with students. This is especially an issue with the new lab course. While the program receives help from outside agencies, the lack of an ACC-owned observing site limits what can be done.

No planetarium – Austin is the largest city in America to not have a planetarium facility. The absence of such a powerful education and public relations tool was seen as a definite weakness.

Faculty – Although most astronomy faculty at ACC are praiseworthy, there are some perceived weaknesses in the program. The biggest problems were the low level of

interaction between faculty, and the lack of astronomy-related faculty development. Also, faculty do not appear to be using the telescopes available to them.

Lack of advertisement – Participants felt that the program was not sufficiently promoted, either by members of the program or by the administration.

No high-level curriculum – The program does not offer astronomy courses beyond the non-major level, nor is there a degree program separate from the general physics program. This was a concern for many participants.

No full-time faculty – Although full-time physics faculty teach astronomy courses, there are no full-time faculty devoted to astronomy. Thus, most sections of astronomy at ACC are taught by adjuncts. Many participants saw this as a weakness.

Students – Some participants noted problems with unmotivated students. This low level of motivation hurts retention and classroom performance.

Analysis: Opportunities

Building a Planetarium – It should not be surprising that many of the opportunities mentioned by the participants were closely connected to the weaknesses of the previous section. The best opportunity that the participants recognized was the opportunity for ACC to be a leader in bringing a planetarium to the city of Austin. While such a project will be two expensive for ACC to attempt alone, participants called upon the ACC astronomy program to spearhead the effort.

Expanding the program – The participants saw many different ways that the already diverse program could expand its horizons. The methods ranged from expanding the curriculum to include a greater variety of astronomy class for transfer, to expanding our pedagogy to include more research and astronomical observations.

Collaborating with other groups – The participants pointed out many opportunities for faculty in the program to work together with members of the community to enhance our performance. The entities included the University of Texas, the Austin Astronomical Society, the Girl Scouts, and local high schools.

Acquiring an observing site – This is another opportunity proposed as a solution to a weakness above: the lack of a dedicated facility for doing astronomical observations. It was proposed that ACC purchase some land reasonably far from city lights, but still accessible to students.

Expanding ACC facilities – In order to accommodate an expanding program, participants felt the need to expand ACC facilities as well, both for teaching and for storage of materials. Among the possible sites for proposed expansion were the Pinnacle

campus, the Northridge campus, the Cypress Creek campus, and the proposed new South Austin campus.

Hiring of faculty – The participants called upon the College to hire a full-time faculty to teach astronomy, and to use the talent pool of the University of Texas graduate program in astronomy to find new adjunct faculty.

Seeking funding – Naturally many of these opportunities will first involve getting funding. Participants offered suggestions such as NASA and the National Science Foundation.

Attending conferences – Participants saw the potential for faculty to use astronomy conferences and workshops as a form of professional development.

Using technology to teach astronomy – As is true of all sciences, there is great potential for using technology, such as the World Wide Web and computer simulations, to teach astronomy.

Responding to community needs – Some participants saw the recent economic downturn as an opportunity for the College, as more people will want to return to school.

Analysis: Threats

Lack of funds – This was far and away the biggest threat perceived by the participants. Mere maintenance, much less growth, of the program requires money, and the participants fear that funds would dry up, due to many factors: problems with the ACC administration ("What will they cut next?"), shrinking state support funds, a failure to win a tax increase, or simply the flagging economy.

Inability to expand facilities – Participants feared that the program will not receive the support it needs to expand the facilities, whether those expansions include a planetarium, an observing site, or just pure teaching space.

Loss of astronomy classes – Some participants feared that, in a desire to cut costs, the Administration will cut sections of astronomy. Such a move could actually cost more money that it saves, and could lead to a downward spiral that would be very detrimental to the program.

Poor preparation of students – Participant felt that many students that come to ACC astronomy classes are poorly prepared by their pre-college schooling, in terms of reading, mathematical, and study skills. This greatly hampers our ability to teach them.

Attitudes of the public – Participants saw a threat in the general attitudes that people have toward science and ACC. Many people have misconceptions about astronomy, largely because science is undervalued in the public school system. Some

people also have religious objections to scientific theories. In addition, as with all community colleges, ACC may have to fight an uphill battle for respect in the eyes of four-year institutions.

Problems with hiring – The lack of a large, diverse pool in the Austin area for hiring new instructors was seen as an important threat by some participants. While the University of Texas is seen as a resource for part-time instructors, it was noted that graduate students are often discouraged from teaching at ACC, so as not to detract from their research.

Problems with administration – Although participants were encouraged to focus on threats outside of ACC, some participants saw ACC's own administration as a threat to the program. The administration was seen as inattentive to the needs of faculty. Students and faculty alike can get tired of all the problems and changes.

Light pollution – This is a problem unique to astronomy. City streetlights are very often positioned so as to wastefully cast light upwards, where the artificial light can interfere with the light of the stars. This phenomenon, called "light pollution," is a threat to astronomy instruction in all urban areas.

Safety on field trips – If because of light pollution, instructors have to take their students far from campus to see the stars, issues of safety come up. These safety issues limit where we can go and what we can do for observations.

Problems with new courses – If we were to create new astronomy courses, they would not fall within the Common Course Numbering system. This could hamper their transferability to other institutions. This, in turn, could harm enrollment.

Competition from other institutions – The primary threat seen here was that other institutions could offer credit for astronomy by distance learning. This could harm our enrollments.

Overall, the picture that the SWOT session painted was of a successful program with many strengths and a wealth of opportunities. While some weaknesses and potential threats were notes, few were seen as insurmountable. The session was of great assistance is assembling the list of Recommendations that concludes this report.

Astronomy Program Review

Section 4:
Summary Analysis of Core Indicators of Effectiveness

4.1 Category: Need

Question: Does the Program address a verifiable need for the student, community, and/or society?

Based upon enrollment figures from past years, and from surveys of students taking astronomy courses, the ACC astronomy program does indeed address a verifiable need. Most astronomy classes offered by ACC routinely meet minimum enrollment figures, and some classes fill nearly to capacity. Most students taking ACC astronomy classes report that they are taking the course for science requirement transfer credit at a four-year institution. There is clearly a demand for ACC astronomy classes, rising out of a perceived need by students for a science classes for transfer.

4.1.1 Core Indicator: Community need

The Austin Community College astronomy program teaches two lecture courses in astronomy. These courses are designed for non-science majors with an eye towards helping these students meet the science requirement for their future degree plans at a four-year institution. An informal survey of students at the beginning of every semester reveals that an overwhelming majority of students taking these courses are indeed planning to transfer to a four-year institution and plan to use ACC's astronomy courses to fulfill their science requirement. Students choose courses offered by ACC, and courses offered by the astronomy program, for a variety of reasons:

- Low cost
- Small class sizes
- A perception that ACC classes will be "easier" than university classes
- The popularity and accessibility of astronomy

The university most cited as a transfer destination is the University of Texas at Austin. The proximity of a large four-year institution that accepts ACC courses for transfer creates a definite need in the community for the ACC astronomy program.

4.1.2 Core Indicator: Enrollment trends

The enrollment trends indicate that there is a demand for astronomy classes at Austin Community College. After a drop-off in the 2000-2001 school year, enrollments have rebounded, although the total number of sections has dwindled. While about one or two sections each semester had to be cancelled due to low enrollment in 2000 and 2001,

no sections had to be cancelled in 2002. Demand for astronomy classes is high, and there are indications that it is increasing.

Semester	Course	number of sections	number of students	sections cancelled	sections 90%+ full
Spring 2000	PHYS 1311	9	144	1	1
	PHYS 1312	9	135	1	1
Summer 2000	PHYS 1311	3	47	0	0
	PHYS 1312	3	62	0	0
Fall 2000	PHYS 1311	8	121	1	1
	PHYS 1312	7	121	1	1
Spring 2001	PHYS 1311	8	144	2	2
	PHYS 1312	7	126	1	2
Summer 2001	PHYS 1311	3	46	1	0
	PHYS 1312	3	55	0	0
Fall 2001	PHYS 1311	8	161	1	2
	PHYS 1312	6	141	1	4
Spring 2002	PHYS 1311	6	155	0	3
	PHYS 1312	6	139	0	2
Summer 2002	PHYS 1311	2	42	0	0
	PHYS 1312	3	75	0	0
Fall 2002	PHYS 1311	8	218	0	6
	PHYS 1312	5	147	0	4

4.1.3 Core Indicator: Outcomes

Austin Community College does not offer an associates degree in astronomy, so there are no "graduates" of the program. Therefore, there were no degrees conferred, and no graduates to transfer to other institutions. As noted above, students taking astronomy classes at ACC are generally looking to transfer the science requirement credit towards a degree at another institution. If the results of informal survey cited above are true, then the majority of students in ACC astronomy classes do so. However, no official data are available to back this up.

4.1.4 Core Indicator: Competition from other institutions

In the FY 2001, Austin Community College offered two courses in astronomy, Stellar Astronomy (PHYS 1311) and Solar System Astronomy (PHYS 1312). These two courses are intended to be a two-semester sequence in astronomy for non-science majors who are seeking to fulfill the science requirement for their degree. In FY 2002, an optional laboratory course was offered for the first time. Other institutions offer a similar sequence, but there are other approaches. Some schools offer only a one-semester survey course in astronomy. Others offer a second lab course, non-major courses on other topics in astronomy, and courses for science majors. In the tables below, we compare the

course offerings of a variety of institutions to the offerings of the ACC astronomy program.

Other two-year colleges

College	One-semester survey course	Stellar Astronomy	Solar System Astronomy	Other non-majors courses	Laboratory Course	Majors courses
ACC		X	X		X	
San Antonio College	X				X	
Blinn College	X				X	
Collin County CC	X				X	
Houston CC System	X					
Tarrant County JC	X	X	X		X	

Private four-year colleges and universities

College	One-semester survey course	Stellar Astronomy	Solar System Astronomy	Other non-majors courses	Laboratory Course	Majors courses
ACC		X	X		X	
University of MHB	X					
Trinity University		X	X		X	X
Baylor University	X				X	X
Concordia University	X					
Huston-Tillotson College						
Southwestern University	X					
St. Edwards University						

Public universities

College	One-semester survey course	Stellar Astronomy	Solar System Astronomy	Other non-majors courses	Laboratory Course	Majors courses
ACC		X	X		X	
Southwest Texas State		X	X		X	
Texas Tech		X	X		X	
Texas A&M	X				X	
University of Texas		X	X	X	X	X

In summary, it appears that Austin Community College astronomy program offers a variety of classes comparable to or superior to the offerings of peer institutions in the state of Texas. When compared to four-year institutions, ACC stacks up nicely as well, being surpassed only by the University of Texas in the variety of classes offered to non-major undergraduates. This variety, combined with ACC's low cost and small class sizes, makes ACC a very attractive option to many students. One way that matters could be improved in the astronomy program is to create more course options for undergraduates, the way the University of Texas does – for example, offering courses on science and science fiction, the history and philosophy of astronomy, or the search for extraterrestrial life. While these courses are not part of the Texas Common Course Numbering System, they are very popular courses at our students' most popular transfer destination, UT Austin. Perhaps a transfer arrangement can be worked out, so that we can broaden the scope of our offerings.

4.2 Category: Cost

Question: Within the context of the College's mission, is the cost of the Program justified?

The question in this category is difficult to answer. If we examine the Mission Statement of Austin Community College, we see part [b] of that Mission is to provide "[f]reshman- and sophomore-level academic courses leading to an associate degree or serving as the base of a baccalaureate degree program at a four-year institution." Although there is no Associates Degree in Astronomy available at ACC, Category 4.1 above indicates that many students take ACC astronomy courses as part of the science course requirements for a degree at a four-year institution. So in this sense, since the astronomy program helps the College to fulfill its mission, the cost of the astronomy program is *justifiable*.

However, *justifiable* does not mean *justified*. This is a value judgment, which requires standards to make. And what shall those standards be? The results in Section 5 of this report, and Category 4.3 below, indicate that the astronomy program is doing a very good job of achieving its educational mission, and, by extension, the College's mission. Therefore, so long as the costs of the Program are within reason, those costs are justified.

How do we determine if the costs of the program are "within reason?" To make such a judgment, a cost-benefit analysis is required. Such an analysis is difficult to make with the data provided by the ACC Office of Institutional Effectiveness, for three reasons:

1. The data for the astronomy program is mixed in with the data for the physics program. Therefore it is difficult to tell which expenses and income are from which program.
2. The data provided for income from tuition are suspect. Examining the data provided for the engineering program, we see an incredible amount of tuition income, far too much to be provided by the approximately 200 students that take ENGR courses each year! It appears that the engineering department may have been given credit for tuition from other programs, particularly English. It is impossible to tell if similar mistakes were made for the "Physics/Astronomy" category. If tuition data for individual courses (of which there are only two in astronomy) were provided, tuition numbers could be viewed with more confidence.
3. The data for "indirect costs" are distributed among programs according to contact hours, which places a high burden upon programs offering lab courses. It is no coincidence that most of the programs that appear to be "losing money" according to the numbers from the Office of Institutional Effectiveness are programs that offer many lab classes. (Others, like English, may simply not be getting credit for the tuition they are generating.) There is no evidence that students enrolled in lecture-lab courses use facilities such as counselors, library services, and

administrative staff twice as often as students enrolled in lecture-only classes. A division of indirect costs according to enrollment would be much more equitable.

(Note: After this report was finished, new budget numbers were released to faculty. These new figures solve some of the problems above, but could not be incorporated into this report)

With these difficulties in mind, a cost-benefit analysis of a single section of an astronomy lecture course at Austin Community College is presented below. The analysis is based on data for FY01, where there was an average of 29 students in each section.

Costs

1. Faculty salary – At the maximum pay rate for an adjunct (according to the ACC Human Resources Website) in FY02, this would amount to (3 x $1107) $3321. The maximum pay rate is assumed because, although some adjuncts teaching astronomy are not at this maximum rate, higher-paid full-time faculty do teach from 1-3 sections of astronomy per semester.

2. Other salaries – It is difficult to estimate how much each section of astronomy costs in terms of Administrative, Classified, etc. In FY01, the Physics program accounted for 197,072 of the College's contact hours, so an average section of astronomy would be (1392 / 197,072) 0.7 % of that total. According to data from the Office of Institutional Effectiveness, the Physics program spent $144,092 in other salaries in FY01. Assuming that 0.7% of the contact hours accounts for a like percentage of other salaries, a section of astronomy costs $1018 in other salaries, or $421.11 for a class with the minimum of 12 students.

3. Supplies – According to data from the Office of Institutional Effectiveness, the Physics program spent $6801 on supplies in FY01. Using the same argument as above for other salaries, an average section of astronomy costs $47.61 in supplies, or $13.60 if there are only 12 students.

4. Travel – This expense varies with the instructor for professional development, and so is impossible to assign to a single section. Astronomy field trips, or "star parties," incur no travel expenses, as students transport themselves.

5. Departmental expenses – According to data from the Office of Institutional Effectiveness, the Physics program spent $43,382 on duplication, postage, memberships, etc., in FY01. Using the same argument as above for other salaries, an average section of astronomy costs $303.67 in departmental expenses. A section with the bare minimum of 12 costs $86.76.

6. Capital outlay – A section of an astronomy lecture course accounts for none of the capital outlay for lab equipment, since all astronomy classes in FY01 were purely lecture in nature.

7. Indirect costs – According to the Office of Institutional Effectiveness, these are expenses outside the program, such as administration, advising, library services, etc. There is absolutely no way of estimate how much each section of astronomy contributes to these indirect costs. As stated above, the practice of assigning direct costs by contact hours is unfair to programs with lots of laboratory courses. Assigning indirect costs by enrollment is a little more equitable, but still seems arbitrary, since there is no way to make a connection between these indirect costs and astronomy students. Because of these difficulties, this analysis will not include indirect costs, with the idea that any extra money the Program makes can be applied to the indirect costs of the College as a whole.

Summary of Costs – An average section of astronomy costs the College a total of $4690.28 for a section that would have gotten the average enrollment of 29. If the section would have had only 12 students, the cost would be $3842.47.

Benefits

1. Tuition – A student paying in-district tuition and fees will spend $135 on a three-hour course (source: ACC Website). Therefore, the tuition generated by an astronomy class with 29 people is ($135 x 29) $3915. The minimum potential tuition (for a section of 12) is $1620.

2. State Funding – According to data from the Office of Institutional Effectiveness, in FY01 the College received $3.67 per contact hour in state funding. Students in an astronomy lecture course have 3 contact hours per week, for a total of (3 x 16) 48 contact hours per student per semester. This leads to a total of (48 x 29) 1392 contact hours for an astronomy class with 29 students. Thus this section of astronomy will generate (1392 x $3.67) $5108.64 for the College. If the class is only 12 students, $2113.92 is generated

Summary of Benefits – A section of astronomy generates a total of $9023.64 in tuition, fees, and state reimbursement. This assumes the average enrollment for astronomy classes remains fairly constant. Even if a section would have had only 12 students (the minimum to "make") the funds generated would still be $3733.92.

The conclusion of this analysis is that an average section of astronomy costs the College $4690.28 in salary and other expenses**.** Note that this is an almost worst-case scenario, assuming maximum adjunct faculty pay and very liberal estimates of costs on supplies and other expenses. On the other hand, that same section generates a total of $9023.64 in tuition, fees, and state reimbursement. This is also a worst-case scenario, assuming that all students are paying the absolute lowest tuition.

Therefore, it is the conclusion of this study that an average section of astronomy generates a net amount of $4333.36 in revenue in the worst-case scenario. The revenue will be even greater if many students pay out-of-district tuition (which many astronomy

students do) and if the faculty member is paid less than the maximum (which is also frequently the case).

Even if the class has only 12 students, the College will only lose $108.55 by eliminating the section. If the section only has one or two more students, or if many students pay out-of-district tuition, or if the instructor is paid even one step below the maximum, the section will quickly become "profitable." For example, note that in the Fall 2002 semester, no astronomy lecture class had less that 23 students enrolled. Therefore, even if all students paid minimum tuition, and even if all instructors were paid the maximum salary, every section of astronomy offered by ACC in the Fall 2002 semester more than paid for itself. This revenue can be allocated to pay for the indirect expenses of the College.

In summary, since the astronomy program plays a role in fulfilling the educational mission of the College, and since the program more than pays for itself in terms of the revenue it generates to meet the College's general costs, we can conclude that the cost of the astronomy program at ACC is justified.

4.3 Category: Program Effectiveness

Question: Are the teaching, learning, course, program, student and student support outcomes of this program of the best possible quality?

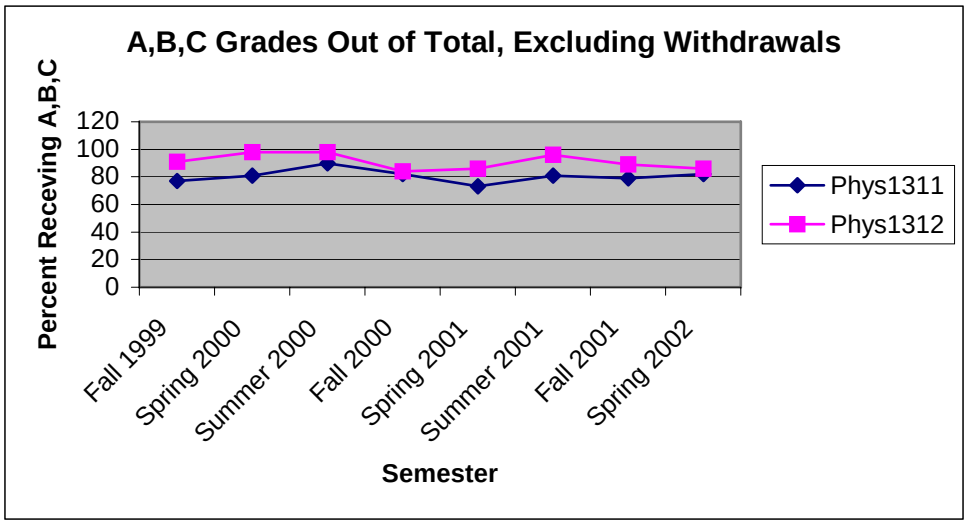
The honest answer to this question is, naturally, "no." Since imperfect human beings teach astronomy, there will always be room for improvement. However, there are many indicators that the outcomes in the laundry list of the question above are of very high quality. In terms of student achievement, most students who complete astronomy classes at ACC earn good grades, and if the results of Section 5 (Institutional Effectiveness Measures) below are an indicator, those good grades point to appreciable knowledge of the subject matter. Students are not only successful in their astronomy classes at ACC, but they seem generally pleased with their educational experience. Student retention could, of course, be better, but the figures for the astronomy program are in line with what is to be expected of classes in the Math and Sciences Division. Classes at ACC are offered at most major campuses and at all times of day. Faculty are well-trained and aggressive in pursuing their professional development. The curriculum is in line with the Common Course Numbering System, insuring transfer of ACC astronomy classes to most institution within Texas.

All in all, the educational outcomes of the ACC astronomy program are of very high quality. Is this "of the best possible quality?" Perhaps not, but a perusal of the "weaknesses" of the SWOT analysis in section reveals the obstacles that the faculty see before them. In the face of shrinking budgets and increasing paperwork, administrative difficulties and poor equipment, the outcomes may indeed be of the best possible quality under the circumstances.

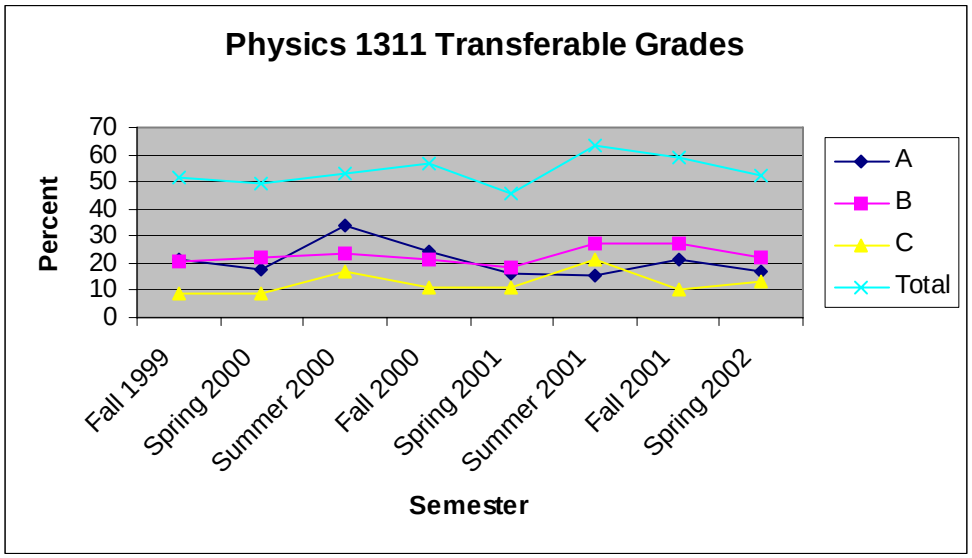
4.3.1 Sub-category: Student Achievement

4.3.1.1 Core Indicator: Course Completion Rates

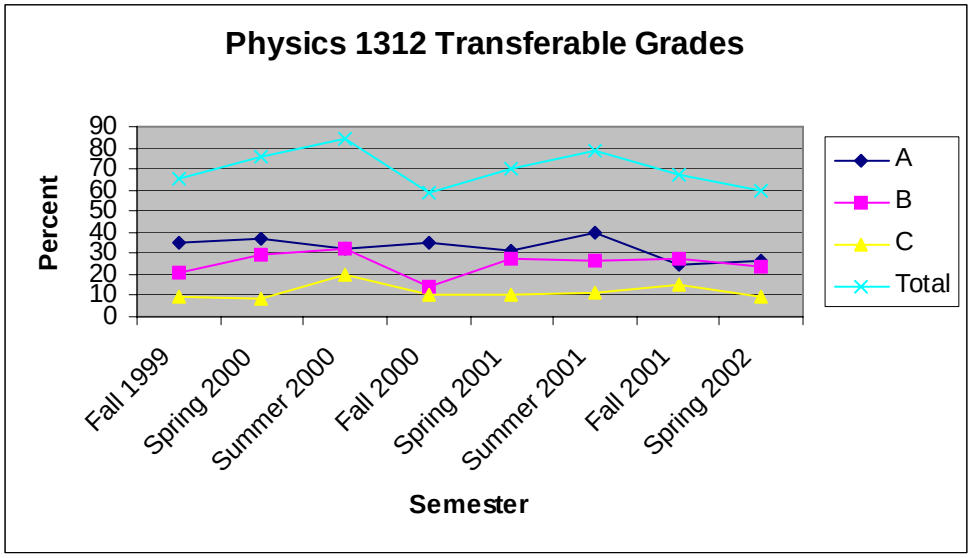
The following graph shows the percent "successful" grades (A, B, C) for all astronomy students receiving grades. It is clear that the vast majority of students who do not withdraw are successful in both PHYS 1311 and PHYS 1312.



Considering all grades, including withdrawals, for Physics 1311 (Stellar Astronomy), the total transferable ranges from 45% to 65% for the given semesters. The percents of each transferable grade (A, B, C) as well as the total percent transferable, out of all grades, including withdrawals, is shown in the graph below.



Considering all grades, including withdrawals, for Physics 1312 (Solar System Astronomy), the total transferable ranges from 60% to 85% for the given semesters. The percents of each transferable grade (A, B, C) as well as the total percent transferable, out of all grades, including withdrawals, is shown in the graph below. Physics 1312 is less conceptually difficult for most students than Physics 1311 (due to the larger amount of mathematics and physics in the latter), and it is not surprising that the success rate is relatively higher for this course.



4.3.1.2 Core Indicator: Program Completion

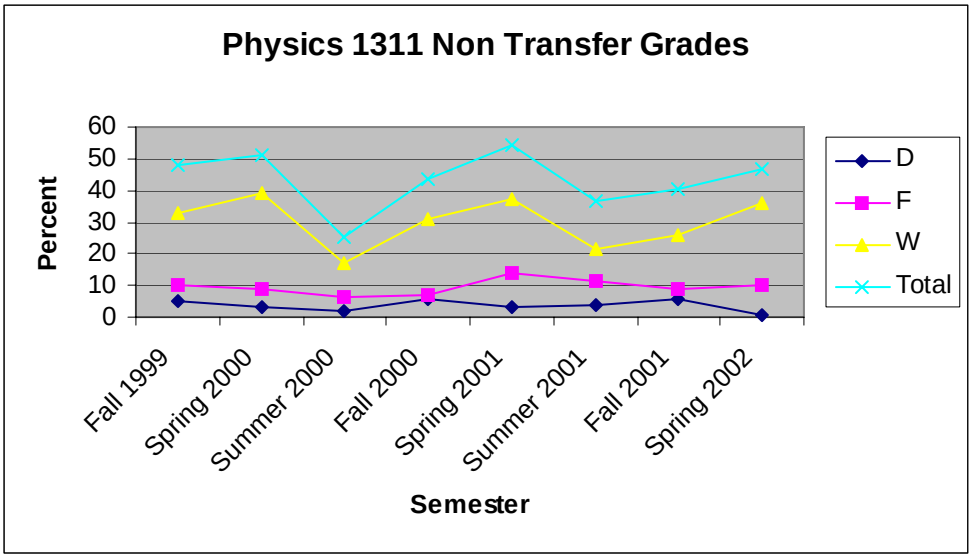
ACC offers no associates degree in astronomy, so this indicator is not relevant. For information about people seeking an associate's degree in physics, please refer to that report.

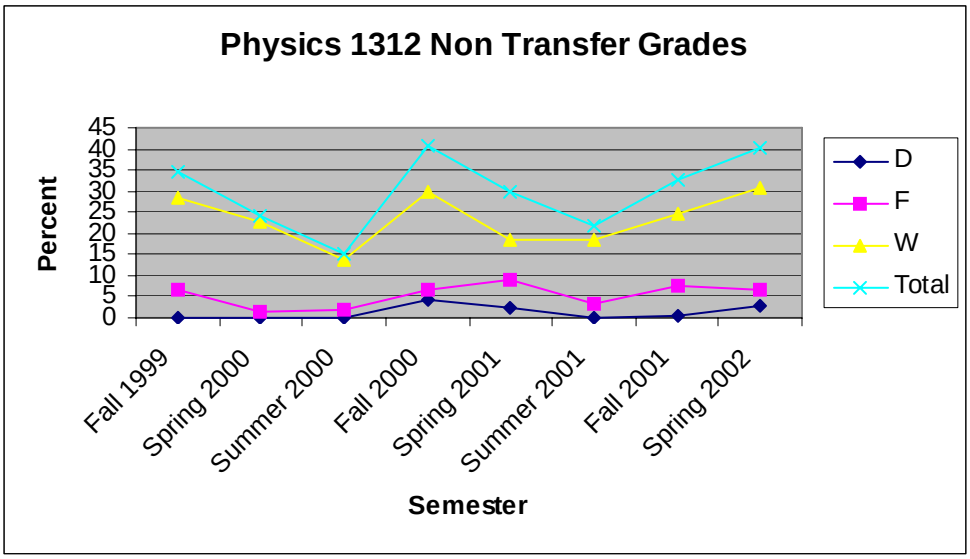
4.3.2 Sub-category: Student Retention

4.3.2.1 Core Indicator: Retention Rates

The non-transfer grades (D, F, W) for PHYS 1311 and PHYS 1312 are shown in the following graph. The total non-transfer percents as well as the percents for D, F, and W individually are plotted. The percents of D and F grades are fairly small. It is the withdrawals that account for a large percentage of the non-transfer grades in both courses. This may be a reflection of the fact that many students are taking ACC astronomy courses for transfer to other institutions. Such a student may be inclined to withdraw a course and "try, try again" if it looks as if they will receive what they view as a sub-par grade. ACC's very liberal withdrawal policies aid and abet such attitudes.

Data from OIE reports that Physics (with Astronomy included) had the second highest withdrawal rate in the college, a rate of 37.4%. Other high withdrawal rate classes were Chemistry 38.0% (1st), Biology 31.3% (3rd), Math 29.3% (4th), and English 25.9% (5th). Since science classes require both a great deal of time outside of class and a broader spectrum of skills (reading, writing, calculation) than other disciplines, it should come as no surprise that science classes in general suffer very high attrition rates. As noted above, the situation could be exacerbated by a perceived "disposability" of ACC classes in general, give ACC's generous withdrawal policies.




Physics 1312 Non Transfer Grades
Percent
45
40
35
30
25
20
15
10
5
0
Fall 1999
Spring 2000
Summer 2000
Fall 2000
Spring 2001
Summer 2001
Fall 2001
Spring 2002
Semester
D
F
W
Total

4.3.3 Sub-category: Student Outcomes

4.3.3.1 Core Indicator: Transfer of Course Completers

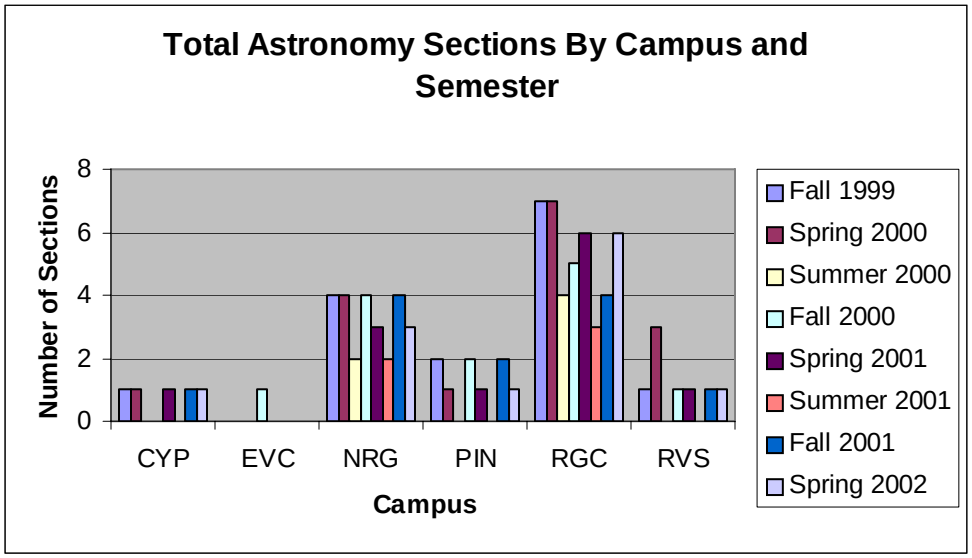
For the years 1999-2000 Physics/Astronomy had 67 students listed as majors in this category. Of these 67 students none received degrees in this area. The transfer rate for this time period was 39% with 26 students transferring to another institution in the Fall of 2000. Of the transfer students, 27% (18 students) were enrolled at the University of Texas at Austin, and 12% (8 students) enrolled at other Texas institutions. These 8 students were spread broadly: 2 at UT San Antonio, with the remaining 6 all attending different institutions. Surprisingly only 1 student was enrolled at Texas A&M.

This data is obviously a sub-set of the general student population. Since few students actually receive degrees in physics or astronomy (none did for the time period analyzed) at ACC or from four-year institutions, the sub-set in question is probably fairly representative of the entire population of students of taking physics and astronomy classes at ACC. The 39% percent transferring to other Texas Public Institutions is an indicator that a sizeable percentage of students taking physics classes are performing well and succeeding in their academic studies for the time period in question. It will be very helpful to find data for long term success of all our students at other institutions and to track students at all other institutions transferred to (not just Texas Public Institutions covered in this data) and to track all students (not just the ones who listed physics or astronomy as a major). However, this data is not available at the time.

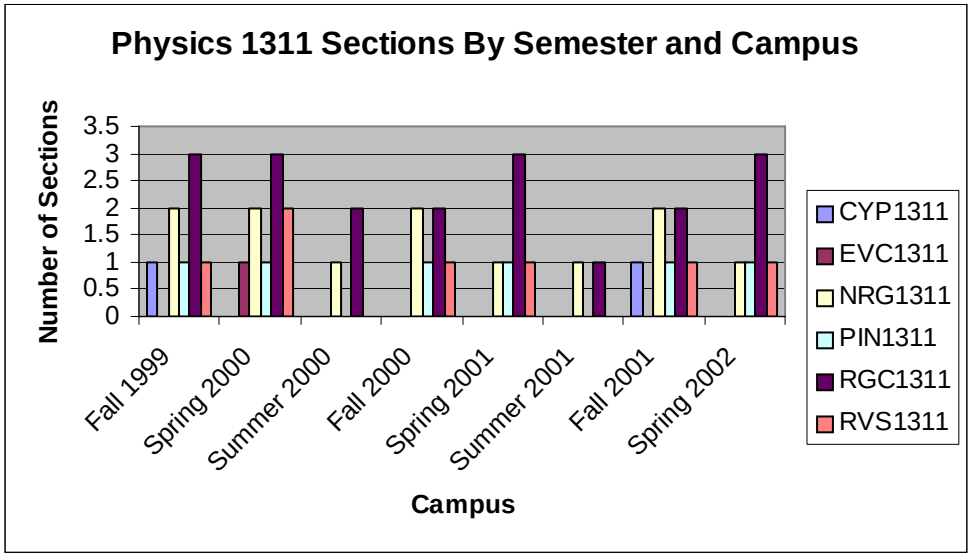
4.3.4 Sub-category: Access

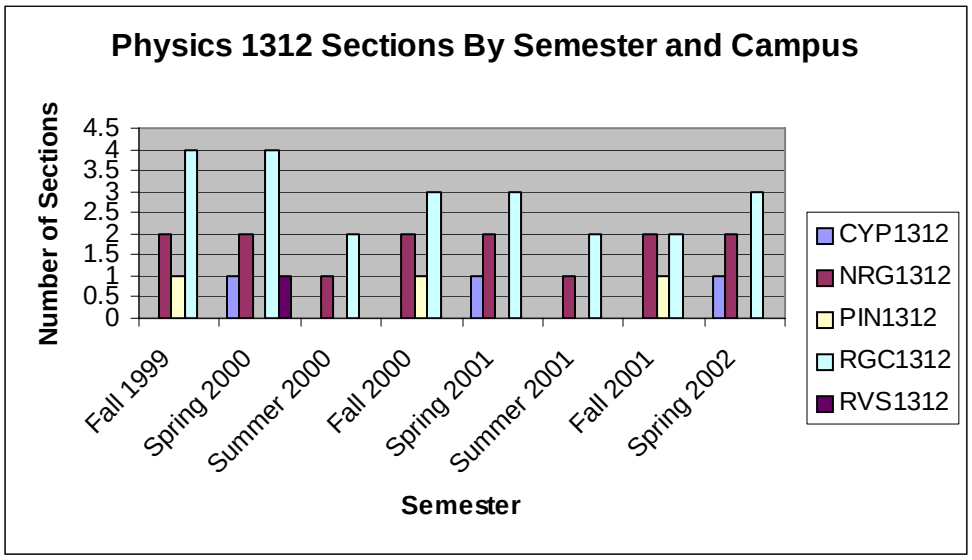
4.3.4.1 Core Indicator: Course Availability

The total number of sections of astronomy offered at each campus for the semesters from Fall 1999 to Spring 2002 are shown below. The majority of astronomy courses are offered at Rio Grande and at Northridge.

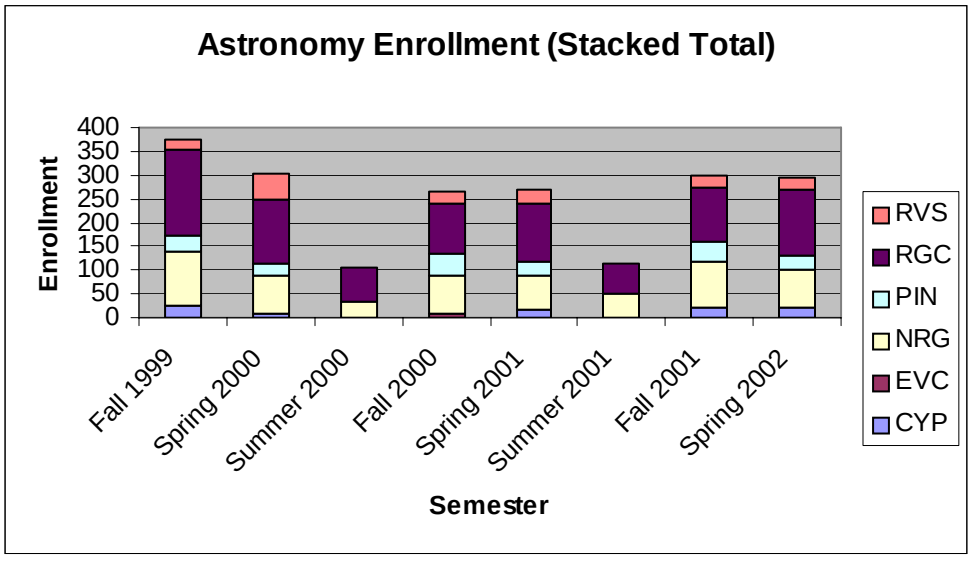


The charts below show information for each astronomy course.

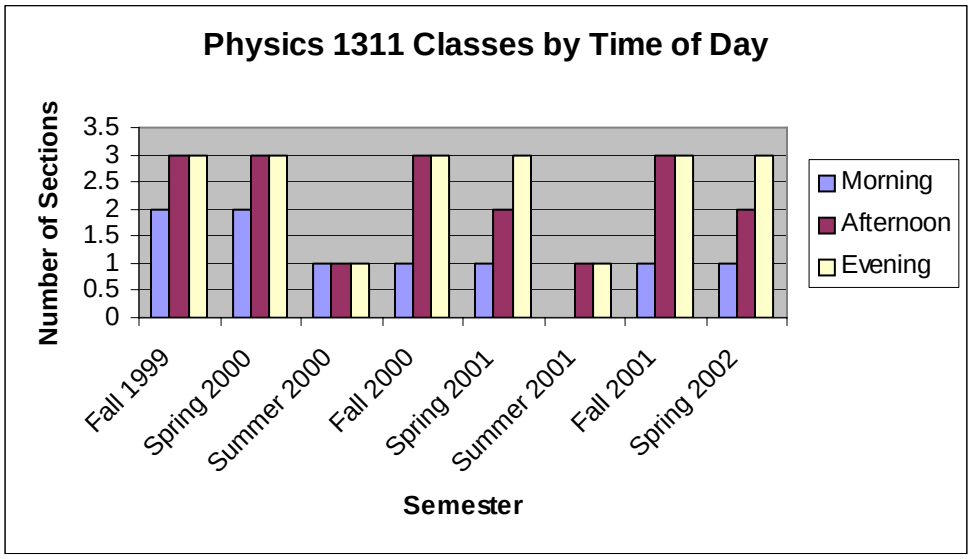




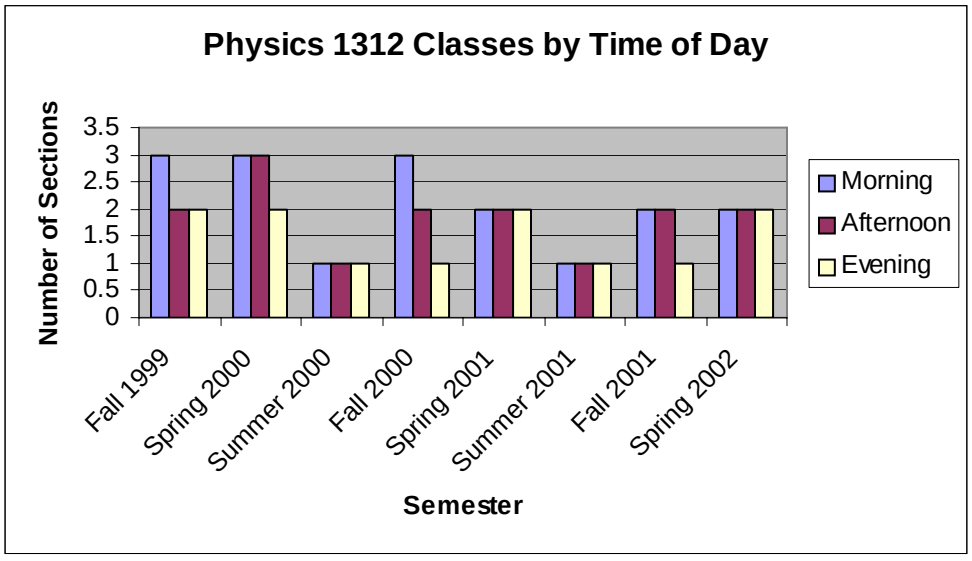
The chart below displays enrollment trends by campus.



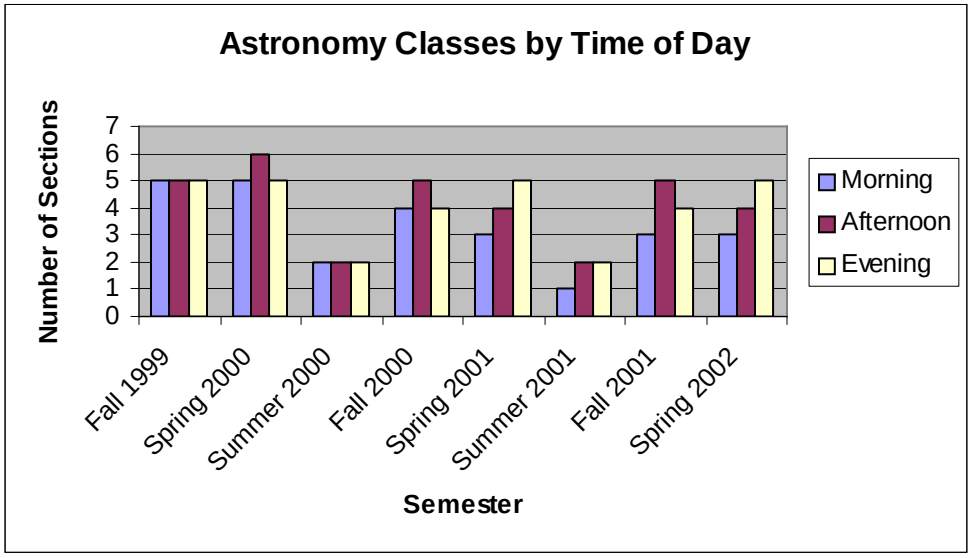
The chart below shows the number of Physics 1311 sections offered at each time of day per semester. The majority of the classes were offered in the afternoon and evening.



The number of Physics 1312 sections offered at each time of day per semester is shown in the following graph. These classes were offered more in the morning and afternoon.



The total number of astronomy sections available by time of day, per semester, is shown in the following graph.



Generally speaking, a student can find an astronomy class at ACC at a variety of campuses, at just about any time of day.

4.3.4.2 Core Indicator: Barriers to Students

Aside from those offered by class sizes and the mathematics prerequisite, there are no barriers to students taking astronomy courses at ACC. As noted above, there seems to be a good variety of times and places from which students can choose. Perhaps one or two more sections, perhaps at the Pinnacle or Riverside campuses, would open things up even more.

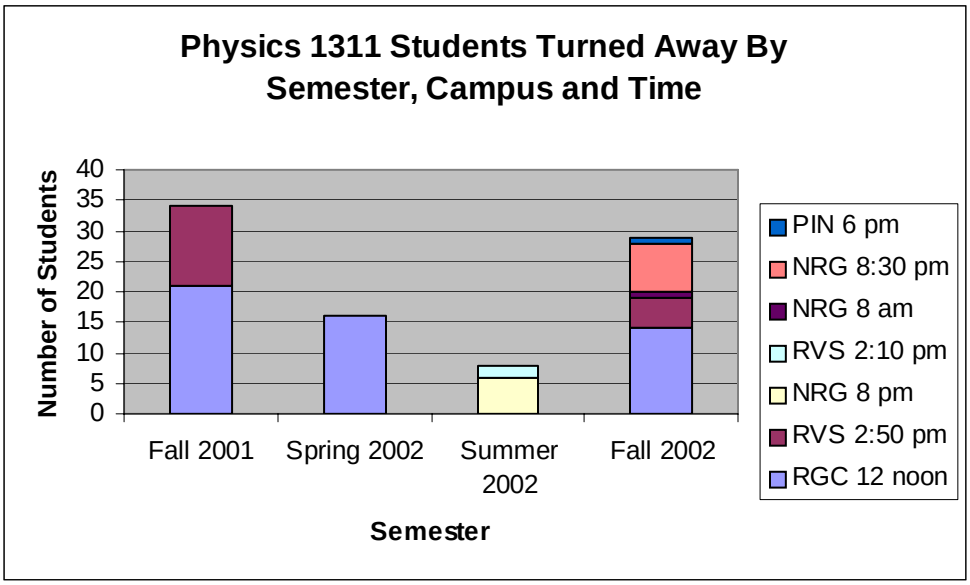
Since astronomy courses are primarily lecture at ACC, students with disabilities generally have no more problems than they would in other lecture courses. Possible exceptions to this are visually impaired students, who will find such a visual science difficult. A completely sightless student would probably not be able to participate in the laboratory course. Star parties are generally held at locations with facilities for mobility-impaired students.

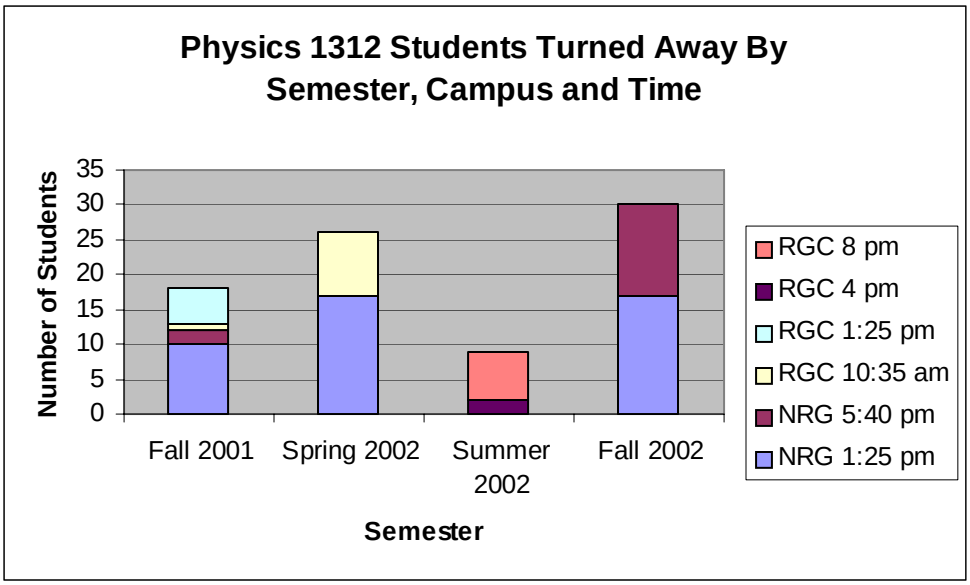
4.3.4.3 Core Indicator: Course Demand

The enrollment trends indicate that there is a demand for astronomy classes at Austin Community College. After a drop-off in the 2000-2001 school year, enrollments have rebounded, although the total number of sections has dwindled. Only about one or two sections each semester must be cancelled due to low enrollment. No sections had to be cancelled in 2002. Demand for astronomy classes is high, and there are indications that it is increasing.

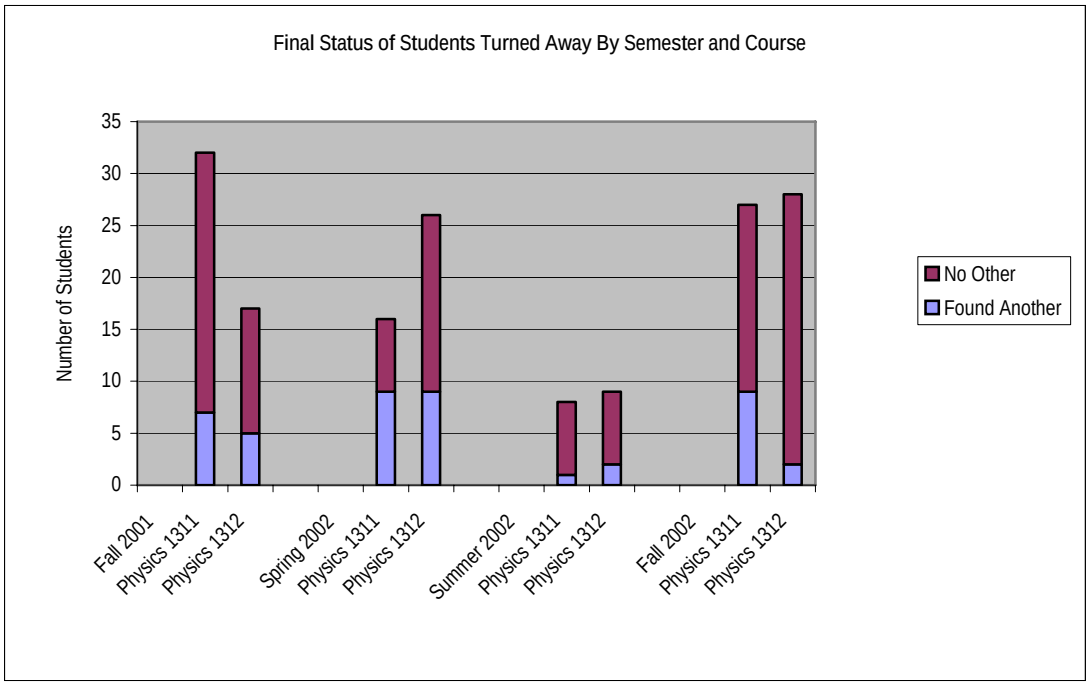
Semester	Course	number of sections	number of students	sections cancelled	sections 90%+ full
Spring 2000	PHYS 1311	9	144	1	1
	PHYS 1312	9	135	1	1
Summer 2000	PHYS 1311	3	47	0	0
	PHYS 1312	3	62	0	0
Fall 2000	PHYS 1311	8	121	1	1
	PHYS 1312	7	121	1	1
Spring 2001	PHYS 1311	8	144	2	2
	PHYS 1312	7	126	1	2
Summer 2001	PHYS 1311	3	46	1	0
	PHYS 1312	3	55	0	0
Fall 2001	PHYS 1311	8	161	1	2
	PHYS 1312	6	141	1	4
Spring 2002	PHYS 1311	6	155	0	3
	PHYS 1312	6	139	0	2
Summer 2002	PHYS 1311	2	42	0	0
	PHYS 1312	3	75	0	0
Fall 2002	PHYS 1311	8	218	0	6
	PHYS 1312	5	147	0	4

Because of the fact so many astronomy classes have recently filled to near capacity, the College has had to turn some students away from astronomy classes. While the situation is not nearly as bad as it is in physics and other sciences, the program must turn away between about 10 and 30 students each semester. The graphs below show the number of students turned away for each course offered by the program for the past four semesters.





The charts indicate that more students are turned away from Stellar Astronomy classes (PHYS 1311) at the Rio Grande campus, while the most students turned away from Solar System Astronomy (PHYS 1312) classes are trying to take classes at Northridge. While the numbers are small, it may be worthwhile to add another section of PHYS 1311 at Rio Grande and another section of PHYS 1312 at Northridge. The graph below demonstrates that many students who cannot get the astronomy class they want do not find another, so opening up possibilities may be preferable to forcing students to look elsewhere.



4.3.4.4 Core Indicator: Marketing of Courses

There has been no need in the past to advertise astronomy courses at ACC, since the program generally has no problem filling classes. However, starting in 2002, the program has begun offering a laboratory course to supplement its lecture courses, for those students who need laboratory science credit for their transfer. The program co-operated with the ACC Marketing Department to advertise the course. A brief description of the class was placed in the printed course schedules in 2002, and astronomy lecture section instructors were asked to mention the course to students. The course was able to achieve the minimum number of students in the Fall 2002 and Spring 2003 semesters, so the marketing campaign can safely be judged a success. The flyer for the course is in Appendix B.

4.3.5 Sub-category: Curriculum

4.3.5.1 Core Indicator: Currency of Course Content

Both astronomy courses use the same textbook: Astronomy Today, by Eric Chaission and Steve MacMillan (Prentice Hall). The book is in its fourth edition, and reflects the state of astronomical knowledge at its printing in 2001. Instructors use the World Wide Web and magazines such as Astronomy and Sky and telescope to keep themselves and their students up-to-date on the latest innovations in astronomy.

4.3.5.2 Core Indicator: Learning Outcomes

The astronomy program does not require instructors to follow a departmental syllabus. However, there are guidelines for syllabus structure and content, as well as a list of required topics for each course. The syllabus standards and the required topics for each course are included in Appendix C. Individual instructors are given the freedom to determine their own specific outcomes for their class. Such outcomes typically include

- Knowledge of the basic concepts of astronomy
- The ability to understand and evaluate scientific claims in the media
- The ability to pursue astronomy as a hobby

4.3.5.3 Core Indicator: Catalog Content

The ACC catalog contains the following descriptions of the astronomy courses offered by Austin Community College:

PHYS 1111 LABORATORY IN INTRODUCTORY ASTRONOMY (1-0-3). An introduction to elements of observational astronomy. Topics include the celestial sphere and coordinates, star maps, the electromagnetic spectrum, telescopes, phases of the moon. Emphasis on naked-eye observation. Students will be required to attend a night-time field trip and a day-time field trip. Fee: $20 Insurance: $2 Skills: G Prerequisites: Credit for or concurrent enrollment in PHYS 1311 or PHYS 1312 or their equivalent or approval of instructor.

PHYS 1311 STELLAR ASTRONOMY (3-3-0). A study of stars, galaxies, and the universe. Discussion of atomic spectra, nuclear energy, and astronomical tools (such as optical, radio, and other telescopes and image enhancers) as they provide knowledge about distant objects. Emphasis on recent discoveries about quasars, black holes, and cosmology. Skills: B Prerequisites: MATD 0370 or one year of high school algebra or equivalent. One year of high school science recommended, but not required.

PHYS 1312 SOLAR SYSTEM ASTRONOMY (3-3-0). A study of the Sun and its solar system: planets, satellites, meteors, comets, asteroids. Theories about the structure and origin of the solar system, with emphasis on recent discoveries. Includes a scientific investigation of other solar systems and the possibilities for extraterrestrial life. Skills: B Prerequisites: MATD 0370 or one year of high school algebra or equivalent. One year of high school science recommended, but not required.

These course descriptions are current and are in agreement with the Texas Common Course Numbering System.

4.3.5.4 Core Indicator: Instructional Resources

Astronomy instructors at Austin Community College make moderate use of the instructional resources of the College. Much is done "in-house" making use of department funds to meet resource needs. Uses of College facilities include, but are not limited to

- Showing LRS astronomy videotapes in class to illustrate astronomical principles as an alternative to lecture;
- Placing newspaper and magazine articles on astronomy on reserve in the LRS;
- Requiring students to look up and summarize articles on astronomy found in the LRS or on the World Wide Web.

It is likely that there are many facilities in the ACC Learning Resource Center that instructors could use, but are not aware of. A meeting between faculty and LRS staff is clearly in order.

4.3.5.5 Core Indicator: Course Syllabi

Every semester, faculty are required to submit updated syllabi to the Department Chair and the Faculty Evaluation Committee. These syllabi and their contents are judged by how well they conform to program and college standards. While there are no departmental syllabi in the astronomy program, the standards are summarized by the samples presented in Appendix C.

4.3.6 Sub-category: Technology

4.3.6.1 Core Indicator: Technology Assessment

Use of technology in the classroom has great potential to have an effect on the teaching of astronomy. This is true especially for astronomy since it is a very visual discipline, and technology can bring useful and visually stunning images into the classroom. Although most ACC instructors use a predominantly traditional, lecture-oriented approach in the classroom, technology can still play a role in instruction. Examples of technology use in the classroom include

- Use of the World Wide Web as a source of information, classroom discussion, and images. Astronomy is a dynamic discipline that is constantly changing, and the Web can give instructors and students alike access to up-to-date information. The Web can also be used as an alternate mode of delivery; one instructor hands very few items out in class, requiring students to get most handouts and homework assignments off a class website.
- Many instructors use projectors, both overhead projectors and, with increasing frequency, computer projectors, to broadcast images onto a screen. The images can come directly from the Web, from specially prepared Powerpoint presentations, or from computer simulations. However, as noted in the "weaknesses" section of the SWOT analysis in Section 3, the multi-media equipment available to instructors is of poor optical quality and is inconvenient to set up and break down. What are needed are more powerful projectors that are continuously set up in dedicated classrooms. This total integration of audio-visual technology with the classroom environment would be a definite boon to astronomy instruction at ACC
- Over the years, the ACC astronomy program has acquired a number of telescopes for instructors to use. These telescopes range in size and complexity from a large pair of binoculars to a computer-driven telescope with an electronic camera. With these instruments, instructors have been able to give students a first-hand look at objects discussed in the classroom. The primary problem here is one of storage space. There is currently no place to store these often large pieces of equipment, and instructors must store them in their homes. This situation makes it inconvenient for other instructors to use the telescopes.

As stated above, ACC astronomy faculty primarily use a traditional lecture-based instructional methodology. There are no classes being taught via distance learning, although one faculty member has some experience in this medium and may develop such a class in the future. Also, some instructors are investigating alternate modes of instruction such as cooperative learning, project-based learning, and computer-assisted instruction in their professional development activities, so such methods may be piloted in the future.

4.3.7 Sub-category: Faculty

4.3.7.1 Core Indicator: Faculty Credentials

Name	Highest Degree	Granting Institution	18+ Hours in Astronomy?	18+ Hours in Related Field?
Dean Becker (Adj)	MA Physics	UT Austin	Y	
John Blum (Adj)	MA Physics	UT Austin		Y
Christina Cavalli (Adj)	PhD Physics	Dartmouth College		Y
Gary Crane (Adj)	MS Physics	Southwest Texas State		Y
John Fulton (Adj)	MS Physics	Southwest Texas State		Y
James Heath (FT)	MA Astronomy	UT Austin	Y	
Frank Mikan (Adj)	MS Geology	Ohio State University	Y	
Marvin Richmond (Adj)	MS Physics	Sam Houston State		Y
Steve Riley (Adj)	PhD Physics	UC Irvine	Y	
Peter Wehner (Adj)	MS Geology	Vanderbilt		Y

4.3.7.2 Core Indicator: Number of Faculty Adequate to Teach Courses

Although it occasionally requires faculty overloads and heroic efforts on the part of the lower-level administration, all sections of astronomy at ACC can be adequately staffed. Unfortunately, the pool of available instructors is only barely adequate at this time to staff all sections. Hiring a full-time faculty to partially teach astronomy, or adding two or three new adjuncts to the pool would insure a safety net and perhaps even allow for expansion of the number of sections.

There are no full-time faculty completely devoted to teaching astronomy at ACC. There always has, however, been a full-time faculty in physics who has split his or her time between physics and astronomy. That faculty member has taught anywhere between 1 and 3 sections of astronomy each semester.

FY	Sections taught by FTF (%)	Contact hours taught by FTF (%)
1997	1 / 41 (2.4%)	816 / 39216 (2.1%)
1998	1 / 37 (2.7%)	624 / 40,464 (1.5%)
1999	2 / 36 (5.5%)	1968 / 40032 (4.9%)
2000	2 / 37 (5.4%)	1824 / 38016 (4.8%)
2001	10 / 30 (33%)	11232 / 31008 (36%)

The abrupt jump in percentage in FY 2001 reflects the retirement of one FT faculty in physics and the hiring of another who committed to teach more astronomy classes. The percentage is still far below the target set by administrative guidelines for ACC, however. The situation would be alleviated by hiring another full-time faculty member to teach some astronomy.

4.3.7.3 Core Indicator: Faculty Professional Development

Astronomy faculty at ACC are very serious about keeping both their astronomy content and pedagogical knowledge current through their professional development. Every member of the faculty pursues at least the number of professional development hours required by the College for a "step increase" in pay.

In addition, there have been efforts in recent years by faculty to look outside the traditional activities offered by the College for more discipline-specific training. For example, faculty have sought out and attended conferences sponsored by the American Astronomical Society, the American Association of Physics Teachers, and the National Science Teachers Association to meet with colleagues from across the country to talk about teaching. In addition, faculty have attended workshops such as the TYC Physics for the 21st Century Workshops and the NSF Chautauqua Program to develop their skills and knowledge. Many instructors maintain memberships in professional organizations such as the American Association of Physics Teachers and the National Science Teachers Association, even going so far as to write articles for those organizations' publications.

There have also been efforts in recent years to provide "in-house" workshops led by faculty for faculty. Topics for these workshops have included small telescope operation, developing a class website, and using computer simulations in the classroom.

4.3.7.4 Core Indicator: Teaching Effectiveness

The table below shows data culled from student evaluation of instructors in the program during the period from Fall 1999 to Fall of 2001. Six items were taken from the student evaluation questionnaire as indicative of the effectiveness of teaching. The first item below is a simple percentage of students who say they would recommend an

astronomy class taught by that particular instructor. The remaining items are questions answered by students using a 5-point Likert scale, where 1 = ”Never” and 6 = ”Always.”

Item	Fall 1999		Spring 2000		Fall 2000		Fall 2001	
	Program	ACC	Program	ACC	Program	ACC	Program	ACC
#6	88%	88%	90%	87%	84%	88%	91%	92%
#8	5.1	5.3	5.4	5.2	5.2	5.3	5.3	5.3
#10	5.4	5.4	5.6	5.3	5.3	5.4	5.4	5.5
#18	5.6	5.4	5.7	5.3	5.5	5.4	5.5	5.5
#26	5.5	5.4	5.5	5.4	5.4	5.5	5.4	5.5
#28	5.3	5.2	5.5	5.2	5.1	5.3	5.3	5.3

Explanation of evaluation items:

#6 – I would recommend this instructor
#8 – Instructor clearly explained concepts
#10 – Instructor clarifies with explanations
#18 – Reading and homework strengthen lecture
#26 – Instructor interested in students learning
#28 – Class is helpful and stimulating

We can see from the table that the student reviews of instructors in the astronomy program have been consistently high during the three-year period. The numbers are in agreement with the evaluation figures for the College as a whole throughout the period. Thus, we can conclude that the faculty within the astronomy program are very effective teachers, at least the equal of other instructors at ACC. The results of the institutional effectiveness measure presented in Section 5 corroborate the results of the student evaluations.

The table below presents data comparing student evaluations for the two lecture courses offered by the astronomy program in three different semesters. The items are the same as the table above.

Item	Fall 1999		Spring 2000		Fall 2000		Fall 2001	
	1311	1312	1311	1312	1311	1312	1311	1312
#6	81%	93%	90%	91%	84%	83%	85%	97%
#8	4.8	5.4	5.1	5.8	5.1	5.1	5.1	5.6
#10	5.1	5.5	5.5	5.8	5.3	5.3	5.2	5.7
#18	5.5	5.6	5.6	5.7	5.4	5.5	5.3	5.6
#26	5.2	5.7	5.3	6.0	5.4	5.4	5.4	5.7
#28	4.9	5.5	5.4	5.7	5.3	4.9	5.3	5.7

The table reveals that for many items, the evaluation numbers for Stellar Astronomy (PHYS 1312) were consistently lower than those for Solar System Astronomy (PHYS 1311). This may be a reflection of the more abstract and mathematical nature of the material in PHYS 1311. Due to the nature of the topic, the

Stellar Astronomy class has a great deal more physics than the other course. The mathematics required for problem solving in Stellar Astronomy is also more complicated than for Solar System Astronomy, which has a more sizable conceptual angle than Stellar. This higher difficulty level for Stellar Astronomy may be leading to lower evaluations.

4.3.7.5 Core Indicator: Faculty Satisfaction

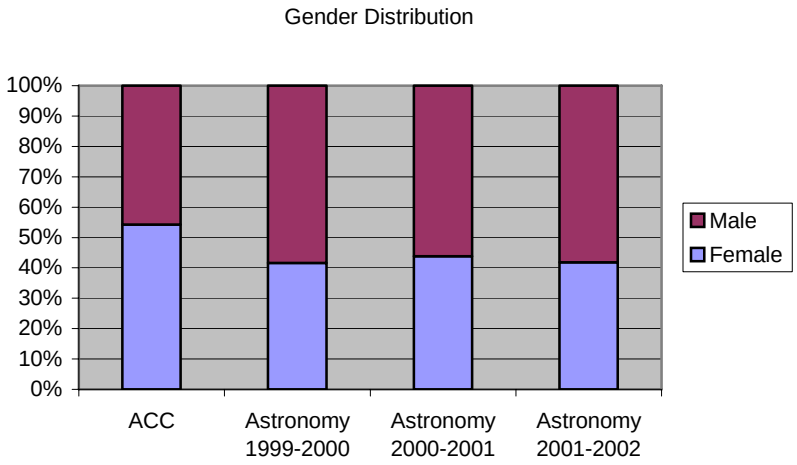
The astronomy faculty at ACC has been very stable for the past three years. A solid core of "regulars" among the adjunct faculty is supplemented by graduate students from the University of Texas earning extra income. Since the only losses to the teaching staff in the past three years have come from early retirement and moving on after graduation into professional astronomy, we can assume that employee satisfaction is high.

4.3.8 Sub-category: Diversity

4.3.8.1 Core Indicator: Student Diversity

- Age – The average age for a student taking an astronomy course at ACC remains fairly consistent throughout the period Fall 1999 through Spring 2002, between 22 and 24 years of age. Students taking the course in the summer seem slightly older on average, but this may be a statistical aberration. Based upon the information in the ACC Fact Book, it appears that students taking astronomy at ACC seem a bit older than students at ACC as a whole. Again, this may be a statistical artifact, or it may be possible that students frequently put off taking a science class until near the end of their stay at ACC.

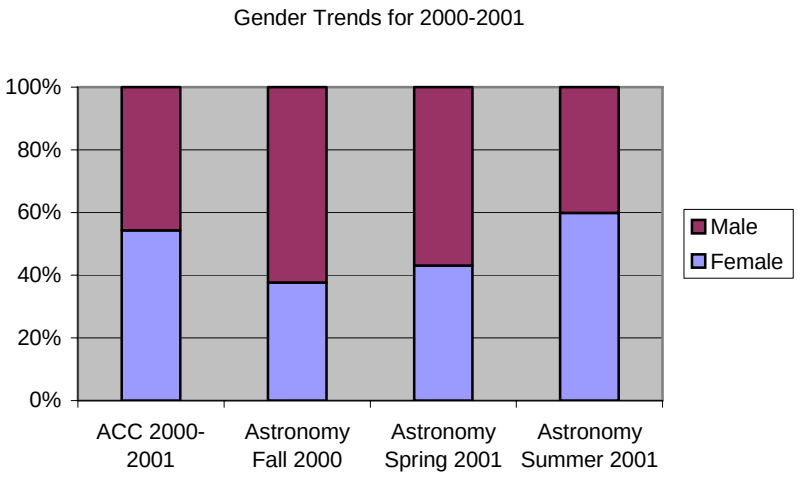
- Gender – The chart below shows the distribution of students by gender, first for the college as a whole in the period 1999-2001, and then for astronomy classes during the same period. Both astronomy courses are combined, since there are no significant gender trends between courses.



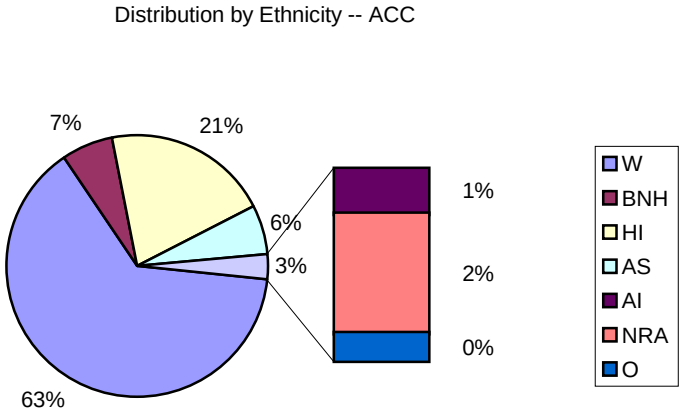
The data indicate that there is a considerable imbalance in the male-female ratio in astronomy classes at ACC. This ratio has been fairly consistent over the past three years. However, the ratio is not consistent with the male-female ratio for ACC as a whole. This

may be a reflection of the unfortunate tendency in society either to discourage young women from studying science at all, or to "funnel" them into the life sciences rather than the physical sciences. Despite the fact that the long, rich history of astronomy is filled with examples of courageous, hard-working, and intelligent women who have changed the way we view the Universe, women are often pushed away from science by counselors, parents, and their own fears. We can only hope that this discouragement will wane in the generations to come, and that the program can play some small role in that by providing the women that do take our courses with a productive and positive learning experience.

The chart below illustrates the trends in gender demographics over the school year Fall 2000-Summer 2001. Overall ACC data from that time period is included for comparison. Note that there appears to be an increase in the percentage of females as the school year progresses. This phenomenon is seen in other years, and its causes remain mysterious.



- Ethnicity – The graphs below show the distribution of students by ethnicity. The first graphs shows the distribution of ACC students as a whole:

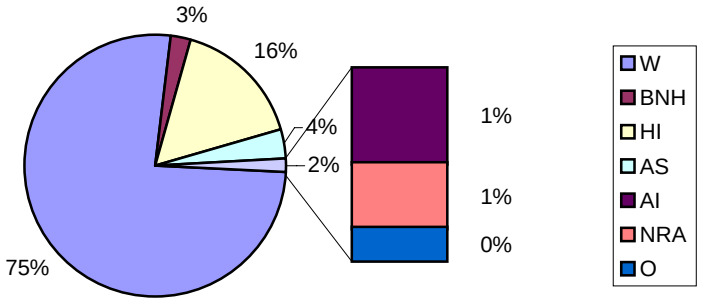


The abbreviations of the key are as follows:

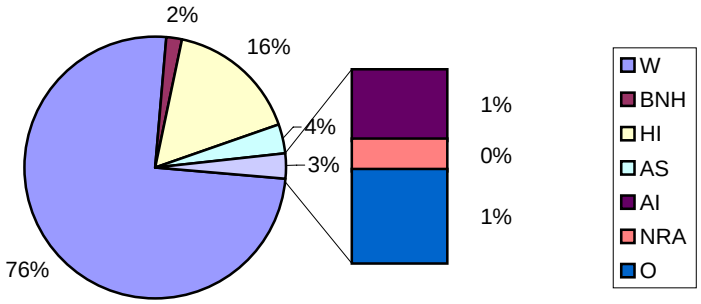
W = White
BNH = Black / Non-Hispanic
HI = Hispanic
AS = Asian
AI = American Indian / Alaskan Native
NRA = Non-Resident Alien
O = Other

The following graphs illustrate the ethnic demographics for ACC students taking astronomy classes:

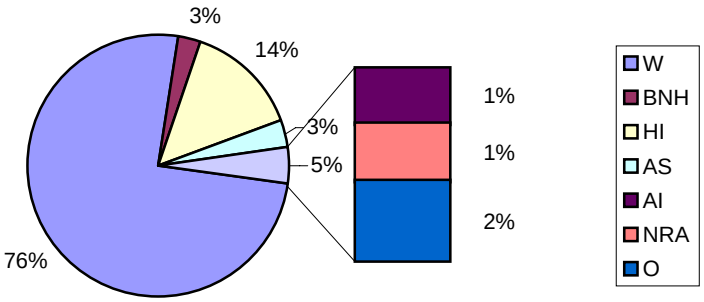
Ethnicity Distribution for Astronomy 1999-2000



Ethnicity Distribution for Astronomy 2000-2001



Ethnicity Distribution for Astronomy 2001-2002



The percentages are very stable over the three-year period. Unfortunately, the ethnicity demographics of students taking ACC astronomy classes differ from those of ACC students as a whole. A larger percentage of the students taking astronomy are white. As we saw in the gender data, this imbalance reflects a general tendency in

society to discourage minority students from taking classes in the physical sciences. The reasons for this discouragement are unclear, since there has never been a clear link made between race and performance in astronomy. As with the gender imbalance, we can only hope that our Program can make some small contribution to righting this ethnic imbalance by affording all students, regardless of gender or ethnicity, an equal chance to learn all that they can about our Universe.

4.3.8.2 Core Indicator: Faculty Diversity

Unfortunately, the astronomy faculty at ACC are not a very diverse group in terms of gender or ethnicity. All but one of the faculty are male, and all are of European descent. For whatever reason, women and minorities are very under-represented in American astronomy in general, and the demographics of ACC astronomy faculty are a reflection of this trend. The Physical Sciences Hiring Committee continues to aggressively seek the best possible potential instructors, and hopefully a by-product of these searches will be a more diverse hiring pool.

4.3.9 Sub-category: Student Satisfaction

4.3.9.1 Core Indicator: Course Evaluations

The table below shows data culled from student evaluation of instructors in the program during the period from Fall 1999 to Fall of 2001. Six items were taken from the student evaluation questionnaire as indicative of the satisfaction of students. The first item below is a simple percentage of students who say they would recommend an astronomy class taught by that particular instructor. The remaining items are questions answered by students using a 5-point Likert scale, where 1 = "Never" and 6 = "Always."

Item	Fall 1999		Spring 2000		Fall 2000		Fall 2001	
	Program	ACC	Program	ACC	Program	ACC	Program	ACC
#6	88%	88%	90%	87%	84%	88%	91%	92%
#8	5.1	5.3	5.4	5.2	5.2	5.3	5.3	5.3
#10	5.4	5.4	5.6	5.3	5.3	5.4	5.4	5.5
#18	5.6	5.4	5.7	5.3	5.5	5.4	5.5	5.5
#26	5.5	5.4	5.5	5.4	5.4	5.5	5.4	5.5
#28	5.3	5.2	5.5	5.2	5.1	5.3	5.3	5.3

Explanation of evaluation items:

#6 – I would recommend this instructor
#8 – Instructor clearly explained concepts
#10 – Instructor clarifies with explanations
#18 – Reading and homework strengthen lecture
#26 – Instructor interested in students learning
#28 – Class is helpful and stimulating

We can see from the table that the student reviews of instructors in the astronomy program have been consistently high during the three-year period. The numbers are in agreement with the evaluation figures for the College as a whole throughout the period. Thus, we can conclude that the students who successfully complete astronomy classes at ACC are very satisfied with their experiences, at least as satisfied as they are in other classes at ACC.

The table below presents data comparing student evaluations for the two lecture courses offered by the astronomy program in three different semesters. The items are the same as the table above.

The table reveals that for many items, the evaluation numbers for Stellar Astronomy (PHYS 1312) were consistently lower than those for Solar System Astronomy (PHYS 1311). This may be a reflection of the more abstract and mathematical nature of the material in PHYS 1311. Due to the nature of the topic, the Stellar Astronomy class has a great deal more physics than the other course. The

mathematics required for problem solving in Stellar Astronomy is also more complicated than for Solar System Astronomy, which has a more sizable conceptual angle than Stellar. This higher difficulty level for Stellar Astronomy may be leading to lower student satisfaction in those classes. Then again, with the small number of sections of astronomy offered at ACC, this may simply be an indicator of dissatisfaction of one or two particular instructors, and not with the program as a whole.

Item	Fall 1999		Spring 2000		Fall 2000		Fall 2001	
	1311	1312	1311	1312	1311	1312	1311	1312
#6	81%	93%	90%	91%	84%	83%	85%	97%
#8	4.8	5.4	5.1	5.8	5.1	5.1	5.1	5.6
#10	5.1	5.5	5.5	5.8	5.3	5.3	5.2	5.7
#18	5.5	5.6	5.6	5.7	5.4	5.5	5.3	5.6
#26	5.2	5.7	5.3	6.0	5.4	5.4	5.4	5.7
#28	4.9	5.5	5.4	5.7	5.3	4.9	5.3	5.7

4.3.10 Sub-category: Transfer Institutional Satisfaction

4.3.10.1 Core Indicator: Transfer Articulation Agreements

Both astronomy courses offered by ACC (to be joined in upcoming years by a laboratory course) are part of the Texas Common Course Numbering System, and therefore should easily transfer to any college that subscribes to that system. Specific information on some institutions that ACC students most frequently transfer to is included in the table below.

ACC course	PHYS 1311	PHYS 1312	PHYS 1111
Transfer Equivalent at other institutions			
The University of Texas at Austin	ASTR 301	ASTR 309K	ASTR 103L
Texas Tech University	ASTR 1300	ASTR 1301	ASTR 1100
Southwest Texas State University	PHYS 1350	PHYS 1340	PHYS 1140

4.3.10.2 Core Indicator: Course Transfer

As indicated above, all three courses offered by the ACC astronomy program transfer to a variety of other institutions. Since the courses are integrated with the Texas Common Course Numbering System, there have been no reported problems or complaints from students transferring within Texas. There have been minor problems when students have transferred to schools outside of Texas, but those have all been cleared up by simply submitting a syllabus and letter to the school.

4.3.10.1 Core Indicator: Satisfaction of Transfer Institutions

There is no information currently for this indicator. However, plans are in the making to exchange information with a major transfer institution, the University of Texas at Austin. Such collaboration may not bear much fruit, however; students frequently take all the classes required to fulfill their science requirement at ACC, and unfortunately never take a science class at the four-year institution they transfer to. Assessing the satisfaction of the transfer institution may thus be difficult, as the University may have no data.

ACC Astronomy Program Review
Section 5:
Institutional Effectiveness Measures

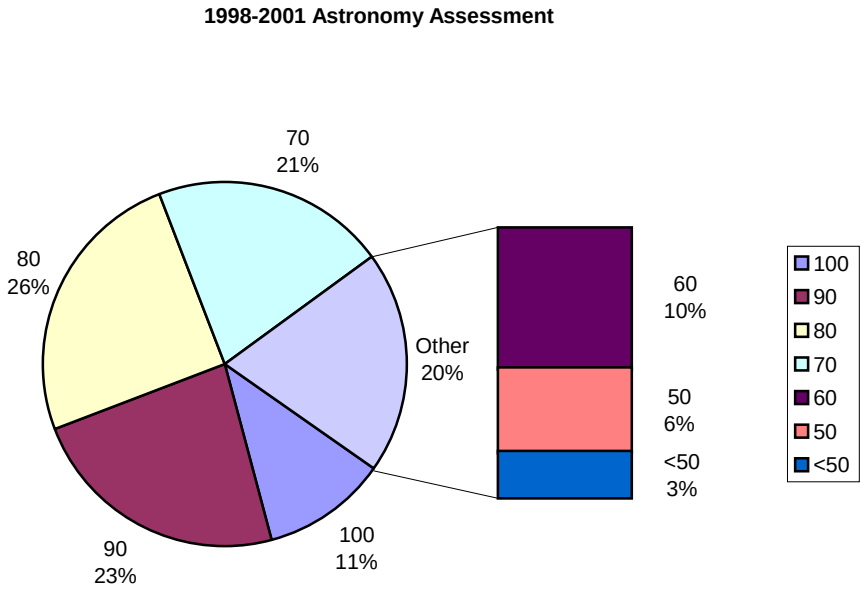
Part 1: Results of Current Effectiveness Measure

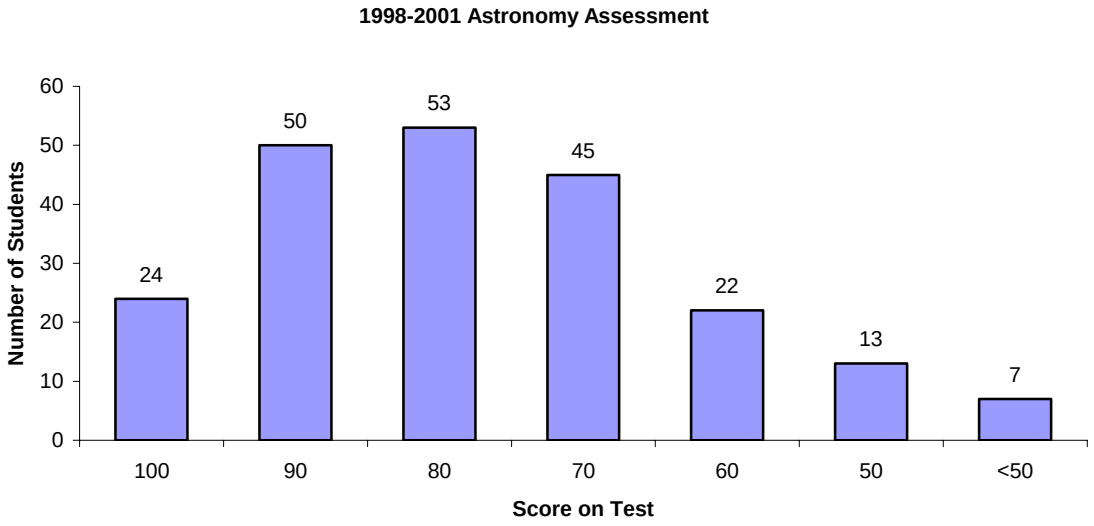
Objective: One of the stated goals of the ACC Astronomy Program is "to provide students with the skills and knowledge required to understand the basic ideas of astronomy, to pursue astronomy as a hobby, and to think critically as a scientifically aware citizen." Our objective is to measure our effectiveness in achieving this goal.

Assessment Instrument: The assessment instrument (see Appendix D) is a ten-question multiple choice test that draws from the subject areas of the nature of light, telescopes, stellar properties, stellar evolution, and cosmology. The test is given to students in most sections of the Stellar Astronomy course (PHYS 1311) at the end of the fall semester of each year. Some tests are also given at the end of the spring semester.

Measurable Outcome: The desired outcome is that at least 70% of the students taking PHYS 1311 that semester will get at least seven of the questions correct (score of 70) at the end of the semester.

Results: For the past four years, the ACC Astronomy Program has consistently achieved, and even exceeded, the desired outcome. As the charts below demonstrate, during the period 1998-2001, 80% of students taking the Stellar Astronomy course scored a 70 or better on the test. Results for 2002 were not available as of this writing.





The information above demonstrates that the ACC Astronomy Program has done an excellent job of introducing students to the basic principles of astronomy. It is worth noting that since 1998, more than half of the students that have taken the test have scored above 80% on it, and a little over a third have performed at the 90% level.

Astronomy instructors at ACC have shown a consistent dedication to providing students with a quality learning experience, as the results of this study bear out. The Academic Dean, Physical Science Task Force Leaders, and support staff have all been extremely helpful in achieving our goals.

However, we realize that there could be an alternate explanation for these stunning results: that students come into our astronomy classes with a large amount of prior knowledge about astronomy. Astronomy is a very popular science with the general public, and many young people may find astronomy more accessible than other sciences before entering college. Therefore, it is possible that many students may already be aware of the principles contained in the assessment instrument before they take an ACC Stellar Astronomy class. This will lead us to modify our use of this instrument in the future, as described below.

In summary, the results of the institutional effectiveness survey from 1998-2001 seem to indicate that most students leave ACC Stellar Astronomy courses with a considerable amount of astronomical knowledge. Whether this is due to the efforts of instructors, or due to students' prior knowledge, remains to be seen.

Part 2: Proposed Future Effectiveness Measures

1. **Pre-test / post-test with existing instrument**

   As noted above, with our current system of assessment, it is difficult to tell whether students' knowledge of astronomy is genuinely improving as a result of our efforts, or if they are simply coming into our classes with considerable knowledge of astronomy. To resolve this conflict, we propose to use the current assessment instrument, but in a pre-test / post-test format. The pre-test will be give in the first three class days, before the relevant subject matter begins to be covered. The post-test will be given the last week of class as before.

   Assessment instrument: ten-question multiple-choice test on basic topics in PHYS 1311, Stellar Astronomy

   Measurable outcome: Students will exhibit statistically significant improvement in their scores on the exam from pre-test to post-test.

2. **Measure of non-mastery rates**

   One of the greatest challenges we face in achieving our educational goal in the sciences is the high rate of non-mastery among students. These are usually in the form of withdrawals, as students discover during the course of the semester that they lack the skills, motivation, or time to do the work necessary to succeed in a science class. As seen earlier in this report, the astronomy program is not immune to these high non-mastery rates. While we realize that we cannot eliminate this challenge due to the work-intensive nature of our discipline, we wish to minimize non-mastery rates for astronomy.

   Assessment instrument: Non-mastery rate information provided by the College

Measurable outcome: The astronomy program will consistently have average non-mastery rates below the average non-mastery rate for courses in the College's Math and Sciences Division.

3. **Measure of student success in future astronomy classes at the University of Texas**

Another stated goal of the astronomy program is "to provide students with classes in introductory astronomy suitable for transfer to satisfy the science requirements of four-year institutions." Many if not most of our students are taking our astronomy courses to fulfill the science requirement for a four-year institution that they are planning to attend in the future. Some of those students take just one astronomy class at ACC, and then take a follow-up course at their institution. We are interested in knowing just how well we prepare students to take that follow-up course.

Assessment instrument: Information on transfer student performance from the University of Texas at Austin

Measurable outcome: Students who take a single introductory astronomy course at ACC and then transfer to the University of Texas do at least as well in a follow-up astronomy course as students who took their introductory astronomy course at the University or some other institution.

ACC Astronomy Program Review
Section 6:
Recommendations for Future Projects

Some of the suggestions below were suggested at the Strengths, Weaknesses, Opportunities, and Threats brainstorming session, while others resulted from the many meetings and conversations generated by the program review process. They are listed roughly in order of importance to those involved in the program review.

1. **A Planetarium for Austin** – Austin is the largest city in the U. S. that does not have a public planetarium. Austin Community College is unusual in that it has substantial offerings in astronomy, yet has no access to a planetarium to enhance instruction. This situation is very strange considering Austin's high tech character and reputation. Planetaria are very expensive (1-2 million dollars is not an unusual price tag), so expecting ACC to build one on its own is quite unreasonable, especially in hard economic times. However, Austin Community College can be a leader in an effort to build a coalition of government, business, and education concerns to get a planetarium for Austin. ACC could also draw upon its pool of talented educators to provide a director for the planetarium.

2. **A Dedicated Observing Site** – One of the major obstacles to providing our students with a meaningful learning experience in astronomy is our inability to take students to a specific place, owned by ACC, where they can observe the sky safely. We are currently relying upon the good graces of other entities, such as Wild Basin Wilderness and St. Stephen's Academy, to provide observation opportunities. While all of these experiences have so far been very positive, they do not allow for spontaneity, and limit what instructors can do. It would be much better to have a small plot of land relatively far from city lights (but still close enough to be accessible) purely for ACC use. This could be a joint project with other science programs, such as geology, biology, and environmental science.

3. **Storage Facilities** – While the astronomy program does possess telescopes for instructors to use with students, there is currently no way to store these telescopes on campus. Thus, instructors must store these telescopes in their homes. This is of course convenient for that instructor, but it is inconvenient for others who may want to use them. We would like to purchase three storage cabinets, two for Rio Grande and one for Northridge, to store telescopes and other astronomy equipment. The two cabinets at Rio Grande would be placed in a large classroom, the one at Northridge in a basement storeroom.

4. **Better Visual Equipment** – Astronomy is a very visual science, and astronomy teachers love to use images to communicate concepts to students. Computers attached to projectors can meet this need very well, projecting Powerpoint presentations as well as images directly from the World Wide Web. The current equipment for this is inadequate: the projectors are difficult to roll out and set up

in a short period of time, the images are of poor quality, and the bulkiness of the devices required frequently blocks students' view. We would like to get new, more powerful projectors dedicated to each of our lecture and lab rooms, attach them to the ceiling where they will be less obtrusive, and run them from similarly dedicated computers. Also, we would like to purchase televisions with video/DVD players for every lab and lecture room.

5. **A New Full-time Physics/Astronomy Faculty –** A large percentage of our astronomy classes are taught by adjunct faculty, some of whom must occasionally work overloads. To alleviate this pressure, we propose that the College hire a new full-time faculty, who would split his or her time between Physics and Astronomy.

6. **An Expanded Curriculum** – We would like add new courses to our offerings for non-majors. If we use the current system in place at the University of Texas as a model, we may be able to secure transfer credit to at least one institution. Possible course offerings include "Science and Science Fiction," "History and Philosophy of Astronomy," and "The Search for Extraterrestrial Intelligence."

7. **A Refracting Telescope** – All of the telescopes currently owned by the program are reflecting telescopes, using mirrors for gathering light. While these telescopes are in many ways superior to refracting telescopes, which use lenses, there are some advantages to refractors, primarily for planet viewing. Thus, we would like to supplement our telescope inventory with an inexpensive refractor.

8. **An Astronomy Club –** Astronomy is a very popular hobby, one that even students not taking astronomy classes can enjoy. We would like to start an Astronomy Club at ACC, and coordinate with other hobbyist organizations, such as the Austin Astronomical Society, to hold events at ACC and in the community.

9. **Regular Faculty Symposia** – To improve connections between faculty and promote the sharing of ideas, we propose to hold regular get-togethers to hear special presentations and discuss teaching astronomy. Ideally, this will also count toward faculty development credit.

10. **A Website for "Star Party" Information** – To also get faculty better connected, we propose the development of a Web page, probably on the existing Physical Sciences Department site, for the announcing of "star parties" and other special events that faculty may discover or organize.

11. **Tougher Math Requirement for Astronomy Courses** – Some instructors are afraid that the current mathematics prerequisite for our astronomy classes is too lax, and that many students come into our classes poorly prepared for the calculations they will have to do. We would like to assess the possibility of raising the bar for our mathematics prerequisite.

ACC Astronomy Program Review
Section 7:
Action Plans

Recommendation 1: **Take a leadership role in building a planetarium in Austin.**			
Year	Actions	Target Date	Responsible
1	Consult with administration on businesses and organizations to approach	Fall	Program
	Begin canvassing for support	Spring	Program and Administration
2	Form committee of community partners to build planetarium	Fall	Program and Administration
	Attend planetarium society meetings in various parts of the country	Fall and Spring	Faculty
	Continue to build partnerships	Fall and Spring	Program and Administration
	Search for location for facility	Spring	Committee
3	Assemble funds from various partners	Fall and Spring	Committee
	Purchase planetarium equipment	Spring	Committee
	Purchase land to build planetarium	Spring	Committee
	Hire contractor to build facility	Spring	Committee
4	Break ground for planetarium	Fall	Committee
	Advertise for planetarium director	Fall	Program
	Interview planetarium director	Spring	Program

Costs: Impossible to estimate. ACC's contribution to this project will depend on how many partnerships can be built.

Recommendation 2: Purchase land for an ACC-owned observing site			
Year	Actions	Target Date	Responsible
1	Consult with other science programs on joint-use possibilities	Fall	Program
	Consult with Administration on purchasing land	Spring	Program
2	Search for suitable plot of land	Fall	Program
	Purchase land	Spring	College
	Build parking lot	Spring	College
3	Build storage shed and other needed facilities	Fall	College
4	Maintain facilities as needed	Fall and Spring	Program

Costs: Difficult to estimate. Costs will depend on how much land is to be purchased (which will in turn depend on how many programs wish to use it). Costs can be somewhat ameliorated by employing the services of the ACC building trades program.

Recommendation 3: Purchase storage facilities for astronomy equipment			
Year	Action	Target Date	Responsible
1	Purchase storage cabinet for Rio Grande	Fall	Program
		Estimated Year 1 Costs:	$700
2	Purchase storage cabinet for Northridge	Fall	Program
		Estimated Year 2 Costs:	$700
3	Purchase second storage cabinet for Rio Grande	Fall	Program
		Estimated Year 3 Costs:	$700

Recommendation 4: Purchase better visual equipment for classrooms			
Year	Actions	Target Date	Responsible
1	Purchase 2 projectors for Rio Grande	Fall	Program
	Install projectors into ceilings of two classrooms at Rio Grande	Fall	Program
	Purchase television and VCR/DVD player for Northridge	Fall	Program
	Install television at Northridge	Fall	Program
		Estimated Year 1 Costs:	$5000
2	Purchase 2 projectors for Northridge	Fall	Program
	Install projectors into ceilings of two classrooms at Rio Grande	Fall	Program
	Purchase 2 televisions and VCR/DVD players for Rio Grande	Fall	Program
	Install televisions at Rio Grande	Fall	Program
		Estimated Year 2 Costs:	$6000
3	Purchase projector for Riverside	Fall	Program
	Purchase third projector for Rio Grande	Fall	Program
	Install projectors at Riverside and Rio Grande	Fall	Program
	Purchase 2 televisions and VCR/DVD players for Rio Grande	Fall	Program
	Install televisions at Rio Grande	Fall	Program
		Estimated Year 3 Costs:	$6000
4	Purchase fourth projector for Rio Grande	Fall	Program
	Install projector at Rio Grande	Fall	Program
		Estimated Year 4 Costs:	$2000

Recommendation 5: Hire a new full-time faculty member in Physics/Astronomy			
Year	Action	Target Date	Responsibility
1	Get approval for new position	Fall	Program
	Advertise new position	Fall	Human Resources
	Interview candidates	Spring	Ad Hoc Committee
		Estimated Year 1 Costs:	Advertising
2-4	Hire new faculty member	Fall	College
		Estimated Year 2 Costs:	$25,000 / yr

Note: Salary costs are shared with physics program

Recommendation 6: Expand the Program's course offerings			
Year	Action	Target Date	Responsibility
1	Explore transfer options to other institutions	Fall	Faculty
	Poll students to see what course they would prefer	Fall	Program
	Seek permission from College to offer course	Spring	Program
	Apply for release time for curriculum development	Spring	Faculty
		Estimated Year 1 Costs:	None
2	Develop curriculum for one new course	Fall	Faculty
	Advertise new course for Spring semester	Fall	Marketing
	Teach new course	Spring	Faculty
		Estimated Year 2 costs:	$2500 (3 LEH release time)
3	Assess popularity of new course	Fall and Spring	Program
	Poll students to see which other course they would prefer	Fall	Program
	Seek permission from College to offer course	Spring	Program
	Apply for release time for curriculum development	Spring	Faculty
		Estimated Year 3 Costs:	None
4	Develop curriculum for new course	Fall	Faculty
	Advertise new course for Spring semester	Fall	Marketing
	Teach new course	Spring	Faculty
		Estimated Year 4 costs:	$2500 (3 LEH release time)

Recommendation 7: Purchase a refracting telescope			
Year	Action	Target Date	Responsible
1	Purchase telescope and equipment	Fall	Program
		Estimated Year 1 Costs:	$1200

Recommendation 8: Start a student amateur astronomy club			
Year	Action	Target Date	Responsible
1	Poll students to determine interest level	Fall	Faculty
	Recruit student leaders for club	Fall	Faculty
	Register club with College	Fall	Faculty
		Estimated Year 1 Costs:	None

Recommendation 9: Organize regular faculty workshops and symposia			
Year	Action	Target Date	Responsible
1-4	Survey Faculty as to possible topics, speakers, or workshop leaders	Fall	Program
	Offer at least 2 workshops or symposia every semester	Every Semester	Program
		Estimated Costs:	None

Recommendation 10: Create a Website for astronomy activity information			
Year	Action	Target Date	Responsible
1	Create web pages on existing Physical Sciences Department Website	Fall	Faculty
2-4	Maintain Website	Every Semester	Faculty
		Estimated Costs:	None

Recommendation 11: Increase the mathematics requirement for astronomy classes			
Year	Action	Target Date	Responsible
1	Survey current students on math classes taken	Fall	Faculty
	Assess potential “damage” to enrollment by raising prerequisite	Fall	Program
2	Increase math prerequisite as appropriate	Fall	Program
		Estimated Costs:	None