# Bakersfield College
# Program Review – Annual Update

Program Name: Physics and Astronomy

Program Type: ☒ Instructional ☐ Student Affairs ☐ Administrative Service ☐ Other

***Bakersfield College Mission***: Bakersfield College provides opportunities for students from diverse economic, cultural, and educational backgrounds to attain Associate and Baccalaureate degrees and certificates, workplace skills, and preparation for transfer. Our rigorous and supportive learning environment fosters students' abilities to think critically, communicate effectively, and demonstrate competencies and skills in order to engage productively in their communities and the world.

Describe how the program supports the Bakersfield College Mission: We primarily offer transfer level courses designed to satisfy the needs of science, engineering, computer science and architecture majors, allied health students, college general education requirements, and liberal studies teacher credential programs. Through our transfer degree, we provide a reliable means of transferring to four-year institutions in continuation of advanced degrees in fields requiring a rigorous background in physics and/or astronomy. In our courses we provide a rigorous and supportive learning environment to think critically in solving problems using logical reasoning and to communicate their knowledge and experiment results in a logically, coherent way. Community outreach efforts comprise a smaller, yet still important, part of the work we do.

Because the Astronomy courses are for the general education program only and are not part of the Physics degree, this program review will be divided into two parts for each question: (1) the astronomy courses and planetarium and (2) the physics courses leading to the Physics AST degree. Based on education and career goals articulated by students on a form the students fill out on the first day of astronomy classes each semester for the past ten years or so, over 95% of the students taking the astronomy courses are non-STEM majors and are not on a Physics pathway in any way shape or form. For purposes of the college's program review process, astronomy is put under the physics umbrella to provide a venue for evaluating the astronomy offerings and needs. We will clearly distinguish between the astronomy and physics parts in the rest of this form.

Program Mission Statement: The mission of the Physics and Astronomy program is to provide the rigorous science foundation necessary for students to acquire the skills, knowledge, intellectual curiosity and scientific literacy essential for a wide variety of careers in this rapidly changing world. We definitely stress critical thinking with problem solving!!

***Instructional Programs only:***

A. List the degrees and Certificates of Achievement the program offers: **Physics AS-T**
B. If your program offers both an A.A. and an A.S. degree in the same subject, please explain the rationale for offering both and the difference between the two.
C. If your program offers a local degree in addition to the ADT degree, please explain the rationale for offering both.

**Progress on Program Goals:**

A. List the program's current goals. For each goal (minimum of 2 goals), discuss progress and changes. If the program is addressing more than two (2) goals, please duplicate this section. Please provide an action plan for each goal that gives the steps to completing the goal and the timeline.

| Program Goal | Which institutional goals from the Bakersfield College Strategic Plan will be advanced upon completion of this goal? (select all that apply) | Progress on goal achievement (choose one) | Status Update – Action Plan |
|---|---|---|---|
| 1. Discipline promotion | ☒ 1: Student Learning<br>☐ 2: Student Progression and Completion<br>☐ 3: Facilities<br>☐ 4: Oversight and Accountability<br>☒ 5: Leadership and Engagement | ☐ Completed: _____ (Date)<br>☐ Revised: _____ (Date)<br>☒ Ongoing: 22 Sept 2017 (Date) | A Physics Olympics is hosted by BC every year (spring semester on campus). This provides an effective promotion of our physics and engineering programs. Planetarium programs, STEM completion team has discipline promotion events in the works. |
| 2. Improve professional development through training in areas specific to STEM and pedagogy | ☒ 1: Student Learning<br>☒ 2: Student Progression and Completion<br>☐ 3: Facilities<br>☐ 4: Oversight and Accountability<br>☐ 5: Leadership and Engagement | ☐ Completed: _____ (Date)<br>☐ Revised: _____ (Date)<br>☒ Ongoing: 22 Sept 2017 (Date) | Experimentation is being done in two of the physics courses that incorporates more of a problem-solving component in the lecture portion of the course. North & South CA AAPT meetings, Chautauqua short courses, Pleiades National Conference (Planetarium). |
| 3. Develop understanding on how to use data analytics to improve student success | ☒ 1: Student Learning<br>☒ 2: Student Progression and Completion<br>☐ 3: Facilities<br>☐ 4: Oversight and Accountability<br>☐ 5: Leadership and Engagement | ☐ Completed: _____ (Date)<br>☐ Revised: _____ (Date)<br>☒ Ongoing: 22 Sept 2017 (Date) | STEM completion coach team work with Data Coaches. Strobel will become additional data coach. Individual course SLO assessment work. |

B. List new or revised goals (if applicable)

| New/Replacement Program Goal | Which institutional goals will be advanced upon completion of this goal? (select all that apply) | Status Update – Action Plan |
|---|---|---|
| 1. Hiring of Lab Technician | ☒ 1: Student Learning<br>☒ 2: Student Progression and Completion<br>☒ 3: Facilities<br>☐ 4: Oversight and Accountability | Submitting classified staff request form (see attached) |

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| | ☐ 5: Leadership and Engagement | |
| 2. Creating online Physics B2A&B course.<br>Creating online Astr B2 course. | ☒ 1: Student Learning<br>☒ 2: Student Progression and Completion<br>☐ 3: Facilities<br>☐ 4: Oversight and Accountability<br>☐ 5: Leadership and Engagement | Online Physics B2A expected to be offered Spring 2018 followed later by B2B.<br>Expect to offer online Astr B2 in summer 2018. |
| 3. Increase number of technology-based labs | ☒ 1: Student Learning<br>☒ 2: Student Progression and Completion<br>☐ 3: Facilities<br>☐ 4: Oversight and Accountability<br>☐ 5: Leadership and Engagement | Equipment requests will be made in this program review cycle. |

**Best Practices:**

Programs often do something particularly well; usually they have learned through assessment – sometimes trial and error – what solves a problem or makes their programs work so well. These are often called Best Practices and can help others. Please share the practices your program has found to be effective.

**Astronomy:** use of lecture tutorials in lecture part of class. Lecture tutorials are designed to have students confront common misconceptions about some astronomical topic and work toward a proper understanding. Students are paired up to work together on the tutorials in class => peer tutoring! Another example of peer tutoring is with the weekly open-note/book quizzes that are very similar to exam questions so the students get practice working through the concepts in a low-pressure situation. Through this practice, students are better prepared for the higher-stakes exams that are closed book, individual effort. Students are paired up during the weekly quizzes to help each other think through the problems. Students are told that one doesn't really know a subject until you have to explain it to someone else. Also, I can be sure that for that 15-20 minutes at least that they are talking astronomy—engaging with the material. Most of the questions are challenging enough that students find working on the questions together very helpful.

**Astronomy:** Using a form of "flipped classroom" students do homework assignments based on the reading on topics before they are further explained or illustrated in class. The homework assignments are designed to force the students to prepare for the upcoming class topic of discussion. The homework questions are on the lower half of Bloom's taxonomy of learning, so IF students do the reading, they'll do fine on the homework questions.

**Physics:** Prior to the fall of 2010, all physics courses had a discussion component. This offered an optional 1 hour meeting for each lab section in the course in which students could attend and develop problem-solving skills in the course in an interactive way not possible in the lecture or laboratory venues. This component of the course has been removed due to restrictions implied within Title V requirements. A CLIP study was done on the effectiveness of the discussion component of physics courses using students in the Physics B4A and the Physics B4B courses, and a strong correlation was found between attending discussion sessions and competency in problem-solving skills. Many students need extra time outside of the regular course lecture in order to be successful and time-efficient when it comes to solving problems in physics. STEM tutoring is effective in addressing this need only if there are competent STEM tutors willing and funds are available for this service. One strategy that has merit (and has been used successfully elsewhere) is that of "flipping" the class. This entails replacing the normal lecture time with a more meaningful, directed problem-solving period in which problem-solving strategies are taught, critical thinking and problem-solving skills are emphasized, and students can work interactively with the instructor on such (much more so than in the traditional lecture format). Conceptual learning that would have been done with traditional lectures is relegated to open educational resources online (such as the MIT physics lecture series or Khan

Academy). Currently, a half-way measure of course-flipping is being used with the Physics B4B+C courses. A significant number of practice problems are worked out with the students in the lecture meeting at the expense of a minor reduction in the volume of formal lecture during this portion of the course. This modification is proving to be helpful in compensating for a now long-running lack of a discussion component of the course. Data analytics work will investigate the effectiveness of this flipped classroom approach.

**Physics:** Since the fall semester of 2011 all the courses in the two physics sequences (2AB and 4ABC) have been using WebAssign as the manager of course online problem set assignments for students. The Cengage texts used in all these courses came with the Enhanced WebAssign version of the service, which utilizes more numerous and more sophisticated help, feedback and visualization strategies for students to benefit from. Such enhancements as "practice another version", "master it", tutorials, videos (including some simulations) and other aids have been extremely helpful in coaching students in problem solving strategies in solving challenging problems. It is especially helpful to students that find it difficult to meet in study groups and get help from peers. Comments from students about Enhanced WebAssign are overwhelmingly positive. We will continue in the future to make sure that texts adopted for our physics courses are supported in WebAssign by enhanced versions.

**Program Analysis**:

Take a look at your trend data (all programs should have some form of data that is used to look at changes over time).

1. Please report on any unexpected changes or challenges that your program encountered this cycle:
   The number of students declaring physics as their major has taken big jumps up over the past two years. Upon looking through student names in those lists, we found that we were familiar with just 10% being in previous physics courses. We suspect that most of the other 90% of physics majors are not intending to pursue a degree in physics but are just claiming that major for some expediency.

2. How does your trend data impact your decision-making process for your program?
   We are seeing a growing number of engineering students applying for physics AS-T degrees. Upon evaluating this phenomenon, we found that many of the engineering fields that students are pursuing require the same core courses as physics students would take. Most engineering students will take courses at Bakersfield College that will qualify them for a Physics AS-T. Therefore, we are encouraging engineering students to apply for those degrees since they will need no extra course work other than what they are already taking.

3. Were there any changes to student success and retention for face-to-face, as well as online/distance courses?
   Not in the past cycle for both Physics and Astronomy.

4. Were there any changes to student demographics (age, gender, or ethnicity) for the past cycle?
   Not in the past cycle for both Physics and Astronomy.

**Resource Request and Analysis:**

| Resource Request | | If Fulfilled, Discuss How Previous Year's Requests Impact Program Effectiveness? |
|---|---|---|
| **Positions:** *Discuss the impact new and/or replacement faculty and/or staff had on your program's effectiveness.* | ☒ 1: Classified Staff<br>☒ 2: Faculty | We are requesting a Lab Technician classified staff person and the justification is given in the Classified Staff Request Form.<br>New Faculty hired have increased our physics and physical science course offerings and will increase access through online course offerings. |
| **Professional Development:** *Describe briefly, the effectiveness of the professional development your program has been engaged in (either providing or attending) during the last cycle* | ☐ 1: Provided Professional Development<br>☒ 2: Attended Professional Development | Faculty have attended discipline-specific conferences using their own funds—no school funds were used. Those conferences have kept the faculty abreast of the latest advances in the field and in effective teaching practices. College professional development workshops such as the Pathways/Guided Pathways institutes have enabled us to better meet the needs of today's students. As the Guided Pathways system is implemented college-wide, we expect improvements in student success and Physics degree attainment. |
| **Facilities:** *If your program received a building remodel or renovation, additional furniture or beyond routine maintenance, please explain how this request or requests impacts your program and helps contribute to student success.* | ☐ 1: Space Allocation<br>☐ 2: Renovation<br>☐ 3: Furniture<br>☐ 4: Other<br>☐ 5: Beyond Routine Maintenance | |
| **Technology:** *If your program received technology (audio/visual – projectors, TV's, document cameras) and computers, how does the technology impact your program and help contribute to student success?* | ☒ 1: Replacement Technology<br>☒ 2: New Technology<br>☐ 3: Software<br>☐ 4: Other_____ | New technology made the physics instruction more engaging for the students. |

| Resource Request | | Discuss How Effective Request is for Student Success? |
|---|---|---|
| **Other Equipment:** *If your program received equipment that is not considered audio/visual or computer equipment technology, please explain how these resources impact your program and help contribute to student success.* | ☐ 1: Replacement<br>☒ 2: New<br>☐ 3: Other_____ | Will improve demonstration of physics concepts to the students and STEM outreach efforts |
| **Budget:** *Explain how your budget justifications will contribute to increased student success for your program.* (*Fiscal requests will be submitted by the faculty chair and/or area administrator.)* | | |

## Conclusions & Snapshot:

Present any conclusions and findings about the program. This is an opportunity to provide a brief abstract or synopsis of your program's current circumstances and needs. Consider this a snapshot of your program, if someone were to only read this portion of your annual program review.

Courses offered by Physics and Astronomy faculty satisfy requirements for the Physics major, Engineering major, Chemistry major, Biology major, Computer Science major, as well as, General Education (area B.1) requirements for all degrees. Three new Physics faculty were hired in Fall 2017 to increase the number of STEM course sections we offer (physics, physical science, and astronomy) to meet the increasing demand. The number of Physics majors is increasing as more students take advantage of the Physics AS-T degree. New faculty are bringing in more advanced technology to their instruction to increase student engagement with more real-world situations that the students will encounter in their STEM careers. More online offerings are being created to increase access opportunities.

**Need for lab technician:** With increased numbers of students and faculty, the Physics program can no longer limp along without a dedicated lab technician as the Physics program has done for the past several years. Due to the lack of a dedicated lab technician, older equipment is falling into disrepair and newer equipment is prematurely aging because of no maintenance. Some concepts cannot be illustrated with currently available computer simulations—they require the tactile interface of hands-on interaction with real physical equipment. Furthermore, the coordination of multiple labs with multiple faculty now requires a dedicated lab technician to handle the increasing complexity of the logistics.