**Bakersfield College**

**Program Review – Annual Update**

**I. Program Information:**

Program Name: Physics and Astronomy

Program Type:  Instructional  Non-Instructional

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!!

Program Description: 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.

**II. Program Assessment (focus on most recent year):**

1. How did your outcomes assessment results inform your program planning? **Astronomy:** Data from assessment of the SLOs in the astronomy courses is posted in Curricunet. The data do not show any need to modify astronomy course offerings. The outcomes assessment data do show a need to increase in-class instruction on lunar phases in the Solar System Astronomy B3 course and Physics of the Cosmos Astronomy B1 course, so a new set of worksheets was developed. It is too soon to evaluate the effectiveness of the new curriculum for lunar phases. Retention rates in the Solar System course are higher than for the Physics of the Cosmos course (+14% in Spring 2014, +3.5% in Fall 2013, +27.3% in Spring 2013, +0.3% in Fall 2012, +12.1% in Spring 2012, & +10.9% in Fall 2011). Success rates in Astronomy B3 course are higher than for the Astronomy B1 course (+20.7% in Spring 14, +3.5% in Fall13, +26.8% in Spr13, +2.7% in Fall12, +5% in Spr12, & +12.1% in Fall 2011). Besides the more tangible (less abstract) subject matter, the Solar System class has been using a sophisticated interactive online homework system through Pearson Higher Education that enables homework to be assigned *and graded* before every class lecture. This forces the Solar System students to remain focused on the course content. The Physics of the Cosmos students are now using the online homework system starting Fall 2014. For the planetarium outreach part of our program, the continued rave reviews, repeat visits by K12 schools year-after-year, and very rapid selling out of planetarium evening shows illustrate the need to continue our planetarium offerings. The Planetarium is also a draw for the NON-science major students to enroll in the astronomy classes. **Physics:** Assessment results from physics course SLO’s indicates students in all physics courses (and especially in courses in the calculus-based sequence) rate extremely well in showing proficiency in critical thinking exercises such as qualitative and quantitative synthesis problems. Data collected also shows that knowledge of and appropriate use of conservation laws to accomplish problem solving is very evident in student assignments and evaluations. Areas of weaknesses in course SLO’s includes a less than satisfactory ability to communicate technical information in a fashion understandable to an educated reader in critical writing assignments as are placed in the lab component of the course. Another weakness seems to be a slightly lower than hoped for attention to units and uncertainties associated with observations and physical quantities dealt with in the lab portion of the course. These two mentioned weaknesses can be remedied somewhat, we believe, by stand-alone exercises in the lab during the first portion of the semester that emphasize and reinforce this learning.
2. How did your outcomes assessment results inform your resource requests? **Astronomy:** assessment of our SLOs did not necessitate resource requests beyond the normal red pens and staples requests needed for evaluating assignments. We had a technology request for a new SciDome system based on the age of the system (system is now 8 years old). Physics: Slightly reflected in course SLO’s but more directly concluded from anecdotal evidence supplied by students, simulations used in the last two courses in the calculus-based physics sequence and the last course in the trig-based physics sequence were deemed to be less than engaging by a fraction of the students in the course (although many others argued otherwise). It has been determined to either revise those simulations to make them more engaging (probably by source selection) or to request the purchase of more expensive lab equipment, the lack of which was the reason that we resorted to simulations. **Physics:** A noticeable weakness shown in the assessment of one of the SLO’s used in both the PHYS B4B and PHYS B2B courses was interpreted as being due to the diluted involvement of students in laboratory activities in exercises in which limited equipment necessitated working in larger than normal lab teams. Additional apparatus has been requested for those lab experiments that are involved in hopes that it will make a difference.
3. Instructional Programs only**:** How do course level student learning outcomes align with program learning outcomes? **Physics:** Physics courses have fairly specific and detailed course SLO’s that are not nearly as aligned to the program SLO’s as they are with the SLO’s listed in the C-ID descriptors for those C-ID course with which ours articulate. **Astronomy:** Astronomy courses have broadly-defined SLOs that mesh closely with the program SLOs. Each Astronomy course stands on its own---they are not part of a sequence, so they achieve the same SLOs through different content. The mapping of course SLOs to PLOs to ILOs is shown in the following mapping.

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| **Course SLO** | **Program Learning Outcome** | **Institutional Learning Outcome** |
| Demonstrate a correct understanding of the cause of a given phenomenon, the physical nature of a given object, and the properties and processes of a habitable world [this is the "what we know" SLO] | Demonstrate a knowledge of and recognize the processes that explain natural phenomena | I. Think critically and evaluate sources and information for validity and usefulness.  II Communicate clearly and effectively in both written and oral forms *[we focus on written form]*  III. Demonstrate competency in a field of knowledge or with job-related skills. |
| Describe the scientific method, give the evidence for an explanation and describe the technique(s) used in determining either the property of something, how it interacts with its environment, or its origin and history [this is the "how we know" SLO] | Apply the methodologies of science when approaching a problem | I. Think critically and evaluate sources and information for validity and usefulness.  II Communicate clearly and effectively in both written and oral forms *[we focus on written form]*  III. Demonstrate competency in a field of knowledge or with job-related skills. |
| Solve word problems and apply concepts to new situations not given in the book or in lecture using logical, deductive reasoning. | Apply logical quantitative and qualitative reasoning in solving problems or analyzing arguments | I. Think critically and evaluate sources and information for validity and usefulness.  II Communicate clearly and effectively in both written and oral forms *[we focus on written form]*  III. Demonstrate competency in a field of knowledge or with job-related skills. |
| Use a computer to locate information on the internet. |  | I. Think critically and evaluate sources and information for validity and usefulness.  III. Demonstrate competency in a field of knowledge or with job-related skills. |

1. How do the program learning outcomes align with Institutional Learning Outcomes? **Astronomy:** See mapping in previous question.
2. Describe *any significant changes* in your program’s strengths since last year. **Astronomy:** No significant changes in the astronomy strengths. **Physics:** No significant changes in the physics strengths.
3. Describe *any significant changes* in your program’s weaknesses since last year. **Astronomy:** No significant changes in the astronomy weaknesses. **Physics:** No significant changes in the physics weaknesses.
4. If applicable, describe any unplanned events that affected your program. **Astronomy:** Not applicable. **Physics:** Not applicable.

**III. Resource Analysis:**

1. Human Resources
2. If you are requesting any additional positions, explain briefly how the additional positions will contribute to increased student success. (Faculty Request form; Classified Request form) **Astronomy:** None. **Physics:** In recent years the physical science department has typically offered 3 sections of PHYS B2A, 1 section of PHYS B2B, 4 sections of PHYS B4A, 3 sections of PHYS B4B, and 2 sections of PHYS B4C. This amounts to 1.9 full loads in physics courses for the year, which has been handled by two full-time physics instructors and two adjuncts (note that each of the two physics instructors teach partial loads in engineering subjects). The many students on waitlists in the physics courses who are turned away each year is a concern to us. Data indicates that one extra section of PHYS B2A, one extra section of PHYS B2B, one extra section of PHYS B4A, one extra section of PHYS B4B (which is just this year being offered), and one extra section of PHYS B4C would fill if they were offered on a “non-restricted” basis during registration. These extra sections would amount to an extra 0.5 full load. If such additional students were to be allowed access to these physics classes in the future, that would necessitate: (1) hiring a new physics instructor who may be able to teach a partial load in engineering; (2) finding additional adjuncts to handle some of the increase; (3) reassigning teaching loads so that the current physics instructors teach the extra physics sections and less of the engineering courses; or (4) a combination of the aforementioned.
3. Professional Development (Professional Development form)
4. Describe briefly the effectiveness of the professional development your program has been engaged with (either providing or attending) during the last cycle, focusing on how it contributed to student success. **Astronomy:** Great Teachers Seminar brought people from a variety of disciplines together to improve the craft of teaching. We shared tools that are successful and worked on problems/road blocks that were common to us all. Points of Origin Conferences highlighted the power of student success data analysis and the need to develop metrics. **Physics:** Attendance of the fall and/or spring meetings of the Southern California Chapter of the American Association of Physics Teachers (SCAAPT) has been an effective venue for the sharing of teaching strategies and lecture demonstrations. Webinars given by online homework services, such as WebAssign (which is used in three of the physics courses) are extremely helpful in allowing instructors to become more effective in helping students with this instructional and evaluative component of the courses.
5. Provide rationale for future professional development opportunities and contributions that your program can make. **Astronomy:** Looking forward to training on how to use the student success data at the course level to improve student success. **Physics:** We are interested in obtaining more information on the use and effectiveness of using open educational resources in physics courses.
6. Facilities (M&O requests can be submitted by completing the [M&O request form](https://committees.kccd.edu/sites/committees.kccd.edu/files/Copy%20of%2012%20M%26O%20Needs%20Workbook%2012-13%20APR.xlsx).)

Has your area received any facilities maintenance, repair or updating in this cycle? **Physics:** Physics has received no significant maintenance, repair, or updating this cycle. **Astronomy:** The Planetarium’s Goto Chronos star project is serviced every year by Ash Enterprises as part of an annual preventative maintenance contract for this $500K+ hardware. We also have an annual insurance type of agreement with Spitz, Inc. for the SciDome all-dome video projector. The SciDome is approximately $270K.

1. If yes, how has the outcome contributed to student success? **Astronomy:** Both the Goto Chronos and SciDome projector systems are an essential part of the Astronomy curriculum and their annual maintenance ensures we can continue to use them in the Astronomy classes and in our outreach to the community.
2. If no, how will your facilities request contribute to student success?
3. Technology (Technology requests can be made by filling out the [ISIT Request form](http://www.bakersfieldcollege.edu/irp/Annual%20Program%20Reviews/2012-13/13%20ISIT%20Priority%20Workbook%2012-13.xlsx).)
4. Has your program received new or repurposed technology in this cycle? **Astronomy:** New brighter data/video projector.
   1. If yes, how has this technology contributed to student success? **Astronomy:** More vivid images with higher resolution better illustrate objects and processes being discussed.
   2. If no, how will your new or repurposed technology request contribute to student success? **Astronomy:** new SciDome system will enable Planetarium outreach to community and K12 feeder schools to continue and will continue the use of the immersive environment in the Astronomy classes. The SciDome is essentially a computer system with a data projector and the computers are now eight years old.
5. Do you need new or repurposed classroom technology to support student success and/or new office technology to support faculty/staff success? Justify your request. **Astronomy:** A new SciDome system will be requested. The SciDome system enables the students to visualize complex 3D models of astrophysical phenomenon that cannot be done with a flat 2D image. The SciDome system is an essential part of the Planetarium’s role in BC’s outreach to the community. The system is essentially a computer system with a data projector. The computers are now 8 years old. NONE of the money generated from ticket sales goes into any hardware replacement fund—they all go into GUI. BC student headcount served is between 250-350 (depending on number of sections offered) but over 5000 K12 + adult general public attend the planetarium shows. Without the SciDome system, the adult general public shows will not be offered.
6. Budget (Changes to the budget allocation can be requested using the [Budget Change Request Form](http://committees.kccd.edu/bc/committee/programreview)).

If you are requesting any additional funding, explain briefly how it will contribute to increased student success. **Astronomy:** No additional funding being requested. **Physics:** No additional funding is requested at this time.

**IV. Trend Data Analysis:**

Highlight *any significant changes* in the following metrics and discuss what such changes mean to your program.

1. Changes in student demographics (gender, age and ethnicity). **Astronomy:** No changes in *gender*. *Age:* Shifting proportion of 19&younger and 20-29 year olds: since 2009-10 to 2013-14, the percentage of 19&younger has dropped from mid-50s to 40% and percentage of 20-29 year olds has increased from 40% to mid-50s. *Ethnicity:* from 2009-10 to 2013-14 the percentage of Hispanic/Latino has increased from 46% to 59% while percentage of White has decreased from 44% to 32%. Other groups have no change. **Physics:** One demographics item that has become notable in physics courses over the recent past is that of gender in physics courses. The PHYS B4B course (offered every fall semester) is considered a key course in the calculus-based physics sequence. A large portion of students taking the calculus-based physics courses are in the engineering program (in one discipline or another). Not all engineering students need to take the last course (PHYS B4C) in the sequence, so PHYS B4B represents an “survival attainment” level in physics for all engineering students. The population of this course in the last six years in gender (taken from final class rosters) has shown that female enrollments have been very low, and also extremely variable. The population of this course in terms of percentage of female students at the withdrawal deadline has been 14.8% in 2009, 16.7% in 2010, 23.2% in 2011, 15.1% in 2012, 30.6% in 2013, and 14.5% this year (first census date).
2. Changes in enrollment (headcount, sections, course enrollment and productivity). **Astronomy:** 2009-10 to 2013-14 had about 100 more students (headcount and course enrollment) when 8 sections were offered vs. 6 sections offered. FTES/FTEF has declined from 24.4 to 20.5 from 2009-10 to 2013-14, though still well above collegewide average. **Physics:** This is the first year that we have had four full sections of PHYS B4B, and the indications are that the upswing in enrollment will be repeated in the future.
3. Success and retention for face-to-face, as well as online/distance courses. **Astronomy:** No significant change in Retention and Success rates. **Physics:** No significant changes in success and retention rates. They are fairly constant.
4. Other program-specific data that reflects significant changes *(please specify or attach).*

**V. Progress on Program Goals:**

1. 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.

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| **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)** | **Comments**  **(if applicable)** |
| 1. Discipline promotion | 1: Student Success  2: Communication  3: Facilities & Infrastructure  4: Oversight & Accountability  5: Integration  6: Professional Development | Completed:  \_\_\_\_\_\_\_\_\_\_ (Date)  Revised: \_\_\_\_\_\_\_\_\_\_ (Date)  Ongoing: all year long (Date) | **Astronomy:** Continue outreach to community through planetarium shows and bi-monthly Night Sky column in Californian.  **Physics:** We intend to host the KHSD Physics Olympics at Bakersfield College every year that it will be held in order to promote interest in physics and engineering to students in the Kern high schools. |

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| **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)** | **Comments**  **(if applicable)** |
| 2. Improve professional development through training in areas specific to STEM and pedagogy | 1: Student Success  2: Communication  3: Facilities & Infrastructure  4: Oversight & Accountability  5: Integration  6: Professional Development | Completed:  \_\_\_\_\_\_\_\_\_\_ (Date)  Revised: \_\_\_\_\_\_\_\_\_\_ (Date)  Ongoing: \_\_\_\_\_\_\_\_\_\_ (Date) | **Astronomy:** STEM grant paid for Great Teachers Seminar for astronomy professor in Spring 2014. Astronomy professor self-funds other astronomy specific professional development.  **Physics:** Physics instructors intend to attend local chapter biannual meetings of the American Association of Physics Teachers, and also to participate in periodic webinars hosted by online services such as WebAssign. |

1. New or revised goals (if applicable)

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| **New/Replacement Program Goal** | **Which institutional goals from the Bakersfield College Strategic Plan will be advanced upon completion of this goal? (select all that apply)** | **Anticipated Results** |
| 3. Develop understanding on how to use data analytics to improve student success | 1: Student Success  2: Communication  3: Facilities & Infrastructure  4: Oversight & Accountability  5: Integration  6: Professional Development | Better understanding of how to use ATD data to target specific groups of students needing additional or different type of instructional intervention. |

**VI. Curricular Review (Instructional Programs only):**

1. Review of Course Information:
   * Column A list all of the courses associated with the degree.
   * Column B list the Fall term the review process will be started for ongoing compliance.
   * Column C list the compliance due date.
   * Column D list any changes to courses with regard to distance education.
   * Column E list corresponding C-ID descriptors if available. <http://www.c-id.net/>

**\*\*Dates listed should reflect a five year cycle allowing for one year of review**

**to maintain ongoing compliance.\*\***

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| **A. Course** | **B. Fall Term Review will be Submitted** | **C. Compliance Due Date** | **D. Distance Education Changes** | **E. C-ID Descriptors Available** |
| Astr B1 (Gen Ed only – not in physics degree) | 2014 | Fall 2015 |  |  |
| Astr B2 (Gen Ed only – not in physics degree) | 2014 | Fall 2015 |  |  |
| Astr B3 (Gen Ed only – not in physics degree) | 2014 | Fall 2015 |  |  |
| Physics B2A | 2017 | Fall 2018 |  | PHYS 105 |
| Physics B2B | 2017 | Fall 2018 |  | PHYS 110 |
| Physics B4A | 2017 | Fall 2018 |  | PHYS 205 |
| Physics B4B | 2017 | Fall 2018 |  | PHYS 210 |
| Physics B4C | 2017 | Fall 2018 |  | PHYS 215 |
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1. Review of Program Information:

Is the program information housed in CurricUNET accurate? (Considerations: changes in course(s) names and/or suffixes as well as additions/deletions of courses). If not, then a program modification needs to be started in CurricUNET to reflect the necessary changes. Explain the requested changes below.

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Is the program and course listing information in the current catalog accurate? If not, list the requested

changes below. Catalog information should reflect what is in CurricUNET.

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1. Student Education Plan (SEP) Pathway(s) uploaded to “Attached Files” in CurricUNET.

If applicable, SEP Pathway with CSU Breadth indicated? Yes or No

If applicable, SEP Pathway with IGETC indicated? Yes or No

If applicable, SEP Pathway with BC General Education indicated? Yes or No

**\*\*Please ensure that the information housed in CurricUNET and the current catalog match. \*\***

1. If applicable, provide a description of the program’s future adoption of C-ID descriptors and Associate Degree for Transfer (ADT) or Model Curricula.

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**VII. Conclusions and Findings:**

Present any conclusions and findings about the program.

* The **Astronomy area** in the Physical Science Department remains strong with steady enrollments and productivity levels. The Planetarium continues to be a place treasured by the community. Student success and retention levels could be improved with more peer tutoring paid with STEM grant money or GUI funds.
* The **Physics area** in the Physical Science Department also sees enrollment and productivity levels that have been and are projected to be very strong and predictable into the near future. The adoption of an AS-T degree in physics should be a powerful asset to any student completing those courses for which it is awarded, whether they are in a physics, engineering, or other program. The beginning of an extended period or cycle in which the assessment of student learning outcomes is pursued promises a methodical approach to evaluating teaching strategies that will improve our program.

**VIII. Attachments (place a checkmark beside the forms listed below that are attached):**

[Faculty Request Form](http://committees.kccd.edu/bc/committee/programreview)  [Classified Request Form](http://committees.kccd.edu/bc/committee/programreview)  [Budget Change Request Form](http://committees.kccd.edu/bc/committee/programreview)

Professional Development  [ISIT Form](http://committees.kccd.edu/bc/committee/programreview)  [M & O Form](http://committees.kccd.edu/bc/committee/programreview)

[Best Practices Form](http://committees.kccd.edu/bc/committee/programreview) **(Required)**  Other: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**IX. Certificates of Achievement:**

Programs with stackable certificates fill out the following form.

Stand alone certificates fill out the entire Annual Update.

**Certificate Form**

**Annual Update 2014-15**

**Name of Program:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| **Certificate Name** | **JSC** | **CA** | **Is the certificate stackable?** | **Is the certificate a**  **stand alone program?** |
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Please discuss the following questions regarding all area Certificates of Achievement (CA):

1. List certificates that are proposed for *addition*.
2. List certificates that are proposed for *deletion*.
3. For this CA, what are the SOC codes (Occupational Titles and codes) that students who complete the CA will be able to obtain entry-level employment in, and what are the projected annual openings and median salary for each occupational title? You can use your latest Program Review data for your response.
4. For this CA, what process was followed to ensure the required and possible elective courses were adequate for entry level employment (such as advisory committee input, surveys, industry feedback, licensing or accreditation agencies)? How often do/will you re-examine the effectiveness of certificate requirements?
5. What is your annual completion target (number of certificates awarded) for this CA? What was the number of awards in this CA for each of the past three years? Based on your results, what changes could you make in your program to meet or continue to exceed your target (such as course content, scheduling/sequence, outreach, instructional strategies)?
6. Based on what you know about your area, what emerging/potential institutional factors (internal) and industry factors (external) will impact this certificate? How are you planning to incorporate these factors in your planning and evaluation of this certificate?