Application Details

Manage Application: Textbook Transformation Grants: Round Ten

**Award Cycle:** Round 10

**Internal Submission Deadline:** Friday, September 29, 2017

**Application Title:** 336

**Application ID:** 001882

**Submitter First Name:** William

**Submitter Last Name:** Baird

**Submitter Title:** Professor of Physics

**Submitter Email Address:** william.baird@armstrong.edu

**Submitter Phone Number:** 912-344-2708

**Submitter Campus Role:** Proposal Investigator (Primary or additional)

**Applicant First Name:** William

**Applicant Last Name:** Baird

**Co-Applicant Name(s):** Jeffery Secrest

**Applicant Email Address:** william.baird@armstrong.edu

**Applicant Phone Number:** 912-344-2708

**Primary Appointment Title:** Professor of Physics

**Institution Name(s):** Armstrong State University

**Submission Date:** Monday, October 2, 2017

**Proposal Title:** 336

**Proposal Category:** No-Cost-to-Students Learning Materials

**Are you using an OpenStax textbook?:** Yes

**Final Semester of Instruction:** Spring 2018

Team Members (Name, Title, Department, Institutions if different, and email address for each):

William Baird, Professor of Physics, and Jeffery Secrest, Associate Professor of Physics, Department of Chemistry & Physics, Armstrong State University
Sponsor, (Name, Title, Department, Institution):
Will Lynch, Department Head, Chemistry and Physics, Armstrong State University

Course Names, Course Numbers and Semesters Offered:
PHYS 2211K Principles of Physics I, offered Sp, Su, Fall

List the original course materials for students (including title, whether optional or required, & cost for each item):
- WebAssign homework (including eBook) – one semester - $90.70 Not available without eBook.

Average Number of Students per Course Section:
25

Number of Course Sections Affected by Implementation in Academic Year:
3

Average Number of Course Sections Per Semester:
Currently 1.5 average per semester, but see transformative impact

Total Number of Students Affected by Implementation in Academic Year:
77* (please see transformative impact)

Requested Amount of Funding:
$10,800

Original per Student Cost:
$90.70 to $164.70

Post-Proposal Projected Student Cost:
$32.50 (Paper copy of OpenStax text adds $40)

Projected Per Student Savings:
$58.20 to $92.20

Projected Total Annual Student Savings:
$4,480 to $7,100 based on 2016 enrollment and ignoring Summer.

Project Goals:
We propose to significantly enhance student success and engagement while reducing the financial burden associated with purchasing modern textbooks. We will adopt the OpenStax University Physics book and move from WebAssign online homework to ExpertTA. We will record video homework solutions to ensure students are able to solve all of the assigned problems by the time a test is given. We will also create computerized demonstrations using
VPython (a free, multi-platform high-level computer language designed for physics modeling and instruction) to aid in the explanation of difficult concepts. Finally, we will develop at least two laboratory exercises in which students will actually program in VPython. We expect to see increased learning gains, a reduction in the DFW (grade of D, F, or W/WF) rate for the course, greater student retention from 2211K to 2212K, and a higher level of student satisfaction.

**Statement of Transformation:**

We have recently piloted the use of open-source materials in our algebra-based physics courses and in selected upper-level courses for majors. This grant would make it possible to extend this process to our first-semester calculus-based course. The materials to be created will allow a significant recapture of course time that would otherwise be spent on solving homework questions. By recording video solutions, students can watch (and re-watch) how to solve the “hard” problems without having to sit through explanations of solutions to problems they worked easily. Based on Dr. Baird’s experience with this method, 10-15% of course time was previously devoted to demonstrating homework solutions and would now be available for other uses.

According to the Armstrong State University 2016-2017 Common Data Set, the yearly “Books and Supplies” line item is estimated to be larger than the “Required Fees” and exceeds the cost of 9 credit hours of in-state tuition. Academic stakeholders would be students, who will get enhanced and more individualized instruction; faculty, who will reduce the monotony inherent in repeatedly solving the same homework problems over and over; and the department as a whole, since greater student success means fewer students repeating a course and ultimately necessitating larger/more sections to be staffed. Financial stakeholders would include anyone responsible for payment of educational expenses (i.e., students, parents, taxpayers, etc.).

Transformative Impact - We believe that removing the financial impediment to buying a book will improve student learning as well as reduce the total cost of college for the students in our courses. The decrease in total cost as compared to other local or regional institutions may lead to slightly higher enrollments for our courses. Positive results in student outcomes would suggest that we expand this idea to other courses, providing benefits for other students of physics.

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The amount saved based on the 2016 spring and fall enrollments in 2211K would have been between $4,480 and $7,100. We note, though, that PHYS 2211K has been taught once per
summer session for at least the past twelve years. Including those students changes the savings to between $5,587 and $8,850.

While we have not claimed it in the calculations above, the coming merger between Armstrong and Georgia Southern is expected to dramatically increase enrollment in the calculus-based physics sequence. While questions about consolidation so far outnumber answers, at least a few things are known at this point: 1) we can expect more engineering students on the Armstrong campus, all of whom must take the PHYS 2211/2212 sequence 2) Chemistry majors, who have traditionally had the option to take either calculus-based or algebra-based physics, depending on their chosen degree, will now all take PHYS 2211/2212. The total number of Chemistry and Biochemistry majors (per the 2016 Fact Book) is over 200; the vast majority of them currently take the algebra-based sequence. 3) Cell/Molecular track Biology students as well as pre-professional Biology students (between 1/3-1/2 of the total number of Biology majors, of which there are 380 according to the 2016 Fact Book) will also move to PHYS 2211/2212.

This will amplify the impact of the transformation described herein and will require the addition of multiple sections of PHYS 2211/2212. While we hope to eventually add faculty to deal with the increased enrollment, we expect the students will arrive first. This will lead to a problem we had years ago, where repeating students fill up PHYS 2211K and keep out new (so later-registering) students. Helping students to be successful on the first try (without lowering standards, of course) will ease the staffing tension for students, faculty, and administration alike.

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Transformation Action Plan:

Drs. Baird and Secrest will jointly identify appropriate homework problems from the collection available through ExpertTA. Dr. Baird will record video solutions to all problems to be posted after the due date for each homework. Since Summer 2016, Dr. Baird has recorded over 500 videos solving homework problems (about 175 per course) and has found the time spent doing so is repaid in recovered class time.

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The demonstrations will be available online through each instructor's web page and the laboratory exercises and video solutions will be shared with any other instructor who contacts us. We have debated making the solutions available on the web at all times rather than only posting them after the homework deadline, since students would still need to watch the videos for problems they were unable to solve.
**Timeline:**

Late October 2017 – As soon as notification is received, the PIs will begin the process of selecting homework problems and identifying potential VPython demonstrations.

November 2017 – Dr. Baird will begin recording video homework solutions. Previous experience suggests that this process can be completed by or before the end of 2017. Dr. Secrest will begin coding VPython demonstrations and will have an initial library of 15 of these finished by the end of 2017.

December 2017 – The PIs will outline potential laboratory exercises, with a target of producing two finished labs by the end of January 2018.

January 8, 2018 – First day of Spring 2018 semester. Dr. Baird will administer the FCI.

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**Quantitative & Qualitative Measures:**

The materials will be used for PHYS 2211K in Spring 2018. We have for years employed a standard assessment instrument known as the Force Concept Inventory (FCI), a widely-used 30-question test of concepts discussed in first-semester physics courses. We have (and will) administer this as a pre- and post-test. The normalized gain, defined as (post-pre)/(30-pre), where pre and post are the FCI scores at the beginning and end of the semester, will be calculated. This is the number commonly reported in the Physics Educational literature, since it takes into account the student’s prior familiarity with the subject. We will compare this gain with existing FCI results gathered at ASU for the past several semesters. Drs. Baird and Secrest both offer extra-credit incentives to students based on their performance on the final FCI to ensure that students try to do well on it.

Students will be given a survey about the text (attached) and their use of it, and their answers will be compared with data gathered during the previous semester. This will allow us to record student attitudes and opinions about the course materials, as well as providing them the opportunity to mention other resources they believe would have been helpful. We will investigate any student proposals for these added resources, and adjust our focus on existing materials in response to the multiple-choice questions. Finally, DFW rates will be compared to historical averages.
Spring Semester 2018 – The PIs will meet weekly to discuss the progress of the course and to plan additional VPython demonstrations and possible laboratory exercises.

April 27, 2018 – Last day of classes for Spring 2018. Dr. Baird will again administer the FCI as well as the Student Survey of Course Resources (SSCR).

Summer 2018 – Assessment data (FCI, SSCR, DFW rate) will be assembled for final report.

Budget:

We request $5,000 salary for each PI. We also request $800 for registration, mileage, and hotel expenses for travel to events such as the required kick-off meeting and/or conferences where the results of this work may find an audience (e.g., SACS-AAPT, etc.).

Salary – Dr. Baird $5,000
Salary – Dr. Secrest $5,000
Travel $800

=================================
Total $10,800

Sustainability Plan:

If, as expected, the assessment outcomes from this experiment are encouraging, we will continue to use the resources developed in future offerings of this course. The no-cost nature of the materials will allow future modifications to them as needed, and we will make these available to our ASU colleagues and future GSU colleagues as well as the general public as outlined earlier. The initial effort to create video solutions and VPython demos and labs is significant; once that has been done, however, using what we have produced beyond 2018 is the easy part.
September 28, 2017

Dear Review Committee,

I am pleased to write with enthusiastic support for the Affordable Learning Georgia Textbook Transformation grant proposal submitted by Dr. William Baird and Dr. Jeffery Secrest of Armstrong’s Department of Chemistry and Physics. Their proposal, entitled “Composite Physics Resource (CPR),” intends to compile and enhance a group of existing free-ware materials for use in Principles of Physics I (PHYS 2211K), an introductory calculus-based physics course. The course is fundamental for science, mathematics and engineering majors. Professors Baird and Secrest plan to use the OpenStax University Physics digital textbook as the basic course material and will supplement that e-book with video recordings and computer demonstrations to facilitate homework assignments as well as design e-laboratories where students will learn to program in VPython.

Professors Baird and Secrest are familiar with the open source materials available and have piloted the use of open-source materials in teaching our algebra-based sequence courses. They bring considerable experience and knowledge to their project, and I expect that it will provide a high-quality, rigorous course experience for our students. The grant requests funding to support the creative portion of the project, which is the time and cost heavy part. Once created, however, the materials will be easy to revise and maintain so that it will be a sustainable resource for several academic cycles.

It is important to recognize that commercially published General Physics textbooks are generally quite expensive, as are most science texts. Further, due to the very high cost, students often feel that they cannot afford to purchase the text and hence, do not do so. Thus, assembling such a no-cost alternative to a traditional textbook will have a significant impact on both students’ cost for taking PHYS 2211K, as well as their performance, by making high-quality free materials readily available.

Armstrong recognizes the importance of engaging our students in the STEM disciplines and the proposed project will further this objective, by utilizing modern technology and multimedia to assist student learning in this challenging area. I am pleased to support this project wholeheartedly.

Sincerely,

Christopher M. Curtis, Ph.D.
Interim Provost and Vice President for Academic Affairs
**Affordable Learning Georgia Textbook Transformation Grants**

**Round Nine**

For Implementations beginning Summer Semester 2017

Running Through Spring Semester 2018

## Proposal Form and Narrative

<table>
<thead>
<tr>
<th><strong>Submitter Name</strong></th>
<th>William Baird</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Submitter Title</strong></td>
<td>Professor of Physics</td>
</tr>
<tr>
<td><strong>Submitter Email</strong></td>
<td><a href="mailto:william.baird@armstrong.edu">william.baird@armstrong.edu</a></td>
</tr>
<tr>
<td><strong>Submitter Phone Number</strong></td>
<td>912-344-2708</td>
</tr>
<tr>
<td><strong>Submitter Campus Role</strong></td>
<td>Proposal Primary Investigator</td>
</tr>
<tr>
<td><strong>Applicant Name</strong></td>
<td>William Baird</td>
</tr>
<tr>
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<td>Armstrong State University</td>
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<td>Sponsor, Title, Department, Institution</td>
<td>Will Lynch, Department Head, Chemistry and Physics, Armstrong State University</td>
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<tr>
<td>Award Category (pick one)</td>
<td>☒ No-or-Low-Cost-to-Students Learning Materials</td>
</tr>
<tr>
<td>Are you planning on using an OpenStax textbook?</td>
<td>☒ Yes</td>
</tr>
<tr>
<td>List the original course materials for students</td>
<td>WebAssign homework (including eBook) – one semester - $90.70 Not available without eBook. Paperback copy: Vol. 1 of 9th edition Halliday, Resnick &amp; Walker Fundamentals of Physics</td>
</tr>
<tr>
<td>Item</td>
<td>Cost</td>
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<tr>
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<td>$74 at Amazon.com</td>
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1.1 PROJECT GOALS

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<td><strong>Total</strong></td>
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1.7 SUSTAINABILITY PLAN

If, as expected, the assessment outcomes from this experiment are encouraging, we will continue to use the resources developed in future offerings of this course. The no-cost nature of the materials will allow future modifications to them as needed, and we will make these available to our ASU colleagues and future GSU colleagues as well as the general public as outlined earlier. The initial effort to create video solutions and VPython demos and labs is significant; once that has been done, however, using what we have produced beyond 2018 is the easy part.


1.8 REFERENCES & ATTACHMENTS

Student Survey of Course Resources (SSCR)
Letter of support – VPAA/Provost

Student Survey of Course Resources

I identify as Male Female Other Prefer not to answer

Major_____________________________________________________

My current status is
<30 credit hours (Fr) 30-59 cr hrs (Soph) 60-89 cr hrs (Jr) >90 cr hrs (Sr)

Buying a textbook would have been a significant financial strain

Strongly Agree Agree Disagree Strongly Disagree

Hours/week I used the OpenStax book: <3 3-5.9 6-8.9 9-11.9 >12

If the cost for each were the same, I would prefer a paper book to a PDF or an e-book

Strongly Agree Agree Disagree Strongly Disagree

Please rank the following resources in order of their importance to your success in this course (5 = very useful, 4 = somewhat useful, 3 = not very useful 2 = not at all useful, 1 = did not try to use)

Textbook ______ Lectures in class______ Online class notes______

Work w/fellow students______ ExpertTA______ Non-ExpertTA problems______

Video Homework Solutions______ Video lectures provided by instructor______

Online resources not listed here______ Tutoring Center______ Other books______

Other______ (please describe below)

______________________________________________________________________

______________________________________________________________________

What are your thoughts about the required text for this course?
______________________________________________________________________

______________________________________________________________________

For the items above you listed as most/least useful, can you explain why?
What do you think could have been useful to you for this course?