Summer 2018

Principles of Physics I (GA Southern)

William Baird
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Grants Collection
Georgia Southern University

UNIVERSITY SYSTEM OF GEORGIA

William Baird and Jeffery Secrest

Principles of Physics I

Affordable Learning Georgia

Georgia's Virtual Library GALILEO
An Initiative of the University System of Georgia

Grants Collection

Affordable Learning Georgia Grants Collections are intended to provide faculty with the frameworks to quickly implement or revise the same materials as a Textbook Transformation Grants team, along with the aims and lessons learned from project teams during the implementation process.

Each collection contains the following materials:

- Linked Syllabus
  - The syllabus should provide the framework for both direct implementation of the grant team's selected and created materials and the adaptation/transformation of these materials.
- Initial Proposal
  - The initial proposal describes the grant project's aims in detail.
- Final Report
  - The final report describes the outcomes of the project and any lessons learned.

Initial Proposal

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. Paperback copy (optional): Vol. 1 of 9th edition Halliday, Resnick & Walker Fundamentals of Physics - $74 at Amazon.com
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.

In concert with this change, we will move our online homework system from WebAssign ($90.70 per semester including mandatory eBook rental) to ExpertTA ($32.50 per semester) to provide additional savings to students. ExpertTA neither requires nor offers extra-cost eBooks. We would point out that it has long been our practice to not use the latest textbook in our 2211K/2212K sequence; we are usually one or more editions behind the latest since we have seen no substantive benefits and few differences between editions, except for a large jump in price. We only move to a more recent version when the bookstore finds it impossible to gather a sufficient quantity of “old” books. Our amount saved would increase significantly if we compared the latest version of a physics text to our proposal (e.g., the 10th edition of the book we use currently is available at Amazon for just over $250!) .

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.

It has been pointed out to us that it is common for students to use the same book in both 2211K and 2212K, and that changing the book for only one course does not result in a savings. We disagree. Some students choose not to purchase the book for financial reasons. Surely it would be better for them to at least have a book in 2211 and perhaps understand the value of it when deciding whether to purchase the book for 2212. Also, as the book is available (e.g., Amazon.com) in two separate volumes, the students can still save money even if PHYS 2212K is never converted to open source materials. Of course, if the 2211K trial goes well, the next logical step would be to implement it in 2212K. A wholesale change of the entire sequence may or may not be desirable; we do not believe it is necessary, however. We have chosen to start with 2211K since it has a significantly higher DFW rate than 2212K. For the 2016 calendar year, 10 % of the students taking 2212 K failed to earn a C or better, while the DFW rate for 2211K was a troubling 39.6%. Clearly, students in the first semester of physics are in greater need of help.

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.

Drs. Baird and Secrest will also discuss suitable demonstrations of physical concepts using

VPython, which Dr. Secrest will then create. They will also collaborate on the development of laboratory exercises in which the students themselves will program in VPython. This free software is an add-on for the popular and powerful Python computing language. It was created to make simulation of physical concepts easier. The software includes a sample file where the motion of a binary star system is realistically modeled in about 15 lines of easily understandable code. Students taking the calculus-based physics sequence are quite likely to need to do some programming eventually, and this is a gentle introduction to a tool they could use many times in the future. The extra time gained by the use of video homework solutions will provide more than enough time to add these programming exercises.

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.

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.

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.

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.
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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.

Armstrong
STATE UNIVERSITY

Provost and Vice President for Academic Affairs
11935 Abercorn Street | Savannah, Georgia 31419
912.344.2589 | Fax 912.344.3492 | armstrong.edu

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

Submitter Name	William Baird
Submitter Title	Professor of Physics
Submitter Email	william.baird@armstrong.edu
Submitter Phone Number	912-344-2708
Submitter Campus Role	Proposal Primary Investigator
Applicant Name	William Baird
Applicant Email	william.baird@armstrong.edu
Applicant Phone Number	912-344-2708
Primary Appointment Title	Professor of Physics
Institution Name(s)	Armstrong State University
Team Members	William Baird, Professor of Physics, and Jeffery Secrest, Associate Professor of Physics, Department of Chemistry & Physics, Armstrong State University

Sponsor, Title, Department, Institution	Will Lynch, Department Head, Chemistry and Physics, Armstrong State University				
Proposal Title	Composite Physics Resource (CPR)				
Course Names, Course Numbers and Semesters Offered	PHYS 2211K Principles of Physics I, offered Sp, Su, Fall				
Final Semester of Instruction	Spring 2018				
Average Number of Students Per Course Section	25	**Number of Course Sections Affected by Implementation in Academic Year**	3	**Total Number of Students Affected by Implementation in Academic Year**	77* (See transf. impact)
Average Number of Course Sections Per Semester	Currently 1.5 average per semester, but see transformative impact				
Award Category (pick one)	☒ No-or-Low-Cost-to-Students Learning Materials ☐ Specific Core Curriculum Courses				
Are you planning on using an OpenStax textbook?	☒ Yes ☐ No				
List the original course materials for students	WebAssign homework (including eBook) – one semester - $90.70 Not available without eBook. Paperback copy: Vol. 1 of 9th edition Halliday, Resnick & Walker Fundamentals of Physics				

(including title, whether optional or required, & cost for each item)	- $74 at Amazon.com
Requested Amount of Funding	$10,800
Original Per Student Cost	$90.70 - $164.70
Post-Proposal Projected Per Student Cost	$32.50 for ExpertTA (homework system) Paper copy of OpenStax text - $40 (PDF copy is free)
Projected Per Student Savings	$58.20 - $92.20
Projected Total Annual Student Savings	Between $4,480 and $7,100 based on 2016 enrollment and ignoring Summer.

NARRATIVE

1.1 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.

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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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1 https://www.armstrong.edu/images/uploads/institutional-research/CDS_2016-2017.pdf

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1.4 QUANTITATIVE AND 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.

1.5 TIMELINE

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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.

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

1.6 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

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 **<u>could</u>** have been useful to you for this course?
_____
_

_____
_____

_____
_____

Syllabus

PHYS 2211K – 1:00 PM – 2:50 PM MWF

Text: OpenStax University Physics
(available at https://openstax.org/details/books/university-physics-volume-1)

Professor: Bill Baird Office: Science Center 2014 Phone: 344-2708
Web: http://www.chemphys.armstrong.edu/baird/
E-Mail: William.Baird@armstrong.edu

Office Hours: 11:00 AM-Noon MW,1:00-2:30PM Tu,10:30 AM-Noon F & by appt.

Our schedule for the semester is to finish most of volume I of the OpenStax book (and a small part of volume II) by covering approximately one chapter per week. This is a large amount of material, and you should spend time each day working problems, reading the book **and the online notes**, and reviewing your own notes.

Homework

You are free to work in groups on your homework assignments, but you should be careful not to use the group as a crutch. When you're taking a quiz or test, there won't be anyone there to help, and you'll have to rely on your own understanding. Homework will be assigned and graded via ExpertTA. You will need to purchase a key online at www.theexpertta.com or at the bookstore. Your name and Armstrong student email has been used to register you in this class at the web site. You should go to the web site and try to log on as soon as possible. There is a free trial period, and after that the cost is something like $35.

You should print a copy of your homework while you are solving it. If you have waited until the last minute before the homework is due and your internet connection goes down, you can still work the problems on your printed copy and bring them to class that morning for a grade (this should happen once or less in a semester!). Otherwise, you will get no credit for the assignment.

Working problems is extremely important in any physics class. Although the online homework would make it possible, I'm not going to assign a huge volume of problems. You are advised to work as many problems as you can – you'll soon see that there can be a big difference between following along in class and being able to do problems on your own (during a test). **There will be no extensions or makeups for homework.**

Once the deadline has passed for a homework assignment, video solutions will be posted online (you will be given or emailed the location later). You should watch the solution for any problem you did not solve or were not sure about. I can solve the problems in class, but doing it this way will allow you to avoid sitting through solutions you already know, and to replay difficult ones. We are going to devote some of the time gained by doing this to the use of VPython (free at vpython.org). It will be installed on the lab computers, and we'll use it for some demos as well as eventually using it to do a little programming in a lab or two.

Attendance

When you arrive, please turn off your cell phones, computers and all other electronics, and put newspapers, etc. away. **I do not want to see your phone during class – no texting, calling, etc.** You should bring an ordinary scientific calculator to class and **especially** to the tests. I will clear the memory of all programmable calculators before each test. If your calculator is programmable and **not** a TI of some kind, **sometime before the first test**, make sure you have brought it to me so I'll know how to clear it and you'll be able to use it during your test.

The lecture and lab portions of the course are blended together in an effort to have a smoother integration between these parts. This means that we will probably not have a solid schedule of what lab or activity we'll be doing every day this semester. I can give you estimates of when things will happen, but there's going to be uncertainty attached to those estimates. For that reason, I would advise you to attend each class. One lab exercise will be dropped, but beyond that, they will start adversely affecting your grade. You

should expect to be in class the entire time every day; if we happen to finish early, that's a bonus. When we are doing a lab, anyone leaving early (even with permission from his/her fellow group members) should expect a **disproportionately large** penalty on his/her portion of that lab.

Labs will typically occur at the beginning of a given class period. Because arriving late is both inconsiderate and unfair to the rest of your group members, you will lose 1 point (out of a possible grade of 10) if you are less than 10 minutes late. From 10-19 minutes late, you will lose two points, three from 20-29, etc.

Honor Code

The ASU Academic Integrity Policy (found at www.armstrong.edu/studentintegrity) will be strictly upheld. Any violations will become part of the student's permanent educational record and will receive the harshest punishment allowed, including but not limited to a grade of **F** for the course. Plagiarism, which is defined as using someone else's words or ideas (i.e., paraphrasing) **without proper attribution**, is an honor code violation. **DO NOT** try this! It is assumed that anything in your lab report that is not credited was written by you and/or your group members whose names appear on the front page. This applies to information from the Internet as well as all other sources. Submitting a report for which you have already received a grade (e.g., in a previous semester, etc.) is also not allowed.

Tests and Grading

As of this writing, there will be three tests, the lowest of which will be dropped (others worth 20% each), a final exam worth 25%, in-class exercises and lab reports for 25%, and an undetermined number of homework assignments for the remaining 10%. The tests will be approximately evenly spaced throughout the semester. If you **must** miss a test, you must **contact me as soon as possible** to schedule a makeup exam. While you aren't required to attend class, your excuse must cover the time from the original exam date until you return to class ready to take the makeup. Keep in mind that the make-up test will almost certainly be harder than the original test; I tend to put the most straightforward questions possible on the main test, and the ones on make-up tests are therefore usually more complicated.

For the reports associated with lab exercises, you can get an idea of what is expected from the information at http://www.chemistry.armstrong.edu/baird/Lab.reports.pdf. You should rotate the report-writing and make sure that each group member has a copy of all data as well as a copy of the finished report. **Error analysis is a large part of the report.**

Armstrong is dedicated to providing a safe and equitable learning environment for all students. Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the Title IX Office in Victor Hall Room 245 or by email diversity@armstrong.edu. This is important for the safety of the whole Armstrong community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. The University Counseling Center provides 24/7 confidential support, and the http://www.armstrong.edu/counseling_center describes reporting options and other resources.

Armstrong State University is committed to providing reasonable accommodations to students with documented disabilities, as required under federal law. Disabilities may include learning disabilities, ADD, psychological disorders, brain injury, Autism Spectrum Disorders, serious chronic medical illnesses, mobility impairment, communication disorders, vision or hearing loss or temporary injuries. The purpose of disability accommodation is to provide equal access to the academic material and equal access to demonstrate mastery of the material. Students with disabilities must meet all the academic requirements and standards of the class, including the attendance policy. If you have a disability and need accommodations, please contact the Office of Disability Services, located on the second floor of Memorial College Center, room 208. You will need to meet with Disability Services Staff, who can help you gather documentation of your disability or refer you to an appropriate resource for assessment. Once documentation of the disability is gathered and approved, Disability Staff will provide you with an Accommodation Letter, detailing the appropriate, approved accommodations, which you should present to me so we can discuss and implement your accommodations. Disability accommodations work best starting at the beginning of the semester, but can be approved and started at any point in the semester. Accommodations start at the time the Accommodation Letter is presented to faculty, within reasonable timelines. Accommodations are not given retroactively. Accommodations are not part of your academic transcript.

This syllabus is subject to modifications (which will be announced in class) during the semester.

Week of	Topic
1/8/18	Assessment, 1-D Kinematics (Ch 3), Falling Objects Lab
1/15/18	MLK Jr, Vectors (Ch 2), Inertial Navigation Lab
1/22/18	2-D and 3-D Motion (Ch 4), Projectile Motion Lab
1/29/18	Forces (Chs. 5-6) , Force Table Lab
2/5/18	Problem Solving Lab 1, Forces PhET Lab, Energy (Chs. 7-8)
2/12/18	Test 1, Energy (cont'd), Energy PhET Lab
2/19/18	Momentum (Ch 9)
2/26/18	Rotational Motion (Ch 10)
3/5/18	Angular Momentum (Ch 11), Problem Solving Lab 2, Falling Rod Lab
3/12/18	Spring Break
3/19/18	Equilibrium (Ch 12), Collision Lab, Test 2
3/26/18	Oscillations (Ch 15), SHO PhET Lab
4/2/18	Gravity (Ch 13), Pendulum Lab
4/9/18	Fluids (Ch 14), Gravity Lab
4/16/18	Thermal Physics (Vol. II, Ch 1), Problem Solving Lab 3
4/23/18	Fluids lab, Test 3, Assessment

Final Report

Affordable Learning Georgia Textbook Transformation Grants

Final Report

General Information

Date: Awarded 10/26/17

Grant Round: 10

Grant Number: 336

Institution Name(s): Armstrong State University

Project Lead: William H. Baird

Team Members (Name, Title, Department, Institutions if different, and email address for each): William Baird, Professor of Physics, Jeffery Secrest, Assoc. Prof. of Physics, Georgia Southern Univ. (Armstrong), wbaird@georgiasouthern.edu and jsecrest@georgiasouthern.edu

Course Name(s) and Course Numbers: Principles of Physics I, PHYS 2211 K

Semester Project Began: Spring 2018

Final Semester of Implementation: Spring 2018 (Summer 2018 course was the same, and future offerings are expected to also follow the format in the grant).

Total Number of Students Affected During Project: 33 in Spring 2018. (14 in Summer 2018, transformation expected to continue indefinitely.)

1. Narrative

Our plan was to switch from an expensive (but standard) textbook and the WebAssign homework platform to the OpenStax University Physics book and the ExpertTA homework platform. We created video homework solutions to recapture approximately one hour per week of class time previously used to solve problems. The students now have the opportunity to re-watch solutions they didn't quite get the first time and skip the ones that were trivial (to them).

We used some of the extra time to introduce VPython, a physics-specific add-on to the open source Python programming language. The point of this was not to teach Python itself so much as to give students a basic introduction to the idea of modeling physical phenomena via the computer. Since our classes are populated mostly by engineering students, with most of the remainder being chemistry or physics students, we believe computer simulation will be an important part of their professional lives. We also have seen that learning to program as an end unto itself is much harder than learning when you have a specific task to accomplish with your program.

We created 167 video homework solutions (with closed captioning, which was a larger job than we could have guessed) as well as VPython labs dealing with projectile motion with air resistance, gravitation and orbits, and the physical pendulum without the small-angle approximation.

While we believe the OpenStax book is not quite at the level of the Halliday and Resnick book we replaced, we have observed that the algebra-based OpenStax physics book has gradually improved from its initial offering, and we hope the calculus-based book will do so as well. After all, the original H & R physics book was first published in 1960, so it has had 58 years of revisions; it may be unreasonable to expect a new (and free) book to immediately match it in content and quality. Nevertheless, we have seen no statistically significant downside to the switch, and the increased availability/affordability for our students is a definite positive outcome.

In future offerings, we may include more "pure" Python rather than more VPython; while it is a very useful addition tailored to introductory physics, it is also limited. Python itself is a language used widely across all sciences and is much more likely to be something students will encounter later. VPython is a good introduction to Python, but it is not a substitute for it.

2. Quotes

- In response to asking for an explanation if rating the textbook among most or least useful course materials: "Lots of repetition, variation of method of presentation, specific explanations of problems that confuse me"
- In response to asking for an explanation of rating course materials most/least useful: "Textbook and video were very useful to me because it helps me understand better with steps. I liked that some homework problems were steps by steps"
- In response to asking for thoughts about the required text: "Compared to the Halliday & Resnick book, OpenStax lacks compared to Fundamentals of Physics"

3. Quantitative and Qualitative Measures

3a. Uniform Measurements Questions

The following are uniform questions asked to all grant teams. Please answer these to the best of your knowledge.

Student Opinion of Materials

Was the overall student opinion about the materials used in the course positive, neutral, or negative?

Total number of students affected in this project: __33_____

- Positive: ___42__ % of _24____ number of respondents
- Neutral: __17___ % of __24____ number of respondents
- Negative: __42___ % of ___24___ number of respondents

Student Learning Outcomes and Grades

Was the overall comparative impact on student performance in terms of learning outcomes and grades in the semester(s) of implementation over previous semesters positive, neutral, or negative?

Student outcomes should be described in detail in Section 3b.

Choose One:

- ___ Positive: Higher performance outcomes measured over previous semester(s)
- _X_ Neutral: Same performance outcomes over previous semester(s)
- ___ Negative: Lower performance outcomes over previous semester(s)

Student Drop/Fail/Withdraw (DFW) Rates

Was the overall comparative impact on Drop/Fail/Withdraw (DFW) rates in the semester(s) of implementation over previous semesters positive, neutral, or negative?

Drop/Fail/Withdraw Rate:
Depending on what you and your institution can measure, this may also be known as a drop/failure rate or a withdraw/failure rate.

___18__% of students, out of a total __33___ students affected, dropped/failed/withdrew from the course in the final semester of implementation.

Choose One:

- ___ Positive: This is a lower percentage of students with D/F/W than previous semester(s)
- ___ Neutral: This is the same percentage of students with D/F/W than previous semester(s)
- _X_ Negative: This is a higher percentage of students with D/F/W than previous semester(s)

3b. Measures Narrative

We compared the Fall 2017 PHYS 2211K (using a commercial textbook and WebAssign) to the Spring 2018 PHYS 2211K course (using the OpenStax book and the cheaper online homework provider ExpertTA). Our primary goal, and we presume the primary goal of the TTG program, was to deliver cheaper course materials without sacrificing student learning. Ideally, we would

achieve both learning gains and financial savings, but as long as learning does not suffer, just saving money is still worthwhile for the students.

Dr. Baird's PHYS 2211K DWF rate was higher in Spring 2018 (18%) than in Fall 2017 (9%), however we don't believe this has anything to do with the switch. Firstly, we are dealing with relatively small numbers (6/33 in Spring and 3/32 in Fall) which are of course subject to fluctuations which are **not** small compared to their size. Historically, both of these semesters would rank as having quite low DWF rates (Spring 2016 was 24% and Fall 2016 42%!); we have not included Summer numbers as they are usually inflated relative to the academic year due to the short duration (4 weeks) of the course and the habit of many of these students taking another difficult summer course at the same time, against our advice.

We administered the Force Concept Inventory, a widely-used standard which is to be given on the first and last days of the course to attempt to measure the learning gains made by students. The normalized gain, defined as (final score – initial score)/(perfect score – initial score), is used to control for the fact that students come in with a wide range of pre-existing physics knowledge. We performed a two-tailed t-test and found that, using $p<0.05$ as the standard of significance, the two classes were not different in initial FCI score, final FCI score, or normalized gain.

The final grades of the two classes were also not statistically significantly different. We also administered our own "Attitude Survey" in an effort to learn more about the students and what resources they used, among other things. Both class sections were approximately 2/3 male, and both were 2/3 – 3/4 engineering students.

Across 16 other questions inquiring as to their status (credits towards graduation), study habits, financial hardship associated with course materials, and use of course materials, there were only three questions where the difference between the two sections rose to the level of statistical significance: 1) The Spring 2018 class was one semester behind the Fall 2017 class, on average. 2) The Fall 2017 class placed more value on working with their fellow students (4.4 vs 3.75 on a scale of 1 to 5) and 3) The Spring 2018 section listed "Other books", meaning those besides the text, as more helpful (2.32 vs. 1.32 on the same scale as mentioned previously).

We are quite pleased with the results; in our experience, the first semester (or two) of a significant change to a course tends to make students unhappy since the course they are taking is no longer the same as the one their friends have told them to expect. We encountered similar resistance several years ago when moving from the old-style separate lecture and lab course to the more modern integrated studio approach. We did not seem to suffer from this, as the objective outcome measures (and most of the subjective ones) were unchanged. We had expected that there might be a small dip in outcomes as the wrinkles were ironed out, but we avoided that and the students seem to have saved quite a bit of money with no ill effects.

4. Sustainability Plan

We will continue to offer the course in this format for the foreseeable future. As time passes, we expect to swap out some homework problems for others and produce corresponding video solutions, but this is expected to be a much smaller job than the creation of the original bank of 167 videos. It is easier to continue using the OpenStax book at this point than it would be to switch back to Halliday & Resnick; there is simply no motivation to do that, especially since we have seen that there was no statistically significant difference in student outcomes between the two books. We offered the course in this new format in Summer 2018 to 15 students and we will continue it across both sections of 2211 in the Fall (approximately 50 students enrolled currently).

5. Future Plans

We intend to build on this project by submitting a similar proposal to transition PHYS 2212K to the OpenStax book. Our application will include our plan to again use video solutions for homework problems and use the extra time to incorporate programming exercises. This time, we would like to add the use of the Arduino microcontroller platform to the class. It is a well-established and affordable device which combines both open-source software and open-source hardware, meaning anyone is free to build their own clone of it.

Since the merger between Armstrong and Georgia Southern has finally been completed, we are currently discussing the possibility of applying for a large-scale transformation grant to extend our current work to a much larger body of students. We believe our colleagues in Statesboro could make significant positive additions to this grant, and the savings to students would be much larger than our current enrollment would allow.

6. Description of Photograph

We were unaware of the need for a class photograph until after the class had concluded. The picture enclosed shows Dr. Jeff Secrest (left), Co-PI, and Dr. Bill Baird (right), PI.