Initiative Report for Science 2009-10

Retention and Success: Physics Enhancements

Summary:

This initiative addresses the very real need to enhance the current Physics curriculum through technology, equipment and curriculum development. More than that is needed, however, to create an excellent physics learning environment at Lane that meets the needs of the community. The main component of this need is included despite the fact that the current Unit Planning process does not particularly invite proposals to deal with the well documented need for two more full-time positions which was in previous Unit Planning Initiatives of the Science Division, nor initiatives to expand the physics offerings, which will be possible after additional positions are provided. The two new permanent positions are the most urgent and important initiatives for physics education. In addition, there is a need for further classified staff support for physics.

Description

All elements of the initiative are important, and the ordering of the parts does not necessarily reflect their relative importance or urgency.

A. Create better links between the Principles of Technology curriculum to the programs served and additional programs that could be served.
This is a collaborative effort initiated and stewarded by Physics with programs currently served and potentially served by PH 091,2, our Principles of Technology curriculum. We would work with key professional-technical faculty members to identify both physics concepts and basic physics calculations that would enhance the learning of students in those programs and better connect their specific program experiences with the content of Principles of Technology. The PH 091,2 curriculum would be modified to include those elements identified by this collaboration. Assessment of the PH 091,2 curriculum would include a measure of the effectiveness of the curriculum as well as the elements newly linked to various professional technical programs.

B. Enhance the curriculum infrastructure for the Science Modeling Labs to expand their capacity and to eventually scale up in enrollment capacity to become an integral part of a students study of sustainability.
Initial student response to the GS 110, 210 courses has been extremely positive. This initiative element targets enhancing the curriculum infrastructure (initial models, links to databases, more trained instructors, recruiting materials) for Science Modeling Labs, GS 110 and GS 210. This one unit course, which can be taken concurrently with any 100-level or 200-level science course, has a significant chance to greatly increase in enrollment. Connecting traditional class content with practice in modeling and learning modeling has been shown to enhance learning. With the development of sustainability as a path of study, this course will inevitably become a key element, given that systems

thinking and model building tools are essential to effective understanding, advocacy and decision making regarding issues of sustainability.

C. Replace out of date interfaces and sensors to collect and display data in Room 119, which primarily serves transfer and professional-technical students taking the 100-level conceptual introduction to physics.
Lab equipment is inadequate in room 119, where PH 101,2,3 is primarily taught, a course that serves several professional-programs, For this room, current Vernier LabPro Physics lab station packages would be purchased to replace out of date interfaces and sensors (of an ancient Vernier variety). These sensors and interfaces to collect and display data are an essential part of micro-computer based laboratory (MBL) activities that are central to a number of physics education reforms based on and supported by extensive physics education research. [Note: This is about computer connected electronic sensors and interfaces, not lab material or particular physical systems that are studied.] Funds would be used to purchase 6 lab stations plus an instructor set-up station.

D. Provide a complete set interfaces and sensors (a relatively low-cost brand already familiar to students in chemistry) to collect and display data in Room 144, which primarily serves science and health majors taking the 200-level algebra-based general physics course.
Lab equipment is incomplete in room 144, which is primarily the site of the algebra-based General Physics, PH 201,2,3. Current Vernier LabPro Physics lab station packages would be purchased to complement the instructor station and fill-out the few sensors already available for use in that room. These sensors and interfaces to collect and display data are an essential part of micro-computer based laboratory activities that are central to a number of physics education reforms based on and supported by extensive physics education research. [Note: This is about computer connected electronic sensors and interfaces, not lab material or particular physical systems that are studied.] These Vernier products are used extensively in Chemistry courses, which most PH 201,2,3 students take, so purchasing this brand provides efficiency for students who take physics and other science courses like chemistry.

E. Further integrate, in a sustainable and scalable way, pedagogical advances in physics education.
Physics education research has extensively validated a number of curriculum elements that greatly enhance conceptual learning. These include Interactive Lecture Demonstrations, Micro-Computer Based Lab activities, Workshop Physics, Interactive Physics, Peer Instruction, Just in Time Physics, Ranking Tasks, Physlets, Modeling, Context Rich Calculations, Next Generation Online Homework Systems, Tutorials, among others. Commitment to quality physics education for all our students require that these curriculum elements be accommodated within our physics curriculum. Until recently, these efforts have produced little sustained progress due to a number of factors that did not support improvements from being integrated in a sustainable and scalable way into the physics program. To accomplish this faculty members knowledgeable and committed to these reforms must evaluate and implement them within Lane's learning environment in curriculum elements that become parts of all courses where appropriate

and which are supported by an organized infrastructure of adequate lab and demonstration equipment and materials, hard-copy and electronic copy curriculum materials, and online resources. This element of our initiative is a modest step forward. Its product will be numerous curriculum elements that are integrated into the entire physics curriculum. The initiative will build upon work that goes on in small steps by the permanent faculty members as a regular part of their work, improvements implemented by all faculty members that might otherwise not be carried on as schedules and staff change, previous equipment-based advances in one of our physics rooms, potential equipment-based advances in the other two rooms (C and D of this initiative), and work begun to identify, develop and fabricate physics demonstration equipment.

F. Create enhancements and better alignment and links between the physics curriculum at all levels and the mathematics curriculum which form pre-requisites to physics classes. The aim of this element of the Physics initiative has several parts: (1)To identify and integrate specific calculations, concepts, and problems in both physics and mathematics courses for enhancing the value of Math prerequisites for students taking physics. This is a collaborative effort by Physics and Mathematics led and stewarded by Physics, but involving Mathematics faculty members as they are interested. This work builds upon mathematics related assessment work in Physics involving the Basic Skills Diagnostic Test and Calculus Concept Inventory, and discussion between Mathematics and Physics faculty members. (2) To create math study modules for intervention and help when students in PH 211, who have had calculus, score poorly on the Calculus Concept Inventory. And also, to create math study modules for intervention and help when students in all physics classes when students perform poorly on the Basic Skills Diagnostic Test. (3) Create an Applied Physics Calculations course that would be linked to ongoing physics courses, and which would provide a way for learning elementary math through science applications and provide a new pathway into Math 95.

G. Update the Electrical Fundamentals curriculum.
This course needs a major reassessment and, to the extent needed, enhancements in curriculum. This element of the Physics initiative aims at making that reassessment in a collaborative process involving Engineering faculty members, OSU Engineering faculty members. And then, based on that assessment, the initiative involves developing a plan of curriculum reform, and to the extent possible, implementing that reform. This reform is expected to include new conceptual and problem-solving activities, online resources and labs in a format that can be continued from year to year and improved upon rather than starting over. More specifically, when this element of the initiative is completed, in addition to curriculum elements of the sort common to physics classes generally, there will be curriculum elements of activities involving Pspice, advanced circuit lab experiments, and design projects.

H. Collect, develop and organize online resources for our astronomy courses.
This element of the Physics initiative aims to identify, collect, and organize extensive web-based resources for use in the all astronomy classes. Such resources are available and already used to some extent in our classes. This initiative would seek out more such resources and organize them using the AMSER technology and pedagogically organize

them from the "Curriculum as Conversation" standpoint. The extent of this work can be measured by extent of the curriculum elements developed.

J. Develop a multi-disciplinary thermodynamics course for science majors.
Advances in physics curriculum reform tend to result in fewer topics better understood, and one of the elements missing from the curriculum is thermodynamics. The subject is also typically treated as a minor, by important, topic in chemistry, geology, and biology. There is a significant opportunity to provide students with a multi-disciplinary introduction to thermodynamics, which would provide our majors with a capstone-like experience not generally available and one that would be viable given the multi-disciplinary origins of the students.

K. Develop linked-course learning communities between physics and non-science courses.
This element of curriculum development would support students in creating bridges between physics subject matter and that of non-science disciplines. We would explore a wide variety of options and implement them as our infrastructure and demand allowed.

L. Create two new permanent physics faculty positions to provide adequate levels of permanent faculty positions.

M. Regular support of physics classes at a level that cannot be provided by the current physical science staff which primarily serves Chemistry. (As this staff position is a lower priority than the above and the return of investment is lower, details are not provided in this document.)
This is a long established need, which has been advocated by the Science division in previous unit plans. Current staffing levels are well below national averages in physics faculty members in comparison to the numbers and variety of courses; and the numbers of adjunct positions are far above the best practice standard defined by the major physics teaching professional organization, the American Association of Physics Teachers.

Questions and Answers

How is the initiative linked to the Unit Plans most recently submitted?

1. **How does it continue the achievement of those goals?**
2. **If this is a continuation of an initiative started last year, make sure that relationship is clear.**

How is this initiative linked to the efficiencies and productivities plans you had last year?

1. **How does it continue the achievement of these plans?**
2. **If this is a continuation of an efficiency or productivity plan started last year, make sure that relationship is clear.**

All parts of this initiative have origins documented in recent unit plan initiatives. They are based on long recognized needs and, where possible, build upon previous work funded last year. Of funded work, part H is the less urgent but next logical step in Astronomy after the urgent need to revise the tele-course after the publisher changed the video materials and to produce labs after the lack of labs proved to be a problem.

Part E is the next step, still urgent, that in part builds upon the Curriculum Development grant used for training in the PASCO equipment in the physics room 145 (40 hours) and for identifying and organizing the building of physics demonstration materials (30 hours). In room 145 with the PASCO equipment, new labs and lab activities will be written based on the basis of the knowledge gained about the PASCO hardware and software. Demonstration equipment, which to be effective, needs to be driven by well-founded pedagogical understanding, will be built as part of E. This will build upon the work involving demonstration equipment in the CD grant of two years ago. It also builds upon the Carl Perkins curriculum development grant to enhance curriculum implementation in the PH 101,2 in room 119, supporting the Energy Management program.

Parts A and B are extremely urgent tasks that require funding, given the workload demands on the Physics faculty. C and D have not been funded in the past due, we understand, to a diversion of funds to pay salaries as well as a mistaken perception that the requests are outside the scope of what is funded by the Tech Fee. We have made efforts to clarify that the request is not for physical objects being investigated but for the electronic interface that mediates between the lab element of study and output students make analytical sense of. Parts C and D would bring us to a minimum level of lab equipment fundable through the Tech Fee in our physics classes in three rooms. Part G is, in part, an overlap of an earlier grant through OISS and the Division to allow a new adjunct faculty member to prepare to teach the Electrical Fundamentals course, given that previous curriculum work had not been created in a sustainable form. This work, however, was not organized to involve a permanent faculty member or to be sustainable, and thus in the following year when a new adjunct faculty member taught the course much had to be started from scratch, still without a full strategic look at the course. This year, as last, the same adjunct member will repeat the course so this element of the Physics initiative is less urgent but still very important.

Parts F comes out of work previously envisions and out of a developing partnership between math and physics, and assessment of math levels in physics classes. Parts H, J and K reflect needs developed and seen over the last several years.

Part L is something required and justified by the steady increase in physics enrollment and class sections, and an appreciation of opportunities missed and inefficiencies from two few permanent positions.

Part M comes from the recognition that laboratories and demonstrations in physics are under-utilized at Lane because of the low numbers of permanent position and the over-use of adjunct position, but also because of an inadequate level of staff support which would be needed if the labs and demonstrations were supported at optimal levels.

The entire Physics initiative is informed by planning based on efficiency and effectiveness. The results of this planning was evident last year and the two quarters of this year in significant increases in enrollment. There is not really time or space in this document to provide all the details of this planning.

Describe the resources needed:

760 hours of curriculum development spread among the elements of this proposal in the following way:

A. Create better links between the Principles of Technology curriculum to the programs served and additional programs that could be served.
PH 091,2 Principles of Technology, Curriculum Development 50 hours
Request: Carl Perkins 50 hours
Request: Curriculum Development 50 hours

B. Enhance the curriculum infrastructure for the Science Modeling Labs to expand with the capacity to become an integral part of a students study of sustainability.
GS 110,210 Science Modeling Labs 100, 200, Curriculum Development 70 hours
Request: Curriculum Development 70 hours

E. Further integrate, in a sustainable and scalable way, pedagogical advances in physics education.
PH 091,2 Principles of Technology, PH 101,2,3 Fundamentals of Physics, PH 201,2,3 General Physics (algebra-based), PH 211,2,3 General Physics w/Calculus, Curriculum Development 140 hours
Request: Carl Perkins 70 hours
Request: Curriculum Development 140 hours

F. Create better links between the physics curriculum at all levels and the mathematics curriculum which form pre-requisites to physics classes.
PH 091,2 Principles of Technology, PH 101,2,3 Fundamentals of Physics, ASTR 107 Survey
of Astronomy, ASTR 121,2,3 Astronomy of the Solar System, Stellar Astronomy, Cosmology and the Large Scale Structure of the Universe, PH 201,2,3 General Physics (algebra-based), PH 211,2,3 General Physics w/Calculus, Curriculum Development 80 hours
Request: Curriculum Development 150 hours

G. Update the Electrical Fundamentals curriculum.
ENGR 221 Electrical Fundamentals Curriculum Development 70 hours
Request: Carl Perkins 70 hours
Request: Curriculum Development 70 hours

H. Collect, Develop, and Organize online resources for our astronomy courses.
ASTR 107 Survey of Astronomy, ASTR 121,2,3 Astronomy of the Solar System, Stellar Astronomy, Cosmology and the Large Scale Structure of the Universe, Curriculum Development 80 hours
Request: Curriculum Development 80 hours

J. Develop a multi-disciplinary thermodynamics course for science majors.
New 200-level course
Request: Curriculum Development 100 hours

K. Develop linked-course learning communities between physics and non-science courses.
New courses
Request: Curriculum Development 100 hours

$13335 in new equipment (prices expected to have increased)
Request: $7623 from Carl Perkins
Request: $13335 from Tech Fee
Specifically, by element of the initiative:

C. Replace out of date interfaces and sensors to collect and display data in Room 119, which primarily serves transfer and professional-technical students taking the 100-level conceptual introduction to physics.
PH 101,2,3 Fundamentals of Physics primarily
Request: $7623 from Carl Perkins
Request: $7623 from Tech Fee

- Computer Hardware $5712: 7 Stations for 16/144
    - Motion Detector $78 ea ($546)
    - Dual-Range Force Sensor $108 ea ($756)
    - Microphone $39 ea ($273)
    - Low-g Accelerometer $98 ea ($686)
    - (2) Vernier Photogates $45 ea ($630)
    - Ultra Pulley $24 ea ($168)
    - Picket Fence $7 ea ($49)
    - Stainless Steel Temperature Probe $29 ea ($203)
    - Magnetic Field Sensor $58 ea ($406)
    - Differential Voltage Probe $38 ea ($266)
    - (2) Current Probes $39 ea ($546)
    - Rotary Motion Sensor $169 ea ($1183)

D. Provide a complete set of interfaces and sensors (familiar to students in chemistry) to collect and display data in Room 144, which primarily serves science and health majors taking the 200-level algebra-based general physics course.
PH 201,2,3 General Physics primarily
Request: $5712 from Tech Fee

- Computer Hardware $7623: 7 Stations for 16/119.
    - Vernier LabPro Interface $220 ea ($1540)
    - Motion Detector $78 ea ($546)
    - Dual-Range Force Sensor $108 ea ($756)
    - Microphone $39 ea ($273)
    - Light Sensor $53 ea (371)
    - Low-g Accelerometer $98 ea ($686)
    - (2) Vernier Photogates $45 ea ($630)
    - Ultra Pulley $24 ea ($168)
    - Picket Fence $7 ea ($49)
    - Stainless Steel Temperature Probe $29 ea ($203)
    - Magnetic Field Sensor $58 ea ($406)
    - Differential Voltage Probe $38 ea ($266)
    - (2) Current Probes $39 ea ($546)
    - Rotary Motion Sensor $169 ea ($1183)

Request: Tech Fee (CH) $13335
Request: Carl Perkins (Ch) $13335

What specific measurable program outcomes do you expect to achieve with this initiative? The outcomes should be specific enough to be measurable. Also, outline the method that will be used to determine the results.

The products developed are outlined in the description of each part of the initiative and in the section of this initiative dealing specifically with products. The outcomes listed below are measurable and expected from this initiative. The outcomes in terms of student learning are the following:

- Students will have deeper conceptual learning through a variety of proven pedagogical enhancements of the learning environment involving the active engagement of students.
- More students will achieve conceptual learning through proven enhancement of the learning environment involving the active engagement of students.
- The classes will be more inclusive of different learning styles, particularly for students who need hands-on and context-rich learning.
- There will be greater synergy between physics classes and professional-technical programs of study and mathematics study, which will make more effective and efficient use of student effort.
- There will be a better alignment between what students learn and what students need to know in school and life challenges after the course.
- Students will have greater access to faculty members, and faculty members will have a greater capacity to respond to individual student needs due to increased efficiencies coming from the reforms in this initiative being sustainable and scalable.
- Students will have assurance of a sustainable high quality comprehensive collection of physics learning opportunities.

The outcomes in terms of the capacity of the Physics discipline are the following:

- Effective organization of lab and demonstration equipment and having equipment to carry out the most effective pedagogy will allow the discipline to be more efficient as well as effective.
- Consolidating reforms in a sustainable and scalable form will allow incorporation of advances throughout the physics curriculum. This incorporation will not only benefit student learning but support the professional development of the physics faculty, and allow the faculty to attend to other ways to advance the physics learning environment.
- These advances and future advances have a likelihood of being sustainable.

Department Priority:

5

Unit Resources:

Priority ranking for this initiative was determined by SAC members drawing numbers randomly. All the initiatives are valuable to the proposing disciplines and all have the support of the Division.

Division resources include the normal curriculum development of permanent faculty members as part of their jobs and a certain amount of curriculum development and curriculum support that is part of collegiality developed in the discipline.

Funding Request: Carl Perkins

Is this a Career & Technical Education program approved by the state and offered through Lane for credit?

No

If not a Career & Technical Education program, does your request provide considerable support for students enrolled in these programs?

Yes

Do you have an advisory committee that meets 2-3 times per year?

No

If request is for personnel, will funds be used to replace an existing position?

n/a

How will funding this initiative increase or sustain the academic achievement and technical skills attainment (GPA of 2.0 or better) of Career and Technical Education students?

It will increase the quality of learning in physics courses. This physics learning can be expected to support learning in program areas. And by increasing the efficiency and effectiveness of learning physics, more student time can be devoted to other studies. Physics courses are typically challenging, and in the past have served as gates to advancement. The initiatives for which Carl Perkins funding is sought are all geared to implementing reforms shown to support learning by greater numbers of students. Physics, because of its fundamental subject matter, provides students with knowledge and skills for meeting the challenges of technologically advanced or complex work and changing technologies. Carl Perkins funds may support initiatives supporting PH 101,2 and GS 104, which support the Energy Management program and Physical Therapy Assistant program. Career-technical programs will also be supported by enhancement of mathematics education.

How will funding this initiative increase or sustain the number of CTE students that graduate or receive a one year certificate from Lane and help prepare the students for employment?

Same as above: It will increase the quality of learning in physics courses, positively impact learning in other courses, and increase the efficiency of learning so that more student time can be devoted to other studies.

EQUIPMENT $

COMPUTER HARDWARE $

7623

COMPUTER SOFTWARE $

MATERIALS & SUPPLIES $

CURRICULUM DEVELOPMENT (Hours)

190

PART-TIME FACULTY $

TIMESHEET STAFF $

TRAVEL $

Can this initiative be partially funded?

Yes

EQUIPMENT $

(E) Explanation of effect of partial funding:

COMPUTER HARDWARE $

(CH) Explanation of effect of partial funding:

COMPUTER SOFTWARE $

(CS) Explanation of effect of partial funding:

MATERIALS & SUPPLIES $

(MS) Explanation of effect of partial funding:

CURRICULUM DEVELOPMENT (HOURS)

120

(CD) Explanation of effect of partial funding:

Our most urgent priorities would be met, and enhancing curriculume for Electrical Fundamentals which serves Engineering students would be postponed.

PART-TIME FACULTY $

(PF) Explanation of effect of partial funding:

TIMESHEET STAFF $

(TS) Explanation of effect of partial funding:

TRAVEL $

(T) Explanation of effect of partial funding:

Funding Request: Curriculum Development

1. List the following information

- **Course Numbers (titles if not currently offered)**
- **Instructor Name(s) who will work on the curriculum development**

- **Whether each of the courses is in, or has been through, the curriculum approval process**

- Course Numbers: PH 091,2; PH 101,2,3; PH 201,2,3; PH 211,2,3; ASTR 107, ASTR 121,2,3; ENGR 221; GS 110,210
- Instructor Name(s) who will work on the curriculum development: (Assuming all is funded) Dennis Gilbert, Paul Bunson; Kathy Hadley; Mike Mitchell; Ahmad Rajabzadeh; new faculty members not identified.
- Whether each of the courses is in, or has been through, the curriculum approval process: All courses have been established and approved

2. List each course number (or title) and the materials to be created for each class

- **Instructional goals, objectives, syllabi and outlines**
- **Lab instruction packets**
- **Practice, quiz, presentation &/or demonstration materials**
- **Other (specify)**

- Instructional goals, objectives, syllabi and outlines: These would be enhanced in PH 091,2; PH 101,2,3; PH 201,2,3; PH 211,2,3; ASTR 107, ASTR 121,2,3; ENGR 221; GS 110,210
- Lab instruction packets: These would be enhanced in PH 091,2; PH 101,2,3; PH 201,2,3; PH 211,2,3; ASTR 107, ASTR 121,2,3; ENGR 221; GS 110,210
- Practice, presentation &/or demonstration materials: These would be enhanced in PH 091,2; PH 101,2,3; PH 201,2,3; PH 211,2,3; ASTR 107, ASTR 121,2,3; ENGR 221; GS 110,210
- Other (specify): Infrastructure improvements would be made through better use of current and fuller integration of new equipment and new demonstration equipment.

3. List each course number (or title) and give your timeline for beginning and completing each course curriculum development.

All projects would be completed within the time limits allowed.

4. What are up to 3 departmental instructional goals that are met through the development of curriculum in each class?

The themes for the Science Divisions plans for FY10 are

1. optimizing sustainable access for students and options for quality learning; and
2. optimizing the curricula and resources we already have (continuing from FY09).

This initiative supports these themes by increasing retention among science majors, increasing online learning options for students, and developing additional curricular enhancements.

5. List each course number (or title) and give the value of the development of curriculum in each course to other faculty members.

Every physics faculty member would benefit from the initiative as a whole. Certain elements have a direct impact on every faculty member, particularly elements C, D, E, and F. All elements affect the vitality of the breadth of the discipline, and thus curriculum development that affects one or two courses, like A, G, and H indirectly affect everyone as problems in parts of the discipline are resolved. Since physics is an essential course for all science majors and engineers, enhancing physics has a positive effect on the entire science and engineering faculty. Initiative elements B and J multi-disciplinary in nature, so affects the entire science faculty.

6. List each course number (or title) and say how many students will be served by the development of curriculum in each class.

- PH 091,2: 24+24=48 students
- PH 101,2,3: 96+96+72=264 students
- PH 201,2,3: 24+24+24=72 students
- PH 211,2,3: 72+72+72=216 students
- ASTR 107: 60(telecourse)+48(classroom)=108 students
- ASTR 121,2,3: 24+24+24=72 students
- ENGR 221: 24 students
- GS 110,210: 24+24+24=72 students (much greater potential in future)

7. List each course number (or title) and give the specific benefits to students that you expect from the development of curriculum in each class.

- PH 091,2: Better coordination with program needs; better coordination with mathematics; fuller integration of proven pedagogical advances; better lab and demonstration equipment; more efficient infrastructure allowing faculty more direct time with students; enhanced online resources
- PH 101,2,3: Better coordination with mathematics; fuller integration of proven pedagogical advances; better lab and demonstration equipment; more efficient infrastructure allowing faculty more direct time with students; enhanced online resources
- PH 201,2,3: Better coordination with mathematics; fuller integration of proven pedagogical advances; better lab and demonstration equipment; more efficient infrastructure allowing faculty more direct time with students; enhanced online resources
- PH 211,2,3: Better coordination with mathematics; fuller integration of proven pedagogical advances; better lab and demonstration equipment; more efficient

infrastructure allowing faculty more direct time with students; enhanced online resources

- ASTR 107: Better coordination with mathematics; more efficient infrastructure allowing faculty more direct time with students; enhanced online resources
- ASTR 121,2,3: Better coordination with mathematics; more efficient infrastructure allowing faculty more direct time with students; enhanced online resources
- ENGR 221: Better coordination with mathematics; fuller integration of proven pedagogical advances; better lab and demonstration equipment; more efficient infrastructure allowing faculty more direct time with students; enhanced online resources
- GS 110,210: Opportunity to delve more deeply into science topics and gain significantly greater understanding; practical application of mathematics and the development of an appreciation of relatively basic mathematics; more initial models of interest to engage with; inter-disciplinary practice; access and experience with modeling tools not usually available to undergraduates; the development of an infrastructure for the class that will allow it to be taught at many convenient times.

8. List each course number (or title) and give the specific benefits for diversity that you expect from the development of curriculum in each class.

- PH 091,2: Expands comfort zone by greater alignment with practical needs and experience in the professional technical program. It increases the viability of a course which already serves a full spectrum of learning styles.
- PH 101,2,3: Preferred pedagogies for implementation are more inclusive, and they enhance learning which give students a greater chance of success in later courses. More efficient infrastructure gives faculty members more time to address other avenues for supporting diversity.
- PH 201,2,3: Preferred pedagogies for implementation are more inclusive, and they enhance learning which give students a greater chance of success in later courses. More efficient infrastructure gives faculty members more time to address other avenues for supporting diversity.
- PH 211,2,3: Preferred pedagogies for implementation are more inclusive, and they enhance learning which give students a greater chance of success in later courses. More efficient infrastructure gives faculty members more time to address other avenues for supporting diversity.
- ASTR 107: Use of online resources can allow for more inclusive participation and success in class. The organizing pedagogy will enhance diversity by better preparation for later courses and public discourse.
- ASTR 121,2,3: Use of online resources can allow for more inclusive participation and success in class. The organizing pedagogy will enhance diversity by better preparation for later courses and public discourse.
- ENGR 221: Preferred pedagogies for implementation are more inclusive, and they enhance learning which give students a greater chance of success in later courses.

More efficient infrastructure gives faculty members more time to address other avenues for supporting diversity.

- GS 110,210: Systems thinking encourages supportive ways of thinking about diversity. The interdisciplinary and group work of the class encourages authentic cooperation among a diversity student body.

9. List each course number (or title) and give the specific benefits to sustainability that you expect from the development of curriculum in each class.

- PH 091,2: Physics knowledge, perspectives, and problem solving provides knowledge and skills for addressing issues of sustainability.
- PH 101,2,3: Physics knowledge, perspectives, and problem solving provides knowledge and skills for addressing issues of sustainability.
- PH 201,2,3: Physics knowledge, perspectives, and problem solving provides knowledge and skills for addressing issues of sustainability.
- PH 211,2,3: Physics knowledge, perspectives, and problem solving provides knowledge and skills for addressing issues of sustainability.
- ASTR 107: The long time scales of astronomy and interconnectedness of many processes encourage the complex and long term thinking required for resolving issues of sustainability.
- ASTR 121,2,3: The long time scales of astronomy and interconnectedness of many processes encourage the complex and long term thinking required for resolving issues of sustainability.
- ENGR 221: Physics knowledge, perspectives, and problem solving provides knowledge and skills for addressing issues of sustainability.
- GS 110,210: Modeling skills and practice is an essential tool for dealing practically and theoretically with issues of sustainability. Such a modeling class is a good candidate for an essential part of a sustainability curriculum.

10. List each course number (or title) and give the specific effects on distributed learning that you expect from the development of curriculum in each class.

- PH 091,2: Enhanced online learning, short of hybrid course
- PH 101,2,3: Enhanced online learning, short of hybrid course
- PH 201,2,3: Enhanced online learning, short of hybrid course
- PH 211,2,3: Enhanced online learning, short of hybrid course
- ASTR 107: Enhanced online learning, tele-course supported
- ASTR 121,2,3: Enhanced online learning, short of hybrid course
- ENGR 221: Enhanced online learning, short of hybrid course
- GS 110,210: Enhanced online learning, short of hybrid course

Hours requested for Curriculum Development funding:

Please enter the amount of one of the following:

- **100 hours maximum for new development.**

- **70 hours maximum for course revision**
- **50 hours for 3-4 credit conversion**
- **other (use if multiple courses addressed in one initiative**

Do not enter any characters other than numbers and a decimal.

How many hours are you requesting? If there are multiple courses addressed in the initiative, please list each course number (or title) and give the number of hours requested for each course.

760

Can this initiative be partially funded?

Yes

Partially funded curriculum development HOURS requested:

200

Explanation of effect of partial funding:

Assuming partial funding of a minimum of 120 hours from Carl Perkins for our most urgent priorities, 200 hours will fund some urgent curriculum development needs. Partial funding will delay important collaboration with Mathematics, developing the Electrical Fundamentals curriculum, the next step in developing online resources for Astronomy courses, and the development of new courses.

Funding Request: Technology Fee

1. Category of request

- **Maintain existing technology**
- **Increase student access to technology**
- **New technology**

Please type in the category of the request in the field below.

Maintain existing technology ; Increase student access to technology; New technology

2. Campus location

- **Main Campus**
- **Downtown Center**
- **Florence**
- **Cottage Grove**

- **CLC (list specific locations)**

Please type in the location of the request in the field below.

Main Campus

3. Names of the person(s) with more information (if needed):

Dennis Gilbert and Paul Bunson

4a. Budget ORGN

691600

4b. Budget PROG

111000

5.How many students will benefit per year?

Up to 576 next year, plausibly much more in the future.

6. Describe the benefit?

Allows full use of significant, proven pedagogical advances; enhances our existing courses by providing much needed computer technology.

COMPUTER HARDWARE $

13335.00

COMPUTER SOFTWARE $

STAFFING $

INSTALLATION $

LICENSING $

Can this initiative be partially funded?

Yes

COMPUTER HARDWARE $

7623.00

(CH) Explanation of effect of partial funding:

Partial funding will equip 16/119 which currently serves the most students taking physics, including PH 101,2,3.

COMPUTER SOFTWARE $

(CS) Explanation of effect of partial funding:

STAFFING $

(S) Explanation of effect of partial funding:

INSTALLATION $

(I) Explanation of effect of partial funding:

LICENSING $

(L) Explanation of effect of partial funding: