Reading Education Foundation

Investing in our students, our schools, and the future

Reading Education Foundation Grant Application

Applicants: Completed applications must be sent to your building principal for approval. Applicants may not send applications directly to REF. Building principals are responsible for submitting applications to REF. Any application received directly from an applicant will not be accepted for consideration.

Principals: After review and approval of the application please save a .pdf copy of the completed application as follows: Project director's last name, school, REF GrantApp 2012-13 (e.g. Smith RMHS REF GrantApp 2012-13). Forward all approved applications to grantcommittee@readingef.org. Deadline for applications to REF is on or before 5:00 PM on December 1, 2012. Grants received after the deadline will not be accepted.

Steve Cogger	steven.cogger@reading.k12.ma.us
Project Manager/Primary Contact	Email
Physics Teacher	781-944-8200
Position/Title	Telephone
RMHS	11th Grade Physics
School	Grade or Subject

Implementation of Lab-based Physics	Physics
Project Title	Curriculum Area (s)
RMHS	11
School(s) where project will occur	Grade Level(s)
$11,840	
Total Funding Requested	

Co-applicant Name(s)	Email
	RMHS
Position or Title, Grade or Subject	School
Additional Co-applicant Name(s)	Email
	RMHS
Position or Title, Grade or Subject	School

/s/ Steven D. Cogger 11/24/2012

Project Manager's Signature *(on behalf of all applicants listed)* Date:

/s/ Kevin J. Higginbottom 11/30/2012

Principal's Signature Date:

THE **REF MISSION**

REF supports innovation and excellence in the Reading Public Schools by providing funds for projects that both deepen and expand the scope of traditional classroom learning to strengthen the whole child development of each and every student.

Required Proposal Format

To ensure an equitable review of all applications, please answer the following questions. Successful applications will reflect thoughtful planning, help reviewers clearly understand the content and context of the project, and assure appropriate use of Foundation funds. Grant requests should address a high-priority issue for the Reading Public Schools and align with the mission of REF (above). Incomplete proposals cannot be considered for funding.

Project Description – Please provide a brief (50 word) narrative that summarizes the project (suitable for press release.)

The grant proposal is for the purchase of equipment from Vernier to support a student-centered physics instruction using computer-based labs. The equipment will enable the implementation of a proven physics pedagogy, Interactive Lecture Demonstration (ILD) that lets students "do" science in small group settings. The curriculum is extensible, adaptable, and applicable to students at all levels with multiple learning styles.

Description of Need – What specific need in the existing curriculum are you trying to address? Please specify whether you see this need as a certain population, grade, school, or district level issue. From your experience, please describe at the student and classroom level what is lacking in the current approach. Please provide any available data and/or statistics to back up your assertion. Please link the need to an issue identified as of high-priority for the Reading Public School District.

Physics is a difficult subject area for students to master. Traditional lecture based teaching often leads students to the conclusion that physics is just a hunt for the right formula. In their efforts to find the formula students do not develop an understanding of the key physics concepts. The curriculum supported by the proposed lab equipment places students in small groups where they perform experiments constructing their own knowledge of physics. The small group setting reinforces peer learning and discussion in the Zone of Proximal development first identified by Vygotsky. By building on their existing knowledge and confronting their ideas through experimentation, students learn the concepts of physics. Mathematics becomes a tool of physics rather than a means to an end.

In their paper On the Effectiveness of Active-Engagement Microcomputer-Based Laboratories (1) Redish, Saul, and Steinberg of the University of Maryland have summarized the success of the proposed lab-based curriculum as follows:

Thornton and Sokoloff conjectured that the MBL [using ILD] activities they had designed were unusually effective for five reasons:

1. Students focus on the physical world.
2. Immediate feedback is available.
3. Collaboration is encouraged.
4. Powerful tools reduce unnecessary drudgery.
5. Students understand the specific and familiar before moving to the more general and abstract. (2)

These conjectures are consistent with modern theories of learning, including those built on the work of Piaget and Vygotsky, and on our current understanding of the structure of short and long-term memory buffers. To this list we add a sixth conjecture: 6. Students are actively engaged in exploring and constructing their own understanding.

Reading has made 21st century skills a high priority in education. Implementation of a lab-based curriculum in physics meets many of the skills identified in the March 2010 PTI presentation on 21st Century skills. Lab and inquiry-based learning allows students construct their own knowledge through experimentation. By working in small groups students develop interpersonal and self-direction skills, key elements of 21st century learning. The

proposed lab-based classroom encourages students to defend their predictions and listen to others as they reach an understanding of the concept. The key change in this type of classroom is the teacher becomes a facilitator, allowing greater differentiation in instruction and more time to work with students individually. Although 21st Century skills are not simply using technology, the proposed lab equipment and software lets students develop skills in taking and analyzing real data with computers. These skills are applicable to students who pursue scientific or technological vocational training after high school.

Since lab-based science tends to be more engaging it is expected that all students will benefit from a lab-based curriculum. Traditional students will have the opportunity to develop skills in inquiry and self-direction. Non-traditional students will benefit from a less restrictive classroom environment that provides more active learning. The planned curriculum is in line with the REF goal of strengthening whole child development in each and every student.

The lab-based curriculum is supported by academic research and anecdotal evidence, including the Massachusetts DESE continuing support of Summer Physics Institutes to train physics teachers in the use of the ILD curriculum.

The links below will lead to the research on ILD and student learning in physics. Other supporting papers are available in pdf files and can be forwarded the grant committee if required. Unfortunately these papers are available by subscription so they cannot be linked in this document.

Promoting Active Learning Using the Results of Physics Education Research (3)

Using the Results of Research in Science Educatio to Improve Science Learning (4)

Project Goal – Please provide a specific, well-defined goal(s) for your project. If there are short-term and long-term goals associated with your project, please specify. Please also include the key objectives you have identified that will help you achieve the goal(s) listed. (For those new to grant applications, the goal is "what" you will accomplish; the objectives answer "how" you will accomplish it).
The goal of this proposal is to increase student understanding and mastery of the concepts of physics through a lab-based pedagogy that is aligned with the Reading Public Schools emphasis on 21st Century skills and learning.

The goal will be accomplished by implementing a physics curriculum that will have students doing physics labs for a majority of the instructional days of the school year.

The success of the proposed curriculum will be measured through pre-and post-testing using the Force Concept Inventory, or FCME standardized tests.

Activities/Timetable – Provide a timetable for your project, including starting and completion dates, specific key activities, and events if applicable.
The lab equipment specified supports Newtonian mechanics physics curriculum, taught in the first semester. We would have the labs set up and teacher training complete by the beginning of the 2013-2014 school year.

In future years additional Vernier sensors and materials can be added to support lab based projects in electricty, magnetism, and other physics subject areas.

Participants – Who will play key roles in this project? What are their qualifications for these roles? Note: If you plan to engage outside services such as consultants/speakers please attach resume(s) or include a link to their website.
Physics teacher, Steve Cogger, would be the lead teacher in the project. He will specify the materials and train other teachers in the curriculum. He has been trained in the curriculum by Mark Greenman at Summer Physics Institutes funded by the Massachusetts DESE. (5) Steve has taught this curriculum with the recommended

Vernier equipment in his previous position at Manchester/Essex HS. Dr. Ron Thornton of Tufts University originally developed the ILD pedagogy. Steve has an MS in STEM Education from Tufts where the philosophy of student centered learning is a guiding vision for science pedagogy.

We are requesting two classroom sets of equipment to support teaching of the curriculum by two teachers. Kent Hatton has been testing the ILD curriculum on a limited basis in his classroom as well. He has found that students have been very receptive to the curriculum. Our goal would be to fully implement the curriculum on both classrooms in 2013-2014.

Outputs – Approximately how many teachers will participate in and how many students will benefit from this project? Indicate how the project can be shared with colleagues and across classrooms, grade levels, and schools.
The requested funds would support two classroom labs. Based on present teaching loads and class sizes the grant would benefit approximately 240 physics students per year. By outfitting two classrooms with the proposed equipment we may be able to consolidate the existing mix of lab equipment, (spread inequitably across three physics classrooms) to support the curriculum in a third classroom, increasing student participation to over 300 per year. (See the section on sustainability below.)

Outcomes – Beyond just the number of teachers involved and students impacted (your outputs), please identify your expected outcomes (i.e., actual changes made in the students and/or teachers as a result of the project). How do you plan to measure this change (i.e., student tests, teacher/student/parent surveys, teacher observation etc?
The expected outcome is deeper student knowledge of physics concepts than what is traditionally seen in lecture-based teacher-centered classrooms.

Knowledge gain will be measured by pre- and post-testing using standard test instruments, the Force Concept Inventory developed by Hestenes (6) or Force Concept and Motion Evaluation (FCME) developed by Thornton. Since some have suggested that the FCI is somewhat dated and is written in language that is not clear to students, the FCME may be used as the test instrument. Whichever test instrument is chosen, knowledge gain will be assessed using the analysis method developed an reported by Richard Hake (7), and by Coletta, Phillips & Steinert. (8) In these studies students in traditional lecture based classrooms achieve knowledge gains of 20% where lab-based classrooms achieve knowledge gains of 30% or greater. In my previous implementation of this curriculum in Manchester/Essex, 18 lower level students, including 5 on IEPs, achieved measurable knowledge gains of 30%.

Besides measuring knowledge gain, the test results will be used to evaluate student learning by subject area. We expect that the curriculum and method of instruction will be modified based on the results of testing to ensure continuous improvement of the instruction and labs on a yearly basis.

Sustainability – Will the project sustain itself beyond the current grant cycle? If so, please explain how. Please describe the potential for replication of your project to other classrooms or schools.
The proposed lab equipment is high quality and is supported by a five year warranty. It is expected that the equipment would last many years beyond the grant cycle. By outfitting two classrooms with the proposed equipment we may be able to consolidate the existing mix of lab equipment to support the curriculum in a third classroom.

Although there are other companies providing similar equipment, Vernier (9) is the recommended source. The original ILD pedagogy was developed using Vernier equipment. Additionally, Vernier is the recommended source of lab equipment used in the Project Lead the Way (PLTW) curriculum. Our students will benefit from using familiar devices and measuring software in different subject areas.

Have you requested funding for this project elsewhere? REF partners with PTO's, other fundraising organizations and community groups as much as possible in order to fund as many deserving grants as possible. Is there funding available from any such group for your grant? If so, please list the source, the amount requested, and liaison information. No

Could you achieve these results with materials/supplies currently provided by the District? The request for funding has been made because the current state of the physics lab equipment does not allow full implementation of a student-centered lab-based curriculum. Presently we have lab equipment from several vendors so there is an incompatibilty between the equipment. Many of the sensors do not work properly and/or there are not enough available to let students do the labs. Teachers have had to jury rig existing materials to even perform demonstration labs for the entire class which are better than lectures but do not meet the learning goals of labs with full student participation.

The requested funding is based on quotations, including shipping, from Vernier dated 11/21/2012 . The budget items are listed as Classroom 1 & 2 to show the cost per classroom for full implementation of the labs. If the budgeted amount is not avaliable we would prefer to reatin as muach as possible to fund two classrooms. Reductions may be made by reducing some of the equipment in each classroom set, rather than funding just one classroom with everything requested. This approach could reduce the requested amount by approximately $2,500, allowing implementation in two classrooms. This would reduce our ability to upgrade the third classroom.

Links to materials referenced in the proposal.

1) http://www.physics.umd.edu/perg/papers/redish/mbl/mbl1.html

2) http://www.physics.umd.edu/perg/papers/redish/mbl/mbl3.html#24b

3) http://sydney.edu.au/science/uniserve_science/newsletter/vol13/sokoloff.html

4) http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.114.1832&rep=rep1&type=pdf

5) http://www.doe.mass.edu/candi/institutes/12/ste.html?section=2

6) http://modelinginstruction.org/wp-content/uploads/2012/08/FCI-TPT.pdf

7)http://www.physics.indiana.edu/~hake/PERC2002h-Hake.pdf

8) http://prst-per.aps.org/abstract/PRSTPER/v3/i1/e010106

9) http://www.vernier.com/products/

Estimated Budget

Detail your project budget requests. If an exact cost is unknown, please give an estimate and note that it is an estimate. Group budget items by category (e.g. consultant fees, equipment, honorariums, registration fees, consumable materials, textbooks/reference, etc.).

Note: All equipment purchased for the project will remain the property of the Reading Public Schools at the completion of the project.

Budget Item	Supplier/Provider	Quantity	Cost	Total Cost
Classroom Set 1	Vernier	1	$5,920	$5,920
Classroom Set 2	Vernier	1	$5920	$5920

If this grant involves the purchase of technology please review the following with the instructional technology staff:

The technology requested will work within the existing infrastructure of RPS. Y☒ N☐
The school can provide technical support for items purchased. Y☒ N☐
If the items require on-going fiscal support, is it likely that the school/district will be able to provide that support? Y☒N☐

Ordering and Quote Information

If your proposal is accepted you will be required to submit a completed **Requisition Request Form** for each vendor you plan to use for purchasing materials to the District office within 30 days of award notification. The Requisition Request Form is available in the District Share Folder. When selecting a vendor, please choose one who will accept a purchase order and is known to be reliable. Please be prepared to include the following:

- Name and **all contact information** (address, phone, fax, email, website).
- A valid quote from the vendor**.** Please note we cannot purchase from Amazon.com.
- When requesting a quote please ask to **include shipping costs and any other charges associated with the purchase**. Reading Public Schools (RPS) is tax exempt; therefore, we do not have to pay any taxes on purchases.
- If we do not have the business you would like to purchase from as one of our current vendors, we can set-up them as a new vendor. All we need is a W-9 form for their business and to know they will accept a purchase order from RPS.

Reduction of Budget - Sometimes funds are not available to fully fund a proposal. However, REF may be able to fund part of a proposal with the hope that the shortfall can be found elsewhere, or the scope of the project can be limited to the available budget. If this is the case in this proposal, please indicate the minimum amount needed for you to continue and briefly describe how you would reduce the scope of the proposal to accommodate the minimum amount.
$_____