RENEWABLE ENERGY EDUCATOR LAB: REQUEST FOR PROPOSAL (RFP)
A Program of Solar 4R Schools at the Bonneville Environmental Foundation

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www.b-e-f.org

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Proposals due:
May 25, 2016 by 11:59 pm

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Solar 4R Schools™ is a program of the Bonneville Environmental Foundation.

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INTRODUCTION

Solar 4R Schools, a program administered by Bonneville Environmental Foundation (BEF), is soliciting proposals from K-12 teachers to participate in the Renewable Energy Educator Lab. The Solar 4R Schools Educator Lab is a year-long professional development and curriculum design opportunity where teachers create innovative, hands-on inquiry-based renewable energy lessons for the classroom in a peer-supported environment.

The Solar 4R Schools Renewable Energy Educator Lab is designed to create engaging and relevant renewable energy lessons accessible to teachers in the Pacific Northwest and nationwide. Participating teachers will be part of a small group of educators who collaborate throughout the year to design, test and implement exciting new units of lessons in their classrooms while diving deeper into the science of renewable energy. These "units" are typically multi-day or multi-week investigations of renewable energy concepts that are broken apart into separate lesson plans.

One of the intentions of the Educator Lab is for teachers to develop lessons that are heavily anchored in engineering design principles, or supplement existing engineering and inquiry projects in their classroom. By the end of the program year, participating teachers will have strengthened their understanding of renewable energy and created exploratory, classroom-tested lessons that will become part of the Solar 4R Schools online Educator Library. The Solar 4R Schools Educator Library is accessible online to any teacher at no charge, allowing lesson plans developed in the Renewable Energy Educator Lab to be used by students across the nation and even worldwide. This program is open to teachers at every competency level of renewable energy and electricity concepts. For examples of existing teacher-generated lessons, visit the Solar 4R Schools Website (http://www.solar4rschools.org/teach/teacher-activity-center). Participants in the Educator Lab may also be invited to present their developed lesson plans at teacher professional development conferences as opportunities arise.

To support this development work, participating teachers will receive:

- Access to renewable energy content specialists
- Supportive peer review and feedback of developing lessons
- A $5,000 stipend to develop and test their lessons (milestone-based, two installments)
- Up to $500 in materials for summer testing phase
- Up to $1,000 in materials for implementing their lessons in the classroom
- Up to $2,000 in materials for testing and implementing up to two additional lessons

After participating in the Educator Lab program with Solar 4R Schools, an Everett Middle School Teacher told us, "I am regularly using materials, ideas, and experiences from my lessons in my own classroom as well as in our whole 8th grade science department… Thanks again for this opportunity - I would not hesitate to…refer colleagues to your program in the future as it was one of the most enriching and collaborative professional development opportunities I have ever been a part of. Although it was hard work, it was a joy."

ABOUT BEF SOLAR 4R SCHOOLS

At BEF, we believe education plays a critical role in solving the world's most pressing energy challenges. Solar 4R Schools fosters educator leadership focused on integration of renewable energy science and technology into STEM education. Our innovative approach makes our program uniquely able to address critical issues around climate change, energy generation and national security, STEM workforce development and teacher preparation. Solar 4R Schools leverages the emergence and growth of distributed energy solutions to demonstrate a real-world example that facilitates interactive learning experiences for students while increasing energy literacy and preparing them for STEM related careers.

In response to evolving distribution systems and energy needs, the U.S. is deploying renewable energy technologies that will continue to require skilled talent, which currently is at a deficit. Today's teachers have the daunting task of ramping up to more rigorous standards while preparing students for future challenges and addressing opportunity gaps – particularly in under-resourced communities.

Our Goal: The next generation of clean energy leaders is a diverse, creative group of intellectually prepared people motivated to lead the development of energy solutions that replace fossil fuel based energy generation with resilient, innovative, and renewable energy solutions.

To get there we've developed one of the most comprehensive, teacher-driven renewable energy education programs available to K-12 teachers nationwide. Our customized teacher trainings, **teacher-generated classroom activities**, cutting-edge online **Energy Exploration Center**, and **hands-on science kits** bridge the gap between a demand for STEM education, teacher skill development and seamless integration of these interactive STEM resources into the classroom.

RENEWABLE ENERGY EDUCATOR LAB – PROGRAM DESCRIPTION

Participant Commitment

By agreeing to participate in the Renewable Energy Educator Lab, teachers are committing to participate in all aspects of the program as described below.

1. Program Sessions

There will be a total of **five mandatory in-person sessions** during the course of the program. These sessions last three to six hours and will be held at the BEF office in downtown Portland, Oregon. While we are happy to accept applications from teachers outside of the Portland metro area, we do not reimburse for travel expenses, as the program provides a $5,000 stipend for each participating teacher. We will do our best to schedule these meetings at times that are convenient for the entire group. Due to the collaborative nature of the Educator Lab, attendance for each session is required and will be a time to learn, explore, collaborate, test, and have fun.

The general timeline and objectives for the five required in-person sessions are outlined below:

A. ***Kick-Off Meeting - Mid June 2016****.* All participating teachers will meet at BEF's office to meet one another, sign their contracts, discuss their proposals and formally submit their testing phase material requests. BEF will work with teachers at this meeting to develop a final schedule for the rest of the program year.

B. ***Unit Outline Review Forum – Late July or Early August 2016****.* Participants will meet to share and offer feedback on each other's unit plan outlines, ask questions and exchange ideas.

C. ***Unit Plan Review Forum - Early October 2016****.* Similar to the *Unit Outline Review Forum* described above, the program group will review and discuss their proposed unit plans, offer suggestions and ask questions.

D. ***Implementation Meeting - Early March 2017****.* Prior to this session, most teachers will have received their classroom implementation materials and have started to implement lessons in their classrooms. This *Implementation Meeting* provides an opportunity for participants to discuss how their unit is progressing in the classroom, ask additional questions, offer suggestions and troubleshoot challenges that they've encountered.

E. ***Final Presentations and Celebration - Mid May or Early June 2017****.* This final event is an opportunity to debrief with the group after all teachers' units have been implemented, celebrate the group's accomplishments and give a formal evaluation of the lessons and the program, as well as debrief about any conference events throughout the year.

Aside from the formal program sessions, Solar 4R Schools staff can schedule additional optional group sessions or individual meetings by request to meet with participants to discuss their lessons and the program. Opportunities outside of the formal sessions offer a chance to further develop new ideas, explore integrating inquiry and engineering design into the unit, test lesson procedure, discuss photovoltaic/energy science and/or gain experience working with the materials. Finally, with enough notice, Solar 4R Schools staff may also attend and assist at an implementation event in your classroom.

2. Professional Services Contract

During the first program session and kick-off meeting, teachers will sign a contract with BEF outlining the funding timetable and the expectations of each participant. This will formalize the commitment between BEF and the participating teacher, as well as payment terms and associated obligations.

3. Unit Outline

After the initial kick-off meeting in June 2016, participants will have four weeks to develop their unit outlines, which will be submitted to BEF at the end of July 2016. The unit outline is a simple yet descriptive framework of their renewable energy unit. Typically, these units are comprised of

scaffolded lesson plans implemented over the course of multiple weeks. The outline should also include any questions for the group, a description and evaluation of the materials tested and a summary of lessons learned during the testing phase.

4. Final Unit Plan

After receiving comments on their unit outlines, participants will have six weeks to develop the first draft of their unit plans, which will be submitted to BEF at the end of August 2016. Once these first drafts have been reviewed and participants have received feedback, they will have an additional four to five weeks to submit a second draft of the unit plan, which is due the end of September 2016.

In October 2016 teachers meet at the BEF Portland office and participate in an in-person review of the draft unit plans. Following this in-person review, final drafts of the unit plan are due in November 2016. Ultimately, the final unit plan provided by participating teachers will follow the Solar 4R Schools lesson plan template, which includes:

A. *Unit Title*
B. *Lesson Plan Titles*
C. *Abstract: A brief description of each lesson as part of the unit*
D. *Keywords*
E. *Learning Goal(s)*
F. *Target Grade Level(s)*
G. *Subject Areas*
H. *Classroom Time Required*
I. *Addressed Next Generation Science Standards and Common Core Standards*
J. *Material List for a 30-Student Classroom*
K. *Vocabulary/Glossary*
L. *Teacher Guide:* The teacher guide should provide all the information that a teacher would need to implement the unit or one of its lesson plans in their own classroom, and should include:
    a. Teacher background information: A comprehensive list of necessary background topics along with particular resources that were valuable during the development process
    b. Teacher instructions, lesson procedure, classroom management tips, PowerPoint presentation with notes and/or answer guide to any student worksheets
M. *Student Guide:* The student guide should provide all of the resources needed for students to reach the learning goals of each lesson including:
    a. Student background information
    b. Student instructions, lesson procedure and/or lab manual
    c. Any necessary student hand-outs
N. *Student Assessment*: A rubric or outline of how the learning goals will be assessed
O. *Lesson Extension(s):* Lesson extensions such as follow-up classroom activities, cross-disciplinary linkages, post-lesson discussion topics or a student writing/art assignment are encouraged as part of the final lesson plan.

P. *Opportunities for Re-scale:* Include ideas teachers at higher and lower grade levels to additionally take and adapt this lesson plan to meet their own needs. This can be a brief description of the relating topic matter in these grades.

5. Peer Review

One of the unique and valuable aspects of the Renewable Energy Educator Lab is the interaction among the group and the sharing of ideas and experiences. In addition to developing their own lessons, participants will be asked to engage in a supportive peer review process, both providing feedback to other participants and receiving feedback on their own lessons (e.g., during *Outline Review Forum* and *Final Lesson Review Forum sessions*).

6. Classroom Implementation

BEF requires that participants implement their own unit in their classroom. In addition, participants are free to elect to test – and receive materials for – up to two other units/lessons that have been developed by other members of the group during the classroom implementation phase. Since BEF will require evaluation of all activities implemented in the classroom, good documentation will help aid in developing thoughtful and supportive feedback for each lesson plan tested.

To this end, participants will be provided with a 30-student set of the materials needed to do each lesson (their own and an additional two lessons if desired) as soon as the lesson plans have been finalized. Participants will then have until the beginning of May 2017 to implement and provide a final evaluation for each lesson that they test in the classroom.

7. Integration into Solar 4R Schools Online Educator Library

Once the lesson plans are developed, tested, revised and vetted for accuracy they will be uploaded to the Solar 4R Schools online Educator Library. Participants will be listed as the author of their lesson plans and will be notified if any library users provide comments, upload an lesson extension or ask specific questions about the lesson.

8. Final Evaluation of Unit Plans

Participants will be asked to provide a final evaluation of each unit/lesson that they have tested in their classroom – including their own – as well as an overall evaluation of the Renewable Energy Educator Lab. Final evaluations of both the unit plans implemented and of the Educator Lab offer an opportunity for each participant to reflect on the growth of the unit and of themselves as educators, analyze how the unit(s) could be further improved, and gives each participant the chance to improve the Educator Lab through their own thoughtful feedback. Final unit plan evaluations will be due in June 2017.

9. "Unit" vs. Lesson "Clarification"

The Educator Lab is intended for teachers to develop projects for their students that take multiple sessions to draw scientific conclusions from hands-on renewable energy curriculum and/or explore the engineering design process. Therefore, we decided that the best way to describe the piece created by teachers as a "unit," made up of multiple "lessons" taking place

over numerous days. This is based on the products of past educators from the program. Additionally, the term "unit" is not intended to denote multiple months be devoted by students to this project in the classroom, however, just more than a typical daily "lesson plan." If you see your "unit" that you develop for this program fitting within another larger section of curriculum, that is perfectly fine.

RFP REQUIREMENTS - RENEWABLE ENERGY EDUCATOR LAB

The Renewable Energy Educator Lab is a yearlong, collaborative professional development opportunity that runs from June 2016 through June 2017***. Throughout the year, there will be a minimum of five (5) MANDATORY in-person collaborative work sessions at the BEF office located in downtown Portland***. These sessions function as an opportunity for the teacher group to meet, collaborate, discuss, test, and peer review each other's proposed units. This type of collaboration among teachers is a critical part of what makes this program unique, valuable, and effective

ELIGIBILITY

BEF is soliciting proposals from educators who operate in Kindergarten – 12th grade classroom setting. Any educator currently working with students in a public or private K-12 school who is interested in participating and able to fully participate in the program is encouraged to submit a proposal for consideration. Since the five group sessions all take place at the BEF office in Portland, Oregon, applicants should consider this in their decision to apply.

Preference will be given to candidates who have not yet participated in the program.

If you have questions about your eligibility for this program, please contact Parker Mullins at pmullins@b-e-f.org or 503-553-3950.

RFP OVERVIEW

Teachers interested in participating in the Solar 4R Schools Renewable Energy Educator Lab have until 11:59 p.m. **Wednesday May 25th, 2016** to submit a proposal via email. BEF will review the submitted proposals and select up to five teachers to participate in the program.

In brief, proposals should be a three-four page statement outlining:

1) The proposed hands-on and innovative classroom unit that the teacher will implement during the school year (2016-2017). Classroom lessons should be original works, appropriately referenced, rather than a recap of an existing, published unit plan. For examples of existing lessons, visit the Solar 4R Schools Website (http://www.solar4rschools.org/learn/activities-grade-level).
2) A statement describing:

a) Why the teacher is interested in participating in the Renewable Energy Educator Lab

b) How the program fits into their professional goals and

c) How their participation in the program will enhance and remain a sustainable component of the STEM/STEAM educational programming at their school/school district

3) A commitment to full participation in the Renewable Energy Educator Lab. Full participation includes attending and engaging in all sessions, timely submission of all required documents, and the testing, implementation and evaluation of their unit plan.

For a full description of what the proposal must include please see the following section: *Elements of a Successful Proposal*.

ELEMENTS OF A SUCCESSFUL PROPOSAL

Teachers have until **May 25, 2016** to develop and submit a Unit Plan Proposal. Below is an outline of the necessary elements of a successful proposal. Please note that the proposal should express why the teacher is interested in participating, how this program fits into their professional and classroom development, and what unit plan the teacher would like to develop if chosen to participate. Additionally, although it is understood that a unit contains multiple lesson plans, an overview of the entire unit is acceptable and the specifics of every lesson are not yet required. See Appendix B for a sample proposal.

A. ***Teacher Information***
   a. Name
   b. Email Address (both work and alternative)
   c. Phone Number (both work and alternative)
   d. Grade Level(s) Taught
   e. School Name and Address
   f. Personal Address (for contract/business purposes)
   g. Subject Area(s)
   h. Number of classes taught
   i. Number of students (total) taught

B. ***Applicant's Statement****:* A statement explaining the applicant's interest in the Educator Lab and how it fits into their professional and classroom goals. In addition, please include the type of support and/or collaboration that the teacher hopes to receive and what particular skills or expertise the applicant would bring to the program.

C. ***Statement of the Unit Concept****:* A succinct yet thorough description of the unit that the teacher intends to implement. This section should be 3-4 paragraphs, thoughtfully and clearly written, that include:
   a. Overview of the unit itself
      - Procedural outline of the unit plan including a time estimate, preferred setting (indoor, outdoor, lab, etc.), student management, etc.
      - How it meets inquiry and/or engineering process pedagogy

- A description of how this unit will promote science, math, technology, engineering and/or energy literacy

b. The appropriate and targeted grade level(s)
c. The targeted learning goals for the students
d. Required background information for teachers and students
e. A statement describing why you are interested in: developing this particular unit and its associated lessons, collaborating with other teachers and sharing it with the Solar 4R Schools teaching community.
f. Any additional information you deem necessary for understanding your concept and proposed unit plan

D. ***Relevant Common Core and Next Generation Science Standards***
   a. Include an outline of national and relevant state standards that this unit will satisfy (e.g., NGSS and Common Core). Meeting more than one standard is preferred, as are explicit cross-disciplinary linkages. Please be specific when outlining the standards met.

E. ***Commitment to Educational Equity:*** Solar 4R Schools is devoted to inclusivity in educational efforts aimed at engaging 100% of students in content related to the clean energy revolution and associated new careers. How will your project ensure that the needs of more vulnerable populations of students (e.g. immigrants, communities of color, low-income, and special needs) are taken into account in the implementation of the curriculum? Examples could be strategies to engage English language learners, attention to cultural competence and relevancy, being more gender-inclusive, and inclusion of place-based techniques.

F. ***Ability to Replicate:*** A central focus of the Educator Lab is the continued development of a database of renewable energy curriculum from which teachers across the Pacific Northwest and around the country can pull ideas from and adapt for their classroom. In what way does your unit allow for replication across different grade levels and access to resources? Be sure to look at the Educator Library (http://www.solar4rschools.org/teach/teacher-activity-center) within your grade level range in order to determine how your lesson makes a positive contribution to our curricular database?

G. ***Materials List and Budget****:* Please provide a list of the materials required, with cost estimates, for the Testing Phase and the Classroom Implementation Phase:
   a. Testing Phase. The total budget for the Testing Phase is $500 for materials used during the testing period prior to classroom implementation.
   b. Classroom Implementation Phase. The total budget for the Classroom Implementation Phase is $1000 for a classroom set of materials. The classroom implementation materials should not include items that teachers typically have access to (i.e. rulers, markers, etc.).

H. ***Participant Accountability****:* A great strength of the Renewable Energy Educator Lab is the opportunity for teachers to collaborate in person to design and adapt lesson plans. Please include a brief statement assessing your ability to fully participate in the program as outlined and described in this Request for Proposals. Conflicts or other scheduling concerns will be taken into account during proposal review, but will not necessarily preclude an applicant from being selected.

At Solar 4R Schools we realize that unit plans will evolve during the testing and development phase. We recognize that the evolution of a classroom lesson is not only integral, but adds value to the development process. BEF is also aware that the materials list is subject to change during lesson development. Proposals may include a note about the natural evolution of lesson plans and their material lists with a brief statement describing how the teacher anticipates addressing this development.

SUBMITTAL REQUIREMENTS

- BEF Solar 4R Schools will only accept electronic proposals via email.
- Proposals are due **May 25th, 2016 by 11:59 pm.**
- Proposals should be emailed to the Solar 4R Schools program at solar4Rschools@b-e-f.org
- Proposals should be submitted as an email with attachments as either .pdf or .doc files.

CANDIDATE SELECTION

BEF will select up to five teachers to participate in the program. Teachers will be selected based on an evaluation of how well the teacher's professional/classroom goals match those of the program, the depth and breadth of the proposed unit plan, how the unit will be integrated into the school/district's STEM/STEAM programming, and our assessment of how the unit fits within the larger Solar 4R Schools educational program. The Renewable Energy Educator Lab is focused on bringing valuable, engaging, innovative and diverse activities to educators while providing a unique professional development experience focused on renewable energy to teachers. Proposals will be evaluated in part based on how well a proposal aligns with these goals. See the *Summary Rubric below* for more information on our selection process.

Summary Rubric

Proposal Component	**Percentage**
Proposed Unit Plan Content ▪ Focuses on renewable energy principles ▪ Original and innovative	40%
Alignment to Educational Standards ▪ Targeted toward NGSS and Common Core standards ▪ Incorporates inquiry-based methods and engineering design principles ▪ Project is exploratory in nature rather than confirmatory ▪ Incorporated into school/district STEM/STEAM programming	20%
Attention to Equity • Project is culturally competent and relevant • Meets the needs of all types of learners • Addresses gender inequity in STEM • Incorporates local/community resources	15%
Replicable • Aligns with needs and purpose of Educator Library • Has potential to be scaled to different grade levels • Can be implemented anywhere with moderate adjustments	15%
Applicant Commitment and Goals ▪ Match between program and applicant's professional development goals ▪ Applicant is available and committed to full participation in the program activities	10%

APPENDIX A – TIMELINE

Actual dates for non-specified session times will be determined with the group during the project kick-off meeting. By agreeing to participate in the program, teachers are committing to be present at program sessions, meet program deadlines and participate in supportive peer review.

BEF releases RFP	April 1, 2016
Proposals due	May 25, 2016
BEF reviews proposals	May 25 – June 1, 2016
BEF announces decisions	June 3, 2016
Program Session: Kick-Off Meeting ⇒ Participants review and sign agreements ⇒ Participants submit material lists	June 25, 2016
BEF provides materials to participants	Within 2 weeks of material list submission
Participants submit unit outlines	July 26, 2016
BEF circulates unit outlines to all participants	July 30, 2016
Program Session: Unit Outline Review Forum ⇒ Participants meet to share feedback	First week in August
BEF provides compiled comments on outlines	Within a week of the review session
Participants submit unit plan drafts	August 23, 2016
BEF circulates lesson drafts to all participants	August 24, 2016
Participants provide comments on the unit plans developed	August 31, 2016
Program Session: Unit Plan Review Forum ⇒ Participants meet to share feedback	Early October, 2016
BEF provides compiled comments	Within a week of the review session
Participants submit implementation plan and materials requests as well as any final lesson plan revisions	Early November, 2016
BEF distributes revised unit plans and materials	As requested
Program Session: Check-In Meeting ⇒ Participants meet to check-in, discuss their progress, ask questions, etc.	March, 2017
Teachers test the lessons in their classrooms	As determined by participants
Participants send final unit plans to the BEF staff	Mid-Late May 2017
Program Session: Final Presentations, Celebration & Program Evaluation	Mid June, 2017

APPENDIX B – SAMPLE PROPOSAL

Name: Jennifer Smith
Grade Level(s): 4th Grade Teacher
Subject Area(s): General Elementary (all subjects)
Number of Classes Taught: One per year
Number of Students Taught: 28

Work Address and Contact Information:	Personal Address and Contact Information:
Douglas Fir Elementary School 1234 Schoolhouse Lane Education City, OR 98765 teacher@school.com 503-555-5555	4321 Energy Lane Suntown, OR 98765 mynameis@email.com 123-456-7890

Unit Plan Concept

Overview:

I plan to develop a solar car engineering design unit for 4th-5th grade students. This unit will entail students working in design teams to research various solar car designs, draft a design, provide feedback to each design team, test and evaluate their design, finalize their design, and then present their final version to the class. I propose allowing students to first build a simple solar car using an easy template from SunWind Solar or another prototype. Then, once students are comfortable with a simple design they can modify and create their own, even using recycled materials if desired.

Through this process students will gain an understanding of the engineering process, how solar modules work, how energy transformations occur, and how to design and test an idea. In addition students will gain experience researching ideas, recording quantitative data (such as speed and distance), evaluating data, working as a team, and communicating to a larger group during their final presentations.

I anticipate that this small unit will take three to four one-hour lessons, likely spaced out over a week. The proposed extension (designing a brochure or commercial promoting their solar car design) would take another two hours of classroom time and would be linked to our language arts and visual arts standards.

I would like to develop this unit because it would give my students a way to engage with solar energy technology (and the concept of renewable energy) in a meaningful and relevant way. This unit would offer a real world example of how energy transformations occur and give them a chance to work within the engineering design process. In addition, my students need more opportunities to work in teams, gain basic research skills, and develop their social and communication skills, which this unit would provide.

Applicant Statement

This Renewable Energy Educator Lab fits in my own professional development goals by offering me the chance to learn more about solar and renewable energy, specifically the photovoltaic effect, so that I can interpret this information for my students. I teach a unit on renewable energy

(and energy in general) and am looking for ways to increase my understanding of how solar works which in turn will help make that unit more engaging, hands-on, and relevant to my student's lives. I'm also looking for ways to integrate solar energy into my science lessons as well as math, language arts, and technology lessons. I'm hoping to both share my ideas with others within my school and district by contributing my lessons to the district's curriculum library. I am also hoping to learn from other teachers as well regarding integrating inquiry and how to manage materials in the classroom.

I've participated in a similar process during graduate school and found that the feedback improved my teaching. I am looking forward to receiving feedback particularly in how to integrate engineering design into my lessons and on the content side. I'm also happy to offer my expertise to others. I have four years of teaching experience in the elementary grades (mostly Kindergarten thru 5th grade) and a background in graphic design. I would bring both my classroom experience and my graphic design experience into the program, helping other teachers find ways to extend lessons into the arts.

Grade Levels: 4th – 5th Grades

Learning Goals/Objectives:

- Students understand that solar modules generate electricity when put into sunlight due to the photovoltaic effect.
- Students will also understand the relationship between force, motion, and resistance. Students will also become familiar with the engineering design process, gain experience in researching ideas/models, and learn how to design a fair test and interpret data.
- Students work in teams to accomplish a goal and examine how to communicate an idea to a larger group.

Standards Correlation:

Common Core

- *W.4.7*. Conduct short research projects that build knowledge through investigation of different aspects of a topic.
- *W.4.8.* Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
- *W.5.7*. Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.
- *W.5.8*. Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.

Next Generation Science Standards

- *4-ESS3-2*: Generate and compare multiple solutions to decrease the impacts of natural earth processes

- *4-PS3-2*: Make observations to provide evidence that energy can be transformed from place to place by sound, heat, light, and electrical currents
- *4-PS3-4*: Apply scientific ideas to design, test, and refine a device that converts energy from one form to another
- *5-ESS3-1:* Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment
- *3-5ETS1-1*: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, and cost
- *3-5ETS1-3*: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved

Unit Procedure:

- Working in teams of 3-4, students build solar cars based on step-by-step, easy, illustrated instructions
- Students then do some free, exploratory testing of these simple cars, (e.g. orienting them in different ways, changing the tilt of the solar module, testing different tires)
- Working in design teams of 3-4 students, teams will research solar car designs, draft a design, build their design, test it, receive feedback, revise their design, and then present their final design to the class
- Class provides feedback on each team's final design and asks questions about the different designs based on their growing knowledge of solar power, force, and motion
- Potential extension: students create brochures or commercials promoting their solar car design

Teacher Background Information:

⇒ Basics on the sun and energy
⇒ What the photovoltaic effect is and how it works
⇒ Incident angle and how it affects PV module productivity
⇒ The pros and cons of solar technology versus other energy sources
⇒ Understanding of force, motion, and resistance
⇒ Steps in the engineering design process
⇒ Understanding of inquiry-based methods

Background for Students:

⇒ Students understand the term "photovoltaic effect" and the concept that this is a phenomenon where electricity is created when a photovoltaic material is exposed to light
⇒ A basic understanding that solar modules produce electricity through the photovoltaic effect, and that this electricity is essentially the same as the energy we use to power the electrical devices we all use every day
⇒ An understanding that the amount of energy produced by a PV module is directly proportional to the amount of sunlight that strikes its surface
⇒ Basic understanding of the engineering design process
⇒ Basic experience recording and analyzing simple data such as speed and distance

Equity in the Classroom:
My school receives significant Title I funding yet oftentimes struggles to provide basic materials for science teachers. This grant would provide significant relief for myself, first of all, with the acquisition of classroom supplies as I annually struggle to provide my students with both classroom necessities as well as specific lab tools. Additionally, 45% of the student body comes from homes where the primary language is not English, with many speaking Vietnamese, Spanish, or Russian at home This necessitates that I frequently include a variety of tools in my lesson plans to meet the needs of English Language Learners, such as:

- Bilingual acknowledgment as a classroom value, with students expressing vocabulary and concepts in their first language whenever possible.
- Visual tools like sentence frames, graphic organizers/guided notes, and picture association
- Hands-on activities coupled with verbal dialogue to provide additional context while practicing vocabulary application

As these pedagogical techniques are practiced daily in my classroom, they will inevitably be a part of my solar car unit and guide a large portion of the practice. I will ensure that all tools and techniques are provided. In addition to these tools, I hope to have a guest speaker from our local electric utility come in to discuss with my students the importance of knowing where their power comes from and taking control of this resource. I am hoping that, as a female leader in a male-dominated industry, she will be an encouraging role model to the girls in my classroom who may be wary of STEM professions due to historically gendered roles in the sciences.

Making My Lessons Replicable:
Designing small solar cars is an activity that can be scaled up or down to find usage at any level from K-12. It is a phenomenal piece to use both for exploration amongst younger students as well as a jumping point for older students to begin designing vehicles with their own materials and energy sources. At present, it appears that the Educator Library is lacking in lesson plans that specifically address the Engineering Design Cycle for younger grade levels, where students directly acknowledge different stages. I believe I can help make a meaningful contribution to your library. As part of my lesson, I will be sure to insert extensions for each section of the Engineering Design Cycle at which this activity can be scaled up for grades higher than the Elementary School level at which I am implementing. These extensions will include ideas for Middle School Physical Science, High School Physics, and environmental science classes.

Testing Phase Materials Budget:

Item	**Number**	**Cost**
OWI Solar Car Kit	1	$45
Tamiya Solar Car Kit	1	$43
SolGear Solar Car Kit	1	$25
Silicon Solar Car Kit	1	$15
SunWind Solar Drive II Kit	1	$15
Total		**$143**

Classroom Set of Materials:
Note: This list is my based on my proposed lesson plan. I realize that if chosen my lesson plan, and materials list, will evolve over time with feedback from other teachers and BEF staff. I anticipate this happening and will inform BEF staff as soon as possible of any changes to the list.

- Full Classroom Set of Solar Car Kits to be selected after material testing and lesson development
- Two shop lights for testing and backup if the sun isn't out
- Other design materials such as glue, tape, cardboard, rulers for track barriers, scissors, etc. (I have access to some of these materials and I can purchase some on my own)

My Availability and Commitment:
I currently know of no conflicts in my schedule that would prevent me from attending the in-person sessions or participating fully in the program. If selected, I am committed to being present, handing in materials and documents on time, providing feedback to all participants, receiving feedback on my lesson plan and implementing my lesson in my classroom. Since I'm part of our school's Green Team, I am also committed to sharing what I've learned with fellow teachers in my school, within my school district during special trainings as well as via our curriculum library, and within my grade level team.

When not in school (e.g., over summer break or holidays) I can be reached at mynameis@email.com or on my phone at 123-456-7890.