

# ESP

energizing student potential

Exelon Foundation.

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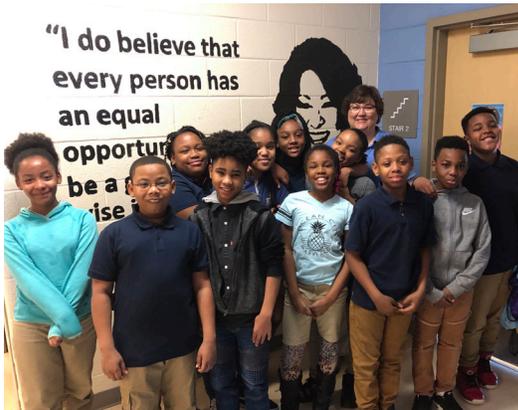
## ENERGIZING STUDENT POTENTIAL

# PROGRAM GUIDE

### Pepco Program Schools - D.C. & MD

### 2019-2020

[www.need.org/espcmd](http://www.need.org/espcmd)



# A NOTE FROM THE ENERGIZING STUDENT POTENTIAL SPONSORS...

Pepco and The Exelon Foundation, in partnership with the National Energy Education Development (NEED) Project, District of Columbia Schools, the Office of the State Superintendent of Education, Montgomery County Public Schools, Prince George's County Sustainable Energy and Prince George's County Public Schools are pleased to welcome teachers to **Energizing Student Potential**. ESP is a STEM-focused energy program for grades 4 - 8 in the District of Columbia and Maryland. This program brings together standards-based curriculum for use in the classroom, library, or afterschool programs in public and private schools, and the resources of the region's largest energy companies. The program will help schools meet Next Generation Science Standards goals and more.

Energizing Student Potential is a collaborative educational initiative designed to empower students to explore opportunities in STEM fields and help them discover their own path to innovation through a variety of classroom subjects. ESP is designed to help educators bring energy into the school and to provide all the tools and resources necessary for students and teachers to learn together, explore energy together, and teach their local communities about energy. The program begins with a kickoff workshop in early fall and follow-up trainings in the winter months. The program culminates with school-hosted Energizing Student Potential Energy Fairs.

Participation in ESP provides schools with the following:

- Three days of Professional Development for classroom teachers and/or library and media specialists
- NGSS and Environmental Frameworks aligned curriculum and hands-on kits
- An opportunity to apply for a small cash grant to supply your ESP STEM program
- An Energizing Student Potential Energy Fair Kit to host an Energy Fair and Carnival at your school
- A free half-day Educational Energy Audit for students to learn about their school building with energy professionals (optional)
- Support from the ESP Team at The NEED Project
- Connections to STEM professionals to help students see all the possibilities of STEM and Energy Careers

Students and educators engage in science, technology, engineering and mathematics activities in the library and classroom while learning fundamental principles of energy use and conservation. Students learn best when engaged in inquiry learning, and the activities and explorations included in the program allow them to think, explore, share, and develop a profound respect for energy and the world around them.

We know that teaching others helps us learn as well and the Kids Teaching Kids philosophy woven throughout The NEED Project curriculum helps keep students of all learning styles engaged and excited to learn. The lessons and projects in this program are designed to allow students to teach their peers as well as their local community.

***Welcome to Energizing Student Potential!***

**#energizingSTEM**

**[www.need.org/espdcmd](http://www.need.org/espdcmd)**

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## CONTACT INFORMATION FOR QUESTIONS OR ASSISTANCE:

### **The NEED Project**

Info@need.org                      800-875-5029                      www.need.org and www.need.org/espdcmd

### **For Curriculum and Kit questions:**

Emily Hawbaker, Curriculum Director                      ehawbaker@need.org                      800-875-5029

### **For Workshop questions:**

Wendi Moss, Training Coordinator                      wmoss@need.org                      800-875-5029

### **For Energy Fair Questions:**

Joe Lazarony, Program Associate                      jlazarony@need.org                      800-875-5029

### **For Educational Energy Audits and Evaluation questions:**

Kimberly Swan, Outreach & Evaluation Coordinator                      kswan@need.org                      800-875-5029

### **For Program questions, and all others:**

Mary Spruill, Executive Director                      mspruill@need.org                      800-875-5029/703-628-8673 (c)  
Rebecca Lamb, Program Director                      rlamb@need.org                      800-875-5029

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## THE PARTNERS

### The Exelon Foundation

#### About Exelon Corporation

Exelon Corporation (NYSE: EXC) is the nation's leading competitive energy provider. Headquartered in Chicago, Exelon does business in 48 states, the District of Columbia and Canada. Exelon is one of the largest U.S. power generators, with over 32,500 megawatts of owned capacity comprising one of the nation's cleanest and lowest-cost power generation fleets. The company's Constellation business unit provides energy products and services to more than 1.8 million customers. Exelon's utilities deliver electricity and natural gas to approximately 10 million customers in Delaware (Delmarva), Maryland (BGE and PEPCO), New Jersey (Atlantic City Electric), Washington, D.C. (PEPCO), northern Illinois (ComEd) and southeastern Pennsylvania (PECO). Follow Exelon on Twitter @Exelon.

#### About Pepco

Pepco Holdings is a member of the Exelon Corporation (NYSE: EXC) family of companies, and delivers electricity and natural gas to over 880,000 customers in Maryland and the District of Columbia. Pepco Holdings also includes two subsidiaries - Atlantic City Electric and Delmarva Power - which provide utilities to another 1.2 million customers in New Jersey, Delaware, and Maryland

#### The National Energy Education Development (NEED) Project ([www.need.org](http://www.need.org))

The mission of The National Energy Education Development (NEED) Project is to promote an energy conscious and educated society by creating effective networks of students, educators, business, government leaders, and community leaders to design and deliver objective, multi-sided energy education programs. The NEED Project is dedicated to developing innovative energy education materials and training programs for teachers and students. Launched by Congressional Resolution in 1980, the NEED serves over 65,000 classrooms in the United States and around the globe.

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## ENERGIZING STUDENT POTENTIAL PROGRAM TEAM

**Steve Solomon**, *President, Exelon Foundation*

**Mellanie Kai Lassiter**, *Senior Manager, Corporate Relations, Exelon Corp.*

**Lauren Allen**, *STEM Management Analyst, STEM Integration, Office of the State Superintendent of Education*

**Dewayne McClary**, *Director, Digital Learning and Innovation, District of Columbia Public Schools*

**Sakon Kieh**, *Specialist, Digital Learning and Innovation, District of Columbia Public Schools*

**Dr. Godfrey Rangasammy**, *Supervisor of Science, Prince George's County Public Schools*

**Jamee Alston**, *Management Analyst, Prince George's County Public Schools*

**Erica Bannerman**, *Manager, Sustainable Energy Prince George's County*

**Andrea Christman**, *Supervisor, School Library Media Programs, Montgomery County Public Schools*

**Laurie Jenkins**, *Supervisor, Outdoor Environmental Education Programs, Montgomery County Public Schools*

**Mary E. Spruill**, *Executive Director, The NEED Project*

**Rebecca Lamb**, *Program Director, The NEED Project*

**Emily Hawbaker**, *Curriculum Director, The NEED Project*

# WHAT IS THE ENERGIZING STUDENT POTENTIAL PROGRAM?

The **Energizing Student Potential** Program is “STEM project-based,” combining classroom activities with a school energy audit by students, a student-run energy fair, and an energy-focused STEM Challenge.

1. Select a team of teachers and or librarian/media specialists to implement the program. It is recommended that no fewer than two teachers participate – to provide support for each other and to reach the most students. Consider selecting a career and technology teacher and a science teacher, for example, or a librarian and cooperating science teacher.
2. Participate in a mandatory three-day series of trainings from October through April. These workshops are designed and delivered by The NEED Project with breakfast, lunch, parking, and substitute reimbursement or stipend provided. Attendance and full participation is required for participation in program. Please remember to secure release time for each session.
3. Incorporate the program’s energy-focused curriculum and related activities into the 4<sup>th</sup>-8<sup>th</sup> grade science/technology programs/classrooms between October and May.
4. Work with students, faculty, parents and community members to plan and implement an energy-focused STEM project in your community.
5. Host an Energy Fair at your school for the local community. This Energy Fair will include an Energy Carnival and hands-on energy lessons for your school community. Schools will be provided an Energy Fair Kit that will include all needed resources for the Energy Fair and a \$150 cash grant for any necessary supplies.
6. Work with NEED to plan for the Educational Energy Audit experience for a select team of students. NEED’s Certified Energy Manager will work with a group of students to survey the school building and make recommendations for increasing energy conservation in the school. Students execute both school and home energy audits (OPTIONAL).
7. Communicate with the ESP team about how things are going in your program. Respond to emails, take quick surveys about progress, and share your successes.
8. Share about your program via your school and community communication networks and social media. Good platforms for sharing include PTA newsletters, community newsletters, Facebook, Instagram, Twitter, and local news channels. Use the hashtag #energizingSTEM.
9. Gather photos, student work, and other exciting elements together to create a Final Project. This final project will be submitted in the form of a presentation or video, and will showcase your program activities and results. Submit the project for review by June 1, 2020.
10. Complete teacher and student evaluations and submit to NEED no later than June 1, 2020.

# WHAT RESOURCES DOES THE SCHOOL RECEIVE?

## The ESP Program includes:

1. Three days of teacher training (breakfast, lunch substitute reimbursement or stipend, parking, and CEUs provided)
2. Curriculum and hands-on kits to teach about:
  - the science of energy and energy transformations
  - electricity generation
  - renewable energy
  - energy efficiency and conservation
3. The opportunity to apply for a small cash grant (up to \$400) to supplement the program
4. An Energizing Student Potential Energy Fair Kit and small cash grant to host an Energy Fair and Carnival at your school
5. Access to educational energy audits

## The Curriculum and Hands-on Kit

NEED curriculum and kits for the program will be showcased throughout the workshop. All curriculum guides are found online at [www.need.org](http://www.need.org). The website for program resources for ESP is [www.need.org/espdcmd](http://www.need.org/espdcmd).

## Standards Correlations and Support

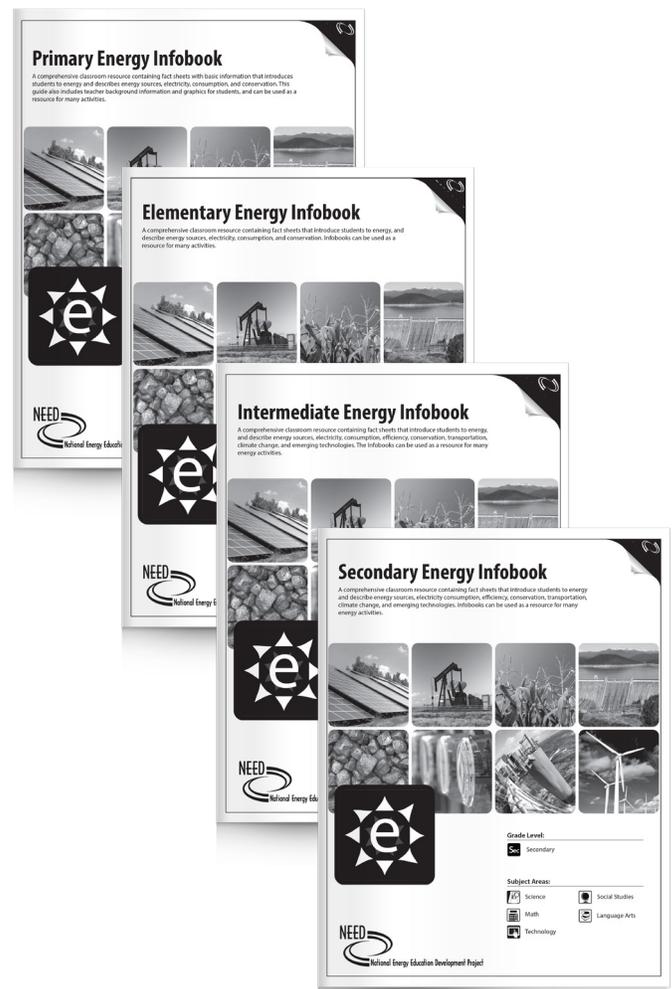
All NEED curriculum supports and is correlated to relevant national standards and state standards. For correlations documents for NGSS and CCSS, visit [www.need.org/curriculumcorrelations](http://www.need.org/curriculumcorrelations).

## Curriculum Guides

We have chosen from over 130 teacher and student guides for teaching the science of energy, sources of energy, electricity and transportation, and efficiency and conservation. These student readers serve as the text for a comprehensive energy education program. All other guides can be downloaded or ordered from NEED for supplementing the unit, if time permits.

## Hands-on Student Kits

The program will include a *Science of Energy Kit* and a choice between a wind or solar hands-on kit.



## ESP Program Guide

This program encourages students to learn about energy through direct engagement – discovering and applying energy knowledge to the energy choices and challenges we all face, both now and in the future. This guide to teaching about energy was created to provide the background and foundation components for the successful completion of the program. Most of the resources referenced within the guide will be provided to participating educators, but are also available for download at any time at [www.NEED.org/espdcmd](http://www.NEED.org/espdcmd).

## Educational Energy Audits - Optional

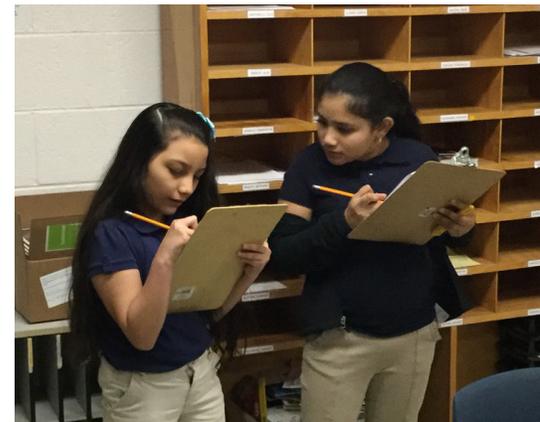
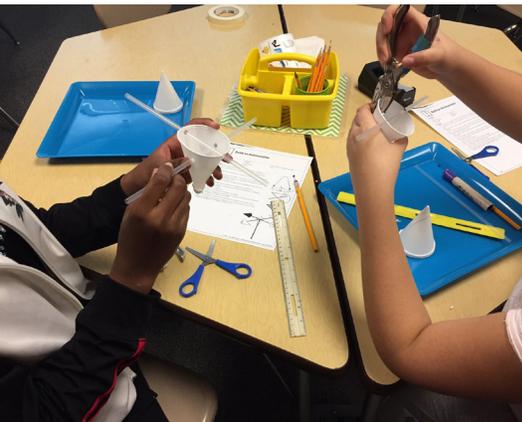
Teams of students and teachers from the schools will work with NEED's Certified Energy Manager, on an Educational Energy Audit of their school building. The CEM will work with students for a half-day to provide them an authentic learning experience about building performance and school energy efficiency while taking measurements and collecting data about their building energy use. Students will need the tools from their energy efficiency and conservation kit. NEED will help schedule your energy audit. To discuss further details of your audit, contact Kimberly Swan at [kswan@need.org](mailto:kswan@need.org).

## Final Project

Each school will submit a final project to share the work they have done throughout the school year. Projects can be in PDF format and/or videos uploaded to YouTube. Files and video links will be uploaded to the program management software by June 1, 2020. See page 22 for more information on the project and its requirements.

## Program Management Software

Throughout the ESP program, you'll have the opportunity to sign up for audit dates, share your fair dates and submit your final project through the program management software. This website provides a central location for all your program files through the year. You'll also be able to access contact information for NEED staff and program partners to share what you're doing in your school. To log-in visit <https://app.wizehive.com/appform/login/ESPDCMD2019> or [www.need.org/espdcmd](http://www.need.org/espdcmd).



# 2019-2020 DETAILED PROGRAM TIMELINE

- November 30**
- All kits and materials received from NEED
  - All kits shipped will be based on selections made at the first training/online application. Materials should be opened, verified, and any questions should be directed to Emily at ehawbaker@need.org
- December 15** Educational Energy Audit Dates Available for scheduling
- December** Begin teaching *Science of Energy* and basic energy sources
- January/  
February**
- Continue energy activities (transformations, sources) with continuous assessment
  - Begin efficiency and conservation activities
  - Brainstorm STEM Challenge
  - Plan for community energy fair/carnival
- March/April**
- Finish energy activities
  - Work on STEM Challenges
  - Finalize planning/execute community energy fair/carnival
  - Continuous assessment of student activities
- June 1** Final Project submission
- Submit project presentation/video/performance via program management software
  - Science of Energy, Energy Sources, Electricity, and Energy Efficiency Curriculum continues to be used and assessed
- June 1** Program Wrap-up
- Print/copy Student Evaluations for each student. Once students have completed the evaluations, mail evaluations to NEED. Be sure to label your school clearly:  
**The NEED Project**  
**attn: Kim Swan**  
**8408 Kao Circle**  
**Manassas, VA 20110**
  - Complete Leader Evaluation and email to Kim Swan at kswan@need.org.

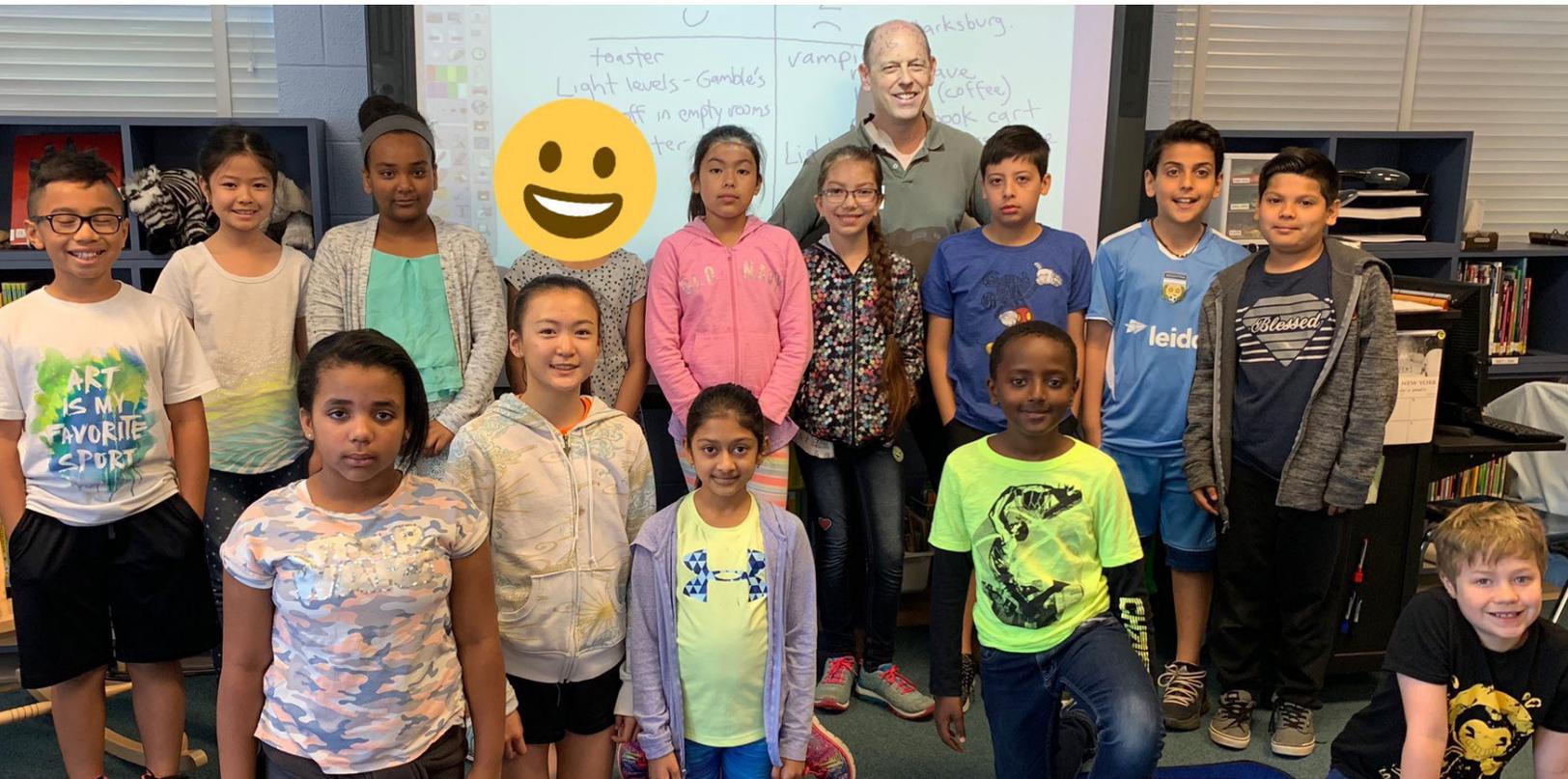
## Workshop Calendar

Program Location	Workshop 1	Workshop 2	Workshop 3
<b>Washington, D.C. Schools</b>	<b>October 24</b> Clyde's Gallery Place	<b>November 19</b> Pepco Edison Place Gallery	<b>December 17</b> Pepco Edison Place Gallery
<b>Prince George's County Schools</b>	<b>October 19</b> Comfort Inn & Suites Bowie	<b>February 8</b> Comfort Inn & Suites Bowie	<b>April 25</b> Comfort Inn & Suites Bowie
<b>Montgomery County Public Schools</b>	<b>November 9</b> Lathrop E Smith Center Rockville	<b>February 1</b> Lathrop E Smith Center Rockville	<b>April 18</b> Lathrop E Smith Center Rockville

# SAMPLE ESP PACING GUIDE

<b>Day 1</b> <b>Unit Introduction</b> <b>Pre-test /poll</b> <ul style="list-style-type: none"> <li>Preview : unit goals &amp; STEM project</li> <li><i>Energy Conservation Contract</i></li> </ul>	<b>Day 2</b> <b>The Science of Energy - Introduction</b> <ul style="list-style-type: none"> <li>Teacher Demo</li> <li>Intro to forms of energy &amp; energy transformations</li> <li>Discuss schedule</li> </ul>	<b>Day 3</b> <b>The Science of Energy - Station Investigations</b> <ul style="list-style-type: none"> <li>Station explorations</li> <li>Read to understand</li> </ul>	<b>Day 4</b> <b>The Science of Energy - Station Investigations</b> <ul style="list-style-type: none"> <li>Prepare presentations</li> <li>Students present stations to peers</li> </ul>	<b>Day 5</b> <b>The Science of Energy - Station Investigations</b> <ul style="list-style-type: none"> <li>Students present stations to their peers</li> </ul>
<b>Day 6</b> <b>Forms and Sources of Energy</b> <ul style="list-style-type: none"> <li>Review stations</li> <li><i>Forms and Sources of Energy</i></li> <li><i>Science Of Electricity Demonstration</i></li> </ul>	<b>Day 7</b> <b>Electricity Generation Model Engineering and Design</b> <ul style="list-style-type: none"> <li>Students redesign and/ or prepare models of generators</li> </ul>	<b>Day 8</b> <b>Energy Sources Activities</b> <ul style="list-style-type: none"> <li>Energy Roundup</li> <li>Renewables and nonrenewables</li> <li>Kit-based activities</li> </ul>	<b>Day 9</b> <b>Energy Sources Activities</b> <ul style="list-style-type: none"> <li>Renewables and nonrenewables</li> <li>Kit-based activities</li> </ul>	<b>Day 10</b> <b>Energy Sources Activities</b> <ul style="list-style-type: none"> <li>Renewables and nonrenewables</li> <li>Kit-based activities</li> </ul>
<b>Day 11</b> <b>Energy Sources Activities</b> <ul style="list-style-type: none"> <li>Renewables and nonrenewables</li> <li>Kit-based activities</li> </ul>	<b>Day 12</b> <b>Energy Sources Activities</b> <ul style="list-style-type: none"> <li>Renewables and nonrenewables</li> <li>Kit-based activities</li> </ul>	<b>Day 13</b> <b>Energy Sources Activities</b> <ul style="list-style-type: none"> <li>Renewables and nonrenewables</li> <li>Kit-based activities</li> </ul>	<b>Day 14</b> <b>Energy Sources Activities</b> <ul style="list-style-type: none"> <li>Renewables and nonrenewables</li> <li>Kit-based activities</li> </ul>	<b>Day 15</b> <b>Energy Sources Activities</b> <ul style="list-style-type: none"> <li>Renewables and nonrenewables</li> <li>Kit-based activities</li> </ul>
<b>Day 16</b> <b>Introduction to Saving Energy</b> <ul style="list-style-type: none"> <li>Students read to gain background knowledge about energy consumption</li> </ul>	<b>Day 17</b> <b>Introduction to Using Energy Efficiency and Conservation Tools</b> <ul style="list-style-type: none"> <li>Students learn how to use tools</li> </ul>	<b>Day 18</b> <b>School Building Survey</b> <ul style="list-style-type: none"> <li>Students analyze their school's energy systems</li> </ul>	<b>Day 19</b> <b>Saving Energy at School</b> <ul style="list-style-type: none"> <li>Survey reflection</li> <li>Brainstorm possible changes</li> <li>Students brainstorm ideas for STEM projects</li> </ul>	<b>Day 20</b> <b>Planning Day</b> <ul style="list-style-type: none"> <li>Students begin organizing ideas for their STEM projects</li> <li>Plan for Energy Fair</li> </ul>
<b>Day 21</b> <b>Saving Energy at Home</b> <ul style="list-style-type: none"> <li>Explore home applications of building survey</li> <li>Begin Energy House</li> </ul>	<b>Day 22</b> <b>Saving Energy at Home</b> <ul style="list-style-type: none"> <li>Revisit <i>Energy Conservation Contract</i></li> <li>Energy House</li> </ul>	<b>Day 23</b> <b>Why is saving energy important?</b> <ul style="list-style-type: none"> <li>Climate activities</li> </ul>	<b>Day 24</b> <b>Review and Wrap-up</b> <ul style="list-style-type: none"> <li><i>Energy in the Round</i></li> <li><i>Energy Web</i></li> </ul>	<b>Day 25</b> <b>Review and Wrap-up</b> <ul style="list-style-type: none"> <li>Post-test/poll</li> <li><i>Energy Carnival</i></li> </ul>
<b>Day 26</b>	<b>Day 27</b>	<b>Day 28</b>	<b>Day 29</b>	<b>Day 30</b>
<hr style="border: 1px solid blue;"/> <b>Wrapping up STEM Projects &amp; Energy Fair Activities</b> <hr style="border: 1px solid blue;"/>				

- The planning sequence on the previous page for your Energizing Student Potential Unit provides a sample sequence to use. Due to the time frame of this project, lessons are expedited. You may wish to delve deeper into these topics and investigations and allow more time for planning and executing your STEM project and Energy Fair, should time allow. Time for the Educational Energy Audits and other school activities have not been included.
- If you wish you can plan your own sequence on page 11, based on your familiarity with the topic, or your time constraints. It is suggested you thoroughly review materials before planning.
  - Essential elements of the unit include: pre/post tests, *Science of Energy*, renewable and nonrenewable sources, and efficiency and conservation activities.
  - Include time in your sequencing for the Educational Energy Audit of the school.
- All NEED materials have been aligned to relevant national and state standards. Download standards correlation spreadsheets and information at [www.need.org/curriculumcorrelations](http://www.need.org/curriculumcorrelations)



# MY ESP PLANNING GUIDE

Day 1	Day 2	Day 3	Day 4	Day 5
Day 6	Day 7	Day 8	Day 9	Day 10
Day 11	Day 12	Day 13	Day 14	Day 15
Day 16	Day 17	Day 18	Day 19	Day 20
Day 21	Day 22	Day 23	Day 24	Day 25
Day 26	Day 27	Day 28	Day 29	Day 30
<b>Wrapping up STEM Projects &amp; Energy Fair Activities</b>				

# ESP RECOMMENDED PACING LESSON GUIDE

## Day 1: Unit Introduction

### Activity

Introduce students to energy and the goals of the unit through a pre-test and a contract.

### Objective

- Students will commit to saving energy at home and school, by creating their own pledge.

### Materials

- *Energy Conservation Contract*
- NEED Energy Polls ([www.need.org/evaluation](http://www.need.org/evaluation))

### Procedure

- Direct students to assess their knowledge of energy prior to the unit, by taking the NEED *Energy Poll* as a pre-test. Discuss with them that they will be learning about energy – everything from the science of energy, to how we use energy, to how we should save energy.
- Preview the unit with students and what their desired outcomes should be. Tell them they will be working together as a group to create a community outreach project to share with others what they have learned.
- Assign the *Energy Conservation Contract* activities to students and ask them to pledge with their families to make a commitment to saving energy over the next 30 days. They will revisit their ratings and pledges at the close of the unit. ***\*\*It may be helpful to assign the survey portions of the activity to students as home activity, prior to this Session. If you choose to do this, you can help students determine their conservation ratings in a group and devise a pledge for their family.***



## Day 2: The Science of Energy - Introduction

### Activity

Introduce students to the science of energy through demonstrations and discussions.

### Objectives

- Students will identify and describe the forms of energy and examples of each.
- Students will be able to identify basic transformations of energy between forms.

### Materials

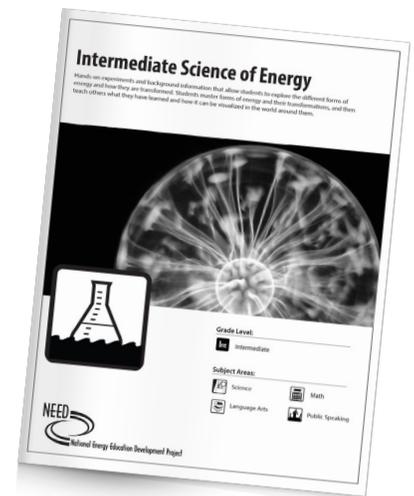
- Teacher Demonstration (Science of Energy Kit)

### Suggested Handouts

- *Forms of Energy, Energy Transformations (Intermediate Science of Energy)*

### Procedure

- Perform the teacher demonstration from the Science of Energy Kit. While students are shaking the jars of sand, go over potential and kinetic energy and their respective forms. Have students give other examples of each form of energy, other than those listed on the handout. Once the forms have been introduced, revisit the jars of sand from the demonstration and discuss. Ask students why there was a temperature change. (*Motion energy was transferred into thermal energy as the sand was shaken – friction created thermal energy.*)
- Outline the Law of Conservation of Energy using the Energy Transformations handout. Discuss that, no matter what, energy is never destroyed – it simply changes form, and most energy transformations begin with the sun. Encourage students to think of other simple energy transformations and draw them out.
- Outline the schedule for completing the *Science of Energy* stations, and put students into groups.



## Day 3-5: The Science of Energy - Station Investigations

### Activity

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Students investigate stations and use inquiry process skills to learn about energy transformations within various systems. Each station will take approximately 20-30 minutes.

### Objective

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- Students will understand that energy does not disappear, but changes from one form to another.

### Materials

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- *Science of Energy* Kit and additional materials listed within guide

### Procedure

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- Organize students into groups. Each group should be assigned a station, 1-6. Set up stations ahead of time with copies of handouts and all supplies for students. Students will investigate the station with their group. Students should record the question and then answer as appropriate in their notebook or on the handout you have copied. Offer as open an experience as your students can handle. As students investigate they should keep track of all relevant data and observations, surprises, real-world connections, and thoughts in their science notebooks.
- After each investigation the group should reflect on what they observed by answering the questions, "What happened at the station? What energy transformations did you observe?" These questions should be provided to students so that they can refer back to them as they write their conclusions. Students should be encouraged to use evidence to support their thinking. They should read "What Was Happening?" and reflect with their group to confirm their thinking or change their misconceptions.
- The group will then prepare to present their station and the involved transformations to other groups using the planning guide. Once groups have prepared their presentation, divide each group in half. During round one of presentations, half of the group will stay put and present. The other half will rotate to other stations. Once all students have rotated and presented in round one, the groups should switch roles.

## Day 6: Forms and Sources of Energy

### Activity

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Make connections between the various forms of energy and the related sources that allow us to harness their energy through a transformation or series of transformations.

### Objectives

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- Students will identify the ten sources of energy and the forms of energy stored or delivered by each source.
- Students will also be able to differentiate between renewable and nonrenewable resources.
- Finally, students should be able to list the chief sources of energy the United States consumes for energy and how the energy is harnessed.

### Materials

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- Assembled *Science of Electricity* demonstration model (*Energy of Moving Water Teacher Guide*)

### Suggested Handouts

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- *Forms and Sources of Energy* (*Intermediate Science of Energy*)

### Procedure

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- Begin by reviewing the station investigations and all of the energy transformations students witnessed. Explain to students that energy transformations are what allow us to turn energy into something useful. Motion can be transformed into electrical energy. Chemical energy can be transformed into motion energy. In the United States we use a variety of sources to power our lives. Each of those sources relies on a transformation of energy. Have students complete the *Forms and Sources of Energy* worksheet and discuss. What do students notice about the sources of energy we use for most of our energy?

- Ask students where they think electricity comes from? Ask them to explain how electricity is created. Many students may be unable to do so. Show the class the *Science of Electricity* model. Ask students to describe what they see and diagram it. Explain to students that many of the sources are used to turn larger turbines like this one in order to generate electricity or energy. Although the turbine generator is much larger in a power plant, they contain the same simple items – magnets and coils of wire. Ask students to discuss with their partners how they think each of the ten sources is used to generate electricity. For homework, have students come up with alternative design strategies to improve the output of the demonstration model.

## Day 7: Electricity Generation Model Engineering and Design

### Activity

Students will design generators or redesign the *Science of Electricity* model from the previous demonstration to optimize, increasing electrical output and/or reducing materials.

### Objectives

- Students will be able to identify the materials used in a generator and explain how they work to generate electricity.

### Materials

- Assembled *Science of Electricity* demonstration model (*Energy from Uranium*)

### Procedure

- Give students time to work in groups and design or redesign the generator model, explaining how they would improve upon the design and how it would work. If time and materials allow, give groups the opportunity to test, improve, and re-test their designs.

## Day 8-15: Energy Sources Activities

Teachers will select a renewable or nonrenewable energy unit to use with their students.

*\*Each kit is individually designed as a one-two week unit. Teachers are encouraged to examine each kit and activities carefully and choose which lessons will best meet their objectives and the students' needs. Teachers can also use this time to explore nonrenewable sources of energy through various activities or whole units.*

### Activity

Students will investigate energy from various sources.

### Objectives

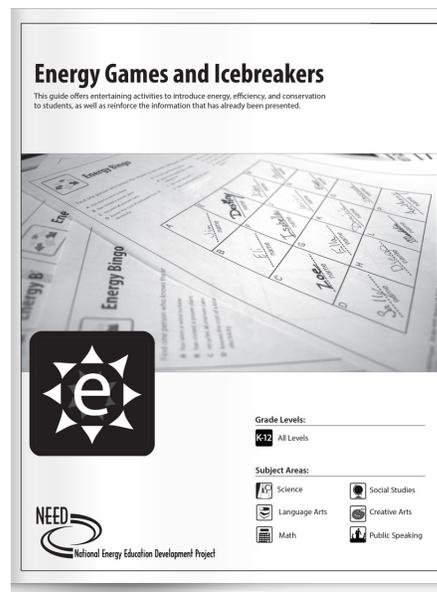
- Students will understand how renewable and nonrenewable resources are being used to generate energy and, more specifically, electricity.

### Materials

- Solar, wind, or oil and natural gas kits
- materials for nonrenewable activities
- copies of activities for students
- *Energy Roundup* supplies (*Energy Games and Icebreakers*)

### Procedure

- Examine the kits you received and the list of suggested resources below.
- Choose the activities you wish to explore with students.
- Gather materials and make copies or project the activities you choose to explore.
- Open the mini-unit on sources of energy by playing the game *Energy Roundup* with the class.



# SUGGESTED RESOURCES NONRENEWABLE AND RENEWABLE SOURCES OF ENERGY

Sources of Energy	NEED Resources	Activity Suggestions
Oil and Natural Gas	<i>Exploring Oil and Natural Gas</i> <i>Fossil Fuels to Products</i> <i>Energy Expos</i>	<ul style="list-style-type: none"> <li>• Exploring Porosity</li> <li>• Exploring Core Sampling</li> <li>• Perforated Well Casing</li> <li>• Career Networking Template</li> <li>• Oil and Gas Industry or Natural Gas in the Round</li> <li>• Natural Gas Production to Market</li> </ul>
Nuclear (non-kit-based)	<i>Energy from Uranium</i>	<ul style="list-style-type: none"> <li>• Atomic Mass Model</li> <li>• Isotopes activities</li> <li>• Candy decay activities</li> <li>• Nuclear Power Plant Simulation</li> </ul>
Coal (non-kit-based)	<i>Understanding Coal</i>	<ul style="list-style-type: none"> <li>• Coal Mining Match</li> <li>• Mining Challenge</li> <li>• A Cool Coal Story</li> <li>• Baseload Balance</li> </ul>
Biomass/Waste-to-Energy Facilities (non-kit based)	<i>Museum of Solid Waste and Energy</i>	<ul style="list-style-type: none"> <li>• Museum Set-up</li> </ul>
Solar (kit-based)	<i>Energy from the Sun</i>	<ul style="list-style-type: none"> <li>• Radiation Cans</li> <li>• Solar Concentration</li> <li>• Temperature and UV Beads</li> <li>• Solar Oven Challenge</li> <li>• Solar House</li> </ul>
Wind (kit-based)	<i>Energy from the Wind</i>	<ul style="list-style-type: none"> <li>• Measuring Wind Speed</li> <li>• Wind Can Do Work</li> <li>• Wind Blade Investigation</li> </ul>

**NOTE:** NEED's Energy Infobooks (at any level) are also good resources for basic information on all of the sources of energy.



## Day 16: Introduction to Saving Energy

### Activity

Students are introduced to energy consumption, conservation, and efficiency. After brainstorming ways they use energy, students read more information to gain a foundation before conducting energy audits.

### Objective

- Students will be able to list how energy is used at home and school.

### Materials

- *School Energy Inspectors, Experts, or Managers* Teacher and Student Guides

### Reading

Student Informational Text (Student Guide)

### Science Notebooks

Students should list ways that they use energy in the classroom and at home as they read. Optional: Make copies of the graphic organizers in the Student Guides, and have students record their notes on the organizers.

### Procedure

- Students can complete the reading individually or as a jigsaw. Make sure to discuss and highlight main ideas and supporting details that students picked out from their reading.

**School Energy Experts**  
**Teacher Guide**

Hands-on activities that introduce students to the ways in which we use energy in school buildings. The school becomes a living laboratory as students explore thermal energy transfer, electricity, lighting, and even conduct their own building audit.



**Grade Level:**  
Int Intermediate

**Subject Areas:**  
Science Social Studies  
Language Arts Math  
Technology

**NEED**  
National Energy Education Development Project

**NEW!**

## Day 17: Introduction to Energy Efficiency and Conservation Tools

### Activity

Students learn how to use various energy management tools. Once they have read the directions, students should be allowed to gather informal data around the classroom and/or building.

### Objective

- Students will understand how to operate tools and measure to collect data about energy usage.

### Materials

- Tools from the Energy Efficiency and Conservation Kits

### Suggested Handouts

*School Audit Form*

### Science Notebooks

Students draw a diagram of the tool they've been assigned and explain how it works, recording sample data as they go.

### Procedure

- Break students into groups to learn various monitoring tools/conduct investigations. Below is the break-down to have eleven small groups. If you would like larger groups you can combine or take out activities to meet your needs. Students should practice using the instruments and record data.

## Day 18: School Building Survey

### Activity

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Students conduct a *School Building Survey* to further understand how their school uses energy.

### Objective

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- Students will be able to identify how their school uses energy and list ways it could save energy.

### Materials

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- Energy Efficiency and Conservation guides and kit

### Science Notebooks

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Students should keep notes about their survey and observations in their notebooks.

### Suggested Handouts

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*School Building Survey*, or *Energy at School* (depending on the grade level and guide used)

### Procedure

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- Break students up into groups that will focus on each section of the survey or *School Building Survey (School Energy Experts Student Guide)*. Have the groups research the answers either by physically looking at the system in question, or by talking to your school or district building manager. You may want to invite that person in to talk to your students, or ask if your students can email him/her with questions they cannot answer.

## Day 19: Saving Energy at School

### Activity

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Students share how their efficiency and conservation tools work. They also share the results of their investigations and surveys.

### Objectives

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- Students will analyze and interpret their survey data.
- Students will be able to identify energy saving measures and behaviors.

### Materials

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- Energy Efficiency and Conservation guides and Kit

### Science Notebooks

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Students should brainstorm changes that could be made, and the part they can play in making the changes happen.

### Suggested Handouts

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Survey data from previous activity and *Findings and Recommendations* or *Building Buddy Energy Plan*

### Procedure

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- Break students up into groups so that each group has a member who surveyed a different part of the building. Students should analyze their data from each investigation and fill in the remainder of their survey sheets from the other group members. As a group they should brainstorm energy saving solutions for each part of the building, based on the group's data. They can record their findings on the *Findings and Recommendations* handout.

## Day 20- Planning Day

### Activity

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Students design and implement a STEM challenge project that will share their new found energy knowledge with some component of the community.

### Objective

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- Students will be challenged to participate in/create a project that showcases what students have learned and incorporates science, technology, engineering, and mathematics principles to demonstrate an energy concept and how energy functions in a system. Students will identify ways that they can help inform the public and inspire changes to be made. Students will be able to identify and explain energy saving measures and behaviors for the school and home.

### Materials

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- Materials may vary, based on student ideas

### Science Notebooks

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Students should begin to brainstorm plans and sketch ideas.

### Suggested Handouts

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*STEM Project* worksheets (Program Guide, pages 26-29)

### Procedure

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- Discuss the project parameters with students and what they have learned about so far. Begin to brainstorm and plan ideas as a class or in groups.

## Day 21-23: Saving Energy at Home and Why is Saving Energy Important?

### Activity

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By analyzing their own living and work spaces, students apply what they have learned to making energy changes in their personal lives at home, and at school. Students will then think about how their energy - related actions relate to the climate.

### Objective

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- To identify how their actions affect energy consumption at home and school. Students will be able to identify energy saving measures and behaviors for the home and school.
- Students will be able to describe how using energy can contribute to change in climate.

### Materials

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- *Energy Conservation Contract*
- *Understanding Climate Change*
- *Energy House*

### Science Notebooks

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Students should use their notebooks to reflect on what they have learned about saving energy in the classroom and apply it to the home environment. Students should also relate their energy use to stewardship for the environment and describe why saving energy is beneficial for our environment and climate.

### Procedure

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- Students will be applying what they have learned so far to their home environment. Students are encouraged to involve their families in these activities! Students should revisit their *Energy Conservation Contract* activity from Day 1. They should rate their homes again and evaluate their pledge to decide if they should revise or add to their current energy saving behaviors. Students can build an energy efficient house and test its efficiency using *Energy House*. Save your Energy Houses for your Energy Fair as a display item! Teachers are also encouraged to visit NEED titles like *Saving Energy at Home and School* for more examples of at-home application activities.

- Choose climate activities you wish to explore with students, gather materials, and/or make copies. Good activity options include *Climate Web Game*, and *Carbon in my Life*.

## Day 24-25: Review and Wrap-up

### Activity

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Students review what they've learned and revisit their commitments to being energy savers.

### Objectives

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- Students will identify and describe the forms of energy and examples of each.
- Students will explain how renewable and nonrenewable resources are being used to generate energy and power our lives.
- Students will be able to identify and explain energy saving measures and behaviors for the school and home.

### Materials

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- Materials will vary based on the activities selected.

### Procedure

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- Use this time to review with your students and tie all the pieces together. Students should also revisit their *Energy Conservation Contract* activity from Day 1. They should rate their homes again and evaluate their pledge to decide if they should revise or add to their current energy saving behaviors. This is also an excellent time for evaluation of student knowledge. This can be done in many ways. A few suggested activities to use that are all-encompassing and fun include: *Energy in the Round* and *Energy Web* (both are found in *Energy Games and Icebreakers*), as well as *Energy Carnival*. See the list of recommended extensions for other classroom activities to use, should you have more time for your unit, or need extra activities. Use the review activities as extra games in your energy fair!

## Day 26-30: STEM Projects & Planning your Energy Fair

### Activity

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Students work together to outline and organize their STEM project and community event.

### Objectives

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- Students will be challenged to participate in/create a project that showcases what students have learned and incorporates science, technology, engineering, and mathematics principles to demonstrate an energy concept and how energy functions in a system.
- Students will identify ways that they can help inform the public and inspire changes to be made.
- Students will be able to identify and explain energy saving measures and behaviors for the school and home.

### Materials

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- Materials may vary, based on student ideas. Be sure to make use of your NEED kits as student exhibits.

### Suggested Handouts

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*STEM Project* worksheets (Program Guide, pages 27-29)

### Procedure

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- Use this time to plan and prepare your event and project with your students. Review your plans from previous activities and planning time, and adapt where necessary. Sample rubrics are provided on pages 30-31 of this Program Guide to use for assessing student knowledge, application, and project goals.
- Prepare a final project for submission. Project guidelines are found on page 24.

## RECOMMENDED EXTENSION AND CULMINATING ACTIVITIES

- **Energy Carnival** (grades 3-8) – Students play or lead fun and exciting carnival style games to reinforce or review content or teach others.
- **Energy Expos** (grades 4-12) – Students work in groups to develop exhibits and make presentations on sources and conservation.
- **Energy Flows** (grades 5-12) – Students learn about the forms of energy, how energy is converted from one form to another, and how energy flows through systems, by creating their own energy flows.
- **Infobook Activities** (grades K-12) – These guides at each level serve as a companion to the Energy Infobooks, and contain reinforcement activities about the forms and sources of energy.
- **Great Energy Debate** (grades 6-12) – Students evaluate the advantages and disadvantages of the major sources of energy in a debate format.
- **U.S. Energy Geography** (grades 4-12) – These maps of the United States cover each of the sources of energy and work well to reinforce social studies in the science classroom.
- **Energy Stories and More** (grades K-5) – A series of stories and activities to introduce and reinforce concepts of energy.
- **Current Energy Affair** (grades 6-12) – Students create television news broadcasts to report on the major areas of electric power generation.
- **Mission Possible** (grades 9-12) – Students are challenged to develop an energy plan for a growing country. This math-based activity incorporates spreadsheets and teaches students to consider the environmental and economical costs and benefits associated with producing electricity today.
- **Global Trading Game** (grades 5-12) – Students become economic advisors, geologists, and miners, as they learn about their assigned country's resources and needs, then trade resources with other countries.
- **Energy Enigma** (grades 7-12) – Student teams research clues to uncover energy facts about different sources, while trying to hide the identity of their own source. Teams use brainstorming, organizational, and analytical skills to play.
- **Understanding Climate Change/Exploring Climate Change** (grades 6-12) – Students will understand why we use the sources we do and how their use is impacting the world.
- **Energy Math Challenge** (grades 3-12) – Strengthen your students' math and critical thinking skills while also reinforcing their knowledge of energy.
- **Energy Live!** (grades 4-12) – Students form rock bands and write songs to perform about energy sources, electricity, and efficiency and conservation.
- **Energy Jeopardy** (grades 4-12) – What is FUN, Alex? Students review energy topics through team play in an online or paper format.



# 2019 - 2020 FINAL PROJECT GUIDELINES

**Due Date: June 1, 2020**

The ESP Final Project is a chance for you to show us all the great work your student have done throughout the school year.

## Format

Choose to submit a PDF project OR a video project, OR both!

### PDF Project Directions

Create a slideshow presentation using power point or similar presentation software. Keep in mind that things like slide transitions, music or narration will not transfer to a PDF. If you want to use these features, consider submitting a video project.

#### Include

- 10-20 slides
- School name on the first slide
- Short descriptions of all the ESP activities you did during the school year.
- Photos of the ESP activities you did during the school year.
- When saving your file, use your school name as your filename.
- Projects may be shared publicly, so make sure you have any photo releases required by your school.

Save your project as a PDF. **DO NOT submit .ppt, .jpeg, Google Slides, or other alternative formats.**

### Video Project Directions

Create a video using video production software of your choice. (iMovie, Final Cut, Premiere Elements, Movie Maker, etc.)

#### Include

- Keep your video length under 3 minutes!
- School name at the beginning of your video.
- Either text or narration to explain what is happening in your video.
- Photos and videos of all the ESP activities you did during the school year.
- Projects may be shared publicly, so make sure you have any photo releases required by your school.

Upload your completed video to YouTube. Make sure your video is set to Public or Unlisted. **DO NOT** include links to google drives, vimeo, etc.

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## Submit

1. Go to <https://app.wizehive.com/appform/login/ESPDCMD2019>
2. Log in to your account.
3. Choose Project Submission
4. Answer the following questions
  - a. Number of people who attended your Energy Fair (or estimate anticipated attendance)
  - b. Total number of students involved in your project (creating or learning from it)
  - c. Number of hours spent in/out of class on ESP activities (Estimate total student hours. Example: 200 students x 10 hours = 2,000 total hours. Just list the total number of hours. No need to include your math)
5. Upload the PDF of your project.
6. Provide the link to your YouTube video.
  - a. Only include YouTube video links. DO NOT include links to google drives, vimeo, etc.
  - b. Be sure that your YouTube video is listed as PUBLIC or UNLISTED so that we can watch it, share it with the sponsors.

### Youth Awards (optional)

Consider submitting your ESP project to NEED's Youth Awards competition! There are just a few differences between a Youth Awards project and an ESP project.

For all the details on Youth Awards projects visit [www.need.org/youth-awards](http://www.need.org/youth-awards)

### Differences between Youth Awards projects and ESP projects

- Youth Awards projects are due April 15th.
- Youth Awards projects MUST include a PDF. A video is optional.
- Youth Awards projects are limited to 15 total slides.
- Youth Awards projects are judged against a rubric that looks at Goals, Process, Student Leadership, Evaluation and more. Check out the rubric in the link listed above.

If you follow the Youth Awards requirements, your project will also meet the ESP requirements!

Questions? E-mail Bekki at [rlamb@need.org](mailto:rlamb@need.org)

# SCIENCE NOTEBOOKS

Science notebooks are places for students to record their thinking. Throughout the unit, and in many NEED materials, you will see that students are encouraged to record their thoughts, observations, data, and conclusions in a notebook format. If you currently use science notebooks or journals, you may have your students continue using them.

There are many different looks to science notebooks, ways to use them, and ways to assess them. You may choose to have your students use more of a hybrid model, where they incorporate or tape worksheets into their notebooks for certain activities, and for others they use their own design. Over the course of this unit pages may get ripped, folded, or spilled on, and this is okay - it is a sign of a real scientist at work!

Below is a general rubric you can use to assess students' work in their science notebooks, or as a basis to design a rubric to meet your specific needs.

	<b>Understanding of Concepts</b>	<b>Scientific Inquiry</b>	<b>Presentation</b>
<b>4</b>	Students demonstrate thorough understanding of concepts through pictures, writing, and verbal communication.	Students are able to follow all steps of the scientific process independently: predict/hypothesize, observe/record data, and draw more complex conclusions related to their data. Students show higher level thinking by asking pertinent questions.	Handwriting is legible. Pictures are realistic and include labels. All parts of the assignment are complete.
<b>3</b>	Students demonstrate sound understanding of concepts through pictures, writing and/or verbal communication.	Students are able to predict/hypothesize, observe/record data, and draw a basic conclusion with some teacher support. Students begin to ask their own questions. May include some teacher support.	Handwriting is legible. Pictures are realistic and have labels for some items. All parts of the assignment are complete.
<b>2</b>	Students demonstrate a basic understanding of concepts, fewer major misconceptions remain.	Students require teacher support and/or are able to do two of the following independently: predict/hypothesize, observe/record data, and draw conclusions. Students need prompting to think of their own questions.	Words and/or pictures may be hard to decipher at times. Pictures are present but are missing labels. The notebook has some missing components.
<b>1</b>	Students demonstrate confusion about concepts. Many misconceptions remain.	Students do not follow the scientific process independently and require significant support to do the following: predict/hypothesize, observe/record data, and draw conclusions. Students are uncomfortable asking questions.	Words and/or pictures are hard to decipher. They may not be connected to the investigation. The notebook has many missing components.





# STEM PROJECT ASSIGNMENT SAMPLES

## Assignment

Create a project that will challenge students to explore an energy concept in-depth. Student work should help others learn about energy, analyze energy consumption, and inspire positive change using the materials and content you have covered in your unit. Students should document their work and will work together create and submit a project to showcase their participation and results, as well as how they shared their individual work with others.

## Challenge Examples

### • Energy Efficiency Blackout

- Students learn about energy efficiency and conservation
- Use Monitoring and Mentoring kit tools and spreadsheets to establish a baseline energy consumption for a series of identical weekdays and determine an average consumption for that day of the week
- Conduct a blackout (or several), on the selected weekday, school-wide
- Design and implement an energy savings plan for other days of the week
- Measure savings during blackouts and from energy savings plan measures
- Present findings at a community event

### • Energy House Design

- Students learn about sources of energy and energy efficiency and conservation
- Design and create models of energy efficient homes that employ new knowledge and showcase energy sources working as a system in a comfortable home (solar, wind, geothermal, natural gas, efficient technologies)
- Showcase models at a community event

### • Wind Turbine Challenge

- Students learn about wind energy and turbines
- Design and create the best turbine blades
- Test/showcase their blades at a community event, determine whose blades generate the most electricity

### • Electricity Generation Design Challenge

- Students learn about energy, energy transformations, and electricity generation
- Students design and build the best generator model using a set of materials
- Students design and build the best accessory to generate electricity from another source (attach generator to a student created turbine)
- Test/showcase their designs at a community event, determine whose model generates more electricity

### • The Natural Gas Challenge

- Students will learn about oil and natural gas and create a plan or design a model, using one or all of the following guidelines:
  - Students will design a plan for exploring and producing natural gas, including understanding natural gas development and the use of technologies to explore and produce natural gas
  - Students will consider the challenge of developing natural gas in populated areas and from small drilling pad sites
  - Students will consider the geology of the region and design ways to produce natural gas from the local geology
  - Students will follow the molecule and design ways to be most efficient with natural gas throughout the entire process – from exploration to local delivery to usage at home
- Showcase their work at a local event

# STEM PROJECT BRAINSTORM PAGE



**Group Members:**

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**STEM Challenge Concept:** \_\_\_\_\_

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**The idea we like best and why:** \_\_\_\_\_

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**What will we need to create our project?**

**What is our plan?**

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**Teacher Signature for Idea Approval:** \_\_\_\_\_



## SAMPLE STEM PROJECT RUBRIC

	Research and Planning	Design and Construction	Evaluation and Team Work	Application of Energy Concept(s)
4	Evidence of thorough research exists in addition to the completion of experimental trials to test design ideas.	In addition to meeting project goals, construction was neat and of high quality, showing evidence of innovation.	Team effectively evaluated all aspects of the design process and worked together to problem solve and make improvements to improve their design.	Project successfully applies many energy concepts.
3	Several research questions were asked and answered effectively, with some evidence of research and planning.	Most or all project goals were met and design is functional. Quality of construction shows.	Team evaluated their design together, but improvements or enhancements to their process and design were modest or not present.	Project applies more than one energy concept successfully.
2	Minimal evidence that research or planning was undertaken or considered.	Some project goals were met, but design is not fully functional or construction is flawed.	Minimal evaluation and team work was evident and led to no improvement in design.	Project applies just one energy concept successfully.
1	No evidence of research or planning that lead to design and construction.	Many of project goals were not met. Construction is sloppy and the design does not meet the needs of the challenge.	Team did not evaluate their project or work/and or did not make any improvements to their design.	Project does not show evidence of application of content.

# SAMPLE COMMUNITY ENERGY FAIR/EVENT RUBRIC

	<b>Understanding of Energy</b>	<b>Understanding of Efficiency and Conservation</b>	<b>Application of Learning</b>	<b>Project Effectiveness</b>	<b>Student Leadership in Activities</b>
<b>4</b>	Students communicate an awareness of a variety of ways that energy is generated and consumed.	Students clearly showcase a wide variety of efficiency and conservation tactics.	Students demonstrate understanding that they affect energy systems in their daily choices.	Students' project helps others analyze their energy usage and encourages ways to bring about meaningful change.	It is evident that students took ownership of planning goals, carrying out activities, involving the community, and reporting of their work.
<b>3</b>	Students communicate awareness of 3-4 ways that energy is generated and consumed.	Students identify/ demonstrate 3-4 efficiency and conservation tactics.	Students demonstrate understanding that they use energy.	Students' project helps people become aware of their energy usage.	Student leadership is evident in most of the project
<b>2</b>	Students communicate awareness of 1-2 ways energy is generated and consumed.	Students identify/ demonstrate 1-2 efficiency and conservation tactics.	Students demonstrate some understanding that they affect energy systems.	Students' project informs people about energy.	Student leadership is evident in a part of the project.
<b>1</b>	Students are unable to communicate how energy is generated and or consumed.	Students are unable to demonstrate or identify methods for reducing consumption.	Students are unclear that their actions affect energy systems.	Students' project is unclear or confusing as to how it relates to energy and/or energy conservation.	Project is unable to show student leadership and student work to achieve goals.



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# ESP

energizing student potential

Exelon Foundation.

