



Exelon Foundation.



ENERGIZING STUDENT POTENTIAL

PROGRAM GUIDE

2018-2019

WWW.NEED.ORG/ESPILIN



A NOTE FROM THE ENERGIZING STUDENT POTENTIAL SPONSORS...

The Exelon Foundation, ComEd, Nicor Gas, Peoples Gas, North Shore Gas, and BP America, in partnership with the National Energy Education Development (NEED) Project, are pleased to welcome teachers to **Energizing Student Potential**, a STEM-focused energy program for grades 5 - 8 in their respective customer regions in Illinois and Indiana. This program brings together Illinois and Indiana standards-based curriculum for use in the classroom or in 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 designed to help educators bring energy into the classroom 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.

This program, in its fourth year, will accept up to **40 new** schools. Each new school will be provided with the following:

- An opportunity to apply for a grant to be used to support the STEM classroom activities
- \$2,000 of hands-on kits and curriculum
- An Energizing Student Potential Energy Fair Kit to host an Energy Fair and Carnival at your school
- Access to Educational Energy Audits (optional)
- Two-Day Professional Development for a team of 2 teachers per school, and a one-day, mid-year refresher workshop
- Connections to STEM professionals to help students see all the possibilities of STEM and Energy Careers

ESP will also accept up to **80 renewing** schools. Each renewing school will be provided with the following:

- An opportunity to apply for a grant to be used to support STEM classroom activities and the Energy Fair
- Replenishment of consumable materials and equipment from previous ESP kits
- Replenishment of Energy Fair Kit
- Access to Educational Energy Audits (optional)
- Two days of Professional Development for the school's ESP team, plus special opportunities for schools involved in 3+ years of ESP
- Connections to STEM professionals to help students see all the possibilities of STEM and Energy Careers

Teachers and students engage in science, technology, engineering and mathematics activities in the 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!

TABLE OF CONTENTS

The Partners	4
The Program Team	6
Program Overview	7
Overview of Resources Provided	8-9
Educational Energy Audits	9
2018-2019 Detailed Program Timeline	10
Program Planning and Pacing Guide	11-13
Lesson Guide	14-24
Sources Activities	14-17
Saving Energy Activities	18-21
STEM Project	21
Recommended Extension Activities	22
Resources from the Partners	23
Student Pages	
STEM Project Assignment Samples	26
STEM Project Brainstorm Page	27
STEM Project Planning Page	28
Evaluation and Assessment Pages	
Science Notebook Rubric and Checklist	24-25
Sample STEM Project and Community Event Rubrics	29-30

CONTACT INFORMATION FOR QUESTIONS OR ASSISTANCE:

The NEED Project

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

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 Educational Energy Audits, Energy Fair, and Evaluation questions:

Kimberly Swan, Program Associate 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



THE PARTNERS

The Exelon Foundation **About Exelon Corporation**

Exelon Corporation (NYSE: EXC) is the nation's leading competitive energy provider, with 2014 revenues of approximately \$27.4 billion. Headquartered in Chicago, Exelon does business in 48 states, the District of Columbia and Canada. Exelon is one of the largest competitive U.S. power generators, with approximately 32,000 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 2.5 million residential, public sector and business customers, including more than two-thirds of the Fortune 100. Exelon's utilities deliver electricity and natural gas to more than 7.8 million customers in central Maryland (BGE), northern Illinois (ComEd) and southeastern Pennsylvania (PECO). Follow Exelon on Twitter @Exelon.

About ComEd

Commonwealth Edison Company (ComEd) is a unit of Chicago-based Exelon Corporation (NYSE: EXC), the nation's leading competitive energy provider, with approximately 7.8 million customers. ComEd provides service to approximately 3.8 million customers across northern Illinois, or 70 percent of the state's population. For more information visit ComEd.com, and connect with the company on Facebook, Twitter and YouTube.

About Nicor Gas

Nicor Gas is a natural gas distribution company that serves more than 2.1 million customers in a service territory that encompasses most of the northern third of Illinois, excluding the city of Chicago. For more information, visit www.nicorgas.com.

About Peoples Gas

Peoples Gas, a subsidiary of Integrys Energy Group, Inc. (NYSE: TEG), is a regulated natural gas delivery company that serves approximately 831,000 residential, commercial and industrial customers in the city of Chicago. For more information about Peoples Gas, visit the company's website: www.peoplesgasdelivery.com.

About North Shore Gas

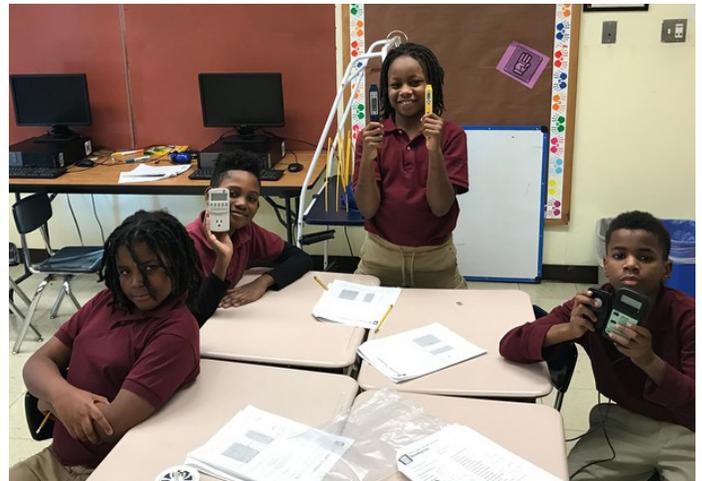
North Shore Gas, a subsidiary of Integrys Energy Group, Inc. (NYSE: TEG), is a regulated natural gas delivery company that serves approximately 159,000 residential, commercial and industrial customers located in 54 communities within the northern suburbs of Chicago. For more information about North Shore Gas, visit www.northshoregasdelivery.com.

About BP America

Over the past 10 years, BP has invested more than \$90 billion in the U.S. – more than any other energy company. BP is a leading producer of oil and gas and produces enough energy annually to light nearly the entire country for a year. Employing about 17,000 people across the country, BP supports more than 170,000 additional jobs through all of its business activities. For more information, go to www.bp.com/us.

The National Energy Education Development (NEED) Project (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.



ENERGIZING STUDENT POTENTIAL PROGRAM TEAM

Paula Conrad, *Senior Manager of Corporate Relations, ComEd*

Justin Elder, *Corporate Relations Specialist, ComEd*

Tom Wolf, *Director, Communications and External Affairs, BP America Inc*

Jamie Graves, *Director, U.S. Internal Communications, BP America Inc.*

Mary Houpt, *Manager, Community Partnerships, Peoples Gas and North Shore Gas*

Margi Schiemann, *Director, Infrastructure Programs and Support, NICOR Gas*

Steve Solomon, *President, Exelon Foundation*

Pat Whiteside, *Vice President Business Support, NICOR Gas*



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, a STEM Challenge potential for, field trips and classroom visits, and other exciting opportunities.

1. Select a team of science and/or technology teachers 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.
2. Participate in a mandatory training session in September, designed and delivered by the NEED Project. New schools must attend both days, while renewing schools will attend one day only. A one-day mid-year refresh workshop will be held late January or early February. Attendance and full participation at these workshops is required by the program.
3. Incorporate the program’s energy-focused curriculum and related activities into the 5th-8th 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. This project is to be completed and submitted by April 26, 2019.
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 or replenishment materials that will include all needed resources for the Energy Fair as well as a \$150 Energy Fair 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. Participate in monthly “how’s it going” check-in calls or email surveys to be certain the program is meeting classroom and school needs.
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.
9. Execute the STEM project and create a presentation, video, and/or student performance about the project and its results. Submit the project for review by April 26, 2019.
10. Complete teacher and student evaluations and submit to NEED no later than May 30, 2019.

WHAT RESOURCES DOES THE SCHOOL RECEIVE?

The ESP Program includes:

1. Teacher training (substitute reimbursement, parking, and PDUs provided)
2. A cash grant to support the school's STEM and energy-focused project (schools submit request for grant)
3. Curriculum and hands-on kits to teach about:
 - the science of energy and energy transformations
 - electricity generation
 - renewable energy
 - oil and natural gas
 - energy efficiency and conservation
4. An Energizing Student Potential Energy Fair Kit and mini-grant of \$150.00 to host an Energy Fair and Carnival at your school
5. Access to educational energy audits, classroom visits
6. Connections to STEM professionals to help students see the many possibilities of STEM and energy careers

The Curriculum and Hands-on Kits

NEED curriculum and kits for the program will be showcased throughout the workshop. All curriculum guides are found online at www.need.org. The website for program resources for ESP is www.need.org/esp.

Standards Correlations and Support

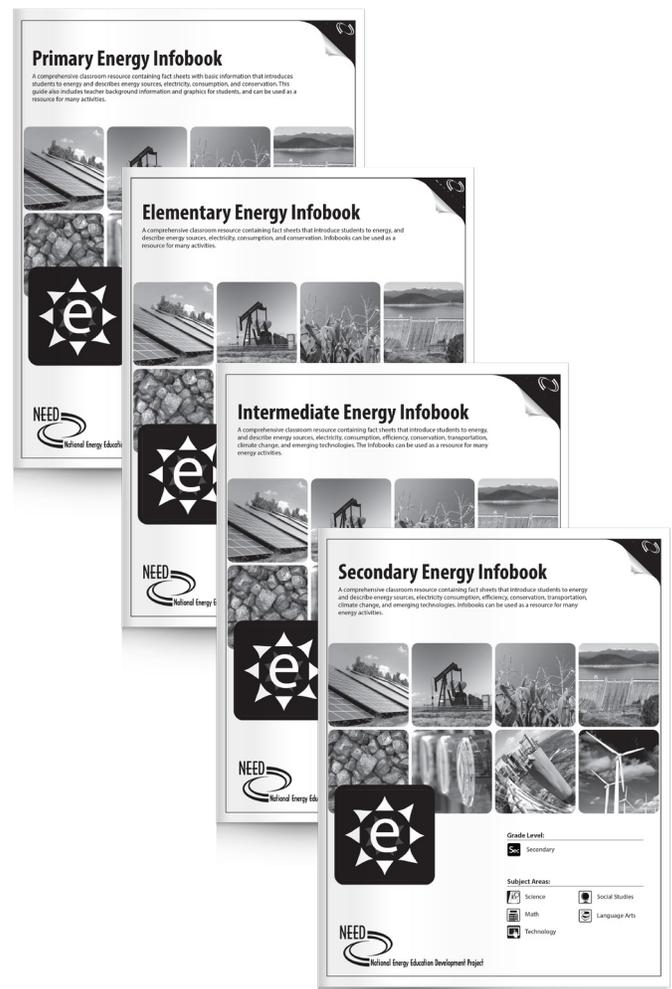
All NEED curriculum supports and is correlated to relevant national standards and state standards. For correlations documents for NGSS, CCSS, Illinois or Indiana State Science Standards, visit www.need.org/curriculumcorrelations.

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. All educators participating in the program will receive a class-set of NEED's Energy Infobooks at their selected appropriate grade level. 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 selections from NEED's hands-on classroom kits. All teachers will choose from the *Science of Energy* Kit, *Exploring Oil and Natural Gas* Kit, and a renewable energy kit (solar or wind).



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/espilin.

Educational Energy Audits-Optional

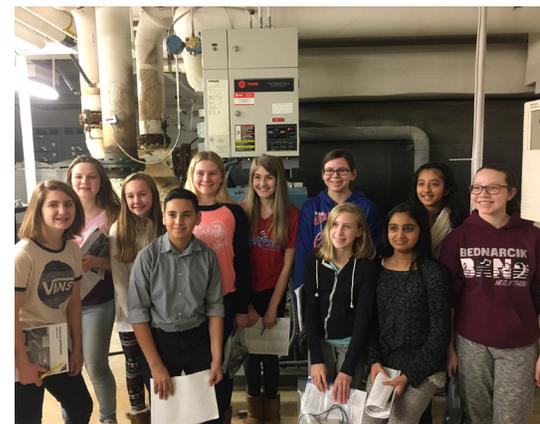
Teams of students and teachers from the schools will work with NEED's Certified Energy Manager, on an Educational Energy Audit of their school building. The CEM will work with students for a half-day to provide them an authentic learning experience about building performance and school energy efficiency 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.

Community 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 April 26, 2019.

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/ESPIL2018> or www.need.org/espilin.



2018-2019 DETAILED PROGRAM TIMELINE

September 25-27	ESP Teacher Training	<ul style="list-style-type: none"> • Create presentation to showcase efforts • Share project with administrators, or other partners, and friends for feedback • Prepare program presentation/video/performance for submission
October 15	All kits and materials received from NEED All kits shipped will be based on selections made at the September Training. All kits should be opened, verified, and any questions about materials sent to Emily at ehawbaker@need.org	
November 1	Educational Energy Audits Requested	
November 21	Completed: Science of Energy sections, some basic energy sources or efficiency and conservation activities, planning of community project has begun.	
January	Program survey check-in (link to be emailed) Teachers participate in a survey and submit responses to questions. Sample questions include: <ul style="list-style-type: none"> • Have you secured any additional community partners for the project and fair? • Who is responsible on the school's team for making sure the projects occur on the timeline you planned? • Have you been able to keep expenses within budget? • Are there obstacles you foresee for which you should seek assistance from NEED? • Are you gathering video and photos along the way? • Have you begun to plan the presentation you will submit? 	April 26 May 30
January / February	Mid-Year Refresh Workshop	Community Project submission <ul style="list-style-type: none"> • 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
Late February	Quick Check - email check-in <ul style="list-style-type: none"> • Completed renewable energy sections and continue work on energy efficiency and conservation • STEM project implementation underway • Are you assessing student performance during the classroom and community project activities? 	Program Wrap-up <ul style="list-style-type: none"> • 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.
March 15	Completed: <ul style="list-style-type: none"> • Energy efficiency and conservation activities projects and events planning nearly complete/scheduled • Continuous assessment of student activities 	Late May (TBD) Teacher Debrief Session and Dinner- Location TBD
April 5	Quick Check & Project Wrap-up – email check-in <ul style="list-style-type: none"> • Finalize/execute STEM projects and Energy Fair 	

SAMPLE ESP PACING GUIDE

<p>Day 1 Unit Introduction Pre-test /poll</p> <ul style="list-style-type: none"> • Preview : unit goals & STEM project • <i>Energy Conservation Contract</i> 	<p>Day 2 The Science of Energy - Introduction</p> <ul style="list-style-type: none"> • Teacher Demo • Intro to forms of energy & energy transformations • Discuss schedule 	<p>Day 3 The Science of Energy - Station Investigations</p> <ul style="list-style-type: none"> • Station explorations • Read to understand 	<p>Day 4 The Science of Energy - Station Investigations</p> <ul style="list-style-type: none"> • Prepare presentations • Students present stations to peers 	<p>Day 5 The Science of Energy - Station Investigations</p> <ul style="list-style-type: none"> • Students present stations to their peers
<p>Day 6 Forms and Sources of Energy</p> <ul style="list-style-type: none"> • Review stations • <i>Forms and Sources of Energy</i> • <i>Science Of Electricity Demonstration</i> 	<p>Day 7 Electricity Generation Model Engineering and Design</p> <ul style="list-style-type: none"> • Students redesign and/or prepare models of generators 	<p>Day 8 Energy Sources Activities</p> <ul style="list-style-type: none"> • Energy Roundup • Renewables and nonrenewables • Kit-based activities 	<p>Day 9 Energy Sources Activities</p> <ul style="list-style-type: none"> • Renewables and nonrenewables • Kit-based activities 	<p>Day 10 Energy Sources Activities</p> <ul style="list-style-type: none"> • Renewables and nonrenewables • Kit-based activities
<p>Day 11 Energy Sources Activities</p> <ul style="list-style-type: none"> • Renewables and nonrenewables • Kit-based activities 	<p>Day 12 Energy Sources Activities</p> <ul style="list-style-type: none"> • Renewables and nonrenewables • Kit-based activities 	<p>Day 13 Energy Sources Activities</p> <ul style="list-style-type: none"> • Renewables and nonrenewables • Kit-based activities 	<p>Day 14 Energy Sources Activities</p> <ul style="list-style-type: none"> • Renewables and nonrenewables • Kit-based activities 	<p>Day 15 Energy Sources Activities</p> <ul style="list-style-type: none"> • Renewables and nonrenewables • Kit-based activities
<p>Day 16 Introduction to Saving Energy</p> <ul style="list-style-type: none"> • Students read to gain background knowledge about energy consumption 	<p>Day 17 Introduction to Using Energy Efficiency and Conservation Tools</p> <ul style="list-style-type: none"> • Students learn how to use tools 	<p>Day 18 School Building Survey</p> <ul style="list-style-type: none"> • Students analyze their school's energy systems 	<p>Day 19 Saving Energy at School</p> <ul style="list-style-type: none"> • Survey reflection • Brainstorm possible changes • Students brainstorm ideas for STEM projects 	<p>Day 20 Planning Day</p> <ul style="list-style-type: none"> • Students begin organizing ideas for their STEM projects • Plan for Energy Fair
<p>Day 21 Saving Energy at Home</p> <ul style="list-style-type: none"> • Explore home applications of building survey • Begin Energy House 	<p>Day 22 Saving Energy at Home</p> <ul style="list-style-type: none"> • Revisit <i>Energy Conservation Contract</i> • Energy House 	<p>Day 23 Saving Energy at Home</p> <ul style="list-style-type: none"> • Revisit <i>Energy Conservation Contract</i> 	<p>Day 24 Review and Wrap-up</p> <ul style="list-style-type: none"> • <i>Energy in the Round</i> • <i>Energy Web</i> 	<p>Day 25 Review and Wrap-up</p> <ul style="list-style-type: none"> • Post-test/poll • <i>Energy Carnival</i>
<p>Day 26</p> <hr style="width: 100%; border: 1px solid blue;"/>				
<p>Day 27</p>				
<p>Day 28</p>				
<p>Day 29</p>				
<p>Day 30</p>				
<p>Wrapping up STEM Projects & Energy Fair Activities</p>				

- 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, school visits, and field trips has not been included above.
- If you wish you can plan your own sequence on page 13, 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



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
Wrapping up STEM Projects & Energy Fair Activities				

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

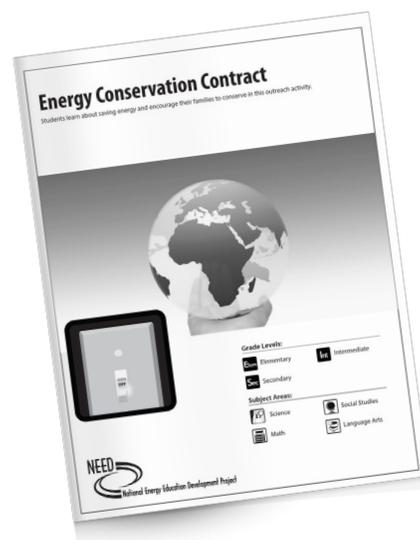
- Students will commit to saving energy at home and school, by creating their own pledge.

Materials

- *Energy Conservation Contract*
- NEED Energy Polls (www.need.org/evaluation)

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

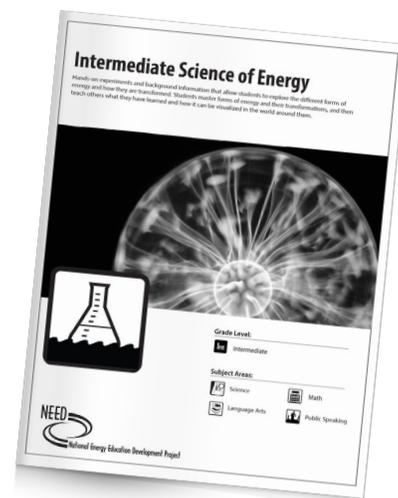
- Teacher Demonstration (Science of Energy Kit)

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

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

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

Materials

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

Procedure

- 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

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

- 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

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

Suggested Handouts

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

Procedure

- 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 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

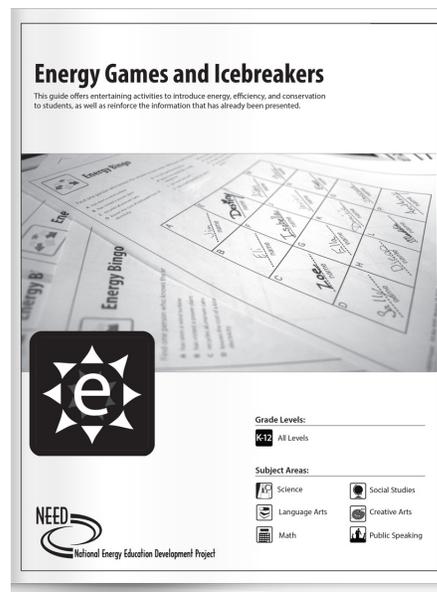
- Students will understand how renewable and nonrenewable resources are being used to generate energy and, more specifically, electricity.

Materials

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

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 Experts* Teacher and Student Guides

Reading

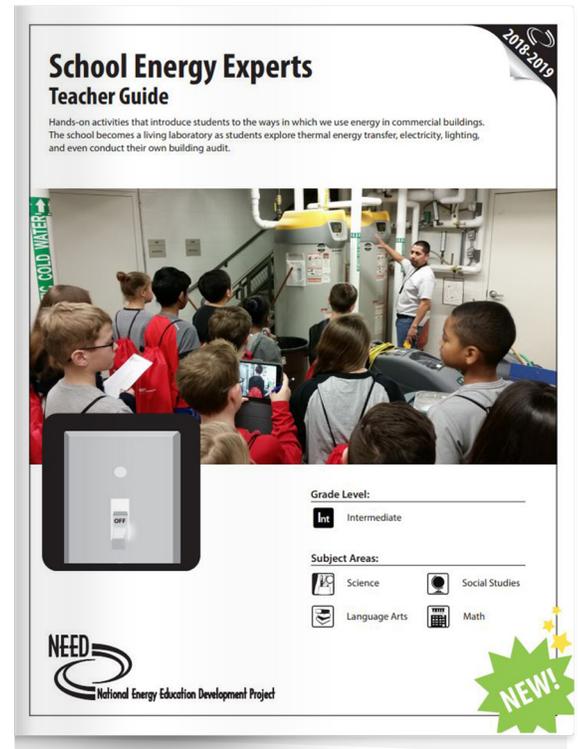
Student Informational Text (Student Guide)

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.



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 Survey Efficiency and Conservation Kits

Suggested Handouts

Copies of applicable pages from the Student Guide

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

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

Objective

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

Materials

- Energy Efficiency and Conservation guides and kit

Science Notebooks

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

Suggested Handouts

School Energy Consumption Survey; School Building Survey, or School Energy Experts

Procedure

- 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

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

Objectives

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

Materials

- Energy Efficiency and Conservation guides and Kit

Science Notebooks

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

Suggested Handouts

Survey data from previous activity and *Findings and Recommendations (Student Guide)*

Procedure

- 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

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

Objective

- 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

- Materials may vary, based on student ideas

Science Notebooks

Students should begin to brainstorm plans and sketch ideas.

Suggested Handouts

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

Procedure

- 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

Activity

By analyzing their own living and work spaces, students apply what they have learned to making energy changes in their personal lives at home.

Objective

- 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.

Materials

- *Energy Conservation Contract*
- *Energy House*

Science Notebooks

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.

Procedure

- 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.

Day 24-25: Review and Wrap-up

Activity

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

Objectives

- 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

- Materials will vary based on the activities selected.

Procedure

- 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

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

Objectives

- 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

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

Suggested Handouts

Community Project worksheets (Program Guide, pages 26-29)

Procedure

- 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 in this Program Guide to use for assessing student knowledge, application, and project goals.

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.



CLASSROOM RESOURCES AVAILABLE FROM ENERGIZING STUDENT POTENTIAL PARTNERS

From Peoples Gas

Natural Gas Basics:

http://www.peoplesgasdelivery.com/company/gas_basics.aspx

Value of Natural Gas:

<http://www.peoplesgasdelivery.com/home/benefits.aspx>

Pipeline Awareness:

<http://www.peoplesgasdelivery.com/home/pipeline.aspx>

Safety:

<http://www.peoplesgasdelivery.com/home/safety.aspx>

http://www.peoplesgasdelivery.com/home/gas_safety.aspx

Game:

<http://www.peoplesgasdelivery.com/safetyforkids/index.html>

Energy Efficiency:

<http://www.peoplesgasdelivery.com/home/saving.aspx>

Energy Savings Tips:

<http://www.peoplesgasdelivery.com/home/tips.aspx>

Rebates and Programs:

<http://www.peoplesgasdelivery.com/home/rebates.aspx>

Teachers and Students:

<http://www.peoplesgasdelivery.com/company/educators.aspx>

Gas Smart Educational Activities:

http://www.peoplesgasdelivery.com/company/gas_smart.aspx

Service:

<http://www.peoplesgasdelivery.com/home/rates.aspx>

Emergency Procedures:

<http://www.peoplesgasdelivery.com/home/emergency.aspx>

Gas Main Replacement Program (Construction):

http://www.peoplesgasdelivery.com/company/main_replacement.aspx

From Exelon

About Exelon:

<http://www.exeloncorp.com/company/about-exelon>

Generation:

<http://www.exeloncorp.com/company/our-generation-fleet>

Innovation:

<http://www.exeloncorp.com/company/innovation-stories>

Sustainability:

<http://www.exeloncorp.com/sustainability>

Careers:

<http://www.exeloncorp.com/careers>

Company Locations:

<http://www.exeloncorp.com/locations>

Exelon Corporate You Tube:

<https://www.youtube.com/user/ExelonCorporation>

Exelon Generation You Tube:

<https://www.youtube.com/user/ExelonGeneration>

From ComEd

Education and Field Trips:

<https://www.comed.com/SafetyCommunity/Education/Pages/ForTeacherStudents.aspx>

Smart Grid & Smart Meter:

<https://www.comed.com/SmartEnergy/SmartMeterSmartGrid/Pages/Default.aspx>

Education:

<https://www.comed.com/SafetyCommunity/Education/Pages/Default.aspx>

Home Energy Savings/Efficiency:

<https://www.comed.com/WaysToSave/ForYourHome/Pages/Default.aspx>

Business Energy Savings/Efficiency:

<https://www.comed.com/WaysToSave/ForYourBusiness/Pages/Default.aspx>

Safety:

<https://www.comed.com/SafetyCommunity/Safety/Pages/Default.aspx>

ComEd You Tube:

<https://www.youtube.com/user/CommonwealthEdison>



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.

	Understanding of Concepts	Scientific Inquiry	Presentation
4	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.
3	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.
2	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.
1	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:

-
-
-
-
-
-

STEM Challenge Concept: _____

The idea we like best and why: _____

What will we need to create our project?

What is our plan?

Teacher Signature for Idea Approval: _____

STEM PROJECT PLANNING PAGE



Steps to Implement Plan	Who is in Charge	Our Deadline

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



	Understanding of Energy	Understanding of Efficiency and Conservation	Application of Learning	Project Effectiveness	Student Leadership in Activities
4	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.
3	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
2	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.
1	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.

ESP

energizing student potential

Exelon Foundation.

ComEd | powering lives
An Exelon Company

bp
 NORTH SHORE GAS[®]
We Keep Life Moving

 Nicor Gas | *We Keep Life Moving*

