The Renewable School

Rachel Odoroff

Henry C. Lea School

Introduction

At the start of the school day, we plug in our laptops, charge our cell phones, adjust the thermostat, and flick on the lights, but do we really know where all that energy comes from? An equally important question to ask might be: Can we rely on those sources to be there at all times and to power a growing demand, not only for use in our classrooms, but also for our homes and businesses and vehicles as well? This unit seeks to demystify the complex array of energy sources that power our modern lives, moving from an exploration of non-renewable sources to an understanding of the renewable options that must be developed and utilized to secure our energy future. Students in middle school are invited to learn about current energy supplies for their community and then re-imagine possible solutions for their school and home: ones that rely on renewable sources, and also work with our urban landscape and address local realities.

Background

Henry C. Lea School sits on the corner of 47th Street and Locust Street in West Philadelphia, a hulk of a building. Built in 1914 at a time when it seemed like fossil fuels would power the country forever, the heating system is antiquated and inefficient and a sure waste of fossil fuels. The building has been under additional scrutiny of late, needing asbestos remediation, enhanced ventilation and other upgrades. There is no elevator for people with disabilities, no central air conditioning for hot summers, very few outlets to power our growing classroom energy needs. The past year has made even more evident our reliance on cheap, abundant energy. Student simply would not have been able to participate in school without electrical energy to power their laptops and the Internet infrastructure to keep virtual schools open. As students will be creating a model design which examines solar, wind and hydroelectric energy for home and school, it will be critical that they learn the specifics of how *their* school and *their* homes are powered now, so they can imagine what changes need to be made in the future.

Pennsylvania state standards in science address this topic for middle school with the following content required at this grade level**:** *Describe renewable and non-renewable resources. (**3.3.8.A2),** and examine how power systems are used to drive and provide propulsion to other technological products or systems*. (**3.4.8.E3**) As the Pennsylvania Department of Education is currently undergoing a process of reviewing, modifying and adopting Next Generation Science Standards (2021), it will be important to embed the core ideas of problem solving, exploration, and model based design that NGSS promotes. While the topic of climate change is not currently covered by Pennsylvania standards, it is of critical importance for students to know, and is also slated to be covered with the adoption of the new standards across the state. The NGSS standards relevant to this topic are: *Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment* (MSESS3-3)

and analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their impacts. (MS-ESS3-2). Please see the following for more on climate change units for middle years students:

- A Place Based Climate Exploration for Middle School (Teachers Institute of Philadelphia/2019. Environmental Humanities from the Tidal Schuylkill River taught by Professor Bethany Wiggin.)
- Engineers Wanted: Climate Change Experience Necessary! (Yale National Initiative to Strengthen Teaching in Public Schools/2020. Solving Environmental Problems Through Engineering taught by Professor Jordan Peccia)

This unit could be taught along side these two units or stand alone as an exploration of renewable and non-renewable energy sources.

Content Objectives

Non Renewable vs. Renewable Energy Sources

In order to explore renewable energy sources, it is helpful for us to first spend some time examining what it means to be non-renewable. We largely rely on the ubiquitous fossil fuel, but what is a fossil fuel? How do we obtain fossil fuels and where and how do we use them? It is likely that most of our middle school students have familiarity with filling the tank at the gas station, but much less experience with charging a car. The term fossil fuels may be confusing to students. What does a fossil have to do with the gasoline and oil their parents' use in their homes and cars? Students live in a largely non-renewable world, but will be members of the generation that has to usher in renewable energy sources, as a response to depleting supplies and climate change. *Non-renewable* energy foretells its own problem in its own name. Once fossil fuels such as coal, gas and oil are consumed, they cannot be replaced, and so by nature will eventually run out.

The Natural Resources Defense Council describes fossil fuels as "formed from the fossilized, buried remains of plants and animals that lived millions of years ago." (Denchak, 2018) These fossilized remains have a relatively high carbon content. The carbon bonds form enormous amounts of stored energy, when converted to fuel, power much of our modern lives. Students should recognize that the stored energy in those carbon bonds is the result of photosynthetic processes that took place millions of years ago, but now comes to us chiefly in the form of oil, gas and coal.

Pennsylvania has a long history of mining fossil fuels and that extraction has been an important part of the economy for over 200 years, with coal mining dating back that far(eia.gov, 2020). Despite more than two centuries of mining, Pennsylvania still has significant fossil fuel reserves in the form of coal and natural gas. The Appalachian Mountains, which run diagonally through much of the state, are sitting on a bed of anthracite coal. And more recently, Marcellus Shale rock formations have yielded natural gas through hydraulic fracturing or "fracking." The United States Energy Information Administration lists Pennsylvania as "…a leading East Coast supplier of coal, natural gas, electricity and refined petroleum products to the nation." (eiai.gov, 2020) Students may be aware of the economic debate across Pennsylvania and the country. The move to

reduce fossil fuels means livelihoods are lost and towns which once thrived on the extraction of these fuels have fallen on hard times. The transition to renewable energy sources will mean new jobs in new sectors, but that requires new job skills and new locations.

No matter what type of non-renewable fuels, one common fact remains. The fuels provide the energy that we need to do work: the work of heating our houses, moving our cars, operating our appliances. But these sources of energy are depleting rapidly. According to the United States Energy Information *Administration International Energy Outlook 2019*, the world has enough liquid energy to meet demands until about 2050, less than 30 years from now. (eia.gov) With that deadline rapidly approaching, renewable energy infrastructure should be developed now. Sources for renewable energy are inherently decentralized and dependent on geographic locale, so solutions to replace fossil fuel sources may be varied. An equally compelling reason for urgency in transition to renewable energy sources is climate change. While this unit does not seek to dive deeply into climate change, students will need a basic understanding of the causes of climate change. The intense use of fossil fuels, which began with the Industrial Revolution, led to a dramatic increase in carbon dioxide in the atmosphere. The carbon dioxide is enhancing the greenhouse effect causing average temperatures across the planet to rise, with varying localized results that affect weather, wild fire, rain, drought, etc. This is not an abstract argument. President Biden has been actively promoting a plan to reduce greenhouse gases by promoting renewable energy sources since before his election in 2020. In April 2021, he announced plans to cut emissions in half in the next ten years. (Sommer, 2021)

Renewable energy sources are by design carbon neutral or low carbon options (the carbon only being part of the manufacturing process, not part of the energy production). While renewable energy sources are not without environmental consequences, they are created by forces (gravity, wind, and sun) which will not run out, and they will send us in the direction of lowering our carbon footprint and hopefully slowing the adverse impacts of climate change. What does the term *renewable energy* tell us? That the sources of energy needed are essentially endless and will not run out.

After an exploration of non-renewable sources (fossil fuels), this unit will then focus on three types of renewable energy that are well known, well developed, and perhaps most importantly, scalable. All three sources have some geographic limitations, while gas and oil can be shipped as discrete units, these sources create electricity which is difficult to store for long periods of time and therefore all three are dependent on proximity of source and site of use.

Photovoltaic Cells (Solar Power)

Photovoltaic cells work by capturing the energy directly from the sun, and while they are the least efficient of the three renewable sources covered here, they also provide numerous advantages. The energy created by photovoltaic panels comes from a free and abundant source in the form of sunlight. Solar panels are quiet and can be installed on existing spaces providing the panels can be oriented to capture enough sunlight to function efficiently. This makes them ideal for small-scale use or for more remote or “off

the grid" use. It also reduces the likelihood that power outages will occur on a large scale. Solar farms that are larger scale will need more land, one drawback. Most solar panels are made of silicon a relatively abundant element. Of course, if the sun is not shining the photovoltaic panels cannot obtain energy. This necessitates a battery, but the battery will only stay charged for so long before more energy is needed. Photovoltaics need to be installed at an angle to receive the rays from the sun at a perpendicular angle. As one moves from the equator where they can be installed horizontally, PV panels must be tilted for maximum effect. Looking at PV panels in Philadelphia, one will see them angled up above our flat roofs, facing south.

Wind Power (Eolic)

Wind turbines are also classified as renewable sources, though again, location is an important factor to consider. Wind turbines create electricity through the rotation of the blades, but if the wind is not blowing or not steady, they are not as efficient and will also require batteries. The blades of a horizontal axis turbine are like the blades of an airplane and the uneven distribution of air pressure across the blades causes them to turn, creating energy. Wind turbines are tall to catch a steady stream of wind and are dependent on geographic location. The amount of energy produced is proportional to the area of the blades, which means that large diameter turbines create large outputs of energy. Horizontal axis turbines have a sensor on them that helps them rotate in the direction of the wind for best effect. Vertical axis turbines are less efficient but may be installed where less space is available.

Hydroelectric Power

Energy created by the movement of water is by far the most efficient, the heaviness and reliability of water moving down hill by force of gravity is key. Hydroelectric energy is also dependent on turbines and requires a steady source of flowing water so, like the other two renewable energy sources listed here, is dependent on location. For maximum efficiency, dams need to be built to funnel water through turbines at a steady controlled rate that can be converted to electricity. Dams create a steady even flow of water to move turbines. This source of energy is by far the most expensive of the three for implementation on scale, due to the engineering and infrastructure costs associated with building dams and changing the course of rivers. The environmental impact of hydroelectric is considerable. While the source is renewable and constant, dams have major impact on the river ecosystem, also impacting communities, wildlife and navigation. Still, hydroelectric is a renewable source lowering our dependence on fossil fuels.

All three of these renewable energy sources create electricity, not liquid fuel. Given our current dependence on liquid fuels for transportation, the increased reliance on renewable sources will necessitate a new set of design challenges. Imagine in the next generation how cars will be charged by plugging in rather than stopping off to fill the tank. Homes heated with fuel or natural gas will also need to be converted to electric sources. Perhaps fuel will be reserved for unique situations where electric plug in is not an option. Will we ever be able to plug in an airplane and rely on it to fly transoceanic? All three of these renewable energy sources create electricity, not liquid fuel. Given our

current dependence on liquid fuels for transportation, the increased reliance on renewable sources will necessitate a new set of design challenges. Imagine in a generation how cars will be charged by plugging in rather than stopping off to fill the tank. Homes heated with fuel or natural gas will also need to be converted to electric sources. Perhaps fuel will be reserved for unique situations where electric plug in is not an option.

Pedagogy: Project Based Learning

Students in middle school thrive with options, exploration, and are craving engagement in a year when so many have been home. Project Based Learning is a unit design template where a central question is posed and students work together to suggest answers to that question and support their reasoning. Project Based Learning (PBL) can embed multiple different disciplines, encouraging students to write, read, research, conduct experiments and make informed arguments including oral and written presentations. Using guidance from the *Buck Institute for Education's* publication, *PBL for 21st Century Success: Teaching Critical Thinking, Collaboration, Communication, and Creativity* from the Project Based Learning Toolkit Series. The book maps out a series of steps to engage groups of students in these types of projects. The unit written here can be used by teachers as a self contained set of lessons, or can be used in conjunction with my unit Engineers Wanted: Climate Change Experience Needed! developed at the Yale National Institute for Excellence in Urban Teaching in 2020. The Renewable Energy Schemes class taught by Professor Jorge Santiago Aviles at University of Pennsylvania through Teachers Institute of Philadelphia held great appeal to me after developing the "Yale" unit as I developed a much greater understanding of renewable energy options that might be included in a student project. The lessons presented here focus on several science concepts important to the understanding of renewable energy but also call on students to support their choices with research and oral and written arguments.

Project Based Learning begins with the teacher posing a central problem statement. The problem statement for students to ponder and solve in this unit will be: *The mayor is coming to visit your school and wants to know how to lower the costs of heating and cooling, fight climate change, and provide a renewable and local solution for the school. What would you recommend to the Mayor and why? You must show a model of what you sugges and justify your choices.* Of course, teachers using this unit can change the question to fit the specifics of their school situation. Problem statements such as this one provide no easy answer. Instead, students are called upon to research and investigate and problem solve on the way to making an informed argument. (Larmer, 2013)

During the *Launch* phase of the project students brainstorm the central question and then determine what they are going to need to know to answer this question. Students are placed in appropriate groups and complete a warm up activity that helps them connect with each other as learners and classmates.

Students then move into *Building Knowledge Understanding and Skills* where they work with each other and their teacher to gather the information needed to come to some kind of response or answer. For this unit, students will conduct a series of science experiments to learn about how renewable energy can be generated. During three teacher led science experiments about the three main types of renewable energy sources: solar power (photovoltaic panels), wind power (wind turbines) and low head hydroelectric (water power which minimizes environmental impact) students will learn about some solutions to replacing their school's heating and cooling footprint with renewable sources. Students will build model turbines to understand the concept of electricity generation from both wind and water. Students will explore the effect of color on temperature to better understand how photovoltaic cells work. It will also be beneficial to look at the use of these in local situations. Students may be able to see photovoltaic panels, wind turbines and hydroelectric in their community either by visiting sites or through photography or video. Students will then complete a physical survey of school (or home) to determine the best options for their proposed energy upgrade and will work together to create a design model showing their decisions. (Larmer, 2013)

During developing and *Revising Ideas and Products* students generate designs, build prototypes, construct arguments and receive critical feedback from other teams and from adults. Students will present their "products" or "answers" to the original question. This could take the form of a presentation, or a model or a video. During this phase, students will work with a plan map of our school (school yard, surrounding side walks and birds eye view of the school) to choose the renewable energy sources most compatible for the locale. Students can work together in teams to make their choices. They will be able to receive ongoing feedback from their teacher and classmates at each level to refine their understandings and choices. (Larmer, 2013)

In the final phase of Project Based Learning *Presenting Products and Answers to Driving Questions* students share design choices and justify not only which choices they made but the placement of them as well. Their key question will be: How did you make the choices about which renewable energy sources to use and where to put them? As part of Project Based Learning, students will need to articulate in writing and orally at the end of the unit and answer the initial question: *The mayor is coming to visit your school and wants to know how to lower the costs of heating and cooling, fight climate change, and provide a renewable and local solution for the school. What would you recommend to the Mayor and why?* Groups can present for each other or for a "mayor". Students are then scored on a rubric using peer and teacher feedback. (Larmer, 2013)

Teaching Strategies

Photography: Students will photograph all of the energy sources that come into their homes and the school, discussing each one and sorting out different types of energy used. Photos can then be used to categorize and discuss commonalities and differences in energy delivery.

Notice and Wonder: Students will take a look at an image or graph and make observations based on what they see. This is an excellent strategy for students who may struggle and also for students who are learning English. They can also write questions

based on what they see. These questions can be answered immediately or students can store them for later.

Project Based Learning: PBL uses a central question or problem statement as impetus for students to explore content and design a solution. Teachers pose a central conflict, and then students gather information, research and work in teams to create a solution. This paper includes an extensive description of PBL above.

Science Experiment: Students conduct simple lab experiments to support evidence of basic scientific principles. Students should use this to gain content knowledge, but also enhance their science process skills.

Resources

Anderson, Erin. "Renewable Energy: Discover the Fuel of the Future with 20 Projects." *Booklist*, vol. 112, no. 16, 15 Apr. 2016, p. 46.

> This book is designed for middle and elementary school students to read to help them learn about renewable energy sources and careers in the field. It also provides age appropriate science experiments and projects for students.

Denchak, Melissa (2018) online source. Fossil Fuels: The Dirty Facts. Natural Resources Defense Council: https://www.nrdc.org/stories/fossil-fuels-dirty-facts - sec-whatis

> Overview of fossil fuel sources, their uses and the harmful effects of the overuse of fossil fuels including climate change, respiratory problems and poor air quality.

Kleinman Center for Energy Policy at University of Pennsylvania Website: https://kleinmanenergy.upenn.edu/news-insights/philadelphia-eagles-go-green-with-renewable-energy/

> This website has photographs and videos of Lincoln Financial Field (home of the Philadelphia Eagles football team). The stadium is LEED certified and students will be able to see the photovoltaic panels and wind turbines used to make this arena green!

Larmer, J., Mergendoller, J., Boss, S. (2013). PBL for 21st Century Success: Teaching Critical Thinking, Collaboration, Communication, and Creativity from the Project Based Learning Toolkit Series, Buck Institute for Education.

Next Generation Science Standards https://www.nextgenscience.org

> Next Generation Science Standards have been in development for the past several years and are currently under review for adoption by the Pennsylvania Department of Education.

Pennsylvania Department of Education Standards Aligned System
https://www.pdesas.org/Standard/Detail?LinkStandardId=0&StandardId=24955

Pennsylvania Department of Education Standard Aligned System lists state standards across all content areas and grade levels.

Sommer, Lauren. How the US could halve climate emissions by 2030. National Public Radio article. April 22, 2021. **https://www.npr.org/2021/04/16/987667828/how-the-u-s-could-halve-climate-emissions-by-2030**

Article describing President Biden's plan to cut greenhouse emissions dramatically by 2030 and also create jobs across the energy sector.

United States Energy Information Administration Website
https://www.eia.gov/state/?sid=PA

This website houses specific information about energy sources listed by state including consumption and production data. Pennsylvania has significant fossil fuels reserves remaining.

Classroom Activities

Lesson #1: How are we powered now? Looking at how we currently use energy and what sources we use.

The first lesson is designed to get students thinking about their daily use of energy. It is a pre-cursor lesson to Project Based Learning, and critical to help get students thinking about energy usage.

Objective: Students will be able to describe non-renewable energy sources currently used to power our modern lives.

- Teacher will assign the following task for students: "Find all of the ways you or a family member use energy in your home. Make a list of all of those and bring in at least three photographs to demonstrate."
- Students will discuss different sources of energy, using chart paper to diagram the myriad of different energy uses. Teacher may choose to categorize energy by source: electric, gas, oil to help students understand the different ways we get energy.
- Teacher will show photographs and use a Notice and Wonder Chart: "Where does this energy come from?" "How do we get electrical energy?" "Where does gas come from?" "Where does oil come from?" "How are the two related?"

Lesson #2: Connecting from our energy consumption to climate change.

- Students review the term *fossil fuel* and its relation to climate change. What is a fossil fuel? How does a fossil fuel relate to all of these energy sources?

- We can burn fossil fuels to create electricity or burn them directly to power our lives. Where do we see fossil fuels burned directly? Where is there indirect use of fossil fuels?
- Students will review the concept that all energy comes from the sun and is stored in a variety of places including in decayed organic material.
- Dead plant matter is stored energy from the sun. Over many years that decayed matter is stored up in fuels under the Earth's surface. These fuels are called fossil fuels.
- Class discussion: How do we get these fuels? What problems do burning these fuels create?
- Review the basics of climate change.
- Explore the term renewable and non renewable. What makes something renewable? What makes it non renewable?

Lesson #3: Beginning the Problem Based Learning Project: The Launch.

Introduce the problem statement: *The mayor is coming to visit your school and wants to know how to lower the costs of heating and cooling, fight climate change, and provide a renewable and local solution for the school. What would you recommend to the Mayor and why? You must show a model of what you suggest and justify your choices in a written statement and be prepared to discuss them.*

Students will begin by working in groups of 4 to brainstorm questions they have about this prompt. Give student a large sheet of chart paper and ask them to write down what questions they have for about 10 minutes. Some questions students may ask:

- How is our school heated now?
- How do we get power for lights, laptops, air conditioning, phone etc?
- Will we need more or less energy in the future?
- How is climate change created?
- What is a renewable energy source?
- How are we going to make our recommendation?

Have students share their questions and create a centralized list together to begin to answer some of their questions.

Lesson #4: Building Knowledge Understanding and Skills. What is renewable energy?

Objective: Students will be able to describe non-renewable energy sources currently used to power our modern lives.

- Assign students to find examples of renewable energy sources in their community. Students can photograph these examples and share with classmates.
- Have they seen solar panels? Electric charging stations? Wind turbines? Students can take photos of these and bring them to class. Teacher may want to take a neighborhood walk and find sources such as these.
- See the appendix for examples. These are also available for use in class.

- Invite the building engineer or other facility support professionals to visit the classroom and answer questions about the current state of the facility.

Lesson #5: Building Knowledge Understanding and Skills. Model a wind turbine.

Objective: Students will be able to describe non-renewable energy sources currently used to power our modern lives. Students will be able to use a model to show how a turbine works.

Materials: Cardboard, straws, etc.

- Students will make their own turbines to be able to understand how they work and as a part of the project.
- Create a central tower using a paper towel base. Poke a hole through the top of the paper towel and put a dowel through the middle.
- Create fan blades using cardboard or paper and attach to a central axis that will insert through the holes.
- Place the model turbines in a windy spot and see if students need to make adjustments to get them to work.
- Explain to students how the rotation of the turbine blades could be used to generate electricity for the school.
- Discuss the pros and cons of the turbines for use at the school.

Lesson #6: Building Knowledge Understanding and Skills. Model a solar panel.

Objective: Students will be able to describe non-renewable energy sources currently used to power our modern lives. Students will be able to describe how color affects energy absorption.

Materials: Beakers, black paper, white paper, water, thermometer

- Students will explore the effect of color on the absorption of heat.
- Have students place a sheet of white paper over a beaker of water. Place a sheet of black paper over an identical beaker of water. Take the temperature reading of the water in both beakers using a thermometer.
- Place each beaker in a spot in direct sunlight. Have students measure the temperature of the water at regular five-minute intervals.
- Student should be able to see the effect of color on the absorption of energy by seeing the temperature rise more quickly and to higher level for the water under the darker paper.
- Relate the temperature rise to the solar panels students have seen in the neighborhood or in photos and explain that the silicon used in the solar panels heats up (called a black body) and generates energy at the source that can be converted to electricity.
- Share photos from appendix or from students. Ask students why solar panels are angled and what direction they are angled.

- Discuss the pros and cons of solar panels for use at the school.

Lesson #7: Building Knowledge Understanding and Skills. Model a water turbine.

Objective: Students will be able to describe non-renewable energy sources currently used to power our modern lives. Students will be able to describe and model a water turbine.

Materials: small paper cups, spoons, rods for axes, water source, bottles.

- Examine photos and videos of water turbines.
- Give students materials to build a model and have them try to construct a structure that will rotate through flowing water.
- Have students try their turbines in running water at the sink.
- Discuss the pros and cons of hydroelectric energy for use at the school.

Lesson #8: Revising Ideas and Products. Create a School Plan for Conversion to Renewable Energy Sources.

Objective: Students will be able to create a model of the school and chosen renewable energy sources. Students will be able to justify their design choices.

(3-5 class periods)

- Students will now work together with their peers to create a model of their school and decide where they would put solar panels, wind turbines or would they choose hydroelectric.
- If they are going to choose hydroelectric energy, they must explain where they are getting a running water source as power.
- They must build a model of the school (or draw a plan of the school and school yard) and indicate where they would locate these renewable sources.
- Students must write a one page persuasive essay to accompany their models. This essay should describe the benefits of renewable energy and the cost effectiveness as well as outline the design choices made by the student. Why would you suggest the mayor invest in a modernized school building with these renewable energy sources? Where would you place your renewable energy sources?

Lesson #9: *Presenting Products and Answers to Driving Questions*: Student presentations.

Objective: Students will be able to articulate their reasons for renewable energy choices and present their arguments to an audience.

Students will end their unit by showcasing their models to the “mayor”. They need to present their ideas in written format, which they can read to the mayor and also be prepared to answer questions to defend their choices. Groups can work together to decide

who will present in what order, but all students must participate in sharing and answering questions. Models and drawings can remain on display so students can take a gallery walk and see other student work.

Appendix

Pennsylvania State Standard:

Describe renewable and non-renewable resources. (3.3.8.A2), and examine how power systems are used to drive and provide propulsion to other technological products or systems. (3.4.8.E3)

Next Generation Science Standards

*Apply scientific principles to design a method fo**r** monitoring and minimizing a human impact on the environment* (MSESS3-3) *and analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their impacts.* (MS-ESS3-2).

Photographs to Supplement Lessons

All photos courtesy of the author of this paper. The author gives permission for the use of these photos for educational purposes. These photos are included as supplements for use as needed to help students visualize how renewable energy is used around them.

Figure 1: Electric Car charging ports on I 476 in PA. Installed Spring 2021.

Figure 2: Photovoltaics at work in Gainesville, FL. Can you guess which way they are facing? Photo detail shows the transfer of energy to the battery for future use.

Figure 3: Another charging station on I 90 in Upstate NY. What does EV mean?

Figure 4: Why do these bicycles need a photovoltaic cell?

Figure 5: A Philadelphia Roof Landscape. Can you spot the photovoltaic panels?

Figure 6: Wind Turbines off I 476 in Pennsylvania.

Summary

This unit seeks to demystify the complex array of energy sources that power our modern lives, moving from an exploration of non-renewable sources to an understanding of the renewable options that must be developed and utilized to secure our energy future. Students in middle school are invited to learn about current energy supplies for their community and then re-imagine possible solutions for their school and home: ones that rely on renewable sources, and also work with our urban landscape and address local realities. Lessons for students revolve around a central question which must be answered by students through science experiments, model building, writing and an oral presentation.