

FORMS OF ENERGY – LESSON PLAN 2.9

Renewable and Non-Renewable Energy

This lesson is designed for 3rd – 5th grade students in a variety of school settings (public, private, STEM schools, and home schools) in the seven states served by local power companies and the Tennessee Valley Authority. Community groups (Scouts, 4-H, after school programs, and others) are encouraged to use it as well. This is one lesson from a three-part series designed to give students an age-appropriate, informed view of energy. As their understanding of energy grows, it will enable them to make informed decisions as good citizens or civic leaders.

This lesson plan is suitable for all types of educational settings. Each lesson can be adapted to meet a variety of class sizes, student skill levels, and time requirements.

Public School System Teaching Standards Covered

State Science Standards

- [AL GLE 3.1.3](#) 3rd
- [AL GLE 3.3](#) 3rd
- [MS 9.c](#) 4th
- [KY SC-5-ET-U-2](#) 5th
- [TN SPI 0407.7.2](#) and [WCS](#) 4th

Common Core Language Arts/Reading

- [ELA.CCSS.W.4.1 MS](#), TN 4th
- [ELA.CCSS.W.5.1 KY](#) 5th
- [ELA.CCSS.W.3.1 AL](#) 3rd

Setting	Lesson Plan Selections Recommended for Use
Smaller class size, higher student ability, and /or longer class length	<ul style="list-style-type: none"> • The “Modeling” Section contains teaching content. • While in class, students can do “Guided Practice,” complete the “Recommended Item(s)” and any additional guided practice items the teacher might select from “Other Resources.” • NOTE: Some lesson plans do and some do not contain “Other Resources.” • At home or on their own in class, students can do “Independent Practice,” complete the “Recommended Item(s)” and any additional independent practice items the teacher selects from “Other Resources” (if provided in the plan).
Average class size, student ability, and class length	<ul style="list-style-type: none"> • The “Modeling” Section contains teaching content. • While in class, students complete “Recommended Item(s)” from “Guided Practice” section. • At home or on their own in class, students complete “Recommended Item(s)” from “Independent Practice” section.
Larger class size, lower student ability, and/or shorter class length	<ul style="list-style-type: none"> • The “Modeling” Section contains teaching content. • At home or on their own in class, students complete “Recommended Item(s)” from “Independent Practice” section.

Electrical Safety Reminder: Teachers should remind students that electricity is dangerous and that an adult should be present when any recommended activities or worksheets are being completed at home. Always obey instructions on warning labels and ensure one has dry hands when touching electronics or appliances.

Performance Objectives

By the end of this lesson, students will be able to:

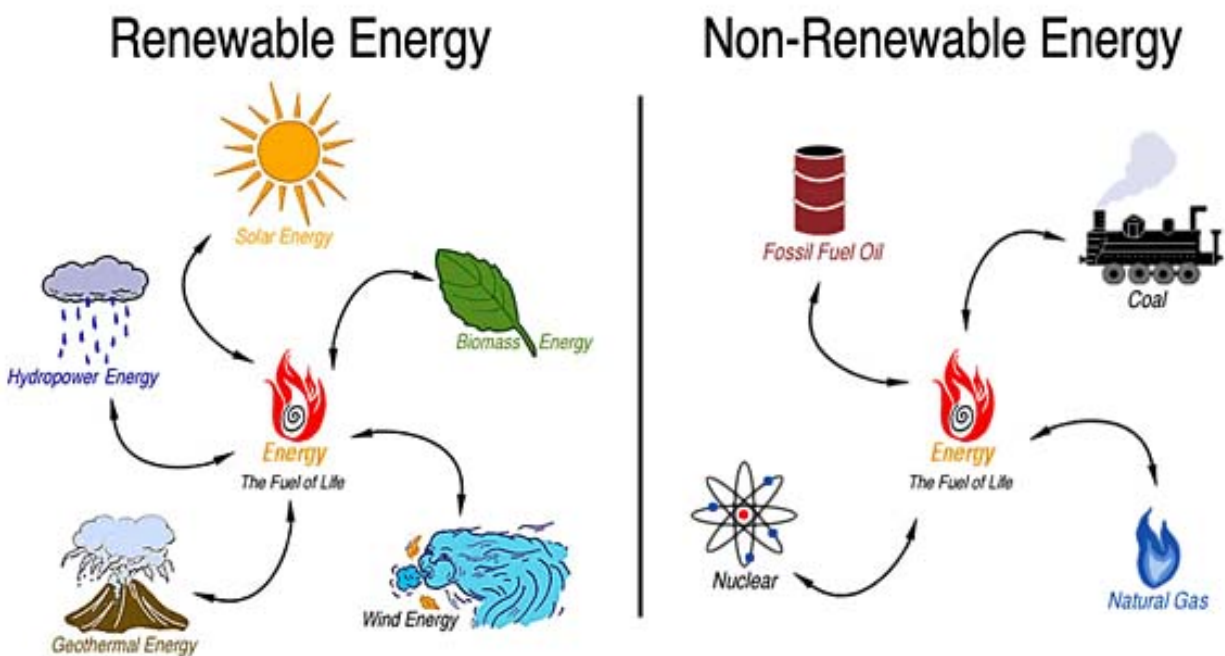
- Identify, explain, and provide examples of both renewable and non-renewable energy sources.
- Discover ways to conserve energy.
- Evaluate their families’ use of energy.
- Understand the benefits and disadvantages of using renewable resources.

I. Anticipatory Set (Attention Grabber)

? Essential Question

How can we be sure to never run out of energy?

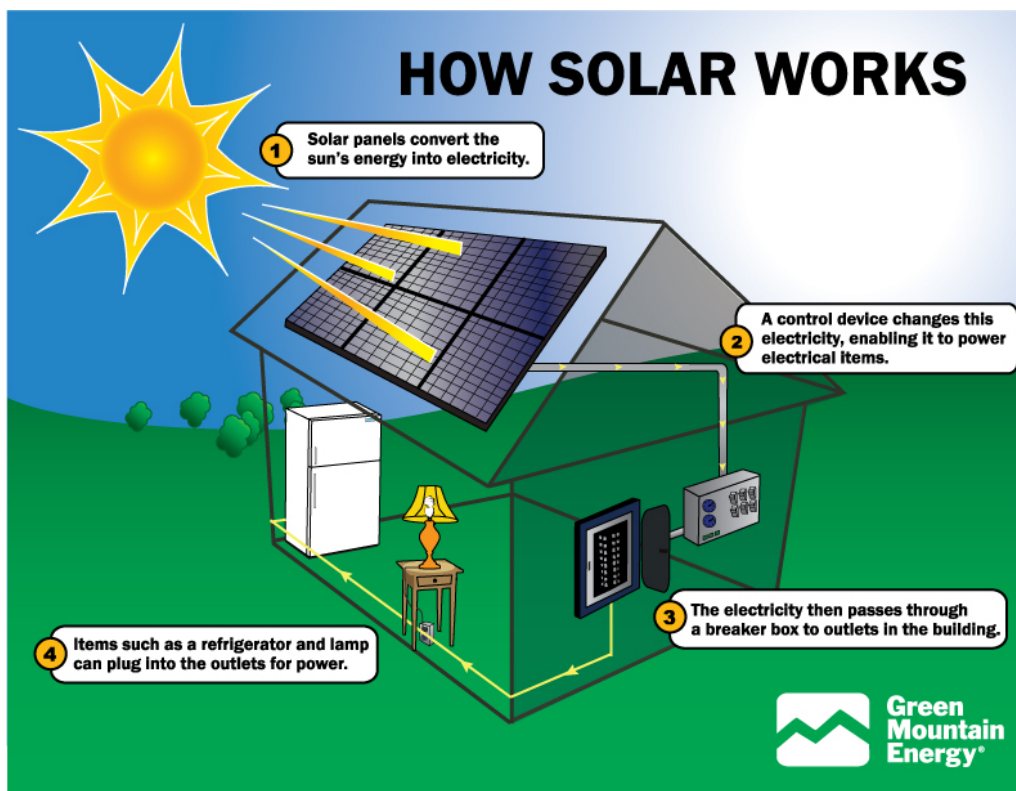
II. Modeling (Concepts to Teach)



A natural resource is given by nature and can be used as a source of energy. A **renewable natural resource** is one that can be renewed, or replenished in a reasonable amount of time (in years or a human-life span), once it has been used. Renewable energy is generated from natural sources (sun, wind, rain, tides, and vegetation) and can be generated again and again when needed. It is generally replenished naturally. For example, trees are a renewable resource because once a tree is removed and used, a new tree can grow in its place. Additional information is available at <http://www.tva.gov/renewable/>.

Types of Renewable Natural Resources

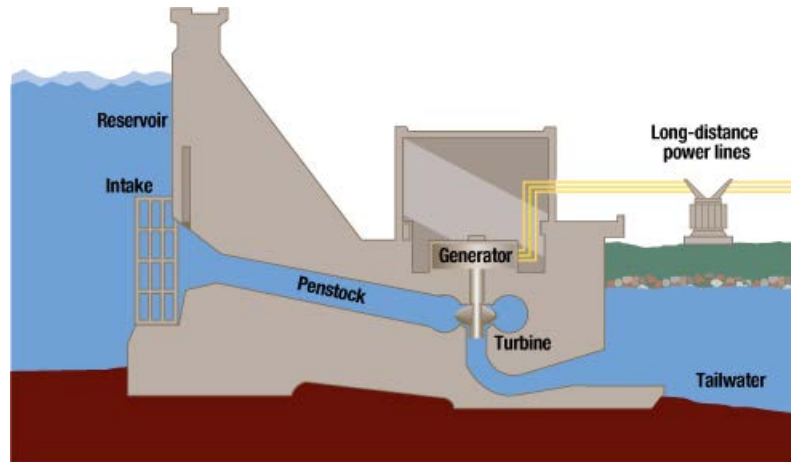
1. **Solar Energy** – The sun’s light contains energy in the form of electromagnetic waves. Usually, when light hits an object the energy turns into heat, like the warmth felt while sitting in the sun. But when light hits certain materials, like silicon, the energy turns into an electrical current instead, which can then be harnessed for power. This was discovered earlier in history when Einstein explained the Photoelectric Effect and proposed that light can act like a particle, as well as a wave. For more information, see <http://www.tva.gov/greenpowerswitch/solar.htm> and <http://www.tvakids.com/electricity/solar.htm>.



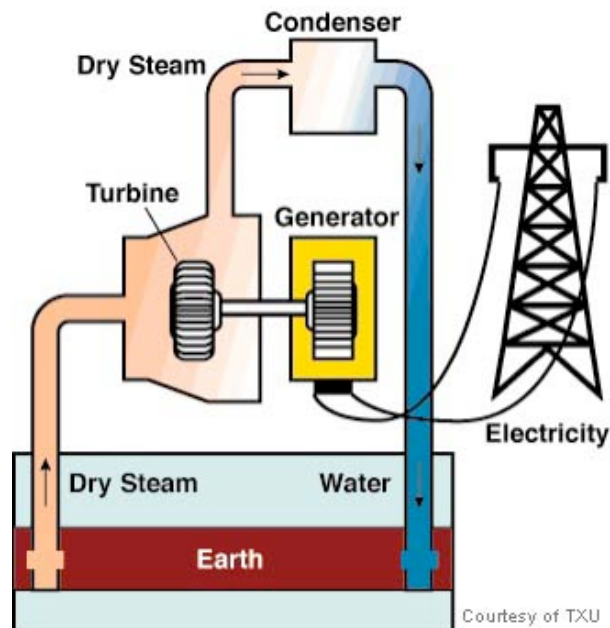
A WORKING SCHEME OF HOW SOLAR WORKS

Image source: lerablog.org

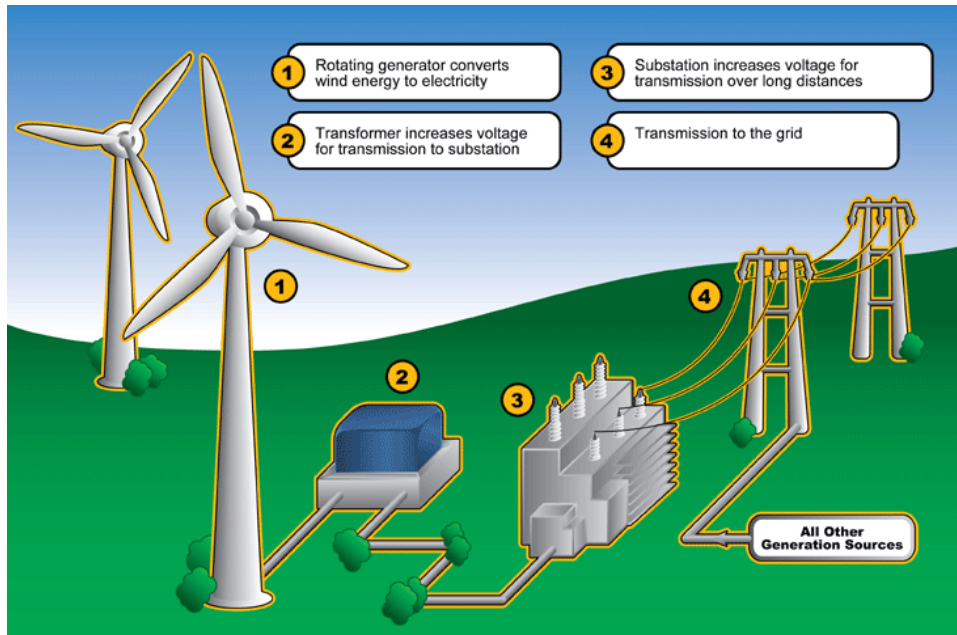
2. **Hydroelectric Energy** – Hydroelectric plants use falling water from a dam to turn the turbine of a generator. The generator then produces electricity. <http://water.usgs.gov/edu/hyhowworks.html> or <http://www.tvakids.com/electricity/hydro.htm>, <http://www.tva.com/power/hydro.htm>



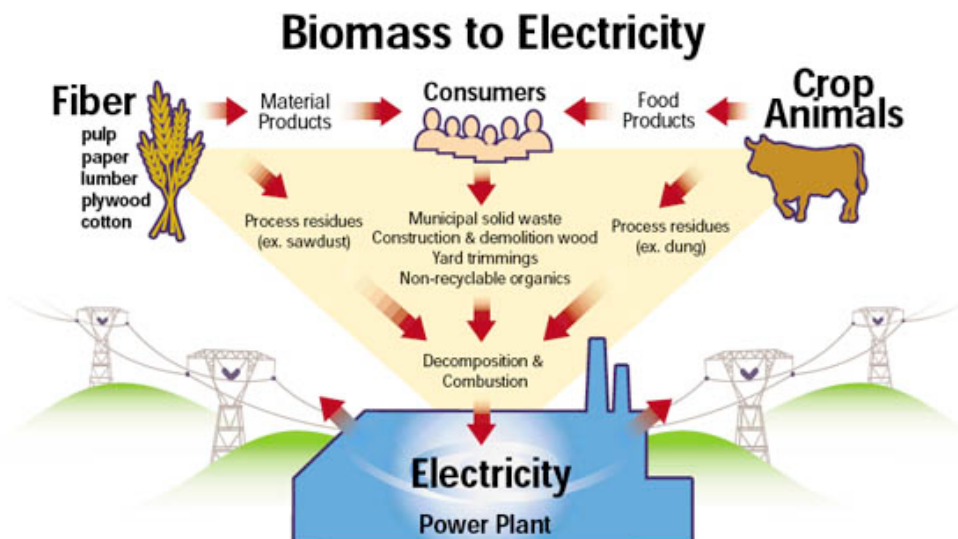
3. **Geothermal Energy** – from the Greek words *geo*, or “earth,” and *therme*, meaning “heat.” Deep inside the Earth lies hot water and steam that can be used to heat homes and businesses and generate electricity cleanly and efficiently. The steam is used to drive turbines of a generator and the generator produces electricity. <http://www.tvakids.com/electricity/geothermal2.htm>



4. **Wind Energy** – The energy of the wind is transferred to the turbines of the generator and the generator produces electricity. Wind turbines use the momentum of moving air to quietly turn large blades that are attached to the shaft of an efficient electric generator. <http://www.tvakids.com/electricity/wind.htm>



5. **Biomass Energy** – Biomass is matter usually thought of as garbage. This matter includes things like leaves, tree branches, leftover crops, wood chips, and bark. It can even include animal manure and old tires.

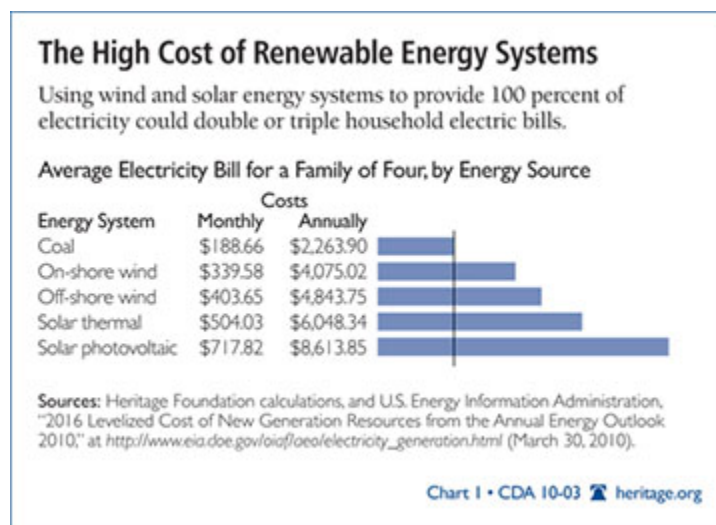


The biomass is then placed into a furnace and burned, or the methane gas in a liquid or gaseous state from algae or rotting / decomposing materials is captured. The heat generated is used to boil water. The steam from the boiling water is used to turn turbines and generators to produce electricity.

A **non-renewable natural resource** is one that has specific conditions that made them (like fossilized plant matter converting into coal), and can take many generations to reproduce. Sometimes the conditions are not likely to occur again so they are limited in supply and once used cannot be re-generated within a short span of time. Non-renewable sources exist in the form of natural gas, oil, and coal. For example, fossil fuels have been percolating beneath the Earth for hundreds of millions of years, and once they're gone, they're going to take millions more years to replenish.

Types of Non-Renewable Natural Resources

1. **Coal Energy** – Coal is the product of millions of years of pressure on organic matter from plants buried underground. According to Energy Information Administration, coal-burning power plants are the number one



source of electricity in the U.S., and burning coal is an inexpensive way to generate electricity compared to many renewable sources. However, burning coal produces greenhouse gases, which scientists believe is contributing greatly to global warming. <http://www.tvakids.com/electricity/fossil.htm>

2. **Oil Energy** – Crude Oil is referred to as Liquid Petroleum. It is used for gasoline, heating oil, and diesel fuel. In addition, manufacturers utilize oil for such products as plastics and industrial chemicals.
3. **Natural Gas Energy** – Natural gas reserves often share space with underground oil reserves, so the two

non-renewable resources are often extracted at the same time. Consumers use it as cooking fuel, to heat houses, and sometimes as vehicle fuel. It is also used to generate 27.6% of the U.S. electricity. It would take many generations, perhaps millions of years, to replenish natural gas.

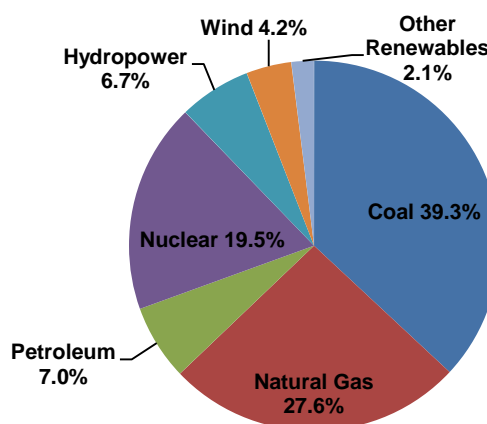
<http://www.tvakids.com/electricity/combustion.htm>

4. **Nuclear Energy** – Nuclear energy makes use of Uranium-235, a radioactive chemical naturally found in the earth. This radioactive substance undergoes decay and in the process releases a great deal of heat. The heat is then used to create steam; that steam is used to turn a turbine in a generator. The generator produces the electricity. There are no greenhouse gases released in this process. However, there are radioactive byproducts that must be stored safely because they are an environmental hazard. It is considered a non-renewable form of energy because it takes real manipulation to split an atom.

<http://www.tvakids.com/electricity/nuclear.htm>

U.S. NET ELECTRICITY GENERATION BY ENERGY SOURCE (2013)

Source: Energy Information Administration (EIA), Monthly Energy Review, May 2014, Table 7.2a, 2014.
<http://www.eia.gov/totalenergy/data/monthly/-electricity>



The above chart shows the percent of electricity generation by energy source. Most power is now generated from coal, natural gas, and nuclear plants. If time permits, teachers can go over each source in the pie chart.

III. Checking for Understanding

Teachers can ask students these questions to determine understanding of concepts.

REMEMBER	List the renewable energy sources. List the non-renewable sources of energy. (Teachers can list these on the board with help from students. Ex. Renewable – solar, wind, etc.)
UNDERSTAND	Explain the difference between a renewable and a non-renewable energy source. (Class discussion)
ANALYZE	Categorize a list of sources of energy (water, wind, coal, natural gas, etc.) into the correct categories of renewable and non-renewable energy. (Class discussion)
EVALUATE	Debate the pros and cons of using non-renewable energy. (Class discussion)
CREATE	Create a brochure that persuades people in your community to conserve energy. (Teachers instruct students to create a brochure on a piece of paper. http://www.education.com/activity/article/make_a_fun_brochure_fourth/)

IV. Guided Practice Ideas

Recommended Items

Shoobox Solar Oven (see below)

Class Activities

- **Classroom exercise:** Separate classroom board with a line. Put Renewables title on one side and Non-Renewables title on the other side. Teachers have students draw the different types of energy to tape or post on the board. At the end of the lesson, hand out a piece of paper to each child to write down and/or draw the types of energy in their respective categories of renewable and non-renewable energy. Children can take the paper home to teach adults in the household.
- **Field trip:** If school location permits, consider a field trip to a hydropower dam or Raccoon Mountain Pump Storage plant visitor center. Raccoon Mountain is a Pump Storage Plan that uses power to pump water at night, and then uses water to generate electricity during the day. Discuss how a Pump Storage Plant like Raccoon Mountain fits. Is it a renewable or non-renewable or hybrid (both)?

Experiments

- **Shoobox Solar Oven Experiment** http://www.ehow.com/how_6303306_make-oven-school-project-shoobox.html
- **Power From Water Experiment:** <http://www.education.com/science-fair/article/water-produce-energy/>
- **Hydropower: The Final Experiment:** <http://blogs.cas.suffolk.edu/mattersofsci/2012/05/03/hydropower-the-final-experiment/>
- **Create a Windssock Experiment** (Duke Energy) <http://www.duke-energy.com/pdfs/wind-power-education-for-kids.pdf>
- **Sun Angles and Solar Power Experiment** <http://www.kidwind.org/>

Games

- Interactive Game – Save the World: <http://www.wonderville.ca/asset/save-the-world>

Other Resources

Practice that uses math/reading standards:

- Wind Energy Math: Measure the sweeping area of a wind turbine <http://www.kidwind.org/>
- Class-wide debate between renewable and non-renewable energy sources. Teachers facilitate a classroom debate about the pros and cons of using renewable vs. non-renewable energy.

Other activities and knowledge sites:

<http://learn.kidwind.org/teach>
<http://www.greenprophet.com/2010/04/green-legos-solar-cars-and-wind-powered-lego-robots/>
<http://www.sciencekids.co.nz/sciencefacts/energy/windenergy.html>
<http://www.green-planet-solar-energy.com/high-bounce-ball.html>

V. Independent Practice Ideas

Recommended Items

See the Wind; At-Home Checklist: Renewable Energy at Home (see below)

Other Resources

Personal Practice

- Wind Power Worksheets: All four worksheets listed below are available at the following Duke Energy address:
<http://www.duke-energy.com/pdfs/wind-power-education-for-kids.pdf>
 - Wind Power Crossword Puzzle
 - Create Your Own Wind Turbine – connect the dots and color
 - Wind Maze
 - T/F, Fill in the Blank Worksheet
- Venn diagram: Teachers ask students to compare wind energy with their choice of another form of renewable energy using a Venn diagram. (Ex. Draw two large intersecting circles. Label one circle wind energy and the other circle another renewable energy, such as solar).
http://www.learninggamesforkids.com/graphic_organizers/writing/venn-diagram.html
- Journal (if the students have a journal). Teachers write the following question on the board and ask students to copy and answer the question in their journals: How is the use of different energy (renewable and non-renewable) going to impact society long and short term?

Practice That May Involve Parents or Guardians

- At-Home Activity: See the Wind (kite, streamers, string, and balloon)
http://www1.eere.energy.gov/education/pdfs/wind_seethewind.pdf
- At-Home Checklist: Renewable Energy at Home – Teachers write the following question on the board and ask students to copy it on a sheet of paper. What renewable energy sources does your home use?
- At-Home Activity: Teachers write the following question on the board and ask students to copy it on a sheet of paper. How could you include more renewable energy in your home?

VI. Assessment

These items provide a check for understanding so teachers can easily determine whether concepts need to be reinforced. These items can be graded, if desired.

- Journal (if completed as Independent Practice, as shown above)
- Wind Power Worksheets (if completed as Independent Practice, as shown above)
- Venn diagram (if completed as Independent Practice, as shown above)

VII. Materials Needed

The following materials are needed for the “Recommended Items” in Guided Practice & Independent Practice sections.

- Shoebox with a lid
- Black paper or black paint
- Ruler
- Knife or box cutter
- Craft glue
- Plastic wrap
- Aluminum foil
- Dowel rod

VIII. Closing the Lesson

In addition to the Essential Question shown below, teachers can reference Performance Objectives at the top of the Lesson Plan.

Essential Question

How can we be sure to never run out of energy?