NSTA - AHEEC Curriculum Guide - Middle School - Grades 6-8

The **America's Home Energy Education Challenge (AHEEC)** is designed to help educators:

- educate students across the United States in grades 6-8 about energy and the benefits of energy conservation and efficiency;
- teach students to recognize that lowering their home energy use saves money;
- engage schools, students, and their families in a **Save Energy, Save Money** initiative.

Sponsored by the U.S. Department of Energy, this curriculum guide supports educators in meeting state and national standards for teaching energy concepts, while enabling students to earn Energy Fitness Awards by improving their knowledge of energy use and conservation. In addition, students earn points for their school or group in the AHEEC by completing in-class assignments and optional Quests.

Objectives

Students will:

- participate in class activities which investigate energy and how it is produced, transmitted, conserved, and managed at local, national, and global levels.
- analyze energy resources and examine ways to minimize human impacts on the environment.
- evaluate their personal use of energy and develop a plan for conservation.
- explore modifications to improve energy efficiency by reducing energy transfer to the environment.
- use research and reasoning to empower their communities (home, school, and local) to adopt energy and money-saving practices.
- engage in STEM activities with real-world applications for their daily behaviors.

Standards

The AHEEC curriculum is aligned with the **Next Generation Science Standards** for grades 6-8 *(note: NGSS Standards will be finalized and updated in April 2013)*. Students who demonstrate understanding can:

- **MS-PS3-a.** Construct and interpret graphical displays to describe the relationships between the kinetic energy of an object and its mass, and between the kinetic energy of an object and its speed, in order to better define a real world problem.

- **MS-PS3-c.** Design, construct, and test a device that either minimizes or maximizes thermal energy transfer by conduction, convection, and/or radiation. *Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.*

- **MS-PS3-d.** Design an investigation to determine the relationships among the energy transferred, the type of matter, the amount of sample, and the resulting change in temperature of the sample. *Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added. Experiments can be designed individually and collaboratively.*

- **MS-PS3-e.** Use and present written arguments that contain evidence to support the claim that when the motion energy of an object changes, energy is transferred to or from the object. *Arguments are supported by empirical evidence and reasoning, and can include an inventory or other representations of the energy before and after the transfer. Evidence should be provided to students in the form of temperature changes or motion of object. Students will need to argue conceptually that energy transfers always result in some energy being transferred to the surroundings.*

- **MS-PS3-g.** Modify the design of a machine to improve its efficiency by reducing energy transfer to the surrounding environment. *Energy transfer can include the transfer of energy from motion to thermal energy due to friction. Solutions should focus on the use of advancements in technological and material science to reduce environmental impacts. Familiar machines could include vehicles, bicycles, and pulleys.*

- **MS-ESS3-a.** Construct explanations based on evidence from multiple sources for how the uneven distribution of Earth's mineral and energy resources, which are limited and typically nonrenewable, is a result of past and current geologic processes often associated with plate tectonics. *For example, the global distribution of coal is a result of the burial and lithification of ancient swamp matter; the global distribution of petroleum is the result of the burial of organic marine sediments and subsequent development of petroleum traps; and the global distribution of many precious metals (e.g., gold, copper) correlates with past volcanic and hydrothermal activity associated with subduction zones.*

- **MS-ESS2-n.** Use models of Earth's atmosphere and surface to support the explanation of the greenhouse effect. *Model explanations, physical or conceptual, reveal various ways that heat energy moves through and is stored within Earth's systems.*

- **MS-ESS3-d.** Read critically to evaluate competing ideas and present the findings regarding the use of technologies that rely on renewable and nonrenewable energy resources. *Reading sources could be scientific assessments such as the National Research Council's, "America's Energy Future" study and other NRC publications. Energy resources include renewable energy resources (e.g., hydroelectric, geothermal, biomass fuels), inexhaustible energy sources (e.g., sunlight, wind, tides, ocean waves), and nonrenewable energy sources (e.g., coal, oil, natural gas, nuclear fission). Constraints on resource use include geographic availability, costs, benefits, safety, performance, sustainability, and environmental impacts.*

- **MS-ESS3-e.** Design and communicate solutions that meet criteria and constraints for minimizing human impacts on environments and local landscapes by: (1) managing water resources, (2) reducing pollution, and (3) reducing the release of greenhouse gases. *The design process could include examining an example of human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating a solution that could reduce that impact. Examples of human "impacts" include but are not limited to: (1) the withdrawal of stream water and groundwater, construction of dams and levees, and removal of wetlands; (2) air and water pollution, light pollution, noise pollution, landfill contamination, and plastics in the ocean; and, (3) carbon dioxide release from combustion and cement production, methane release from agriculture and the warming of permafrost and coastal regions, and nitrous oxide release.*

Materials and Suggested Timeframe

- The Next Generation Science Standards above are detailed according to grade levels 6-8; state requirements for energy-related education will vary somewhat from grade to grade, but are consistent with the content of this curriculum. The following lesson plans may be differentiated for learners across the span of the three grades. Sixth graders will most likely require more guided instruction through the material than 8th graders, who may have greater experience with the content as well as more highly developed independent learning skills. As the educator and expert in your classroom, you determine the best methods for exploring this content, engaging in the activities, and evaluating your students. It may be that you have already covered the energy concepts required for these activities. Whatever the case, each lesson provides several options for teaching background information, engaging students in the content area, and extending their knowledge with additional hands-on experiences.

- Prior to beginning this lesson series, check to be sure that you have access to the associated web content listed below, texts containing necessary information, or can make necessary photocopies to replicate online or textual information.

Website Title	URL
EIA Kids	http://www.eia.gov/kids/
NEED - The Great Energy Debate	http://www.need.org/needpdf/Great%20Energy%20Debate%20Game.pdf
NEED - Energy Flows	http://www.need.org/needpdf/Energy%20Flows.pdf
NEED - Exploring Energy: Hands-On Activities	http://www.need.org/needpdf/Exploring%20Energy.pdf
National Geographic Great Energy Challenge	http://environment.nationalgeographic.com/environment/energy/great-energy-challenge/global-personal-energy-meter/
Solar Oven Experiment	http://www.uen.org/Lessonplan/preview?LPid=2536
Energy House Lab	http://www.need.org/needpdf/Energy%20House.pdf
EPA's Student Guide to Global Climate Change	http://www.epa.gov/climatechange/kids/index.html

- Determine which activities your students are going to complete for each lesson and prepare additional materials as needed for labs. Secure computer lab time if necessary. Copy the lesson worksheets and required materials for labs and activities well in advance of implementing the lessons. Take a look at the associated links and become familiar with navigating around the sites, try out the energy calculators, complete your own personal energy audit, browse the lab options, and preview the optional quest activities. With a strong sense of the content and objectives for the overall curriculum, you can help your students make meaningful connections between activities as they explore them one by one.

- Unless otherwise indicated, each lesson requires the following materials: single computer with projection capability or computer access for each student, and lesson worksheets in photocopied form or access to online completion and printing. Labs and experiments require additional materials as noted on lab instructions.

- Items to photocopy per student:

Lesson #	Item to Copy	Where to Find It
Introduction	Glossary Pre-Assessment Quiz	Curriculum Guide pg. 6-10 Curriculum Guide pg. 39-40
1	Lesson 1 Worksheet Energy Flows Materials	Curriculum Guide pg. 12-15 http://www.need.org/needpdf/Energy%20Flows.pdf
2	Field Trip Worksheet OR Great Energy Debate Materials	Curriculum Guide pg. 17-19 http://www.need.org/needpdf/Great%20Energy%20Debate%20Game.pdf
3	Lesson 3 Worksheet	Curriculum Guide pg. 21-24
4	Lesson 4 Worksheet Home Energy Audit	Curriculum Guide pg. 26-27 Curriculum Guide pg. 28-31
5	Lesson 5 Worksheet	Curriculum Guide pg. 33-35
Projects	Quests	Curriculum Guide pg. 36-38
Assessment	Post-Assessment Quiz Energy Fitness Award Rubric	Curriculum Guide pg. 40-43 Curriculum Guide pg. 45

- Activity worksheets, lab responses, and procedures are provided for each lesson. A complete glossary is provided on pg. 6-10. Optional pre-assessment and post-assessment quizzes follow the lesson plans on pg. 40-43. The Quests on p. 36-38 can be used as project categories for individuals or groups, or as extra credit incentives. Remember that the Quests earn additional points for your school or group in the AHEEC. Finally, an answer key for all worksheets begins on pg. 46. You may adapt the plans as needed to differentiate instruction for your students, fit your schedule of classes, account for prior knowledge, or work within technological constraints.

- The basic lessons and activities are designed to be five of the ten class periods suggested for implementing the *America's Home Energy Education Challenge.* Some activities, such as labs, are intended to reinforce the energy concepts in the basic lessons through immersion in a hands-on experience. These labs typically require an additional class period or extended block of time. A team-teaching approach would allow you to implement activities across the curriculum, while enabling your students to take their understanding of the content beyond a single classroom.

SUGGESTED 5-LESSON TIMEFRAME				
Lesson	**Topic**	**Time**	**Objectives**	**Tasks**
1	***Getting Energized*** (Energy Basics)	90 minute block + optional 45 minute activity	Students will be able to describe the forms and sources of energy, how energy is used and conserved, and how that use affects the environment.	* Review energy concepts through pre-assessment quiz and web-quest. * Preview essential vocabulary and Energy Fitness Award lessons. * Participate in an Energy Flows activity (extension).
2	***Gaining Energy Perspective*** *(Energy Resources and Usage)*	90 minute block, + 1/2 day for Field Trip Option	Students will be able to evaluate the advantages and disadvantages of the major energy sources.	* Take part in the Great Energy Debate. * Visit a local energy source (field trip extension).
3	***Reducing Energy Loss*** *(Energy Transmission)*	90 minute block + optional 90 minute lab	Students will be able to explain the Law of Conservation of Energy with models, compare energy conservation and efficiency, and explain the concept of the transfer of energy.	* Model the Law of Conservation of Energy. * Review energy efficiency verses conservation. * Analyze Energy Guide labels. * Build and compare efficiency of two different solar cookers (extension).
4	***Making Energy Personal*** *(Energy Conservation)*	90 minute block + optional 2-class lab	Students will be able to explain how their personal energy use connects to global issues, and argue that reducing their energy usage affects more than their personal costs.	* Explore the use of energy in homes & schools. * Calculate personal use with National Geographic mini calculators. * Complete a detailed home energy audit. * Build and test insulation in a model cardboard house (extension).
5	***Powering the Future*** *(Energy Management)*	90 minute block	Students will be able to describe connections between energy use and climate change, and use research and reason to predict the results of applying energy conservation at local, state and national levels.	* Read and respond to EPA's Student Guide to Global Climate Change. * Prepare a final report which discusses the widespread benefits of applying energy conservation locally, statewide, and nationally.

Glossary

- Alternative Fuel - A popular term for "non-conventional" transportation fuels made from natural gas (propane, compressed natural gas, methanol, etc.) or biomass materials (ethanol, methanol).
- Alternative-Fuel Vehicle (AFV) - A vehicle designed to operate on an alternative fuel (e.g., compressed natural gas, methane blend, electricity). The vehicle could be either a vehicle designed to operate exclusively on alternative fuel or a vehicle designed to operate on alternative fuel and/or a traditional fuel.
- Appliance - A piece of equipment, commonly powered by electricity, used to perform a particular energy-driven function. Examples of common appliances are refrigerators, clothes washers and dishwashers, conventional ranges/ovens and microwave ovens, humidifiers and dehumidifiers, toasters, radios, and televisions.
- Biodiesel - An alternative fuel that can be made from any fat or vegetable oil. It can be used in any diesel engine with few or no modifications. Although biodiesel does not contain petroleum, it can be blended with diesel at any level or used in its pure form.
- Biofuels - Liquid fuels and blending components produced from biomass (plant) feedstocks, used primarily for transportation.
- Bioreactor - A landfill where the waste actively decomposes rather being simply buried in a "dry tomb."
- Biomass - Any organic (plant or animal) material which is available on a renewable basis, including agricultural crops and agricultural wastes and residues, wood and wood wastes and residues, animal wastes, municipal wastes, and aquatic plants.
- British thermal unit (Btu) - The amount of heat required to raise the temperature of one pound of water one degree Fahrenheit; equal to 252 calories. British thermal unit is abbreviated as Btu.
- Carbon Dioxide - A colorless, odorless noncombustible gas with the formula CO_2 that is present in the atmosphere. It is formed by the combustion of carbon and carbon compounds (such as fossil fuels and biomass) and by respiration, which is a slow combustion in animals and plants, and by the gradual oxidation of organic matter in the soil.
- Chemical Energy - Energy stored in a substance and released during a chemical reaction such as burning wood, coal, or oil.
- Climate Change - A term used to refer to all forms of climatic inconsistency, but especially to significant change from one prevailing climatic condition to another. In some cases, "climate change" has been used synonymously with the term "global warming"; scientists, however, tend to use the term in a wider sense inclusive of natural changes in climate, including climatic cooling.
- Coal - A fossil fuel formed by the breakdown of vegetable material trapped underground without access to air.
- Combustion - Chemical oxidation accompanied by the generation of light and heat.
- Diesel Fuel - A fuel composed of distillates obtained in petroleum refining operation or blends of such distillates with residual oil used in motor vehicles. The boiling point and specific gravity are higher for diesel fuels than for gasoline.
- DOE - U.S. Department of Energy.
- Electricity - A form of energy characterized by the presence and motion of elementary charged particles generated by friction, induction, or chemical change.
- Electricity Generation - The process of producing electric energy or the amount of electric energy produced by transforming other forms of energy, commonly expressed in kilowatt-hours (kWh) or megawatt-hours (MWh).
- Electric Power - The amount of energy produced per second. The power produced by an electric current.

- Electromagnetic Energy - Energy that travels in waves, such as ultra-violet radiation. It can be thought of as a combination of electric and magnetic energy.
- Emission - A discharge or something that is given off; generally used in regard to discharges into the air. Or, releases of gases to the atmosphere from some type of human activity (cooking, driving a car, etc). In the context of global climate change, they consist of greenhouse gases (e.g., the release of carbon dioxide during fuel combustion).
- Energy - The ability to do work or the ability to move an object. Electrical energy is usually measured in kilowatt-hours (kWh), while heat energy is usually measured in British thermal units (Btu).
- Energy Consumption - The use of energy as a source of heat or power or as a raw material input to a manufacturing process.
- Energy Efficiency - Refers to activities that are aimed at reducing the energy used by substituting technically more advanced equipment, typically without affecting the services provided. Examples include high-efficiency appliances, efficient lighting programs, high-efficiency heating, ventilating and air conditioning (HVAC) systems or control modifications, efficient building design, advanced electric motor drives, and heat recovery systems.
- Ethanol - A colorless liquid that burns to produce water and carbon dioxide. The vapor forms an explosive mixture with air and may be used as a fuel in internal combustion engines.
- Filament - The fine metal wire in a light bulb that glows when heated by an electric current.
- Flat-Plate Solar Connector - A device designed to capture the sun’s energy and produce low temperature heat energy. They are commonly used as collectors in solar heating systems.
- Fossil Fuels - Fuels (coal, oil, natural gas, etc.) that result from the compression of ancient plant and animal life formed over millions of years.
- Fuel - Any material that can be burned to make energy.
- Gasoline - A complex mixture of relatively volatile hydrocarbons with or without small quantities of additives, blended to form a fuel suitable for use in spark-ignition engines.
- Generator - A device that turns mechanical energy into electrical energy. The mechanical energy is sometimes provided by an engine or turbine.
- Geothermal Energy - The heat energy that is produced by natural processes inside the earth. It can be taken from hot springs, reservoirs of hot water deep below the ground, or by breaking open the rock itself.
- Greenhouse Effect - The effect of the Earth's atmosphere, due to certain gases, in trapping heat from the sun; the atmosphere acts like a greenhouse.
- Greenhouse Emissions - Waste gases given off by industrial and power plants, automobiles and other processes.
- Greenhouse Gases - Gases that trap the heat of the sun in the Earth's atmosphere, producing the greenhouse effect. The two major greenhouse gases are water vapor and carbon dioxide. Lesser greenhouse gases include methane, ozone, chlorofluorocarbons, and nitrogen oxides.
- Green Pricing - In the case of renewable electricity, green pricing represents a market solution to the various problems associated with regulatory valuation of the non-market benefits of renewables. Green pricing programs allow electricity customers to express their willingness to pay for renewable energy development through direct payments on their monthly utility bills.
- Grid - The layout of an electrical distribution system.

- Heating Equipment - Any equipment designed and/or specifically used for heating ambient air in an enclosed space. Common types of heating equipment include: central warm air furnace, heat pump, plug-in or built-in room heater, boiler for steam or hot water heating system, heating stove, and fireplace.
- Hydroelectric Power Plant - A power plant that uses moving water to power a turbine generator to produce electricity.
- Hydrogen - A colorless, odorless, highly flammable gaseous element. It is the lightest of all gases and the most abundant element in the universe, occurring chiefly in combination with oxygen in water and also in acids, bases, alcohols, petroleum, and other hydrocarbons.
- Hydropower - Energy that comes from moving water.
- Incandescent Light Bulb - A type of electric light in which light is produced by a filament heated by electric current. The most common example is the type you find in most table and floor lamps. In commercial buildings, incandescent lights are used for display lights in retail stores, hotels and motels.
- Kilowatt - A unit of power, usually used for electric power or to energy consumption (use). A kilowatt equals 1000 watts.
- Kilowatt hour (kWh) - A measure of electricity defined as a unit of work or energy, measured as 1 kilowatt (1,000 watts) of power expended for 1 hour. One kWh is equivalent to 3,412 Btu or 3.6 million joules.
- Kinetic energy - The energy of a body which results from its motion.
- Liquefied Petroleum Gas (LPG) -A group of hydrocarbon-based gases derived from crude oil refining or natural gas fractionation. They include ethane, ethylene, propane, propylene, normal butane, butylene, isobutane, and isobutylene. For convenience of transportation, these gases are liquefied through pressurization.
- Load - The power and energy requirements of users on the electric power system in a certain area or the amount of power delivered to a certain point.
- Mechanical Energy - The energy of motion used to perform work.
- Methane -A colorless, flammable, odorless hydrocarbon gas (CH_4) which is the major component of natural gas. It is also an important source of hydrogen in various industrial processes. Methane is a greenhouse gas.
- Miles Per Gallon (MPG) - A measure of vehicle fuel efficiency. MPG is computed as the ratio of the total number of miles traveled by a vehicle to the total number of gallons consumed.
- Municipal Solid Waste (MSW) - Residential solid waste and some nonhazardous commercial, institutional, and industrial wastes.
- Natural Gas - An odorless, colorless, tasteless, non-toxic clean-burning fossil fuel. It is usually found in fossil fuel deposits and used as a fuel.
- Non-biogenic waste: Waste made from fossil materials or materials of non-biological origin, such as plastics, and tire-derived fuels.
- Nonrenewable - Fuels that cannot be easily made or "renewed." We can use up nonrenewable fuels. Oil, natural gas, and coal are examples of nonrenewable fuels.
- Nuclear Energy - Energy that comes from splitting atoms of radioactive materials, such as uranium.
- Oil - The raw material that petroleum products are made from. A black liquid fossil fuel found deep in the Earth. Gasoline and most plastics are made from oil.
- OPEC - The Organization of Petroleum Exporting Countries organized for the purpose of negotiating with oil companies on matters of oil production, prices, and future concession rights. Current members (as of the date

of writing this definition) are Algeria, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, the United Arab Emirates, and Venezuela.

- Organic Waste - Waste material of animal or plant origin.
- Passive Heating System - A means of capturing, storing, and using heat from the sun.
- Peak Load Plant- A plant usually housing old, low-efficiency steam units, gas turbines, diesels, or pumped-storage hydroelectric equipment normally used during the periods that demand the maximum power.
- Petroleum - Generally refers to crude oil or the refined products obtained from the processing of crude oil (gasoline, diesel fuel, heating oil, etc.) Petroleum also includes lease condensate, unfinished oils, and natural gas plant liquids.
- Power - The rate at which energy is transferred. Electrical energy is usually measured in watts. Also used for a measurement of capacity.
- Power-Generating Efficiency - The percentage of the total energy content of a power plant's fuel which is converted into electric energy. The remaining energy is lost to the environment as heat.
- Power Plant - A facility where power, especially electricity, is generated.
- Refined Petroleum Products - Refined petroleum products include, but are not limited to, gasoline, kerosene, distillates (including No. 2 fuel oil), liquefied petroleum gas, asphalt, lubricating oils, diesel fuels, and residual fuels.
- Renewable Energy Sources - Fuels that can be easily made or "renewed." We can never use up renewable fuels. Types of renewable fuels are hydropower (water), solar, wind, geothermal, and biomass.
- Solar Cell - An electric cell which changes radiant energy from the sun into electrical energy.
- Solar Dish - A device that receives radiation collected by motorized collectors which track the sun.
- Solar Energy - The radiant energy of the sun, which can be converted into other forms of energy, such as heat or electricity.
- Solar Thermal Heating System - Systems using concentrating collectors to focus the sun's radiant energy onto or into receivers to produce heat.
- Space Heating - The use of energy to generate heat for warmth in housing units using space-heating equipment. The equipment could be the main space-heating equipment or secondary space-heating equipment.
- Thermal Energy - The total potential and kinetic energy associated with the random motions of the molecules of a material.
- Thermostat - A device that adjusts the amount of heating and cooling produced and/or distributed by automatically responding to the temperature in the environment.
- Transformer - A device which converts the generator's low-voltage electricity to higher-voltage levels for transmission to the load center, such as a city or factory.
- Transmission (Electric) - The movement or transfer of electric energy over an interconnected group of lines and associated equipment between points of supply and points at which it is transformed for delivery to consumers or is delivered to other electric systems. Transmission is considered to end when the energy is transformed for distribution to the consumer.
- Turbine - A device which blades, which is turned by a force, such as wind, water, or high pressure steam. The mechanical energy of the spinning turbine is converted into electricity by a generator.

- Vehicle Fuel Consumption - Vehicle fuel consumption is computed as the vehicle miles traveled divided by the fuel efficiency reported in miles per gallon (MPG). Vehicle fuel consumption is derived from the actual vehicle mileage collected and the assigned MPGs obtained from Environmental Protection Agency (EPA) certification files adjusted for on-road driving. The quantity of fuel used by vehicles.
- Waste Energy - Fuel which is derived from municipal solid waste, landfill gas, methane, digester gas, liquid acetonitrile waste, tall oil, waste alcohol, medical waste, paper pellets, sludge waste, solid byproducts, tires, agricultural byproducts, closed loop biomass, fish oil, and straw.
- Water Heater - An automatically controlled, thermally insulated vessel designed for heating water and storing heated water at temperatures less than 180 degrees Fahrenheit.
- Water Turbine - A turbine that uses water pressure to rotate its blades. Primarily used to power an electric generator.
- Watt - A metric unit of power, usually used in electric measurements, which gives the rate at which work is done or energy used.
- Wind Tower - Devices, some as tall as 120 feet, which lift wind turbine blades high above the ground to catch stronger wind currents.

Procedures

Lesson 1: Getting Energized *(90 minute block + 45 minute optional activity)*	
Objective: Students will be able to describe the forms and sources of energy, how energy is used and conserved, and how that use affects the environment.	
Materials	1. As noted in the introduction - computer access and/or copies for Lesson 1 content and worksheet. Copy pre-assessment quiz if you plan on using it. 2. Extension activity materials vary depending on educator selections.
Procedures	1. This lesson is an introduction to the Energy Fitness Award activities, and is intended to renew and engage your students' prior energy knowledge. 2. Optional: Distribute and have students complete the pre-assessment quiz. 3. Using a Think-Pair-Share format, instruct your students to create an energy word cluster on a piece of paper. Have them write ENERGY in the center of the paper. They should **think** of every energy word or concept that comes to mind, and cluster them around the word ENERGY, grouping similar concepts together if possible. 4. After five to ten minutes, have the students **pair** with a classmate and share their clusters, adding any new words or concepts to their papers as the sharing occurs. **5.** After five minutes, have a spokesperson for each pair **share** their clusters; record all correct ideas on a classroom cluster on the board or projector screen, grouped into the following six categories: **Forms/Types of Energy, Laws/Conversion of Energy, Renewable/Nonrenewable Sources, Energy Usage, Energy Conservation/Efficiency, and Effects on the Environment.** 6. Tell students to be sure their clusters include all concepts by the end of the sharing - they should add concepts to their papers as you add to the master example. **7.** Explain that they are embarking on an energy journey as part of the America's Home Energy Education Challenge (AHEEC), and introduce them to the AHEEC website http://www.homeenergychallenge.org/**.** Point out the Energy Lab Desk where they can find all materials for their journey and optional quest activities. Briefly introduce the five main lessons and topics that you will be covering in class. 8. Distribute the Lesson 1 Worksheet and preview the questions -- can any of them be completed based on the clusters you made? 9. Explain that they responsible for exploring energy further by following the link for the EIA Kids Web-quest and URL on the Lesson 1 worksheet. Textbook research could be used in place of the web-quest, with the questions adapted to the text being used. 10. Using individual computer stations or a class computer projected on a screen, follow the links/URL on the worksheet to discover answers to all the questions. Students may benefit from a "guided tour" of EIA Kids prior to independent work. 11. When all students are finished with the worksheet, they should file it in an energy folder for future reference. Remind students they are responsible for maintaining this folder throughout the AHEEC. You will need to check their Lesson 1 Worksheet for accuracy and completion and note a score on the AHEEC rubric. 12. Given your remaining time or for an additional class, you can extend this introductory lesson with an activity on energy flows found at http://www.need.org/needpdf/Energy%20Flows.pdf. The activity leads students through various energy source flows, and ends with the interactive reading of a "Cool Coal Story" with props. 13. Some alternative hands-on activities can be found at: http://www.need.org/needpdf/Exploring%20Energy.pdf

Lesson 1: Getting Energized
NAME: _____ **DATE:** _____

Welcome to your first Energy Fitness Award Lesson! You will be using the EIA Kids website to discover the answers to the questions on this worksheet. Before you get started, can you answer any using your energy cluster? If not, then it's time to start finding the information that you need. Use the Energy Kids URL here to get to the main website, and navigate your way through the website using the titles for each section on this worksheet, and the headings on the site. Click here or enter the URL in your browser to get started! http://www.eia.gov/kids/energy.cfm?page=1

Part 1: Definition of Energy

Energy is: _____
_____.

Part 2: Types and Forms of Energy

There are many forms of energy, but they can all be put into two categories. Write and define the two types of energy and list the forms in the table below.

Type: _____ **Definition:** _____ _____ _____	**Type:** _____ **Definition:** _____ _____ _____
Forms	Forms
1	1
2	2
3	3
4	4
	5

Part 3: Law of Conservation of Energy and Energy Conversion

a. The Law of Conservation of Energy says _____
_____
_____.

b. The law of conservation of energy says that when you use energy, it doesn't disappear. What happens to it? _____
_____.

c. Converting energy means changing it from one form into another. List one example of an energy conversion, including the initial form of energy and the form that it becomes.

Conversion example: _____
_____
_____.

d. Are energy conversions ever 100% efficient? Explain why or why not. _____
_____
_____.

Part 4: Sources of Energy

Humans use nine major sources of energy to power their activities. Some of these sources are renewable and some are nonrenewable. What does it mean when we say an energy source is:

a. Nonrenewable: _____

b. Renewable: _____

List the sources and the percentage of energy consumed through their use in the U.S. in the table below. Then add the % columns to compare their usage.

Nonrenewable Sources	% of Energy Consumed by Use of this Source	Renewable Sources	% of Energy Consumed by Use of this Source
Total % Nonrenewable:		Total % Renewable:	

c. Which source provides the most energy? _____.

d. Most of the energy used in the U.S. comes from _____ sources.

e. Why is there concern about this? (Think to answer the question -- the answer is not on the website.)
_____
_____
_____.

Part 5: Energy Usage

Use the information found on Energy Basics to describe the four major sectors that use energy in the U.S.:

Sector	Examples	% of Energy Consumed

Part 6: Using and Saving Energy in Homes

We spend more time in our homes than anywhere else, and we use energy in a lot of different ways. Look carefully at each category of use in the pie chart.

a. According to the pie chart, what does the average U.S. home use the most energy for? _____ _____.

b. According to the bar graph, what are the top two types of energy consumed in homes? Name the types and list their percentages.

Type 1: _____ Percentage: _____
Type 2: _____ Percentage: _____

c. Gains in home energy efficiency can be offset (or reduced) by the use of more _____ _____.

d. What are two examples of devices you own that require electricity that your parents did not have when they were your age? _____ _____.

Part 7: Energy Conservation and Efficiency

Define the following terms and give an example for each.

a. Energy conservation: _____
_____
_____
_____.

b. Energy efficiency: _____
_____
_____
_____.

Part 8: Effects on the Environment

a. What are greenhouse gases? _____
_____
_____
_____.
Name two examples: _____ and _____.

b. Using the pie chart for U.S. greenhouse gas emissions by gas, what is the gas with the highest percentage of emissions? _____

c. What two energy sources contribute most to these emissions: _____ and _____.

d. When greenhouse gases warm the planet, what is the result? _____
_____
_____
_____.

Part 9: Recycling

Growing up in today's world, we know that recycling is a good idea, but how does recycling save energy? _____
_____
_____
_____.

Lesson 2: Gaining Energy Perspective *(90 minute block + more for field trip)*	
Objective: Students will be able to evaluate the advantages and disadvantages of the major energy sources.	
Materials	1. The Great Energy Debate game board (one master copy), YES/No cards, and debate sheets (one set per student, plus one set for each group). Debate materials are found at: http://www.need.org/needpdf/Great%20Energy%20Debate%20Game.pdf. 2. Arrange for adult volunteers to serve as judges, or assign three students. 3. Field Trip worksheet (for extension activity only).
Procedures	1. Engage your students in a transition from the previous lesson (review of energy basics) to how energy is generally transmitted from sources in the United States. You might begin with the question: "Do you wonder what makes it possible for you to flip a switch and turn the lights on in your home?" Allow students to respond and discuss responses for a few minutes. 2. Introduce the Great Energy Debate game, using these concepts as a guide: * ***We use ten major sources of energy in the United States.*** * ***Some energy sources are nonrenewable; others are renewable.*** * ***Energy is used for transportation, heating, manufacturing, and making electricity.*** * ***Some energy sources affect the environment more than others.*** * ***Some energy sources provide lots of energy used in the U.S.,others a small amount.*** * ***Some energy sources provide energy at a low cost; others are more expensive.*** 3. Distribute one set of debate sheets to each student. Using one as an example, model how to complete the sheets. Instruct the students to complete all of the debate sheets individually. Note: these could be done as a homework assignment before the debate to allow for more time. 4. Divide & gather your students into ten groups (each representing one of the ten sources). 5. Distribute a set of debate sheets to each group. Have the students complete the debate sheets as a group, using their individual sheets as guides. This should take about thirty minutes as they compare sheets and finalize their group's stance on each question. 6. Begin the game by explaining that the object of this game is to be the first team to reach the top of the game board. The game is played in rounds, with each team given the opportunity to move its token up by giving an advantage of its energy source. Teams may instead choose to move an team's token down by giving a disadvantage of the opponent's energy source. The teams will present their advantages or disadvantages to a panel of judges. If a team gives an advantage of its energy source and the judges agree, then the team moves up one space. An opposing team can object to the judges' decision. The opposing team must convince the judges that the statement is not an advantage. The team that stated the advantage will then have the opportunity to defend its position. The judges will vote again and one of two things will happen. The judges may vote in favor of the defending team. In this case, the defending team maintains its new position and the opposing team moves down one space. Or, the judges may decide the statement is a disadvantage or just a fact. In this case, the defending team moves back to its original position. If a team states a disadvantage to try to move an opposing team down, then the opposing team can defend itself without penalty. 8. Ask the first team to give an advantage or disadvantage. Action continues until one team reaches the top line, until time is called, or until each team has had the opportunity to begin a round. **Collect the debate sheets from each student for assessment purposes.** 9. At the conclusion of the debate, point out that all sources of energy have advantages and disadvantages. Ask the class the following questions: * ***Why isn't there an obvious winner in this debate?*** * ***Even if the debate continued, would there be a winner? Why or why not?*** * ***Why do we use energy sources that have negative impacts on the environment?*** * ***What are some other factors that we need to consider in our choice of energy sources?*** 10. Extension: take a field trip to a local energy source -- for this option, use the Lesson 2 Field Trip Worksheet and make necessary arrangements for transportation, related fees, and interview experiences at a local energy source. Visiting an energy source and speaking with professionals takes the content to a very practical level as well as endorsing energy-related careers, particularly in renewable energy fields.

Lesson 2: Field Trip Option
NAME: _____ DATE: _____

You flip on a switch and all of a sudden your kitchen is full of light. This can seem like magic, but it is not! The electricity that is powering so many things in your life is generated somewhere — usually pretty far away from where you are actually using it. The energy source used to generate your electricity might be coal, hydropower, wind, or any one of a number of other sources. Do you remember the nine sources of energy from Lesson 1 (renewable and nonrenewable)? The source could even be a combination of many of these sources.

Your educator has arranged for you to visit a place in your community where electricity is being produced, fuels are being processed or transferred, or energy technology is being developed. This should be a place where you have something new to learn. Some examples of energy locations are:

- a local utility company
- a hydro-power dam
- a wind farm
- an alternative fueling station
- an electrical substation
- a geothermal power station
* a local home that has its own wind or solar power

You are going to visit: _____!

Evidence
On the field trip, you must gather evidence of your visit. For example, you may take pictures or short video clips, collect informational brochures, request business cards of the professionals you speak with, take notes, ask questions and record the answers. *Use this sheet for your prepared interview questions, answers, and general note-taking.*

This field trip will help you understand more about where your energy comes from and how it gets to you. That light coming on in your kitchen is not magic! We have a big energy system designed to make things like that possible!

Interview Questions
Prepare several interview questions for the professionals you speak with on your visit. You might consider asking how this person chose this field of work, what they like best about their job, how long they've been in the industry, what changes they've seen during their work there, etc. Leave room below each question for recording the answers you receive on your visit.

Question 1: _____
_____
_____
_____.

Speaker's name and job title: _____

Question 2: _____
_____
_____
_____.

Speaker's name and job title: _____

Question 3: _____
_____
_____
_____.

Speaker's name and job title: _____

NOTES:
This is a place for you to record additional information you receive from the professionals at the location you are visiting today -- listen carefully to all the speakers, including any classmates who ask questions. Use your best manners, take turns, and try not to repeat a question that has already been asked. If you have any additional questions during the speaker's presentation, write them down here. That way, you'll remember them when the speaker asks if there are any questions!

EVIDENCE:
What items did you collect from the field trip? What does this evidence teach you and others about the energy source or service provided here? (answer in complete sentences)

Lesson 3: Reducing Energy Loss *(90 minute block + 90 minute lab)*	
Objective: Students will be able to model the Law of Conservation of Energy, compare energy conservation and efficiency, and explain the concept of the transfer of energy.	
Materials	1. As noted in the introduction, computer access and/or copies for Lesson 3 content and worksheet. 2. Energy Guide labels for two comparable water heaters - copied or projected. 3. Solar Oven materials as noted in the lab instructions/link.
Procedures	1. Lesson 3 is designed to demonstrate the Law of Conservation of Energy in relation to energy conservation and efficiency. 2. There are several options for modeling the Law as a way to engage your students' understanding: create your own model and demonstrate it, show a short video presentation of an educator modeling the Law (see link below), or ask students to come up with examples of models of the Law of Conservation from previous class activities. This can be done as individuals or as a group activity (10-30 minutes). 3. Following the model demonstrations (educator-led, video, or group-designed), ask students to explain or summarize the main points in the demonstration: * *the total energy of an isolated system remains constant;* * *energy may change form but not leave the system;* * *potential energy transforms to kinetic energy;* * *some energy is released during transformation but none is gained;* * *there are methods available to reduce energy transfer.* 4. Review the difference between energy conservation and energy efficiency (from Lesson 1 - EIA Kids web-quest). Explain that we can reduce energy loss by creating more efficient appliances and processes, and by purchasing energy-efficient appliances that already exist. 5. Ask students why people might choose a less-efficient model of an appliance over a more efficient model? Answers will vary but should include the concept of upfront cost comparisons. 6. To demonstrate the pros and cons of buying and using more energy-efficient appliances, introduce students to Energy Guide Labels, focusing on the life-cycle cost and payback period of different appliances. 7. Distribute the Lesson 3 worksheet for students. Locate the sample Energy Guide label and explain the areas of data they need to interpret in the activity. 8. Two labels are provided for water heaters with similar capacity. Use these to fill in the data chart. Update the labels with different ones as needed. 9. Have students complete the data chart for the two water heaters. 10. Once the data is recorded, model the first two rows of calculations in the operating cost chart. Have students use the water heater Energy Guide labels to complete the table and answer the questions on their worksheets. 11. Discuss the responses to question five and seven, noting any changes in water heater choices based on efficiency and emissions. 12. If you have some additional class time to dedicate to energy efficiency, allow your students some hands-on experience with creating an "appliance" that heats more efficiently. Conduct the Solar Oven experiment found at: http://www.uen.org/Lessonplan/preview?LPid=2536.
Links	1. Video modeling of the Law of Conservation of Energy using a bowling ball: http://www.neok12.com/Law-of-Conservation.htm (video #3). 2. Solar Oven experiment/lab: http://www.uen.org/Lessonplan/preview?LPid=2536.

Lesson 3: Reducing Energy Loss

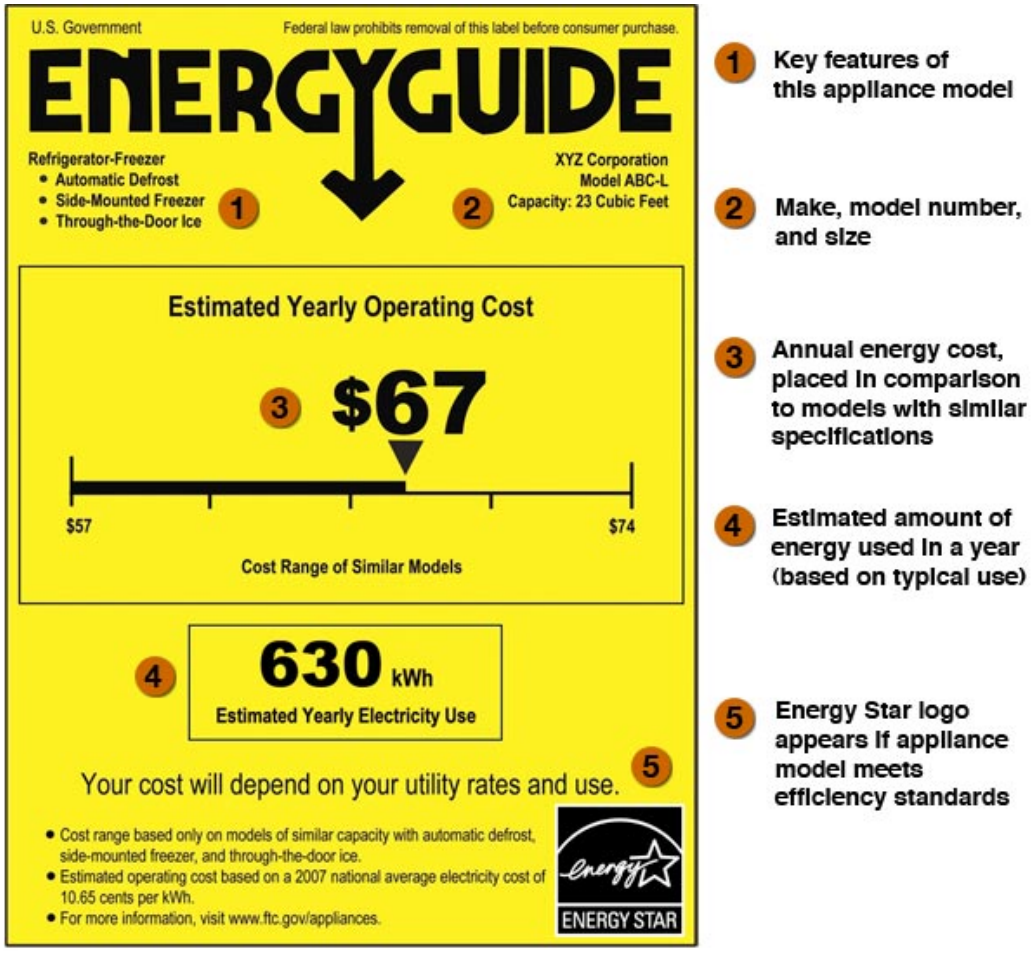
NAME: _____DATE: _____

Comparing Appliances

If you have ever visited a local store that sells appliances like stoves, refrigerators, dryers, dishwashers, and hot water heaters, then you probably recognize the sample **Energy Guide Labels** that are on your computer screen or projected in your classroom. The information on the label isn't hard to understand if you know how to read it. This knowledge can help you, the consumer of appliances and energy, make energy-efficient choices to benefit your budget and your planet!

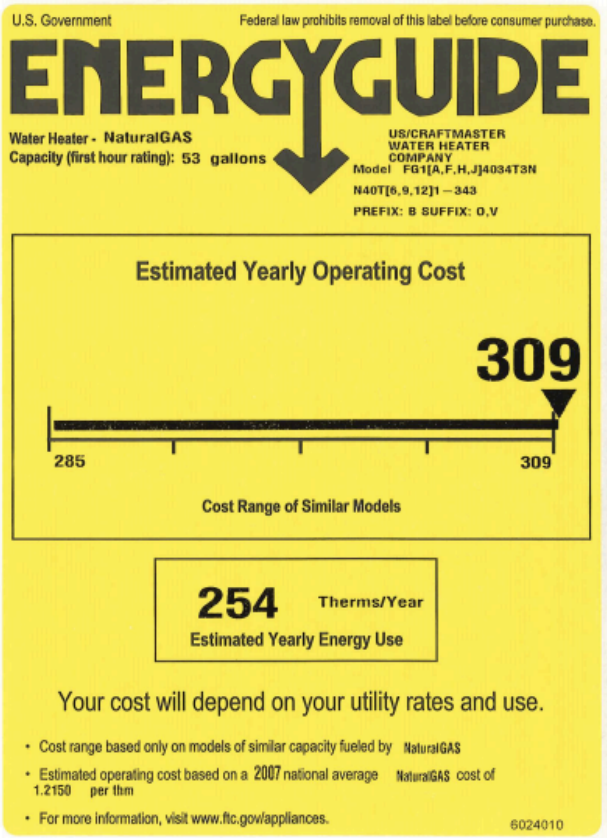
For this activity, imagine that your family needs to buy a new water heater. You, with your vast and up-to-date knowledge of energy-efficiency, need to help choose the better one. Water heaters usually last a long time -- ten to twenty years -- so you can save a lot of money by purchasing an energy-efficient one. Use the sample Energy Guide Label on this page to understand the data being shared about each particular water heater.

Sample Energy Guide Label

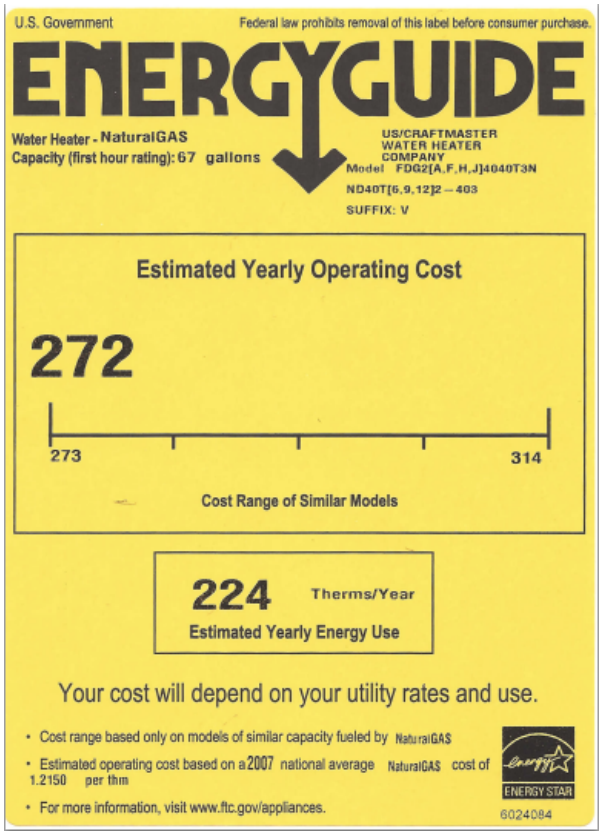


Comparing Water Heaters

Complete the data chart below with comparative data for two hot water heaters of the same capacity (advertised capacity is 40 gallons), taken from their Energy Guide Labels above each column.



MODEL #1



MODEL #2

Data	Model #1	Model #2
Purchase Price	$595	$382
Key Features		
Make, model # & size		
Estimated Yearly Operating Cost		
Estimated Yearly Energy Use		
Energy Star Logo		

Step 1: Using the water heater data, list the purchase price in the first row of the expense column in the chart below. This is your cost-to-date for this row as well. Do this for both models. So far, you have only spent the purchase price for this water heater.

Step 2: List the estimated yearly energy use for each model in row #2 - Year One.

Step 3: To calculate the "cost to date" column, add the purchase price to the estimated yearly operating cost for year one, and write this total in the Cost to Date column for Year One.

Step 4: Continue this process, adding the estimated yearly operating cost for each year to the previous total in the Expense column, and adding each year's estimated yearly energy use to the total in the Energy Use column. Do this for years one through seven.

Water Heater # 1	Expense	Energy Use	Cost to Date	Water Heater #2	Expense	Energy Use	Cost to Date
Purchase Price				Purchase Price			
Year One				Year One			
Year Two				Year Two			
Year Three				Year Three			
Year Four				Year Four			
Year Five				Year Five			
Year Six				Year Six			
Year Seven				Year Seven			

Use your completed chart to answer the following questions:

1. Which water heater uses less energy over the seven-year period? _____

2. Is either water heater an Energy Star Rated appliance? _____

3. Which water heater has the higher cost-to-date at the end of seven years? _____

4. If you were going to suggest one of these models to your family, which would you choose and why? _____
_____
_____
_____.

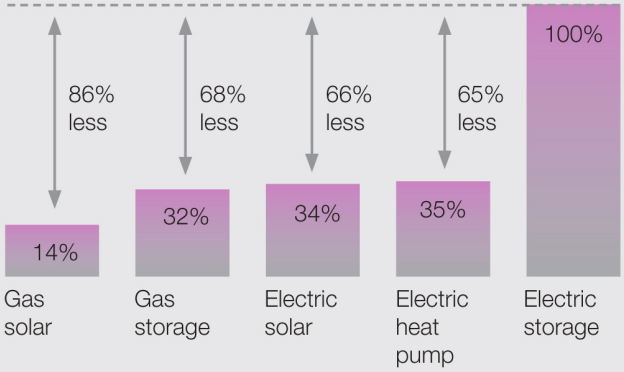
5. Given the additional information in the chart to the right, what kind of water heater would be the most efficient choice when considering the effects on the environment?

_____

6. Does this alter your answer to #4? Why or why not? _____

_____
_____
_____
_____
_____
_____
_____
_____.

Greenhouse gas emissions of different water heaters compared to conventional electric storage



Source: REES Review of Energy Efficiency Activities (ESCOSA)

Lesson 4: Making Energy Personal *(90 minute block + optional 2-class lab)*	
Objective: Students will be able to explain how their personal energy use connects to global issues, and argue that reducing their energy usage affects more than their personal costs.	
Materials	1. As noted in the introduction, computer access and/or copies for Lesson 4 content and worksheet. 2. **Students will need their average local electricity and gas bill figures for one month,** or educators need to have local averages available for a house, multi-family dwelling, or mobile home. 3. Materials as noted in the instructions/link for conducting the Energy House lab.
Procedures	1. Lesson 4 is designed to take all the concepts previously discussed, and use them to analyze personal use of energy and the related choices they face. 2. Begin by engaging your students in a brief discussion of the countless ways we use energy without really thinking about it. Try turning off all lights and everything powered by electricity in the classroom. Have them write a short response to the question, "What do you miss when the power goes out?" Turn the lights back on, then record responses on a projected screen or board. 3. Access the National Geographic - The Great Energy Challenge online and allow students to browse the categories (start with Personal Energy Meter), (then move to Mini Energy Calculators) clicking on several areas of the home, and following the steps to compare their usage to the national average. Display the average bill figures for a home, multi-family dwelling and mobile home for students who may not know this information. Lastly, have them view the calendar in the Energy Diet and select several months - record the tips given for each month. This visual representation of their usage and resulting carbon output provides a transition into the Home Energy Audit they will complete in steps 4-7. 4. Explain the meaning of an audit, and tell students they will be completing a Home Energy Audit. Ask why they think this matters? Then explain that an audit shows some places where they can conserve energy in their own homes and reduce their carbon dioxide output as well as their bills. 5. Distribute the Home Energy Audit worksheets and go over the directions. Define kilowatt-hours and the cost per kWh/rate for electricity usage in their homes. Preview the questions and goal-setting categories and check for understanding before students get started. Model the first line of calculations in the audit as an example. 6. Allow students at least 30 minutes to complete their audits and goals. 7. Once audits are complete, assign students the task of sharing them with an adult in their home and getting that adult's signature below their goals. 8. If you have one or two additional class periods that you can dedicate to a lab that explores home insulation by building and insulating a cardboard house, follow this link: http://www.need.org/needpdf/Energy%20House.pdf.
Links	Energy House Lab: http://www.need.org/needpdf/Energy%20House.pdf.

Lesson 4: Making Energy Personal
NAME: _____ DATE: _____

You are well on your way to becoming a bonafide energy-saving expert! Today, energy is getting personal. It's time to apply what you've learned to your real-life practices, and see what you can save on a daily basis: energy and money!

We'll begin with checking out some energy calculators online. There are a number of such calculators available for consumers to analyze their energy usage. We're going to use calculators found at **National Geographic's - The Great Energy Challenge: http://environment.nationalgeographic.com/environment/energy/great-energy-challenge/personal-energy-meter/.** The calculators provide amounts of carbon dioxide that your energy use releases into the atmosphere. Carbon dioxide is measured in pounds.

Click on the link or follow the URL to **The Great Energy Challenge** website. Your educator will give you a brief tour of the site and the areas you need to navigate for the calculators. Once you know where you're going, go ahead and get started!

Part 1: Personal Energy Meter
Start by clicking on the Personal Energy Meter tab.
- Enter your zip code.
- Follow the numbers on the house and answer the questions to the best of your knowledge - if you don't know your monthly electric and gas bill totals, use the average amounts your educator has provided.
- Your score calculates as you go.

Your final tally: (look in the black box on the meter and copy the scores here)

Energy Use (tons of CO_2 per year)		
Your Total Score	Regional Average	National Average

_____ tons of carbon dioxide
_____% (yours) compared to regional average
_____% (yours) compared to national average

Part 2: Mini Energy Calculators
- Click on the middle tab labeled Mini Energy Calculators and try a few out while everyone is finishing their Personal Energy Meter. Answer the questions to the best of your knowledge or ask your educator to explain any questions you don't understand.

- To return to the house after each calculation, click on the X in the right-hand corner. Spend five to ten minutes trying out the different calculators. Answer the questions below using the areas of the house indicated in each question.

- Click on **lighting**: By _____ you can reduce your carbon dioxide output by _____ pounds and save $ _____ annually.

- Click on **dishwasher**: If you switched to an Energy Star Rated dishwasher and ran the washer only when it was full, you could reduce your carbon dioxide output by _____ pounds and save $ _____ annually.

- Click on **dryer:** If you used a clothes drying rack for half your loads of laundry, you could save _____ pounds of carbon dioxide, and $ _____ annually.

- Click on **vampire voltage**: By plugging these items into a power strip and shutting them down when not in use, you could save _____ pounds of carbon dioxide, and $ _____ per year.

Part 3: Energy 360° Diet

The Great Energy Challenge includes a year-long calendar with month-by-month suggestions for conserving energy. Choose three months in the calendar, click on each, and write the tips for those months here:

Month 1: _____
_____
_____
_____
_____.

Month 2: _____
_____
_____
_____
_____.

Month 3: _____
_____
_____
_____
_____.

Congratulations! You are now prepared to conduct your own Home Energy Audit!

Lesson 4: Home Energy Audit
NAME: _____ DATE: _____

Part 1: Complete the following audit by checking the first column for each item used in your home; for each category checked, calculate the monthly total operating cost by multiplying the kWh's by $0.10 (an average national cost for electricity per kWh). Write each total in the coordinating column. When the operating cost column is complete, add the costs for a total monthly kWh usage and cost of electricity used in your home.

Electricity Use	Use (Mark with an X if you use this item in your home)	Estimated kWh usage per month (circle kWh for each X'ed category)	Operating Cost (usage per month X $.10/kWh)
Kitchen			
Microwave		16 kWh	
Range with Oven		60 kWh	
Coffee Maker		9 kWh	
Toaster		3 kWh	
Refrigerator		200 kWh	
Deep Freezer		150 kWh	
Dishwasher		30 kWh	
Bathroom			
Water heater (for family of 4)		310 kWh	
Hair Dryer		2 kWh	
Curling Iron/Electric Razor		0.5 kWh	
Electric Curlers		1 kWh	
Hair Straightener		2 kWh	
Other Appliances			
Space heater		540 kWh	
Heating system, fan		90 kWh	
Air Conditioner (central)		850 kWh	
Air Conditioner (room or window unit)		1.5 kWh	

Electricity Use	Use (Mark with an X if you use this item in your home)	Estimated kWh usage per month (circle kWh for each X'ed category)	Operating Cost (usage per month X $.10/kWh)
Fan (single, circulating)		4 kWh	
Fan, ceiling		12 kWh	
Washing Machine		9 kWh	
Clothes Dryer (electric)		75 kWh	
Vacuum Cleaner		4 kWh	
Alarm Clock		1.5 kWh	
Radio or Stereo		9 kWh	
VCR/DVD		27 kWh	
LED Television (*see link below)		15 kWh	
LCD Television (* see link below)		24 kWh	
Plasma Television (*see link below)		44 kWh	
Video Game System		15 kWh	
iPad or iTouch (charged every other day)		1 kWh	
Computer (desktop)		27 kWh	
Laptop computer		6 kWh	
Lighting, 4-5 rooms		50 kWh	
Lighting, 6-8 rooms		60 kWh	
Lighting, outdoors, all night		45 kWh	
Total kWh's and Operating Costs:			

* To calculate a more accurate monthly usage for your particular type of television, use this link to access a TV Electricity Cost calculator. Be sure to convert the calculation to monthly usage, not yearly, on the chart above. The kWh usage noted above is for a 50 inch television used for 5 hours per day. http://www.rtings.com/info/lcd-vs-led-vs-plasma/power-consumption-and-electricity-cost

** 2010 - Average electricity consumption for a U.S. residential utility customer = 11,496 kWh annually (958 kWh per month).

Part 2: Energy Saving Strategies
Here are some energy saving strategies that can lower your monthly usage and bills. Check off those you and your family already do on a daily basis. Use the other strategies to help you determine your energy saving goals in Part 3.

_____ Use low energy lighting such as fluorescent, CFL or LED.
_____ Turn off lights when you leave a room.
_____ Unplug seldom-used appliances.
_____ Turn off appliances such as computers, televisions, and games when they are not in use.
_____ Unplug chargers when they are not in use.
_____ Set computers to hibernate or sleep when not in use; shut them down at the day's end.
_____ Turn down the heat/AC when not at home and at night; use a programmable thermostat.
_____ Run the clothes washer and dryer and the dishwasher only when there is a full load.
_____ Keep the water heater set at about 120º F or lower.
_____ Use a microwave or toaster oven for cooking food whenever possible.
_____ Check furnace and air conditioner filters regularly to ensure they are clean.
_____ Conserve water by fixing leaks and drips, and by only running water when necessary.
_____ Install low-flow shower heads and faucet aerators.
_____ Count the number of appliances in your home with an Energy Star Rating.
_____ Cut drafts around windows and doors with caulk or weather stripping.
_____ Insulate your water heater.

Part 3: Energy Savings Plan
In the last part of this lesson, you will be setting some specific goals for lowering the energy usage in your home.

1. Use your Home Energy Audit to answer the following questions:

   - How many kilowatt-hours do you need to conserve in order to save 5% on your next month's bill? (Total Operating Cost _____ X 5% = $_____.

   - Divide this $ amount by $.10 (the cost per kWh used) and you will find the total number of kWh's you need to omit each month to save 5%. Total kWh's to cut: _____.

2. Using your audit, find three or more categories where you can conserve energy to meet your 5% goal. Consider the energy saving strategies that your home does not yet have in place, as well as look at your audit totals and lower usage in some categories. Think about what devices you might give up or use less, as well as what general behaviors you can change.

- Goal #1: _____
_____
_____
_____
_____.

- Goal #2: _____
_____
_____
_____
_____.

- Goal #3: _____
_____
_____
_____
_____.

3. Share what you have learned with the other people living in your home. List two things you learned from your Home Energy Audit that you think would help the people you live with to change their energy-using behaviors as well.

- One thing I learned from my audit is _____
_____
_____. I plan to talk to
_____ about this and suggest that we _____
_____
_____.

- A second thing I learned from my audit is _____
_____
_____. I plan to talk to
_____ about this and suggest that we _____
_____
_____.

4. Ask a parent or other adult living in your home to listen to your plan and goals. Read them and answer any questions this person might have about your plan. *He/she does not have to agree to the plan or participate in your strategies in order to sign below.* The signature only means that you have shared your ideas with this housemate.

Parent/adult signature: By signing this worksheet, I, _____, acknowledge that (student's name) _____ discussed his/her energy saving goals and plan with me.

Comments:

Thank you for your support of these energy-saving strategies!

Lesson 5: Powering the Future *(90 minute block)*	
Objective: Students will be able to describe connections between energy use and climate change, and use research and reason to predict the results of applying energy conservation at local, state and national levels.	
Materials	1. As noted in the introduction, computer access and/or copies for Lesson 5 content and worksheet.
Procedures	1. Explain to students that this is the last lesson of the Energy Fitness Award -- this one looks toward the future. 2. Engage your students with a question to Think-Pair-Share: "What do you think about the reality of climate change?" Have them think & write for a few minutes, then pair and share, then have the whole class share responses for five to ten minutes. 3. Tell students that they have discussed greenhouse gases, emissions, and carbon dioxide briefly. They are going to visit a website today that looks at the related issue of climate change in more detail. Climate change is one of the most important reasons for learning how to conserve energy. 4. Distribute the Lesson 5 Worksheet and preview the questions. 5. On individual computers or using a projected screen, direct students to the Students Guide to Global Climate Change: http://www.epa.gov/climatechange/kids/index.html. Depending on your computer situation, the following steps can be done individually or as a educator-guided whole class experience. 6. Have students read the overview and follow the directions on the worksheet for "Learn the Basics." 7. Read the overview and follow the directions on the worksheet for "See the Impacts." 8. Read the overview and follow the directions on the worksheet for "Think Like a Scientist." 9. Go to the "Be Part of the Solution" and follow the directions on the worksheet. 10. End with the last category, "More Ways to Make a Difference" which leads directly into spreading the word. 11. Lesson 5 wraps up the Energy Fitness Award with a "Spread the Word" activity: remind students that one day, they will be the adults who hold the power of the future in their hands -- how can they take their knowledge today and use it to influence those in charge? 12. Divide your students into three groups: local, state, and national. Have the students gather in their groups, bringing their energy folders or home energy audits and worksheets with them for reference. 13. Each group should determine the population count for their region: local city, state, or country. 14. Using their population numbers, and their Home Energy Audit from Lesson 4 (Part 1), each group should determine their region's possible energy and monetary savings if every member of the population followed a plan to reduce their usage by 5%. Students can compare their audit totals for usage and cost, and figure an average to apply a 5% savings to their region. 15. Have each group present their savings to the class, with each student recording the data for the other two regions. 16. Individually, have students write a response to the activity, focusing on how personal goals for change (small impact) can grow into regional change (big impact) through research, education and communication.
Links	1. EPA's Student Guide to Climate Change: http://www.epa.gov/climatechange/kids/index.html

Lesson 5: Powering Your Future
NAME: _____ **DATE:** _____

Part 1: A Student's Guide to Global Climate Change
http://www.epa.gov/climatechange/kids/index.html

You are in the final stretch to earning your Energy Fitness Award. We have taken a moment to think about why energy conservation matters. Now you get to research and interact with the reasons on a deeper level. Today, you are visiting the EPA's (Environmental Protection Agency's) climate change website for students. The EPA is speaking directly to the future scientists, inventors, engineers, educators, consumers, and more, about the future of this very important place: your home, your planet. Let's see what they have to say to you.

Part 1: Learn the Basics (green button in the main menu)
Read the overview. Then click on "Learn more about the climate." See the diagram at the bottom with the orange bubbles and blue lines? Summarize the point of this diagram in a few sentences.

_____
_____
_____
_____
_____.

Part 2: See the Impacts (orange button in the main menu)
Read the overview. Then click on "Learn about the changes happening...." at the bottom of the page. Look at the picture and list three signs of climate change you see. _____, _____, and _____.

The effects of those changes are found in great detail on the next page. If you have time at the end of this activity, or at home, it's a good place to come back to for some practical tips.

Part 3: Think Like a Scientist (blue button in the main menu)
Read the overview. Then click on "Examine the clues of climate change." Follow the directions and interact with the picture by clicking when you see a magnifying glass until you have revealed all the clues.

Go to "The Proof is in the Atmosphere." What is the line graph telling you? _____
_____
_____.

Click "next" at the bottom of the page and you should arrive at "Ruled Out." Click on each picture and write the answers you discover with each possible cause of climate change. Use your own words to summarize what you learn - do not just copy what you see word for word.

The Sun: _____
_____
_____.

The Earth's orbit: _____
_____
_____.

Volcanoes: _____
_____
_____.

Click "next" at the bottom of the page, and you should arrive at "Putting the Pieces Together." Write a summary in your own words about what scientists are saying causes climate change. Use the line graphs to help you. _____
_____
_____
_____.

At the bottom of the page are four questions scientists are still investigating. Choose one of these questions, click on it and read what scientists have yet to discover. Summarize it in your own words.
_____
_____
_____
_____.

Part 4: Be Part of the Solution! (purple button in the main menu)
Read the overview. Then click on "What You Can Do" and note the six categories. Click on them one by one and write one suggestion for each that you can do.

- Switch to clean energy: _____
- Use less energy: _____
- Travel green: _____
- Watch your water use: _____
- Reduce waste: _____

It's time for your last click! Select "More Ways to Make a Difference." Read over the the suggestions, then pause at the last one -- **Spread the Word**. This is your final task in earning your Energy Fitness Award.

Part 5: Spread the Word
You need to spread the word about energy use, conservation, and efficiency in order to slow climate change. If you don't, who will? With a group of your classmates, you are going to show what can happen when people work together to reach a common energy-conserving goal. You will be assigned to a group of students who represent either your local region/city, state, or nation.

Write your region's name here: _____

What is your region's population?: _____
(Use a computer to research this information with your group.)

Now take your plan for a personal impact on energy use and make it bigger by getting the whole region involved! Using your population count, and your Lesson 4 Home Energy Audit (Part 1), how much energy & money can your **region** save if *every* member of the population were to reduce their usage and operating costs by 5%? Work with your group to figure an average savings for your region, based on your comparative personal data.

Regional Energy Usage: _____ Reduced by 5%: _____

Regional Operating Costs: _____ Reduced by 5%: _____

Present your savings numbers to your class. Record the other regions' names and savings below when they are presented.

Region #2: _____

Population Count: _____

Regional Energy Usage: _____ Reduced by 5%: _____

Regional Operating Costs: _____ Reduced by 5%: _____

Region #3: _____

Population Count: _____

Regional Energy Usage: _____ Reduced by 5%: _____

Regional Operating Costs: _____ Reduced by 5%: _____

Final Analysis and Written Response

On your own and using a separate piece of paper, write a response to this activity. What happened when you or your classmates took one person's goals to save 5%, and turned them into a whole region saving 5%? How did the impact of a single person's actions create a much larger impact on energy use and conservation? Finally, tie these impacts into the beginning of Lesson 5 and the issue of climate change. Your response should be a multi-paragraph discussion of these impacts.

Be sure to turn your written response in to your educator.

Congratulations on a job well-begun....
because energy conservation is a job you'll have forever!

AHEEC and Energy Fitness Award Quests

Quests are designed as optional extended activities to be completed at home to earn extra points for the AHEEC Contest, for extra credit, or for personal enjoyment. Students access these Quests in the Energy Lab section of the AHEEC website. In order to earn points for their school or group, students will need to verify Quest completion with their educators as noted for each Quest. Educators may record Quest points on each student's scoring rubric. NOTE: Each Quest completed earns one point toward the school's total for the AHEEC Contest.

Quest #1: Interview

For this quest, you are to conduct an interview with an adult who was born prior to 1950 about their energy use in the past and present. Suggested questions are listed here, but you can ask anything related to what you've studied in class this week. Record your answers on a sheet of paper and bring it to the next class. OR you may videotape your interview, edit it, and present it to the class.

Suggested Interview Questions *(adapted from TVAkids.com)*

1. What kind of lights did you use in your home when you were a kid?
2. How was your home heated and cooled?
3. What kind of washing machine did you have?
4. How was laundry dried?
5. What kind of stove and/or what fuel did your family use for cooking?
6. Did you have a refrigerator? If not, how did you keep your food fresh?
7. How was food packaged when it came from the store?
8. Did your family grow much of its own food?
9. What sort of items did your family make for itself?
10. What did milk come in? Was it delivered?
11. What sort of soap did you use? Did it clean as well as the cleaners we use now?
12. How was your water heated for bathing, dishwashing, and laundry?
13. Did your family have a car? If not, how did you get to where you needed to go?
14. Did you have a radio? TV? What did they look like?
15. How is life more enjoyable now that we have so many more products? How were the "good old days" better?

Quest #2: School Energy Audit

http://www.epa.gov/climatechange/Downloads/ghgemissions/wheel_studentact3.pdf

You have the opportunity to help your school save energy! Complete this quest by conducting a classroom and school energy audit; make a list of some changes that would reduce your school's usage and present it to your principal, PTA, or local school board. Some parts of the audit require information from your school building's maintenance employees. Use the above link as a guide for getting started!

Quest #3: Energy Expo Visual Presentation

http://www.need.org/needpdf/Energy%20Source%20Expo.pdf

Create a visual presentation choosing one of the topics from NEED.org's Energy Expos. Bring it to class and be prepared to give a short report on it to the class, sharing what you learned and displayed.

Quest #4: Natural Refrigeration Experiment
http://www.eia.gov/kids/resources/teachers/pdfs/IntermediateActivityNaturalRefrigeration.pdf
Build a refrigerator that doesn't need electricity! Take pictures or make a video of the experiment as you prepare the materials, conduct the experiment, and analyze the results. Record your results and conclusions and answer the question at the bottom. Bring your written or recorded information to your educator.

Quest #5: Hot Dog Solar Cooker Experiment
http://www.eia.gov/kids/resources/teachers/pdfs/SolarCookingIntermediateActivity.pdf
Build a hot dog solar cooker from a Pringles Can and test to see if it works! Take pictures or make a video of the experiment as you prepare the materials, conduct the experiment, and analyze the results. Record your results and conclusions and answer the question at the bottom. Bring your written or recorded information to your educator.

Quest #6: Compare Insulation in a Homemade Slow-Cooker
http://www.need.org/needpdf/SecSlowCooker.pdf
Cook a potato using your own homemade slow-cooker using pots and cardboard boxes insulated with different materials. Determine which materials provide the best insulation capabilities. Take pictures or make a video of the experiment as you prepare the materials, conduct the experiment, and analyze the results. Record your results and conclusions and answer the question at the bottom. Bring your written or recorded information to your educator.

Quest #7: Energy-Efficient Home Designs
http://energy.gov/energysaver/articles/ultra-efficient-home-design
Research energy-efficient home designs such as active or passive solar and earth-sheltered homes, landscaping, and more. Present your research to your educator/class in written form, as a visual presentation, or a combination of the two.

Quest #8: Energy Timeline
http://www.eia.gov/kids/energy.cfm?page=timelines
Synthesize the energy timelines found at EIA Kids into one all-inclusive timeline. Read and determine the five most important events for each source listed, and create a master timeline of events in energy history. Being that this information is several years out of date, find a minimum of five additional events or developments from the past 10 years and add them to the master timeline. Your timeline can be handmade or computer-generated. Bring it to your educator for review.

Quest #9: Global Warming Wheel Card
http://www.epa.gov/climatechange/Downloads/ghgemissions/wheel_instructions.pdf
http://www.epa.gov/climatechange/Downloads/ghgemissions/wheel_studentact1.pdf
Assemble your own Global Warming Wheel Card! Follow the links above to find the materials and activity guide for the card. Make the card and use it to answer the seven questions. Bring your card and answers to your educator.

Quest #10: "Green" Careers
http://www.eia.gov/kids/energy.cfm?page=4
http://www.edc-ctp.org/EnergyAuditPresentation/Energy%20Auditors%20Answer%20Key%20and%20Video%20Links.pdf
Using the links above as a starting place, research some "green" careers in energy's past, present, and future. Name some of the notable minds of the past, list some current career options that support energy efficiency and conservation, and make some predictions about new careers that will open up as new developments in the field of energy occur.

Quest #11: National Geographic - Global Electricity Outlook
http://environment.nationalgeographic.com/environment/energy/great-energy-challenge/world-electricity-mix/
Where does the world's electricity come from? Click on the map to get detailed data for six regions and six countries. See what happens if a fuel type disappears, and jump between 2008 and 2035 to see some projections into the future of electricity. Prepare a written report of what you learn from this site, or prepare a guided demonstration of it for your class.

Quest #12: Energy 101 Video Responses
http://www.youtube.com/playlist?list=PLACD8E92715335CB2&feature=plcp
At this link, you'll find twelve Energy 101 videos from the U.S. Department of Energy. At about two minutes each, these short videos give an overview of a variety of energy related topics. Watch several videos and write about two or three new technologies or breakthroughs that you didn't know about before this. Return your written report to your educator.

Quest #13: Energy All Stars
http://www.youtube.com/playlist?list=PLgU0cHea5t3qPNsUzG9rcNsVG3eVv57qa
On January 19, 2013 as part of Inauguration Weekend, the Department of Energy hosted Energy All Stars featuring prominent energy leaders doing talks outlining what our energy future can and should look like, and steps that can be taken to achieve that vision. Speakers included Secretary of Energy - Steven Chu, former governor of Michigan - Jennifer Granholm, Los Angeles Mayor - Antonio Villaraigosa, CEO of Bloomberg New Energy Finance - Michael Liebreich, President and CEO of CPS Energy - Doyle Beneby, managing principal of the Analysis Group, former Assistant Secretary of Energy - Susan Tierney, and Bill Nye the Science Guy. Watch one or two of these these relevant and exciting presentations and write a letter to the presenter, commenting on their views. Share what you learned by sharing the link with family or friends. Return your letter to your educator. You might even send it!

Assessment

- A recommended scoring rubric for the Energy Fitness Award is provided at the end of this plan and includes all five lessons. Total points earned determine the level of the award each student receives.

  13-15 points: Megajoule Award
  9-12 points: Kilojoule Award
  5-8 points: Joule Award

- Individual assignments are designed to also provide educators with grades for the activities completed that meet requirements across the curriculum. You may choose to collaborate with educators in your team or building on some of the activities and assessments. For example:

  - Lesson 1-5 Worksheets and Web-quest responses (Science and Technology)
  - Labs (Science)
  - Home Energy Audit (Math)
  - Persuasive Letter (English)
  - Quizzes (Test-taking skills)
  - Quests: Independent Projects

- Pre-assessment and post-assessment quizzes begin on pg. 40.

- A comprehensive Educator Answer Key for worksheets and the quiz is found at the end of this curriculum guide, beginning on pg. 46.

Energy Fitness Award Pre-Assessment Quiz
NAME: _____ DATE: _____

Answer the questions by circling the letter of the correct answer.

1. Which of the following is an example of renewable source of energy?

   a. coal
   b. wind
   c. petroleum
   d. uranium

2. Which of the following is an example of a nonrenewable source of energy?

   a. biomass
   b. solar
   c. natural gas
   d. geothermal

3. Most of the energy in the U.S. comes from what source of energy?

   a. natural gas
   b. solar energy
   c. hydropower
   d. petroleum

4. In U.S. homes, most of our energy is used for:

   a. cooking food
   b. space heating
   c. playing video games
   d. lighting

5. The secondary energy source produced through the conversion of primary sources, such as coal, nuclear, or solar, is called:

   a. mechanical energy
   b. radiant energy
   c. chemical energy
   d. electricity

6. Which of the following is NOT an example of current global climate change?

   a. shrinking sea ice
   b. more droughts
   c. cooler oceans and temperatures
   d. wilder weather

7. An cleaner-burning alternative fuel option available in the U.S. today for trucks and buses is:

a. gasoline
b. biodiesel
c. ethanol
d. diesel

8. Which lightbulb type uses the least amount of energy?

a. LED (light emitting diode) light bulb
b. CFL (compact fluorescent) light bulb
c. incandescent light bulb
d. halogen light bulb

9. What does this symbol tell consumers about a product?

a. It is affordable.
b. It is energy-efficient.
c. It will last longer than other similar products.
d. it is made of recycled materials.

10. Solar energy can be used to:

a. heat water
b. heat spaces
c. heat fluids
d. all of the above

Energy Fitness Award Post-Assessment Quiz
NAME: _____ DATE: _____

Answer the questions by filling in the blank with the correct answer.

1. The two types of energy are _____ and _____.
2. Name three sources of renewable energy: _____,

   _____, and _____.
3. Name three nonrenewable energy sources: _____.

   _____, and _____.
4. The Law of Conservation of Energy says _____

   _____

   _____.
5. The average U.S. home uses the most energy for _____.
6. _____ means using less energy.
7. _____ means reducing energy loss through the use of improved technology.
8. _____ is a colorless, odorless gas that traps heat in the atmosphere. An increase of this gas in the atmosphere has led to _____

   _____

   _____.
9. The U.S.DOE is an abbreviation for _____.
10. A careful and detailed analysis of the using and wasting of energy in the home is called

    _____.
11. The four main sectors that use energy in the U.S. are _____,

    _____, _____, and _____.

12. Scientists have ruled out what three factors that people once thought lead to current climate change? _____,_____, and _____.

13. Explain why energy conversions are never 100% efficient. _____ _____ _____.

14. Describe a conversion that explains your answer. _____ _____ _____.

15. _____ saves energy in that people buy and throw away less stuff.

16. An _____ is any "non-conventional" transportation fuel made from natural gas or biomass materials.

17. An _____ Rating shows that an appliance is energy-efficient.

18. Name three pieces of helpful information found on an Energy Guide label: _____ _____ _____.

19. What is vampire voltage? _____ _____ _____.

20. What can you do to reduce it? _____ _____ _____.

Resources

- An alphabetical, all-inclusive glossary of terms can be found on the EIA Kids website: http://www.eia.gov/kids/energy.cfm?page=kids_glossary.

- Educators should take time to familiarize themselves with the EIA Kids (http://www.eia.gov/kids/) prior to starting this lesson unit. There are many alternate articles, experiments and activities that might better suit their student group and time availability.

- The NEED Project - National Energy Education Development Project (http://www.need.org/Educators) hosts an abundance of lessons and activities. Some are used here; many others can be found in the "Educators" section of the home page, listed by topic and grade level.

- Other lesson plans can be found at: the U.S. Department of Energy Education and Workforce Development (http://www1.eere.energy.gov/education/lessonplans/default.aspx) and CLEAN (http://cleanet.org/index.html).

Energy Fitness Award Rubric - Grades 6-8

NAME: _____ DATE: _____

EDUCATOR: _____ SCHOOL: _____

Activity	3 -Exceeds Expectations	2 Meets Expectations	1 Approaches Expectations	0 Does Not Meet Expectations
Getting Energized (Energy Basics)	Lesson 1 worksheet is completed, with no mistakes.	The worksheet is completed with a few mistakes.	Part of the worksheet is not complete and there are numerous mistakes throughout.	The worksheet is not completed or most of the answers are incorrect.
Gaining Energy Perspective *(Energy Resources and Usage)*	Field trip evidence/summary is varied and shows new learning OR The Great Debate sheets are completed.	Field trip evidence/summary is present and shows some learning OR the debate sheets are missing a few notations.	Field trip evidence/summary is there but doesn't show new learning OR the debate sheets are incomplete.	Field trip evidence/summary is missing OR the debate sheets are missing.
Reducing Energy Loss *(Energy Transmission)*	Lesson 3 worksheet is completed, with no mistakes.	The worksheet is completed with a few mistakes.	Part of the worksheet is not complete and there are numerous mistakes throughout.	The worksheet is not completed or most of the answers are incorrect.
Making Energy Personal *(Energy Conservation)*	Student completed a thorough Home Energy Audit, Lesson 4 worksheet and wrote 3 goals for energy conservation.	Student completed a Home Energy Audit; worksheet has only 2 goals or a few mistakes.	Student completed a Home Energy Audit, but did not write goals or complete the worksheet.	Student did not complete Home Energy Audit or goals and worksheet, or all contain major mistakes or omissions.
Powering the Future *(Energy Management)*	Student wrote an exceptional final report; Lesson 5 worksheet is completed with no mistakes.	Student wrote an acceptable final report; worksheet is completed with a few mistakes.	Student's report and worksheet show a lack of understanding or many mistakes.	Student did not complete a report and worksheet.
TOTAL				

Award Categories: Megajoule (13-15 pts), Kilojoule (9-12 pts), and Joule (5-8 pts)

Final Score: _____ Award Received: _____

OPTIONAL QUEST POINTS EARNED: _____

AHEEC Curriculum Guide 6-8
Educator Answer Key

Lesson 1 Worksheet

Part 1: Energy is the ability to do work.

Part 2: (forms may be in any order)

Type: potential **Definition:** stored energy and the energy of position (gravitational)	**Type:** kinetic **Definition:** working energy or motion, of waves, electrons, atoms, molecules, substances, and objects
Forms	Forms
1 chemical	1 radiant
2 mechanical	2 thermal
3 nuclear	3 motion
4 gravitational	4 sound
	5 electrical

Part 3:

a. The Law of Conservation of Energy saws that energy is neither created nor destroyed. When we use energy, it doesn't disappear.
b. It changes from one form to another.
c. A car engine burns gasoline, turning chemical energy into mechanical energy.
d. Energy conversions are never 100% efficient because converting energy from one form to another always involves a loss of energy.

Part 4:

a. Nonrenewable means limited, not able to be easily remade in a short period of time.
b. Renewable means naturally replenished, or easily made or renewed.

Nonrenewable Sources	**% of Energy Consumed by Use of this Source**	**Renewable Sources**	**% of Energy Consumed by Use of this Source**
petroleum	36.2%	biomass	4.5%
natural gas	25.2%	hydropower	3.3%
coal	20.4%	geothermal	0.2%
uranium	8.5%	wind	1.2%
		solar and other	0.1%
Total % Nonrenewable: 90.3%		Total % Renewable: 9.3%	

c. petroleum
d. nonrenewable
e. Answers will vary but should connect to the idea that nonrenewable means we're going to run out of those sources eventually.

Part 5:

Sector	Examples	% of Energy Consumed
commercial	buildings such as offices, malls, stores, schools, hospitals, hotels, warehouses, restaurants, places of worship, and more	19%
industrial	facilities for manufacturing, mining, construction, agriculture	31%
residential	homes and apartments	22%
transportation	cars, trucks, buses, motorcycles, trains, subways, aircraft, boats, barges, and hot air balloons	28%

Part 6:
a. space heating
b. natural gas: 45%, electricity: 41%
c. electronics and appliances
d. Answers will vary but might include: video games, cell phones, tablets, computers.

Part 7:
a. Energy conservation is behavior that uses less energy.
b. Energy efficiency is the use of technology that requires less energy to perform the same function.

Part 8:
a. Greenhouse gases are gases that trap the sun's heat in the atmosphere. Some occur naturally, and some are the result of human activity. Two examples are carbon dioxide and methane.
b. Energy-related carbon dioxide (81.5%)
c. coal and petroleum
d. Rising temperatures cause climate change.

Part 9:
Recycling saves energy in production of new products, because it almost always takes less energy to make a product from recycled materials than from new materials.

Lesson 2 Field Trip Worksheet
Answers will vary. Should include three interview questions with answers and speaker details, notes, and explanation of evidence.

Great Energy Debate sheets should be completed.

Lesson 3 Worksheet

Water Heater Data

Data	Model #1	Model #2
Purchase Price	$595	$382
Key Features	Natural gas	Natural gas
Make, model # & size	USCraftmaster FG1, 53 gallons	USCraftmaster FDG2, 67 gallons
Estimated Yearly Operating Cost	$309	$272
Estimated Yearly Energy Use	254 therms/year	224 therms/year
Energy Star Logo	no	yes

Water Heater Expense

Water Heater # 1	Expense	Energy Use	Cost to Date	Water Heater #2	Expense	Energy Use	Cost to Date
Purchase Price	$595		$595	Purchase Price	$382		$382
Year One	$309	254	$904	Year One	$272	224	$654
Year Two	$309	254	$1,213	Year Two	$272	224	$926
Year Three	$309	254	$1,522	Year Three	$272	224	$1,198
Year Four	$309	254	$1,831	Year Four	$272	224	$1,470
Year Five	$309	254	$2,140	Year Five	$272	224	$1,742
Year Six	$309	254	$2,449	Year Six	$272	224	$2,014
Year Seven	$309	254	$2,758	Year Seven	$272	224	$2,286
TOTAL Energy Used		1,778 therms		TOTAL Energy Used		1,568 therms	

1. Model #2 uses less energy over the seven years.
2. Model #2 is Energy Star rated.
3. Model #1 has the higher cost-to-date at the end of the seven years.
4. Students will probably choose Model #2. Reasons will likely include cost & energy use savings.
5. Gas solar
6. No, because the choices for #4 were both natural gas heaters, but students might opt against those types and research a gas solar one instead.

Lesson 4 Worksheet
Part 1: Answers will vary but should include carbon dioxide emissions scores & percentages.

Part 2: Mini Calculator answers will vary, but should include lighting, dishwasher, dryer, and vampire voltage results.

Part 3: Energy 360° Diet
Answers will vary but should include three months of tips.

Home Energy Audit
Part 1: Answers will vary but calculations should be correct.

Part 2: Answers will vary but should be completed.

Part 3: Answers will vary but should include calculations, three goals for saving energy and money, two "things I learned", and one parent/adult signature.

Lesson 5 Worksheet

Part 1: Learn the Basics
The diagram shows how greenhouse gases are at the center of climate change, with effects rippling out to weather and related problems.

Part 2: See the Impacts
Answers to include three of the following: higher temperatures, more droughts, wilder weather, changing rain and snow patterns, less snowpack, melting glaciers, shrinking sea ice, thawing permafrost, increased ocean acidity, warmer oceans, and rising sea level.

Part 3: Think Like a Scientist

- The line graph shows that current carbon dioxide concentration in the atmosphere is significantly higher than any time in the last 700,000 years.
- The Sun is ruled out as a cause of climate change in that the sun has been cooling slightly in the past 40 years, which the earth has been warming.
- The Earth's orbit is ruled out because it takes tens to hundreds of thousands of years for this kind of climate change to happen. What we're seeing has occurred much more quickly.
- Volcanoes are ruled out because they actually cause a short-term cooling affect on the Earth.
- Scientists have put the pieces together to show the comparison of higher amounts of carbon dioxide emissions in the atmosphere in relation to the rise in carbon dioxide emissions as a result of human activity.
- Answers will vary, but students should discuss ongoing studies regarding one of these four questions: What amount of greenhouse gases will be added to the atmosphere? How warm will Earth become? How much and how quickly will warmer temperatures lead to other changes? How will climate change affect specific places?

Part 4: Be Part of the Solution

Answers will vary but should include one suggestion for each category.
- Switch to clean energy: choose green power or generate your own power
- Use less energy: power down appliances, do an audit, look for the Energy Star label, be energy-wise at school
- Travel green: walk, bike, skateboard, rollerblade, or take a bus to school; give the car a break, buy a fuel-efficient or electric family car

- Watch your water use: take shorter showers, fix leaky faucets, wash clothes in cold water, install low-flow fixtures and appliances
- Reduce waste: buy items with less packaging, reuse or give away items you're done with, recycle, buy recycled products, and teach your school the three R's

Reports and data will vary but should be complete with data for all regions, as well as showing an understanding of how personal impact grows exponentially when applied to a larger population.

Energy Fitness Award Pre-Assessment Quiz

1. b
2. c
3. d
4. b
5. d
6. c
7. b
8. a
9. b
10. d

Energy Fitness Award Post-Assessment Quiz

1. potential, kinetic
2. solar, wind, geothermal, hydropower, or biomass
3. coal, petroleum, natural gas, or uranium
4. The law of conservation of energy says that energy is neither created nor destroyed. When we use energy, it doesn't disappear. We change it from one form of energy into another.
5. heating and cooling
6. Energy conservation
7. Energy efficiency
8. carbon dioxide; naming carbon dioxide a greenhouse gas due to the way it traps heat in Earth's atmosphere
9. Department of Energy
10. Home Energy Audit
11. residential, industrial, commercial, transportation
12. Volcanoes, the Sun, and the Earth's orbit
13. Energy conversions are never 100% efficient because some energy is always released into the environment.
14. An example of a conversion that results in energy lost as heat is chemical energy being converted to to mechanical energy when we burn gasoline in a car's engine. Some energy is released as heat and emissions (answers will vary but should include what source of energy is being converted to which secondary source, and what is lost).
15. recycling
16. alternative fuel
17. Energy Star
18. Energy Guide label information: make, model & size of the appliance, key features. estimated annual energy cost, estimated annual energy usage, and Energy Star Rating.
19. Vampire voltage is the power that is used by chargers or appliances that are plugged in but not currently in use.
20. You can reduce vampire voltage by unplugging items that aren't in use, shutting down computers at night, and using power strips for items like TV's.