

Energy Module

I. Introduction: Save “Watt”?

Background: Energy is the ability to do work. There are two categories of energy: kinetic energy (energy of motion) and potential energy (stored energy). The Law of Conservation of Energy says we cannot create or destroy energy. When we use energy we change it from one type to another.

Examples of Kinetic Energy	Examples of Potential Energy
<ul style="list-style-type: none">• Electrical Energy – Movement of electrons.• Thermal Energy – Heat.• Radiant Energy – Electromagnetic energy that travels in waves.• Solar Energy – A type of radiant energy.	<ul style="list-style-type: none">• Chemical Energy – Energy stored in the bonds that form compounds.• Nuclear Energy – Energy stored in the nucleus of atoms.• Mechanical Energy – Energy stored in objects by the application of force (i.e., rubber band).

For more information on energy visit the following websites:

- www.NEED.org
- www.ecre.energy.gov/states/alternatives/resources_ky.cfm
- www.uky.edu/KGS/emsweb/oginfo/kyenergy.pdf

Subject Area: Practical Living, Science, Social Studies, Math, Writing

Kentucky Connections:

- Learner Goals: #1, #2, #5
- Academic Expectations: 1.12, 1.5, 2.2, 2.3, 2.7, 2.8, 2.18, 2.29, 2.30, 5.1, 5.4
- Core Content: PL-EP-3.1.04, PL-04-3.1.04, PL-05-3.1.04, SC-04-2.3.1, SC-05-4.6.1, SS-EP-3.1.1, SS-04-3.1.1, MA-EP-4.1.1, MA-EP-4.1.2, MA-EP-4.1.3, MA-04-4.1.1, MA-04-4.1.2, MA-04-4.1.3, MA-05-4.1.1, MA-05-4.1.2, MA-05-4.1.3, WR-E-1.1. 0, WR-04-1.1. 3, WR-05-1.1. 3, WR-E-1.2. 0, WR-04-1.2. 3, WR-05-1.2.3,

WR-E-2.3. 0, WR-04-2.3. 3, WR-05-2.3. 3, WR-E-3.5. 0, WR-04-3.5. 3, WR-05-2.4. 3, WR-E-3.6. 0, WR-05-3.5. 3, WR-E-3.6.0

Materials: Pizza circles, Markers, Clock hands (may be made from construction paper), brass fasteners, copies of old utility bills

Length of Lesson: One 30 minute session to make meter faces, and one 60 minute class period for the activity.

Vocabulary Words;

Current: The flow of electrons (measured in amperes-A).

Energy: The ability to do work.

Electricity: The energy in moving electrons (measured in kilowatt hours—kWh).

Force: A push or pull that causes an object to move, stop moving or change direction.

Voltage: The energy available to move electrons (measured in volts – V).

Watt: The measure of electric power ($W = A \times V$).

Renewable energy: Sources of energy that can be replenished through natural or resource management practices.

Nonrenewable energy: Sources of energy that exist in fixed amounts.

Fossil fuel: Coal, oil, and other energy sources formed over millions of years from the remains of ancient plants and animals.

Geothermal energy: Energy that comes from the heat generated by natural processes beneath the Earth's surface.

Biomass: Fuel made from plant material and wastes from living things.

Conservation: The use of natural resources in a way that assures their continuing availability to future generations.

Essential Question: What is the difference between renewable and nonrenewable energy resources?

Activity Description/Goal: Students will identify the different types of energy and how we measure our usage of energy.

Guiding Questions/Outcomes:

- Students will describe the different sources of energy.
- Students will explain how they use energy.
- Students will calculate energy usage.
- Students will understand how to read a power meter.
- Students will recommend ways to conserve energy.

Skills Used:

- Researching
- Observing
- Manipulating

- Evaluating

Activity:

Part I

1. Explain the differences between renewable and nonrenewable energy sources.
2. Make a list of the following energy sources on the board: coal, oil, natural gas, wind, solar energy, water, nuclear, geothermal, biomass, and others.
3. Ask the class to place each energy source under renewable or nonrenewable.
4. Ask the students to make a list of all the things in the classroom that uses energy.
5. Make a chart on the board and have each student place the examples on their list under the proper form of energy.
6. Ask the students to prepare a graph of their results.

Part II

1. Divide the class into groups of four or five. Give each student a pizza round (or piece of poster paper cut into a circle). Have the students write the numbers 0-9 evenly spaced around the circle. On half of the circles, the numbers should go clockwise and on the other half, the numbers should be counter clockwise. All circles will have "0" at the top. Make an arrow from construction paper for the hand of your meter and attach to the center of the circle.
2. Explain to students that these dials will represent the dials on their electric meter and natural gas meter. The electric meter will require 5 dials and the natural gas meter will require 4 dials.
3. Have the students arrange the dials starting with clockwise and alternating each successive dial. Read the numbers on the dials from right to left. If the pointer is between two numbers, you always record the smaller number.
4. Give the students two sets of numbers. One for the morning and one for the afternoon. Have the students set the dials for the appropriate readings. Point out that electricity is read in kilowatt-hours. How many kilowatt-hours of electricity were used during the school day?
5. Repeat the procedure for the natural gas meter but use 4 dials instead of 5. Starting with a counter clockwise dial, arrange the other three in alternating sequence.
6. If the school's utility meters are in an available location have the students take a reading first thing in the morning and late in the afternoon. How much electricity and/or natural gas was used during the day?
7. Ask the Principal to be a guest speaker. Have the students ask questions such as: How many rooms are in the building? How

- many students are enrolled? What are the school's average monthly utility bills?
8. Have the students calculate the amount of each utility used by each classroom and by each student. What was the average daily cost of electricity? Natural gas?

Assessment:

1. Have the students prepare a report on energy usage and present it to the Principal, SBDM, or PTO.
2. Have the students assemble posters on the types of renewable and nonrenewable energy resources. Display the posters in the hallway around your classroom.
3. As a class project, formulate a plan for reducing the amount of energy used in your classroom. Encourage the students to ask other teachers and students to participate. At the end of the month determine if their reduction efforts have made a difference in the energy bills for your school.

Toyota Connections

Saving energy can be as simple as flipping a switch or replacing a light bulb. Here are some ways TMMK has reduced energy consumption:

- By swapping out HID (High Intensity Discharge) lighting for florescent lighting, TMMK saves 147 watts per fixture. TMMK has approximately 7000 fixtures in the plant. The amount of energy saved is enough to run 7900 36" color televisions for one hour.

Old Style Lighting Fixture- 368 Watts



New Style Lighting Fixture- 221 Watts



- To further reduce energy consumption at TMMK, all lighting in process areas (where Team Members work) is turned off during breaks, lunches and in between shifts.
- Overhead lighting in nearly all areas of TMMK (including office and break areas) is wired to motion sensors and will shut off automatically when no movement is detected for 30 minutes.
- Team Members are encouraged to turn off computers, printers, and copiers daily.
- TMMK reduced energy consumption in 2008 by replacing 20- year old air compressors with modern units that are 22% more efficient. This saves enough energy to provide electricity for a year to over 800 homes.
- TMMK uses all-electric vehicles onsite as shuttles. These vehicles take the shape of Toyota's popular RAV4 model, and can travel distances up to 50-70 miles before requiring an electric charge.
- Heating and cooling systems are lowered during non-productive periods.
- Lights in 375 vending machines throughout the plant are turned off, saving 768 watts per hour, per machine, per year. The annual energy savings would be enough to play a home video game system- nonstop- for 50 years!
- Soft drink vending machines have motion sensors that turn them off and on when no motion is detected. This saves approximately \$40.00 per machine every year. TMMK has approximately 200 machines.
- AGVs (Automated Guided Vehicles) are used throughout the plant to transport instrument panels, and other parts needed in the assembly process. Not only are these robotic carts helpful to team members, they run on small rechargeable batteries.

TMMK Fieldtrip Observations **Name** _____

While visiting the Toyota plant, you will learn what it means to be an environmental leader in the automotive industry. Look closely at the processes it takes to build each vehicle, and be sure to use all of your senses while touring the facility. Answer these questions following your trip. (Hint: You may need to refer to the “Toyota Connections” section to help you find some of the answers.)

1. At TMMK, what happens after 30 minutes if someone forgets to turn off the lights in an empty room?

2. What is an AGV? _____
What guides it? _____

3. How do the vending machines save money and energy?

4. Describe the vehicles that are used as shuttles at TMMK. How do these help save energy?

5. What is the name of the 1st American- built hybrid produced at TMMK? _____

6. Why are hybrids good for the environment?



II. Conclusion: Save “Watt”?

(Adapted from “Choosing a Better Future” from Project A.I.R.E, published by EPA.)

Background: Most of the energy we use in our homes comes directly or indirectly from fossil fuels such as coal, oil, and natural gas. These are considered to be nonrenewable resources, which are energy sources that exist in fixed amounts. When we reduce the amount of energy we use, we conserve nonrenewable resources.

Suggestions for Saving Energy and Natural Resources

1. Reduce the amount of waste we produce. We can reduce waste by using reusable dishes, glasses, forks, and spoons. Pack your lunch in reusable containers instead of disposable containers. Remember it takes energy to make things.
2. Reuse things instead of throwing them away after one use. Instead of throwing your old clothes and toys away, donate them to charity for someone else to use.
3. Recycle cans, paper, plastic, and glass. It takes more energy to make new things than it does to recycle them. This saves energy as well as natural resources.
4. Save electricity by turning off lights (or the television) when you leave a room.
5. Save electricity by using compact florescent (CF) light bulbs instead of incandescent bulbs.
6. Save energy (and reduce your carbon footprint!) by turning your thermostat up 2 degrees in the summer and down 2 degrees in the winter.
7. Save gasoline by carpooling, riding your bike, taking the bus, or walking.
8. Write on both sides of your paper.

For more information on energy conservation visit the following websites:

- www.NEED.org
- www.uth.tmc.edu/schools/med/eteam/homeideas.html
- www.energytips.wa.gov

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Materials: Marker board (chalk board), Markers (chalk)

Length of Lesson: 2 - 60 minute class periods plus out of class research time.

Vocabulary Words:

- Demand: The desire to possess a commodity or make use of a service combined with the ability to purchase it.
- Energy: Usable power.
- Manufactured goods: An article of trade or commerce.
- Natural gas: Fossil fuel in the gaseous state; used for cooking and heating homes.

Essential Question: How will my choices affect the environment of the future?

Activity Description/Goal: Students will illustrate how their environmental choices today can impact the environment of the future.

Guiding Questions/Outcomes:

- Students will compare and contrast their lifestyles with the lifestyles of their parents and grandparents.
- Students will conclude how environmental issues have changed over the last 40 years.
- Students will examine how they can make more informed choices about environmental issues.

Skills Used:

- Researching
- Comparing and contrasting
- Considering alternatives
- Making decisions

- Communication

Activity:

1. Explain to the students that their lives are influenced by a series of choices; some made by each of them, some by their parents, and some by the community or government. Briefly discuss the differences and the types of effects these choices have.
2. Ask the students to describe their lifestyle. What type of house (or apartment) do they live in? What kind of transportation do they have? How many vehicles do they have and what kind are they? Do they live in a rural setting or an urban setting? What are the traffic conditions like where they live? What type of energy (electricity, natural gas) do they have in their home? Are energy shortages a problem? What are the major problems with fuel for their vehicles? Include other questions that arise from the discussion.
3. From these questions, as a class design a survey that the students can use with their parents and/or grandparents. The survey should have two columns for answers: present conditions and conditions when their parents (or grandparents) were children.
4. Ask the students to complete the survey with adults from at least two age groups.
5. Use the survey to discuss possible choices that were made by adults and how they have influenced the students' lives.
6. From the data gathered by the surveys, select 5 items that were used in both the parents' lives and the students' lives.
7. Divide the class into five groups and assign each group one of the 5 items (e.g., cars, electricity). Assign the teams to do research to answer the following four questions:
 - a. How has the need and demand for the item changed in the last 40 years?
 - b. How was the demand met?
 - c. What, if any, impact has that had on the environment or on the amount of energy used in their neighborhood, the community, and state (or nation, world)?
 - d. What alternatives are available for reducing, or reversing, the impact?

Day 2

8. Have each team report their findings. Ask students to discuss and make suggestions on how to reverse the environmental impacts. How can energy be saved?
9. After all presentations have been made, make a list of the most practical measures for reducing energy waste in the home or classroom.
10. Ask how they think the types of energy and the way energy is used will be different when their children are in school.

Assessment:

1. Have students perform a skit to illustrate the changes in energy consumption over the past 40 years.
2. Ask students to make a list of energy conservation ideas and present them to the Principal.

Extensions:

1. Have the students collect pictures from magazines and newspapers showing environmental problems arising from energy use. Make a collage for display.
2. Have the students look for energy saving labels on equipment used in the school. How much energy will be saved if every school in your district used that brand of equipment?

Camry Hybrid- Toyota's First American- built Hybrid

- Toyota's Hybrid Synergy Drive consists of gas and electric power sources that are complementary and produce a combined 147 horsepower.
- By definition, a hybrid system varies between gas and electric, or both as needed.
- The Camry Hybrid is equipped with an "ECO" button that limits energy consumption by the Heating/Ventilation/Air Conditioning (HVAC) system and under certain conditions can help improve fuel economy.
- The 2009 Camry Hybrid has an EPA fuel efficiency rating of 33 mpg in the city, 34 mpg on the highway.
- Toyota's Camry Hybrid is certified as an Advanced Technology-Partial Zero Emissions Vehicle (AT-PZEV), one of a handful of cars to meet the strict standard.
- For more information about the Toyota Hybrid System, visit:
<http://www.toyota.co.jp/en/tech/environment/hsd/index.html>.

