



— UTAH OFFICE OF —
ENERGY DEVELOPMENT

Energy Efficiency

Grade/Subject: Earth & Space Science

Strand/Standard ESS.4.4 Evaluate **design solutions** for a major global or local environmental problem based on one of Earth's systems. Define the problem, identify criteria and constraints, analyze available data on proposed solutions, and determine an optimal solution. Examples of major global or local problems could include water pollution or availability, air pollution, deforestation, or energy production. (ESS3.C, ETS1.A, ETS1.B, ETS1.C)

Lesson Performance Expectations: Students will understand the difference between conservation and energy efficiency. Students will discover the importance of energy use in their lives. Students will recognize the difference between behavioral and technological approaches to energy efficiency and conservation.

Materials:

- Student sheet per student
- Computer/projector
- Scratch paper or calculators

Time: 1 class period 45 minutes

Teacher Background Information:

- Almost everything we use today requires some kind of electrical **energy**. Electricity has standardized many basic comforts, such as heat in the winter and cool air for the summer. Without electricity, our day-to-day life would be very different.
- We can cut down on the amount of electricity we use if we learn to practice better efficiency and conservation.
- Electricity is measured in **kilowatt-hours** (kWh). The kilowatt is named after James Watt, who invented the modern steam engine. Because the unit measure uses his name, the W is capitalized in the abbreviation kWh.
- Every month, **consumers** pay for electricity to be delivered to their homes and businesses, and they are charged based on the number of kWh used. This lesson will have students calculate an estimate of their electricity usage, discuss ways to use electricity more efficiently, and calculate how much associated financial savings they may realize. Buying **energy-efficient** products saves energy and can also help to conserve resources.
- In 2016 the entire state of Utah (residential, commercial, industrial, and transportation) used just over 810 trillion Btu ([EIA](#)). A Btu (British Thermal Unit) is a measurement defined as the amount of heat required to raise the temperature of one pound of water by one degree Fahrenheit. Over 164 trillion Btu of Utah's total Btu was from the residential sector, which is a lot of energy we use in our homes. If we make energy-wise choices when purchasing and using appliances, we can save energy and money and reduce emissions.

Student Background Knowledge: Students need to know that a kilowatt is the unit of measurement for electricity and that the electricity used in their homes is measured, usually on a device located outside the home.

Teacher Step by Step: A 3-d lesson should insist students do the thinking. Provide time and space for the students to experience phenomenon and ask questions. The student sheet provided below provides guidance but is only an example of how students might respond.

1. **Phenhourson:** Many people don't even think about how their cell phone gets recharged when they plug it in. Where does that power come from? Show a video from this selection: [Energy 101](#) and [The Story of Electricity](#)
2. Give the students a chance to write down 3 questions they might have about where their energy comes from and how much they use in a day.
3. Have students get into teams of 3 -4. Show the PowerPoint "[How much power does it take?](#)" or have students guess how much power their devices use. The PowerPoint helps keep the guess in a range of possibilities. Students may want to discuss their answers with their group.
3. The students will now individually look into their own lives. What is the cost of energy they use in their homes? Have the students write down how many items are in their house. Next, they will need to calculate the price of using that energy.
4. Through a class discussion, have students share their calculations and costs.
5. Show these two videos and list energy-saving tips:
 - [Energy-Efficient Tips for Homes](#) (6:41 min)
 - [Utah's First Net Zero Community](#) (5:13 min)

Assessment of Student Learning.

1. What is energy efficiency? *Energy efficiency reduces energy consumption by using less energy to attain the same amount of useful output. (Using less energy to do the same thing)*
2. What are three examples that increase energy efficiency in your home? 1) *Newer appliances that use energy. Look for the Energy Star label.* 2) *Change your light bulbs to energy-efficient ones.* 3) *Find better ways to heat your house. Ex. Solar panels*
3. What are three examples of ways to save on energy use in your home? 1) *turn off items that use energy when nobody is using them. Example: turning off lights when no one is in the room.* 2) *Use window shades instead of air conditioning.* 3) *Installing a programmable thermostat to adjust temperatures when you are not home.*
4. Explain the importance of energy efficiency and energy conservation to our world. *When you save energy, you also save money and reduce emissions. This can result in less economic burden via energy bills and better air quality for your community and inside your home.*

Standardized Test Preparation:

Energy Efficiency

1. What is a kilowatt? Choose all that apply.
 - a. 1000 watts.*
 - b. A measure of heat energy.
 - c. A measure of electric energy.*
 - d. A measure of light energy.
2. What is one way you can save on energy use in your home?
 - a. Use fluorescent light bulbs.
 - b. Use LED light bulbs.
 - c. Turn off the lights.*
 - d. Heat rooms with light.
3. What is one way to make your home more energy efficient?
 - a. Use LED light bulbs.*
 - b. Turn off the lights.
 - c. Shut doors and windows.
 - d. Reduce the number of times the refrigerator is opened.

4. What must most people do to reduce energy use in their homes?

- a. Conserve energy.*
- b. Move to another home.
- c. Stop using appliances.
- d. Buy energy-efficient devices.*

Extension of lesson: Homework: Have the students go home and make a list of the appliances they have in their homes. Go to energy.utah.gov and let the students use the energy calculator to discover how much electricity their appliances use. www.energy.gov/energysaver

Career Connections: Potential careers related to this activity: Architect, HVAC Technician, Strategic Energy Manager (SEM), Development Contractor, Facilities Manager

Energy Efficiency

Name _____

Video: [Where Does Electricity Come From?](#)

Phenomenon: Many people don't consider how their cell phone gets recharged when plugged into an outlet. Where does that power come from? Will there always be enough power to charge or run our electrical devices? Watch the video linked above. Ask three questions about what you see.

1.

2.

3.

Every month consumers receive a power bill charging them for kilowatts of electricity used. Estimate what the cost of running each device might be.

Item	How much do you think it costs?
iPhone (charging 10 hours)	
1-60 hour watt Incandescent light bulb (5 hours/day)	
1-CFL light bulb (5 hours/day)	
Refrigerator (24 hours/day)	
Air Conditioner (4 hours/day)	
Washing Machine (1 hour/day)	

Item	How much do you think it costs?
Dryer (1 hour/day)	
Dishwasher (2 hours/day)	
Gaming System (ex. PS4, Xbox) (3 hours/day)	
Desktop computer (8 hours/day)	
Television (4 hours/day)	
1-Ceiling Fan (24 hours/day)	

Use the list below of everyday items that require electricity. Count the number of those devices in your house. Calculate the total costs for electricity use in your home.

Item	Number in the house	Cost per day	Total Cost/Day
Smartphone (charging 10 hours)		\$0.15	
1-60 hour watt Incandescent light bulb (5 hours/day)		\$0.90	
1-CFL light bulb (5 hours/day)		\$0.23	
Refrigerator (24 hours/day)		\$14.46	
Air Conditioner (4 hours/day)		\$50.00	
Washing Machine (1 hour/day)		\$0.92	
Dryer (1 hour/day)		\$10.00	
Dishwasher (2 hours/day)		\$2.38	
Gaming System (ex. PS4, Xbox) (3 hours/day)		\$0.52	
Desktop computer (8 hours/day)		\$3.37	
Television (4 hours/day)		\$2.16	
1-Ceiling Fan (24 hours/day)		\$3.02	
Total cost per day			
Total cost per month			

Videos: As you watch the two videos list energy-saving tips.

Analysis:

What is one way you could save on energy used in your home lighting? (Reduce energy use without changing your devices)

What is one way you could increase efficiency in your home lighting? (Use less energy with different devices)

Summary: Make a **claim** concerning the best way to change energy use in your home. Use the term efficiency or conservation in the claim.

What **evidence** do you have to support your claim?

What **reasoning** did you use?