NATIONAL GEOGRAPHIC

RESOURCE LIBRARY
ACTIVITY : 1 HR 30 MINS

Choosing Energy-Efficient Appliances

Students use a formula to estimate energy consumption. They learn to read an EnergyGuide label and then use that information to select an appliance from a number of models based on a provided problem scenario and the factors that are most important to consider in the problem scenario.

GRADES

6 - 8

SUBJECTS

Mathematics

CONTENTS

14 Images, 9 PDFs

OVERVIEW

Students use a formula to estimate energy consumption. They learn to read an EnergyGuide label and then use that information to select an appliance from a number of models based on a provided problem scenario and the factors that are most important to consider in the problem scenario.

For the complete activity with media resources, visit:
http://www.nationalgeographic.org/activity/choosing-energy-efficient-appliances/

Program

CONNECT! TRANSFORM THE FUTURE

DIRECTIONS

1. Activate students' prior knowledge by having them brainstorm ways they can or do reduce their energy use at home.

Divide students into small groups, with each group at a computer, and have them brainstorm things they can do to use less energy at home. Expand their thinking by asking: *What are some ways you use energy resources? What are some general ways you could use fewer energy resources?* Have one student from each group share the group's ideas, and create a master list on the board. Ask each student to choose two or three ideas from the list that they would like to try at home. Have them make a list of the ideas they selected to bring home with them. Introduce the concepts of energy conservation and energy efficiency. Ask: *How are conservation and efficiency different?*

2. Introduce the ENERGY STAR program and EnergyGuide labels.

If students did not include using more efficient appliances on their list, bring up the idea now. Ask: *How can you find out which appliances are most efficient?* Explain that the Environmental Protection Agency and Department of Energy work together to make efficiency information easily available for consumers. Project an image of the ENERGY STAR logo and ask if students recognize it. If so, where have they seen it before? Briefly describe the history of the ENERGY STAR program and how a product earns an ENERGY STAR certification, as described in the background information. Project How to Use the EnergyGuide Label for students to see. Go over the parts of the label and discuss the information provided. Explain that students can use this information to compare energy and cost savings among appliances.

3. Introduce the formula to estimate the energy consumption of household appliances.

Explain that although appliances that are not ENERGY STAR certified do not have EnergyGuide labels, their energy consumption can still be compared to the energy consumption of ENERGY STAR certified appliances. Introduce the formula for estimating energy consumption explained on the provided Department of Energy's Energy Savers website. Write the basic formula on the board so students can see it. Explain the meaning of each variable in the formula. List the variables and their meanings on the board. Use the

formula to determine the annual energy consumption of a small appliance, such as a laptop, in your classroom. Use information found on the laptop or other appliance to complete the formula. Most appliances contain the information needed for the formula, usually on a sticker. On small appliances this information is usually found on the back or bottom. For larger appliances, the information is usually found on the inside of a door. Give students some practice data and have them work out the annual energy consumption based on the data, working collaboratively in small groups. Show students an electric bill from your area, and demonstrate where to find the cost per kilowatt-hour on the bill. Multiply the cost per kilowatt-hour by the annual energy consumption you calculated earlier to determine the annual cost to operate the appliance. Have students do the same with their practice data.

4. Have students determine their energy consumption for one small appliance.

Assign each small group an appliance in your classroom, such as a television, DVD player, Blu-ray Disc player, radio, microwave, or computer. Have them find the energy information on the small appliance. Explain that this information usually pertains to when the appliance is in active use, but many appliances draw a small amount of electricity even in standby mode. Then have students use the formula to calculate the estimated annual energy consumption and the estimated annual cost to operate the appliance as modeled in Step 4. Draw a chart on the board with the following headings: Appliance, Wattage, Estimated Number of Hours Used Annually, Estimated Annual Energy Use, and Estimated Annual Cost. Title the chart "Estimated Energy Consumption and Costs." As students complete their calculations, have them enter their data in the chart. Discuss the chart with students. Ask:

- *If you could replace only one of these appliances with a more efficient model, which would it be? Why?*
- *Is it an easy decision? When might selecting an appliance involve a more difficult decision?*
- *Which types of appliances in a typical home or building do you think require the most energy to operate?* (heating, cooling, water heating, refrigeration)
- *For which types of appliances could a more efficient model potentially make a larger impact on energy savings?*

5. Introduce the comparison shopping activity.

Explain that students will work in their groups to analyze information about different models of appliances and to determine which model they would purchase. Assign each group one of the following appliances: computer, television, dishwasher, refrigerator, or Blu-ray Disc player. Distribute the appropriate Comparison Shopping worksheet to each group. Each small group will view the EnergyGuide labels for their assigned appliance online. Read through both sets of directions on the sheet and answer any questions students may have. Ask groups to read their assigned problem scenario. Then have them look at the headings on the information chart below their problem scenario. Ask students to discuss in their groups which of the factors listed in the chart headings will be the most important in their decision-making process. Once they decide, have them write a number over each of the headings to rank them from most to least important. Next have students use the EnergyGuide labels for each model to complete the information chart. Encourage students to eliminate options they know are not the best. Make sure students record their reasoning each time they eliminate an option. Ask students to choose their best option or to choose not to buy at all. Have them record at least three reasons for their final decision.

6. Have each group present their purchasing choice to the class.

Distribute the Presentation Rubric to students. Review the rubric with students and answer any questions they might have. Give students a few minutes to prepare their presentation. Have each group present the model they chose to buy to the class and explain their rationale. Allow students to ask questions of each presenter.

TipTeacher Tip

Before doing steps 4 and 5 with students, practice finding the required information on the appliances in your classroom yourself.

TipTeacher Tip

In step 4, model for students how to make a good estimate of the amount of time they use an appliance over the course of a school year. Have students start by estimating how much time they use the appliance in a typical day or week, and then have them multiply their estimate

by the number of days or weeks of school in a year.

TipTeacher Tip

In step 4, review the concept of wattage with students to make sure that they understand what watts measure.

TipTeacher Tip

In step 5, if there are not enough appliances in your classroom for each group, allow students to check appliances in the teacher's lounge or another room. Appliances that generate heat, such as coffee pots, can have dramatically high energy consumption. If students can't find the wattage of an appliance, they can just multiply the amps by the voltage (usually 120 volts).

Modification

If students are having difficulty with the mechanics of the math, allow them to use calculators. It's most important that students understand how the formula works.

Modification

To accommodate visual learners, print images of the various models in step 6 or allow students to search for them online.

Informal Assessment

Check the data students enter into the Estimated Energy Consumption and Cost chart on the board to assess their understanding of the formula and how to use it.

Use the provided Presentation Rubric to assess students' presentations of their choices and rationales.

Extending the Learning

- Have students conduct an energy use scavenger hunt to determine how much energy your classroom appliances use. Invite them to move around the room and examine all the objects that use electricity. Have each student write the name of the object that they believe uses the most electricity in the room in a year, and place their guesses in a jar or box. Encourage them to think about how much electricity the object requires to work, as well as how often they use the object. If you do not have many objects in your room that use electricity, you can expand this activity to the whole building. Divide students into small groups and distribute a copy of the provided Energy Scavenger Hunt worksheet to each group. Have groups use the worksheet to find and record the energy information on appliances such as TVs, DVD players, Blu-ray Disc players, radios, and computers. Then have them use the formula to calculate the estimated annual energy consumption and the estimated annual cost to operate each appliance. Discuss students' findings as a whole class, rank the appliances from least annual energy consumption to most annual energy consumption, and determine the winners of the guessing game.

- Have students select an appliance at home or at school (not ENERGY STAR certified, if possible) and determine how much energy it uses in a year and the total cost to operate it for a year. Then have students find an ENERGY STAR certified replacement for the appliance and determine how much money they would save if operating the appliance for a year.

OBJECTIVES

Subjects & Disciplines

- Mathematics

Learning Objectives

Students will:

- analyze and compare factors involved in determining energy efficiency of household appliances to make educated purchasing decisions
- calculate the energy efficiency of household appliances
- compare the energy efficiency of household appliances to make a purchasing decision
- provide the rationale for a house appliance purchasing decision

Teaching Approach

- Learning-for-use

Teaching Methods

- Brainstorming
- Cooperative learning
- Discussions
- Information organization

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
  - Information, Media, and Technology Skills
    - Information Literacy
  - Learning and Innovation Skills
    - Communication and Collaboration
    - Critical Thinking and Problem Solving
  - Life and Career Skills
    - Initiative and Self-Direction
- Critical Thinking Skills
  - Applying
- Science and Engineering Practices
  - Analyzing and interpreting data
  - Using mathematics and computational thinking

National Standards, Principles, and Practices

ENERGY LITERACY ESSENTIAL PRINCIPLES AND FUNDAMENTAL CONCEPTS

- **Fundamental Concept 6.6:**
Behavior and design affect the amount of energy used by human society.
- **Fundamental Concept 6.8:**
Amount of energy used can be calculated and monitored.

IRA/NCTE STANDARDS FOR THE ENGLISH LANGUAGE ARTS

- **Standard 7:**
Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and nonprint texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience.
- **Standard 8:**
Students use a variety of technological and informational resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.

NATIONAL SCIENCE EDUCATION STANDARDS

- **(5-8) Standard F-2:**
Populations, resources, and environments

COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS & LITERACY

- **Speaking and Listening Standards 6-12:**
Presentation of Knowledge and Ideas, SL.6.4
- **Speaking and Listening Standards 6-12:**
Presentation of Knowledge and Ideas, SL.7.4
- **Speaking and Listening Standards 6-12:**
Presentation of Knowledge and Ideas, SL.8.4

Preparation

What You'll Need

MATERIALS YOU PROVIDE

- Calculators
- A small prize
- Electric bill from your local area
- Pencils

REQUIRED TECHNOLOGY

- Internet Access: Required
- Tech Setup: 1 computer per small group, Projector

PHYSICAL SPACE

- Classroom

SETUP

If you do not have several small appliances in your classroom that students can examine, make arrangements to take students to a teachers' lounge or other room that does.

GROUPING

- Large-group instruction
- Small-group instruction

OTHER NOTES

This activity should be completed over two sessions. Before starting the activity:

- Review the image How to Use the EnergyGuide Label and be certain you understand the various parts.
- Familiarize yourself with the information about the ENERGY STAR program at the ENERGY STAR website.
- Familiarize yourself with the energy formula used in this activity.

BACKGROUND & VOCABULARY

Background Information

Energy conservation refers to efforts to reduce the amount of energy we use. One way to conserve energy is to use energy more efficiently. Energy efficiency refers to the ability to use less energy to produce the same results. There are many ways to increase energy efficiency, from weatherizing a home to grid modernization. The ENERGY STAR program focuses on helping consumers to conserve energy by enabling them to factor the energy efficiency of products into their purchasing decisions. The ENERGY STAR program was introduced by the Environmental Protection Agency in 1992. Today, the ENERGY STAR program is operated jointly by the U.S. Environmental Protection Agency (EPA) and the Department of Energy. ENERGY STAR partners with more than 20,000 organizations to provide consumers with the information about energy efficiency that they need to make informed purchasing choices. Products earn an ENERGY STAR certification when they provide performance that is on par with similar products while using less energy. Specific criteria differ for each type of product that is rated.

Grid modernization includes changes to the grid infrastructure and a variety of technologies that allow for better, more automated communication between the places where electricity is generated and the places where it is used as well as more efficient distribution of energy. For example, during times of peak electrical usage, additional power plants often have to be brought on line to meet an increased demand. A fully modern grid would allow consumers to choose to participate in utility company programs that briefly cycle off individual appliances, such as hot water heaters or air conditioners, in consumers' homes during peak times to help the system run more efficiently. As grid modernization begins to play an increasingly important role in improving energy efficiency, smart appliances that can communicate with the electric grid may become more important.

Prior Knowledge

[]

Recommended Prior Activities

- None

Vocabulary

Term	Part of Speech	Definition
consumer	*noun*	person who uses a good or service.
electricity	*noun*	set of physical phenomena associated with the presence and flow of electric charge.
energy	*noun*	capacity to do work.
energy conservation	*noun*	process of using less energy, or using it more efficiently and sustainably.
energy efficiency	*noun*	use of a relatively small amount of energy for a given task, purpose, or service; achieving a specific output with less energy input.
energy resource	*noun*	source of energy found in nature that has not been subject to any human-induced energy transfers or transformations; for example, oil, coal, gas, wind, or sunlight.
energy source	*noun*	location in which the energy resource (oil, coal, gas, wind, etc.) is converted into electrical energy.
ENERGY STAR	*noun*	voluntary product-labeling program run by the U.S. Environmental Protection Agency that helps businesses and consumers identify energy-efficient products.
formula	*noun*	a general fact or rule expressed in letters and symbols.
kilowatt-hour	*noun*	(kWh) unit of energy equal to 1,000 watt hours.
non-renewable energy	*noun*	energy resources that are exhaustible relative to the human life span, such as gas, coal, or petroleum.
problem scenario	*noun*	hypothetical challenge that requires critical thinking and decision-making to solve.
renewable energy	*noun*	energy obtained from sources that are virtually inexhaustible and replenish naturally over small time scales relative to the human life span.
watt	*noun*	unit of power. Abbreviated w.

For Further Exploration

Websites

- U.S. EPA: About ENERGY STAR

FUNDER

PARTNER

© 1996-2023 National Geographic Society. All rights reserved.