Youth Education & Interpretation It's in Our Nature

Energy Conservation Detective

MISSOURI DEPARTMENT OF NATURAL RESOURCES

GRADE LEVEL:

Upper Elementary/Middle School

SUBJECT AREAS:

Sciences, English Language Arts

DURATION:

Preparation Time: 30 minutes

Activity Time: one to two 50-minute class sessions plus a home-based assignment

SETTING:

Classroom (home-based energy audit)

SKILLS:

Application, Analysis, Synthesis

KEY WORDS:

Energy, Insulation, Energy Conservation, Energy Audit

SUMMARY

Students are introduced to various strategies for reducing energy use in the average American home. The students will conduct an audit of their home looking for ways to improve their home energy efficiency. Each student will prepare a report recommending ways to help their homes conserve both energy and money!

OBJECTIVES

THE STUDENT WILL:

- Discuss application of energy conservation techniques in reducing energy used in a typical American home.
- Conduct an audit of energy related activities in their own home.
- Prepare a report recommending ways to make their own home more energy efficient
- Construct a simple draft detector

MATERIALS

- Each student should get a copy of the home energy audit sheet

Draft Detector

- Tissue Paper
- Pencil
- Tape

BACKGROUND

Americans use more energy per person than any other nation on earth. In Missouri $4,340 is spent per person on energy annually—about 17 percent of the median per capita income. The two largest applications of energy by residential buildings are space heating (41.5 percent) and water heating (17.7 percent). Missouri gets about 80 percent of its electricity from burning coal. Missouri spends more than $1.6 billion a year importing coal into the state.

Most homes could reduce the amount of energy they use by implementing simple energy saving strategies. Efforts to improve insulation, decrease infiltration and use energy efficient lighting can significantly reduce the amount of energy required by a typical home.

In this activity the students will hunt down the areas in their own home that could be improved to lower energy use. These efforts will help their family spend less on energy bills and consume less energy, which can result in environmental benefits.

A quick list of energy saving tips is provided below:

- Replace incandescent bulbs with compact fluorescent or LED lightbulbs.
- Look for the Energy Star label when replacing appliances such as refrigerator, dishwasher, clothes washer and dryer.
- Insulate hot water heater.
- Insure that floor and wall vents are not blocked by furniture, rugs, drapes, etc.
- Install white window shades, drapes, or blinds to reflect heat away from the house in summer.
- During the winter keep the drapes and shades on south facing windows open during the day to allow sunlight to enter your home and closed at night to reduce the chill you might feel from cold windows.
- Set the thermostat at 76° F or higher in summer or less than 74° F in winter.
- Install a programmable thermostat.
- Install weather stripping around windows.
- Install weather stripping around doors.
- Clean or replace furnace filter once a month or as needed.
- Keep lights off in all unoccupied rooms.
- Put fans on timers.
- Install storm windows.
- Plant evergreen shrubs and trees as windbreaks around north and west sides of the building.
- Plant deciduous trees on the south side for summer shade and winter sun.
- Caulk cracks and joints around windows, doors, stairways, pipes and electrical wires.
- Caulk spaces for air leaks between the house and its foundation, replace broken windows or rotted boards, and plug other sources of cold air leaks into the cellar or crawl space.
- Seal cracks in walls and foundations.
- Install a double door or insulated storm door at each outside entrance.
- Air dry dishes instead of using dishwasher's drying cycle.
- Use a microwave oven instead of conventional electric range or oven.
- Turn off computer and monitor when not in use.
- Lower the thermostat on hot water heater to 115° F.
- Move lamps or TV's away from air conditioning thermostats. The heat will cause the air conditioner to run longer.
- If you have a fireplace, make sure that the damper is tightly closed when not in use.

PROCEDURE

WARM UP

Set the stage by asking the students the following questions:

- *What are some uses of energy in your home (a list can be generated on the board)?*
- *What application uses the most energy in your home?*
- *What are the sources of energy used in typical homes (electricity, natural gas, propane, wood stove, etc.)?*
- *How much of your parents' income do you think is spent on energy costs?*

THE ENERGY AUDIT

Review with the class some basic principals of home energy conservation.

The instructor may want to break the class up into groups and ask each group to review and report to the class on a specific element of energy conservation, such as insulation use, air conditioning and heating systems, infiltration, lighting options, water heating, energy efficient appliances, etc.

- Assign the students the role of home energy conservation consultant.
- Distribute the Home Energy Audit sheet and discuss the procedure for recording data on sheet.
- Have each student build a *draft detector* for use in determining infiltration problems with their home (see instructions for *Draft Hunting* included with this lesson). The students can practice during class by checking the room and school for drafts.

ASSESSMENT

Student will use the results of the home energy audit to write an assessment of their home's current energy use and will then formulate a written plan to increase their home's energy efficiency. This report can be scored using teacher or student created scoring guide.

GOING FURTHER

Have the students conduct an audit of the school and then prepare a list of recommendations on how the school could improve its energy consumption.

IMPORTANT WARNING!

Many home heating systems can leak deadly carbon monoxide gas.

Before decreasing a home's infiltration problems (*unwanted air moving into and out of a home)* it is critical to have the heating and cooling system *(including gas hot water heating units)* checked by a trained professional.

Failure to do so can result in the build up of deadly carbon monoxide in the home.

Carbon monoxide is a deadly odorless gas that can be introduced into the home by an improperly functioning gas heating system.

All such systems should be checked routinely.

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MISSOURI DEPARTMENT OF NATURAL RESOURCES

MISSOURI LEARNING STANDARDS: Grades 6-8 [K-5 Correlations]

SCIENCE GRADE LEVEL STANDARDS:

Engineering, Technology, and Application of Science

ETS1 — Engineering Design

Concept A: Defining and Delimiting Engineering Problems

- **6-8.ETS1.A.1:** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

Concept B: Developing Possible Solutions

- **6-8.ETS1.B.1:** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- **6-8.ETS1.B.2:** Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

Earth and Space Sciences

ESS3 — Earth and Human Activity

Concept C: Human Impacts on Earth's Systems

- **6-8.ESS3.C.2:** Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. [Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).]

Concept D: Global Climate Change

- **6-8.ESS3.D.1:** Analyze evidence of the factors that have caused the change in global temperatures over the past century. [Clarification Statement: Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic activity). Examples of evidence can include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities.]

ENGLISH LANGUAGE ARTS STANDARDS:

Writing

2. Approaching the Task as a Writer

A. Development [K-5 correlation W1A, W1B, W1D, W2A, W2B, W2C]

- Grade 6—Follow a writing process to produce clear and coherent writing in which the development, organization, style, and voice are appropriate to the task, purpose and audience; develop writing with narrative, expository, and argumentative techniques.

NGSS:

MS-ETS1 Engineering Design

- **MS-ETS1-1:** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific and principles and potential impacts on people and the natural environment that may limit possible solutions.

Earth and Space Sciences

MS-ESS3 Earth and Human Activity

- **MS-ESS3-3:** Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.* [Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).]

Science and Engineering Practices

Asking Questions and Defining Problems

Asking questions and defining problems in grades 6-8 builds on grades K-5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.

- Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (MS-ETS1-1)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.

- Apply scientific principles to design an object, tool, process or system. (MS-ESS3-3)

Disciplinary Core Ideas

ETS1.A: Defining and Delimiting Engineering Problems

- The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints include consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1)

ESS3.C: Human Impacts on Earth Systems

- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. (MS-ESS3-3)
- Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (MS-ESS3-3), (MS-ESS3-4)

Crosscutting Concepts

Influence of Science, Engineering, and Technology on Society and the Natural World

- All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ETS1-1)
- The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-ETS1-1)

Cause and Effect

- Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. (MS-ESS3-3)

ENERGY CONSERVATION DETECTIVE

Home Energy Audit

Interior Checklist	Yes	No
Compact fluorescent lightbulbs		
Refrigerator less than five years old		
Insulated hot water heater		
Floor and wall vents are not blocked by furniture, rugs, drapes, etc.		
Insulated curtains		
Thermostat is set at 76° F or higher in summer or less than 74° F in winter		
Programmable thermostat		
Windows are caulked		
Weather stripping around windows		
Weather stripping around doors		
Furnace filter changed within last three months		
Lights are off in all unoccupied rooms		
Fans are on timers		
Floor is covered with rugs, padding, and carpeting		

Exterior Checklist	Yes	No
Windows are concentrated on the north and south walls		
The roof on the south side extend out from the house far enough to block summer sun from walls and windows		
Storm windows are installed		
Evergreen shrubs and trees planted as windbreaks around north and west sides of the building		
Deciduous trees planted on the south side for summer shade and winter sun		
Cracks and joints around windows, doors, stairways, pipes and electrical wires are caulked		
There are no spaces for air leaks between the house and its foundation, broken windows, rotted boards or other sources of cold air leaks into the cellar or crawl space		
Cracks in walls and foundations are sealed and holes are plugged		
There is a double door or insulated storm door at each outside entrance		

One Months Home Statistics	
Monthly utility costs:	
Natural gas (cubic feet)	
Electricity (kilowatt hours)	
Propane (gallons)	
Square footage of home	

DRAFT HUNTING-Making a Draft Detector

Materials:

A pencil
A tissue
Tape

Construction:

Tape the tissue over the length of the pencil. Tissue should hang in a manner that allows free movement. Test your detector by blowing gently on the tissue. Use the draft detector to help locate air infiltration into your home.

Procedure:

Hold the draft detector in front of windows, outlets, switches, and doors to detect drafts.

Door	Window	Outlet	Switch	Location	Observations
X				From garage to utility room.	Lots of leaking under the door