Marshall University Sustainability Department

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Insulation

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OBJECTIVES

Students will practice identifying areas of energy waste in the buildings on Marshall's campus through measuring localized temperatures with a heat gun and detecting drafts with a hand-crafted flag device. Students will analyze how this costs energy and develop plans to eliminate the energy waste.

LESSON PARAMETERS

1. **Key Terms** - Energy efficiency, power (watts), energy transfer, energy waste, fossil fuels
2. **Group Size** - groups of 3 to 5 students; applicable for a class ranging from 3 to 30 students
3. **Grade Levels** - 3rd- 12th
4. **Duration** - one 45 minute session
5. **Setting** - indoors/outdoors; walking to and from different buildings
6. **Disciplines** - Science, Mathematics, Engineering, Technology, Environmental Education
7. **Learning Techniques -**
    a. Hands-On
    b. Group-based Collaboration
    c. Problem Solving
    d. Interdisciplinary
    e. Critical Thinking
    f. Activity-based
    g. Real-world application
    h. Expeditions

GREEN CONNECTIONS

- **Connections to Home and Community -** Students connect learning to home as they are challenged to identify drafts in their own homes. This also connects to the community as students realize that energy comes from a shared source.
- **Sustainable Perspectives -**
    - Energy efficiency
    - Energy consumption
    - Eco-friendly steps
    - Going green at home
    - Energy waste identification

LESSON SUMMARY

Students and instructor will participate in a whole class discussion about energy loss (discussion questions 1-3). This will mentally prepare students to engage in the following investigation. Students will also receive a handout displaying spots of energy loss in a common house to help them visualize the common places. After the discussion, the instructor will introduce to the class how they will identify areas of energy waste in buildings through demonstrating how to use the heat gun and draft flag. Each student will receive a lab handout to document their collected data. If possible, students will be placed in small groups to investigate buildings separately, or this may be done as a whole class. Each group will build a draft flag by taping plastic wrap (or tissue) to a pencil.

Students and instructor will visit various parts of different buildings on campus (depending on availability) such as doors, windows, cracks, top floors, basements, etc. They will measure the temperature with the heat gun at each location and identify any drafts with the draft flag. Students must record their observations at each location and the temperature in their tables.

Upon return to the original classroom (at a designated time), students will analyze their data and calculate the average temperatures found at each building and specified locations. Then they will develop graphs presenting the data. They must interpret the data and draw conclusions as a group or whole class. To conclude, the class will discuss their data and discussion questions 4-6. They will be challenged to use their draft flags to identify drafts in their own homes.

ACTIVATING STRATEGY

The students will discuss the first three discussion questions with the instructor. They should relate this discussion to the prior knowledge they learned from the previous lesson about light bulb efficiency. This will give students an opportunity to refocus on energy efficiency to prepare them for the lesson.

LESSON DEVELOPMENT

Explanation Lesson - Students will gather new information through discussion as well as analyzing experimental data. They will also receive handouts identifying the largest sources of energy waste within a building.	**Application Lesson -** Students will practice their concerns for energy efficiency within a building by identifying areas of energy waste through the heating and cooling of buildings throughout Marshall's campus. They will accomplish this by measuring localized temperatures with a heat gun and detecting drafts with a hand-crafted flag device.

LESSON ADDITIONS

If time allows, the students may use the computers to calculate their own carbon footprints, determined by the amount of energy they use on a daily basis through this online simulation Footprint Calculator (www.footprintcalculator.org).

DISCUSSION QUESTIONS

- Where do we lose energy in buildings?
- How much energy is consumed in the heating/cooling of a building?
- How can I identify areas of energy waste in a building?
- How can I eliminate these areas of energy waste?
- How is the energy supplied?
- What are some more efficient sources?

MATERIALS

Physical Materials

- One heat gun per group (or one per class)
- One pencil per group
- A 12 cm x 25 cm piece of plastic wrap per group (Or tissue)
- Tape
- Energy Efficient homes handouts per student or per group
- Lab handouts per student

RATIONALES

- ## Next Generation Science Standards
  - **MS-LS2-1-** Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

    MS-PS3-4 - Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.

    HS-PS3-1 - Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

    MS-ETS1-3 - 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.

    HS-ETS1-1- Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

    HS-ETS1-2 - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- ## 21st Century Science Content Standards and Objectives for WV Schools
  - **SC.O.6.1.05 -** cooperate and collaborate to ask questions, design and conduct investigations to find answers and solve problems.

    SC.O.6.1.10 - utilize experimentation to demonstrate scientific processes and thinking skills (e.g., formulating questions, predicting, forming hypotheses, quantifying, or identifying dependent and independent variables).

    SC.O.6.1.11 - construct and use charts, graphs and tables to organize, display, interpret, analyze and explain

data.

SC.O.ES.2.28 - research alternative energy sources and evaluate the ecological, environmental and economic cost-benefit ratio.

SC.O.ENV.2.4 - evaluate environmental and economic advantages and disadvantages of using nonrenewable and renewable energy.

SC.O.8.2.18 - examine the various sources of energy (e.g., fossil fuels, wind, solar, geothermal, nuclear, biomass).

SC.O.8.2.21 - relate the conservation of energy theory to energy transformations (e.g., electrical/heat, or mechanical/heat).