Input vs. output

Teacher's guide

Description

Using the Law of Conservation of Energy as a centerpiece, this module explores the transference of energy between different objects and the transformation of energy into different forms – potential and kinetic.

Introduction: Match and candle

The module begins with students trying to identify the numerous ways that energy transfers and transforms from a match to a candle. (See the PowerPoint slide notes for the full list.) Then students perform an experiment with a lit candle. In it, students gradually increase their distance from the candle to determine how far away they can stand and still blow it out. They evaluate how much more energy is required to blow it out from greater distances.

Part 1: Law of Conservation of Energy and light bulbs

Students begin by watching an animated definition of the Law of Conservation of Energy, which explains that energy is neither created nor destroyed. Then, they explore the differences between incandescent bulbs and LEDs. LEDs use a lot more of their energy for radiant (light) energy. Students experiment with bulbs and balloons to learn about energy transference and transformation and to understand how much more heat energy emits from incandescent bulbs.

Part 2: What is energy efficiency?

This section connects energy transference and transformation to energy efficiency. An animated definition of electric current illustrates how electricity powers so many things in our homes. Students build on that understanding to develop a consensus definition for energy efficiency. Student groups then examine their everyday uses of energy and determine how to minimize waste and maximize efficiency.

Part 3: Making an impact

In this culminating activity, students determine changes and steps to be more energy efficient. Student groups develop criteria for their recommendations, such as easiest to

implement, likely to have the greatest impact, etc. Students then present and promote their recommendations.

Desired outcomes

The module is designed to:

- Prompt thinking about the relationship between energy input and work output
- Illustrate that energy efficiency can be measured as the difference between input and output
- Identify causes of energy loss and/or lack of efficiency, particularly electric energy
- Extrapolate the effects of efficiency and inefficiency over time and over widespread uses

Academic standards addressed

Wisconsin Science Performance Indicators (Grades 6-8)

SCI.CC5.m

Students understand matter is conserved because atoms are conserved in physical and chemical processes. They also understand that within a natural or designed system the transfer of energy drives the motion and cycling of matter. Energy may take different forms (e.g., energy in fields, thermal energy and energy of motion). The transfer of energy can be tracked as energy flows through a designed or natural system.

SCI.PS3.A.m

Kinetic energy can be distinguished from the various forms of potential energy.

SCI.PS3.B.m

Energy changes to and from each type can be tracked through physical or chemical interactions. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter.

Wisconsin Model Academic Standards for Environmental Education

B.8.1

Describe the flow of energy in a natural and a human-built ecosystem using the laws of thermodynamics (see SC Physical Science).

B.8.15

Analyze how people impact their environment through resource use.

B.8.17

Explain how human resource use can impact the environment, e.g., erosion, burning fossil fuels.

D.8.5

Explain how personal actions can impact an environmental issue; e.g., doing volunteer work in conservation.

Iowa CORE Standards Science

MS–PS1–1

Develop models to describe the atomic composition of simple molecules and extended structures.

MS–PS3–2

Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.

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.

MS–PS3–5

Construct, use and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

MS–PS3–3

Apply scientific principles to design, construct and test a device that either minimizes or maximizes thermal energy transfer.

Suggested time to allot

60 to 90 minutes

Materials

Interactive white board/computer with display screen

Internet access

Materials for experiments

- Strike-anywhere matches (10/group)
- Candles (1/group)
- LEDs and lamps
- Incandescent bulbs (can use the same lamps, if necessary)
- Balloons (3/group)

Cross-curricular extensions

Want to extend this unit beyond its core focus on science? Here are some suggestions.

Deeper into the math

Challenge students to create visual representations that illustrate the positive impact of widespread adoption of greater energy efficiency, at varying degrees of adoption. For example, what if every person in the U.S., and/or your state, and/or your community, and/or your school used only LEDs? How much energy would that save? There are numerous ways to “crunch the numbers.”

Develop a definition of energy efficiency

This module includes three different animated definitions. They can serve as a model for students to develop their own definitions for energy efficiency. Students can script them, as if they were creating their own animated definition. They can act out their definition as a short skit.