Renewable energy challenge

Teacher's guide

Description

This unit builds toward students participating in an engineering design challenge where they build apparatuses powered by a renewable energy source.

Introduction: Interactive quiz

The module begins with a 9-question interactive quiz focused on renewable energy sources. The questions are multiple choice and true/false. Each slide has built-in animations but relies on you to click to reveal the correct answer.

Part 1: Energy conversion and transference experiments

This section kicks off with an animated definition of the Law of Conservation of Energy. The "Catch some air" activity future illustrates the transfer of energy. Give volunteers a tennis ball and a basketball and ask them to determine how to transfer the most energy from the basketball to the tennis ball – i.e., how to use the basketball to make the tennis ball bounce higher. Later, students work in small groups to create a series of energy transferences and conversions with small objects like rubber bands, balloons and magnets.

Part 2: Solar power and turbines

Students learn how solar power and turbines work. This reinforces the concepts of energy conversion and transference in the context of renewable energy sources. Short videos on solar power and turbines transition students into a deeper exploration of renewable energy sources.

Part 3: Renewable energy research

Students embark on an inquiry-driven quest to learn more about renewable energy sources, using the Alliant Energy Kids website. Students may work in small groups or individually. The module provides guidance for their inquiry.

Part 4: Engineering design challenge

The module culminates in an engineering design challenge: Create an apparatus that "powers" an action/activity using a renewable energy source. The module guides students in the engineering process, encouraging exploration, testing and iterative improvement. In the end, students demonstrate their apparatuses and share their experiences creating them.

Desired outcomes

The module is designed to:

- Prompt thinking about how we get the energy we need and use (particularly electricity)
- Evaluate the benefits and limitations of renewable energy sources
- Recognize how the input of energy affects output of power/work
- Solve problems associated with harnessing renewable energy sources
- Design and engineer a power source that relies on renewable energy source

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.

SCI.ESS3.A.m

Humans depend on Earth's land, oceans, fresh water, atmosphere and biosphere for different resources, many of which are limited or not renewable. Resources are distributed unevenly around the planet as a result of past geologic processes.

SCI.ESS3.D.m

Evidence suggests human activities affect global warming. Decisions to reduce the impact of global warming depend on understanding climate science, engineering capabilities, and social dynamics.

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.8.16

Recognize the economic, environmental, and other factors that impact resource availability and explain why certain resources are becoming depleted.

B.8.17

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

B.8.22

Identify careers related to natural resources and environmental concerns.

D.8.5

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

Iowa CORE Standards Science

5–ESS3–1

Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

MS–PS1–1

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

MS–PS1–4

Develop a model that predicts and describes changes in particle motion, temperature and state of a pure substance when thermal energy is added or removed.

MS–PS1–6

Undertake a design project to construct, test and modify a device that either releases or absorbs thermal energy by chemical processes.

MS–PS2–3

Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.

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–PS3–3

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

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–ESS3–3

Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

MS–ESS3–5

Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

Suggested time to allot

120 to 180 minutes

Materials

Interactive white board/computer with display screen

Internet access

Materials for experiments and projects

Energy transference and conversion

- Basketball(s) (depending on whether you do the experiment as a class or in small groups)
- Tennis ball(s) (same as above)
- Rubber bands
- Balloons
- Magnets
- Balls/marbles

- Matchbox cars
- Nuts – heavier ones that can be tied to a string like a pendulum
- Springs
- String
- Inclined planes
- Pulleys

Engineering design challenge

- Materials from above
- Hair dryers
- Fans
- Heat lamps
- Tubs/water troughs

Cross-curricular extensions

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

Letters on renewables

Having studied the benefits and limitations of renewable energy sources, students will have informed opinions on how proactively and/or cautiously we should move toward greater use of renewable energy sources. Students can submit their letters to the newspaper, elected officials or Alliant Energy.

Subsidies for renewables

The federal government provides subsidies for energy sources, including fossil fuels and renewables. They come in the form of financial incentives, reduced costs for use of public lands, etc. Students can evaluate the value of subsidies in energy production, particularly as subsidies can affect the adoption of renewable energy sources.