



Nuclear power, sometimes referred to as atomic energy, has been with us for over 50 years.

It has been associated with abundant, low cost energy that could meet our needs for generations and it has been associated with the disasters at Three Mile Island and Chernobyl. Today, it is seen as an alternative to oil and natural gas.

Aside from the enormous amount of energy which can be produced from a small amount of fuel, the fact that there is no greenhouse gas production associated with its use, makes nuclear power a very attractive replacement to fossil fuel.

Program Objectives

Students will learn that:

- Science and scientists are at work in northwest Ohio solving the problems posed by human activities and their effects on the environment.
- Businesses and governments routinely apply the process of scientific investigation to assess risk and cost to the community and environment.
- Science skills learned in high school are needed in the workplace.

Ohio Science Standards

Earth Science

Benchmark D

Describe the finite nature of Earth's resources and those human activities that can conserve or deplete Earth's resources.

Indicator 5, Grade 10

Explain how the acquisition and use of resources, urban growth and waste disposal can accelerate natural change and impact the quality of life.

Science and Technology

Benchmark B

Explain that science and technology is interdependent; each drives the other.

Grade 10, Indicator 1

Cite examples of ways that scientific inquiry is driven by the desire to understand the natural world and how technology is driven by the need to meet human needs and solve human problems.

Physical Science

Benchmark A

Describe that matter is made of minute particles called atoms and atoms are comprised of even smaller components. Explain the structure and properties of atoms.

Indicator 1, Grade 9

Recognize that all atoms of the same element contain the same number of protons, and elements with the same number of protons may or may not have the same mass. Those with different masses (different numbers of neutrons) are called isotopes.

Benchmark F

Explain how energy may change form or be redistributed, but the total quantity of energy is conserved.

Indicator 14, Grade 9

Summarize how nuclear reactions convert a small amount of matter into a large amount of energy. (Fission involves the splitting of a large nucleus into smaller nuclei; fusion is the joining of two small nuclei into a larger nucleus at extremely high energies.)

Indicator 15, Grade 9

Trace the transformations of energy within a system (e.g., chemical to electrical to mechanical) and recognize that energy is conserved. Show that these transformations involve the release of some thermal energy.

Materials

- Computer with access to the Internet
- Paper and pen
- Handouts

Pre-Viewing Activity – Prepare to Learn

Nuclear energy has been with us for over 50 years. Over those 50 years, the public viewpoint has changed dramatically. During the 1950s, nuclear power was seen replacing coal and gas fired utilities with utilities that would provide abundant, clean, low cost energy. By the year 2000, it was expected that little or no fossil fuel would be burned for the production of power.

Following the accidents at Three Mile Island and Chernobyl, the public's view changed dramatically. Today, discussions surrounding nuclear energy typically are negative, but recently, that has begun to reverse itself.

As we have become aware of the destructive effects of acid rain and

greenhouse gas, once again, we are reevaluating nuclear power as a viable alternative to fossil fuel. The production of electricity using nuclear power produces no greenhouse gases, and as a consequence, does not contribute to global warming, nor does it cause acid rain. Nuclear power does, however, produce nuclear waste, which is a very serious problem.

Based on the interview, what are some of the ways in which nuclear energy might have a positive impact on the environment? One possible discussion might revolve around the production of greenhouse gases and their impact on the environment. For example: what do we know about the production of greenhouse gas and the use of fossil fuel? Another discussion might revolve around the destructive economic effects of high cost oil and gas and the possible benefits of low cost energy. A final discussion might revolve around the problem of nuclear waste storage.

Vocabulary

- Fission
- Fissile isotopes
- Nuclear bonds
- Isotope
- Neutron
- Uranium 235
- Nuclei
- Fuel pellet
- Tertiary

Related Discussion Items

After reviewing the standards, work with the students to create a cognitive map describing the various ways energy use affects our lives. Some possible talking points are:

- Nuclear power does not produce greenhouse gas.
- Nuclear power does not produce acid rain.
- The effects of acid rain and greenhouse gas
- The enormous amount energy produced by a small quantity of fuel
- What are the consequences of nuclear waste?
- Energy transformations — all electricity is produced in a similar manner. Heat is converted to steam which is used to spin a turbine, which turns a generator to produce electricity.

Activity

Create a cognitive map as a follow-up to the guided discussion. Some possible items to map might be the environmental impact of human activity and our need to produce energy. Once the cognitive map is complete, proceed with a short guided discussion of some social and environmental benefits of sustainable energy. This discussion might revolve around how cost savings

might benefit job creation and possible health related issues. Additional topics for discussion might surround the effect of greenhouse gas on the environment or the effects of imported oil on the economy.

Quiz

1. There are substantial differences in the way conventional fossil fuel plants and nuclear power plants produce energy.

True or **False**

2. Nuclear energy is produced using isotopes of uranium 235 and 238 with the majority being uranium 238. An isotope is an element with a different number of neutrons than protons.

True or False

3. There are two ways of producing nuclear energy, one is fusion and the other is fission. Fission is the primary means in which nuclear power is produced.

True or False

4. An equivalent mass of fossil fuel and nuclear fuel will produce the same amount of energy.

True or **False**

5. In the production of power, reactive heat is conducted to a water source to produce steam which is then used to power a turbine, which turns a generator to produce electricity.

True or False

Related Lesson Plans

[Converting Energy](#)

(ORC# 3459)

The purpose of this promising practice lesson is to introduce students to energy through the idea of energy transformations and conversions, and to develop students' ideas of what energy is and how it can be measured. This investigation could be the beginning of a unit on energy. The lesson begins with students exploring several activities on the Atom's Family website. For best results students should carry out the investigations described in the website. Students then pick up some foundational information about energy as they read part of the *Energy Story*, an online book. Finally students design and conduct an experiment around a question they devise about heating water. Safety considerations should be reviewed with students before they begin their experiments.

Splitting the Atom

(ORC# 1058)

Students use the Internet to research the history of the splitting of the atom and prepare a presentation. The focus of the "splitting-the-atom" story should be on the discovery of nuclear fission and its impact on world affairs. It is important not to overlook the science in this episode when considering the ethical and national-security considerations associated with fission and fusion. The story of the discovery of radioactivity and the structure of the nucleus of the atom, along with the incredible results that followed in this century, is drama of the highest order. It also illuminates several features of the scientific enterprise: the role of accidental discovery, the interdependence of disciplines, the ability of women to do outstanding work in both empirical and theoretical science, and the impact of science on world affairs.

Educational Resources

Additional Resources Using: D3A2

Search String = nuclear power
nuclear reactor
Sustainable nuclear energy



The D3A2 helps educators analyze data, and then points them to resources such as lesson plans, assessments and activities designed specifically to address the academic need identified by the data. In addition to linking content to data analysis, educators will have general search capabilities to locate education content resources aligned to the Ohio's Academic Content Standards. Examples of the state resources queried are:

INFOhio

<http://www.infohio.org/>

Ohio Resource Center

<http://ohiorc.org/>

Other Resources

Yucca Mountain Project – Nuclear Waste Management

http://www.ocrwm.doe.gov/ym_repository/index.shtml

U.S. Department of Energy - A great overview on the state of nuclear safety.

<http://www.energy.gov/safetyhealth/nuclearsafety.htm>

U.S. Department of Energy - A great overview on nuclear energy.

<http://www.energy.gov/energysources/nuclear.htm>