Essential Principles of Energy Videos

Teacher Guide

The Energy Literacy Initiative led by the U.S. Department of Energy aims to help individuals and communities make more informed energy decisions through enhanced energy education. The initiative works to develop resources on energy to help all Americans think about their energy future. This video series was developed in collaboration with the Center for Geoscience and Society, which is a service of the American Geosciences Institute, and with the National Center for Science Education. Together with the *Energy Literacy Framework*, the videos provide a valuable set of resources for public understanding and for instruction.

Energy literacy is an understanding of the nature and role of energy in the world and our daily lives. People use this understanding to answer questions and solve problems. The *Energy Literacy Framework*, which is also available in Spanish, identifies seven "Essential Principles" and a set of Fundamental Concepts to support each principle. Rather than attempting to identify all areas of energy understanding, the framework focuses on those that are essential for all citizens in order to understand their energy decisions and public discussions related to energy.

The print version of the *Energy Literacy Framework* provides informational text with which students can engage to gain knowledge that they will recognize as relevant to their lives. The videos provide a way to enhance that understanding and develop skills for strategic use of visual information in general, and in ways that are specific to energy literacy. These two areas — informational text and visual literacy — are important components of instruction, as indicated by their prominence in the Common Core State Standards (CCSS) and other curriculum documents. Some of the CCSS standards that can be addressed with these materials include:

- CCSS.ELA-Literacy.RH.6-8.7: "Integrate visual information (e.g., in charts, graphs, photographs, videos or maps) with other information in print and digital texts."
- CCSS.ELA-Literacy.RST.6-8.2: "Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions."
- CCSS.ELA-Literacy.RST.6-8.9: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.
- CCSS.ELA-Literacy.RST.6-8.10: "By the end of grade 8, read and comprehend science/technical texts in the grades 6-8 text complexity band independently and proficiently."
- CCSS.ELA-Literacy.CCRA.R.7: "Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words."

U.S. DEPARTMENT OF ENERGY

National Center for Science Education

american geosciences institute
connecting earth, science, and people

Center for Geoscience & Society
a service of the American Geosciences Institute

- CCSS.ELA-Literacy.RI.6.7: "Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue."
- CCSS.ELA-Literacy.RI.8.7: "Evaluate the advantages and disadvantages of using different mediums (e.g., print or digital text, video, multimedia) to present a particular topic or idea."

The printed *Energy Literacy Framework* and the videos can be used to supplement instruction in science, including the *Next Generation Science Standards* performance expectations related to energy, such as:

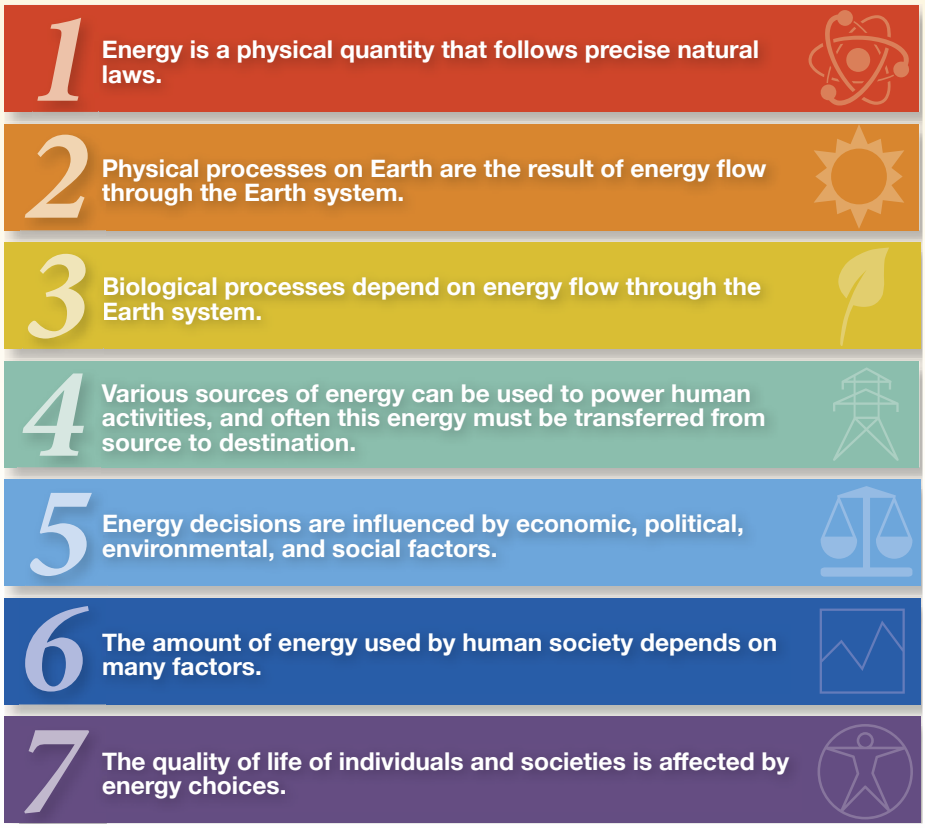
- MS-PS3-2.: "Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.
- MS-PS3-4.: "Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, 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."

What is a Principle?

There are seven Essential Principles in the framework that explain basic and important ideas about energy and energy resources. Understanding and applying these principles allows people to make decisions with a more comprehensive awareness of energy.

What is a Concept?

Concepts are important components that comprise a principle. The Fundamental Concepts given in the framework provide more specific ideas needed for clarifying the elements that need to be included in learning about energy principles.



Energy Literacy: Essential Principles and Fundamental Concepts for Energy Education, (2013). U.S. Department of Energy. www.eere.energy.gov/education/energy_literacy.html

Getting Started:

As you begin planning the energy literacy instructional unit, several steps may be helpful:

- Use the *Energy Literacy Framework* to review the ideas included in the energy lessons you have used in the past and/or those you are planning to use. Is there anything in the framework that is not included in your plans? How could that information be incorporated in ways that will be meaningful to your students?
- Brainstorm key questions about energy related to each principle that students can address. Some of these questions can come directly from the framework. It is also useful to include questions that require understanding and must be inferred from the ideas that are explicitly presented.
- Review the text of the *Energy Literacy Framework*. What words and ideas might be unfamiliar and/or difficult for your students? How can you help them understand those?
- Consider the text features of the *Energy Literacy Framework*. How do those features such as titles, subtitles, graphics, and captions help to communicate the information?

Watching the Videos

- The videos are short enough that they can be watched several times before, during, and after discussion and analysis.
- After an initial discussion of students' understanding about energy, have students consider the video in ways suggested in the Student Analysis Guide format, or a format that you design. Students can analyze the text features, vocabulary, images used in the video, and other elements in order to add meaning to the video.
- For example, students can ask themselves: What information about the concepts and principles do the images provide? What information do the images add that is not in the written text or the narration? What alternative images could have been used? How might those have conveyed different ideas about the concepts and principles from the framework?
- Have students watch the video again, stopping at points to discuss what is stated, what the images show, and to identify key words they don't know or that they have recently learned.

Example of how to get started:

Consider teaching about solar energy. You can ask yourself questions such as: How can I make solar energy more meaningful by using the *Energy Literacy Framework*?

Principle 1: Energy is a physical quantity that follows precise natural laws.

Discuss how light is converted into electricity and vice versa, and the units used to measure them.

Key Words: work, watt, joule, transfer, convection, radiation, conduction, kinetic, potential, fission, fusion, lumens

Principle 2: Physical processes on Earth are the result of energy flow through the Earth system.

Discuss that the sun powers many living and non-living parts of the Earth system (e.g., water cycle), but not all (e.g., tectonic movements).

Key Words: water cycle, carbon cycle, wind patterns, reservoirs, greenhouse gas, gravitational potential, radioactive isotopes, geologic record, fossil record, ice record

Principle 3: Biological processes depend on energy flow through the Earth system.

Discuss how food chains relate to the sun. Connect the importance of energy from the sun to human food systems. Help students understand that energy from biofuels is really energy from the sun.

Where does an apple get its energy?

Key Words: producer, organic matter, food web, molecules, organism, food chain, efficient, abundance, ecosystem, recycle

Principle 4: Various sources of energy can be used to power human activities, and often this energy must be transferred from source to destination.

Use this link to research the development of solar panels.

Look at the development of solar technology across a more than 2000 year history. Travel as far back as the 7th century B.C.E. to when the first magnifying glass was used to concentrate the sun's rays. Or, investigate how the rapid advances in solar energy technology have the potential to provide power to millions of people worldwide who still live without access to electricity.

Key words: transform, fossil fuel, coal, oil, natural gas, biomass, uranium, renewable, nonrenewable, constrained, distribution, natural resources, cyanobacteria, combustion, electrical energy, primary source, secondary source, drawbacks, efficiency, implications

Principle 5: Energy decisions are influenced by economic, political, environmental, and social factors.

Discuss the impacts and potential of solar power in America and how these choices are made at a local, regional, and national level.

Over 3,700 schools in the US are using solar. Check out the report "Brighter Future: A Study on Solar in U.S. Schools".

Key Words: infrastructure, government, corporations, technology, cost benefit, monetary, market fluctuations, environmental factors, social factors, economic factors, political factors

Principle 6: The amount of energy used by human society depends on many factors.

Discuss the growth in solar energy technologies. Are these used everywhere in the world? Why might people in one place depend on solar energy for electricity more than people in another place?

Check out Solar Prospector an interactive online tool that shows where solar energy use is taking hold in the U.S..

Key Words: conservation, manage resources, wasteful, reduction, demand, innovation, embedded, embodied, calculated, monitored

Principle 7: The quality of life of individuals and societies is affected by energy choices.

Discuss how access to energy impacts quality of life. Discuss how the growth and use of solar energy could help people around the world.

Energy choices impact us differently. The US consumes about 19% of the world's energy but has less than 5% of the world population.

Key Words: consequences, national security, limited, finite, supply and demand, socioeconomic, gender equality, equity, access, marginalized, underdeveloped

Additional Energy Literacy Resources:

TEDEd video and lesson on Energy — A Guide to the Energy of the Earth

Energy 101 Videos from the U.S. Department of Energy. Short videos on a variety of energy-related topics.

Watt's Up? The Lowdown on Energy from the Center for Geoscience and Society, a service of the American Geosciences Institute. Information about various energy resources.

BITES is an online scenario tool for Carbon Emissions letting students explore policies and data.

PlanetSEED: Energy theme is a section of the Schlumberger Excellence in Educational Development (SEED) project website that has many resources to build energy awareness.

Lesson Materials Aligned with *Next Generation Science Standards* (NGSS) and the *Energy Literacy Framework* from the U.S. Department of Energy

NEED (National Energy Education Development) Project (http://www.need.org/) has a large library of energy curriculum on a wide range of energy topics

Climate Literacy & Energy Awareness Network (CLEAN) (http://cleanet.org/) has grades 6–16 educational resources on climate and energy. Activities are aligned to *Energy Literacy Framework*.

Energy Explained site (www.eia.gov/energyexplained) allows students to explore data and fun facts on energy topics. For example: Do you understand where your gasoline comes from, what determines the price of electricity, or how much renewable energy people use?

NARA (Northwest Advanced Renewables Alliance) Energy Literacy Principles Matrix (http://www.energyliteracyprinciples.org/) allows you to search for activities by Energy Literacy Principle in the framework.

#energyliteracy

@Energy