

2019 Core Knowledge Science Sequence

Grade 4 Unit 5: Using Natural Resources for Energy



Introduction

This domain focuses on human use of nonrenewable and renewable resources for energy. Students will learn about the natural resources that people use for energy and the uses of new technologies that protect the environment.

We use energy every day of our lives. The sound energy from an alarm clock wakes us up. And if we ride to school in a regular bus, we use the energy from fossil fuels such as gasoline to move us from here to there. Much of the electrical energy we harness is generated at coal-burning or nuclear power plants as well.

The energy we use is derived ultimately from Earth's natural resources, which can be classified as either renewable or nonrenewable. Petroleum is extracted from the ground and then refined. Coal is mined from beneath the surface of Earth. Wind and solar energy are harnessed to power our energy needs as well. The extraction and use of natural resources must be done with care.

Our history has shown that the unwise use of resources can damage the air, land, and water around us. However, new and improved technology can lessen the environmental impact of extracting and using resources. And on the individual level, people can do many things to protect the environment and ensure that nonrenewable resources continue to be available.

Note to Teachers and Curriculum Planners

This unit introduces Grade 4 students to real-world examples and fundamental concepts that will be explored in greater depth in later grades. Students will learn about how energy and fuels are derived from natural resources. The following are preliminary considerations for planning and instruction relative to this unit:

- Examples of renewable energy found in this unit include wind, solar, and hydroelectric technologies. This unit extends learning from CKSci Grade 4 Unit 1, *Energy Transfer and Transformation*.
- Nonrenewable energy sources learned in this unit include fossil fuels and fissile materials (nuclear energy); however, the exact mechanism of fission is not part of the unit's learning objectives.
- Students investigate cause-and-effect relationships between habitats and human use of resources during this unit. Based on their learning across the unit, the focus extends prior knowledge, such as that from CKSci Grade 3 Unit 3, *Habitats and Change*, in order for students to combine and communicate information about the costs and benefits of different types of energy resources.
- The environmental impact of our use of natural resources is explored in further detail in Grade 5 Unit 4, *Protecting Earth's Resources*.

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2019 CORE KNOWLEDGE SCIENCE SEQUENCE	SUGGESTED LEARNING OBJECTIVES	LANGUAGE OF INSTRUCTION
<p>The Sequence guidelines identify specific content and skills for building knowledge coherently from grade to grade.</p>	<p>These suggested learning objectives may be modified to meet state and local standards as well as the needs of specific schools and classrooms.</p>	<p>This word list provides a sampling of the vocabulary to which students should be repeatedly exposed during instruction. The list is not intended for use in isolated drill or memorization.</p>
<p>A. Natural Resources: Renewable and Nonrenewable</p> <ul style="list-style-type: none"> Humans use natural resources to provide energy for much of modern life. Examples: Using coal to produce electricity, oil and wood for heating, and gasoline to fuel cars <p><u>Renewable vs. nonrenewable resources</u></p> <ul style="list-style-type: none"> Renewable resources include: <ul style="list-style-type: none"> wind energy water behind dams geothermal energy sunlight biofuels Nonrenewable resources include: <ul style="list-style-type: none"> fossil fuels (including coal, oil, and natural gas) nuclear fuels <p>NGSS references:</p> <ul style="list-style-type: none"> DCI ESS3.A: Natural Resources Science and Engineering Practices: Asking Questions and Defining Problems Obtaining, Evaluating, and Communicating Information Crosscutting Concepts: Energy and Matter Influence of Science, Engineering, and Technology on Society 	<ul style="list-style-type: none"> Gather information to compare the sources and uses of specific natural resources. Identify natural resources as <i>renewable</i> or <i>non-renewable</i>. List examples of renewable resources. Identify coal, oil, and natural gas as fossil fuels. 	<p>natural resource nonrenewable renewable energy biofuel/biosphere geothermal sunlight (solar) water (hydroelectric) wind fossil fuel sustainable coal gasoline natural gas oil radioactivity consensus reliable authority</p>

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<p>B: Using Nonrenewable Resources for Energy</p> <p><u>Fossil Fuels</u></p> <ul style="list-style-type: none"> Fuel: a material burned to produce heat <ul style="list-style-type: none"> Heat can be converted to other types of energy For example, power plants burn coal to produce electricity. Fossil fuels: formed from the remains of once-living organisms <ul style="list-style-type: none"> Fossil fuels take so long to form that they are considered nonrenewable For example, most natural gas deposits formed over millions of years by decaying plant and animal life. <p><u>The role of technology in extracting and using fossil fuels</u></p> <ul style="list-style-type: none"> Fossil fuels must be extracted from beneath Earth's surface <ul style="list-style-type: none"> Mining, drilling, fracking Surface mining may harm habitats of living things. Crude oil must be refined into products that are useable (such as gasoline, diesel fuel, and heating oil) How electricity is generated from burning coal 	<ul style="list-style-type: none"> Define cost-benefit analysis. Identify and compare examples of pros and cons. Differentiate between verifiable facts and values-based opinions. Identify different types of fossil fuels. Describe the formation of fossil fuels, such as petroleum, coal, and natural gas. Combine information to trace the movement of a fossil fuel (coal, gasoline, oil, or natural gas) from its natural origin to its uses in everyday life. Gather information to compare and communicate the environmental benefits and risks of using renewable resources for energy or using fossil fuels and nuclear fuels. <ul style="list-style-type: none"> Identify technologies that help reduce the negative effects of resources used for energy. Identify reliable sources of information about fossil fuel costs and benefits. Conduct research on fossil fuel costs and benefits and incorporate the research results into a unit project. Gather information to compare the sources and uses of specific natural resources. 	<p>risk/cost benefit analysis criteria fossil fuel decompose combustion petroleum coal gasoline natural gas oil</p> <p>values facts opinions mining/drilling/fracking refinement/refinery industrial air pollution/emission greenhouse gas environment/environmental damage cause and effect electricity generating electricity power plants/grid</p>
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<ul style="list-style-type: none"> Air pollution from burning fossil fuels <ul style="list-style-type: none"> Major sources of pollution include cars and trucks, coal-fired power plants, large industries, and ships and airplanes. <p><u>Nuclear power</u></p> <ul style="list-style-type: none"> Nuclear power plants use heat released from splitting uranium atoms to make electricity. Environmental benefits: lower emissions than power from fossil fuels Environmental risks: <ul style="list-style-type: none"> requires safe storage of dangerous nuclear waste risk of catastrophic disasters (such as Fukushima in 2011 and Chernobyl in 1986) <p>NGSS references:</p> <ul style="list-style-type: none"> 4-ESS3-1 DCI PS3.D: Energy in Chemical Processes and Everyday Life DCI ESS3.A: Natural Resources DCI ESS3.C Human Impacts on Earth's Systems <p>Science and Engineering Practices:</p> <ul style="list-style-type: none"> Obtaining, Evaluating, and Communicating Information <p>Crosscutting Concepts:</p> <ul style="list-style-type: none"> Cause and Effect Influence of Science, Engineering, and Technology on the Natural World 	<ul style="list-style-type: none"> Identify reliable sources of information about nuclear power costs and benefits. Describe the costs and benefits of using nuclear power. Conduct research on nuclear power costs and benefits and incorporate the research results into a unit project. 	<p>nuclear energy/power plants/waste atom enriched uranium nuclear accidents (hazards) pros and cons cost-benefit analysis</p>
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<p><u>C. Using Renewable Resources for Energy</u></p> <ul style="list-style-type: none"> New and improving technologies for using renewable resources for energy <ul style="list-style-type: none"> hydroelectric power plants wind turbines solar panels Environmental benefits of using renewable resources for energy <ul style="list-style-type: none"> reduced need for fossil fuels less need for major construction such as oil fields, offshore platforms, or refineries and storage facilities reduced cost of the transportation of fossil fuels Environmental risks, for example: <ul style="list-style-type: none"> building dams for hydroelectric energy affects water habitats wind turbines may be harmful to birds that fly into them <p>NGSS references:</p> <ul style="list-style-type: none"> 4-ESS3-1 DCI PS3.D: Energy in Chemical Processes and Everyday Life DCI ESS3.A: Natural Resources DCI ESS3.C Human Impacts on Earth's Systems 	<ul style="list-style-type: none"> Describe different forms of renewable energy sources and how each is converted to electricity. Identify reliable sources of information about different forms of renewable energy and their costs and benefits. Trace the steps required to harness wind energy and transform it to electricity. Conduct research on wind energy costs and benefits and incorporate the research results into a unit project. Trace the steps required to harness the energy of moving water and convert into electricity. Conduct research on hydroelectric power costs and benefits and incorporate the research results into the unit project. Trace the steps required to harness solar energy and convert it into electricity or other useful forms of energy. Conduct research on solar power costs and benefits and incorporate the research results into a unit project. Trace the steps required to harness geothermal energy and convert it to electricity. Conduct research on geothermal energy costs and benefits and incorporate the research results into a unit project. Identify technologies that help reduce the negative effects of resources used for energy. Compare the process of obtaining and using a fossil fuel to that of obtaining and using a renewable resource. 	<p>renewable resource sunlight solar panel/solar cells/photon water/hydro- wind turbine/farm geothermal geyser electricity generating electricity viable hydroelectric power (hydropower) technology engineering design/solutions biofuel hybrid fuel cell cause and effect risk/cost benefit analysis criteria constraints pros and cons cost effective/efficiency values facts opinions</p>
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<p>NGSS references (continued):</p> <p>Science and Engineering Practices:</p> <ul style="list-style-type: none"> • Obtaining, Evaluating, and Communicating Information <p>Crosscutting Concepts:</p> <ul style="list-style-type: none"> • Cause and Effect • Influence of Science, Engineering, and Technology on Society • Interdependence of Science, Engineering, and Technology 		
<p>Possible Science Biographies</p> <p>Edwin L. Drake: studied ways to bore/drill for oil; credited with building the first oil well in the U.S. Nikola Tesla: pioneered the generation, transmission, and use of alternating current (AC) electricity Marie Curie: pioneered research on radioactivity Lise Meitner: discovered that nuclear fission can produce enormous amounts of energy Alexandre-Edmond Becquerel: credited with the discovery of the photovoltaic effect that is applied in solar cells and panels</p>		

As noted above, this unit references the following standard that is a part of the [NGSS Grade 4 Topic 4. Energy](#).*

4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. [Evidence Statement](#)

**Note: The remaining Performance Expectations for 4. Energy are supported by the earlier Grade 4 Unit 1 Energy Transfer and Transformation.*