

# Grade 4 – Elementary Science

This sample contains a design for a 20–30 minute lesson directed to an independent 4th grade student.

Topic and essential question for focus of objectives, assessment, and instruction/application on.

- Natural Energy Resources
  - What are some environmental impacts of using fossil fuels?

## Lesson Objectives

Directions: Write one or more lesson objectives and identify the Next Generation Science Standards aligned to objectives.

Lesson Objectives	NGSS
#1 Explain what are fossil fuels.	4-ESS3 Earth and Human Activity  4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.
	Activities: Drag/drop and sequential dropdown (see content for descriptions)
#2 Examine environmental impacts of using fossil fuels	(same as above)

## Lesson Assessment

Directions: Compose an assessment that aligns to the lesson objective(s). Your sample should include, but is not limited to, the following:

- one composite item made up of at least two parts (these items may be traditional or technology-enhanced)
- two technology-enhanced items
- one short answer item

For technology-enhanced items, please provide an explanation as to how the student would manipulate the item to arrive at a response.

Each item should indicate the correct answer and align to one objective-NGSS standard pairing. Each item should also be assigned a Depth of Knowledge rating, which should be accompanied by a brief rationale describing how the item meets the DOK level.

### Assessment – Short Answer Item

Imagine you are a scientist researching a fish population in a lake. You find records from 1950 showing that there were hundreds of fish of several species in the lake. Today, you have found that the population of fish is 70-80 and there is only one species of fish. You also know that the human population in that area increased from 1,000 to 10,000 at the same time. How might the increase in human population be related to the decrease in fish populations in the lake? Justify your answer using what you know about environmental impacts of using fossil fuels.

Answer: The decrease in fish population could be a result of the increase in human population, as more people used/burned fossil fuels for energy. The increase in fossil fuel use could have increased the pollutants in the surrounding atmosphere, which brought back to the surface in the form of acid rain, could have begun to kill the population of fish in the lake.

DOK Level: Level 3

This is Level 3 because the student will need to justify their reasoning with using fairly complex concepts from the lesson instruction, and then relating them back to one another to create a supporting argument for that reasoning. In order to answer the question, they have to grasp the relationship between how fossil fuels are the most used energy source, more people means more fossil fuel use (typically, and for the sake of this argument at a 4<sup>th</sup> grade level), and how this increase can lead to detriments in the natural habitat of arguments. For instance, in this case, one of those detriments could and is acid rain. With the complexity needed to tie together all of these concepts, this brings the problem level up to a Level 3. The DOK Level could be improved/increased to Level 4 by possibly having them research a real-world instance where this happened (like the Adirondacks study in 1988), but I figured that was a little much for a 4<sup>th</sup> grader.

The correct answer also aligns back to the 4-ESS3-1 NGSS, because it addresses and shows understanding of the standard, which states a student should be able to describe how fossil fuel use affects the environment.

Lesson Instruction

Directions: Design appropriate lesson instruction and application supporting your topic of choice.

Energy and Fossil Fuels

Humans use resources for energy every day. Energy sources fall into two categories: renewable and nonrenewable sources. **Renewable sources** are energy sources that are naturally replaced, such as wind, water, and sunlight. **Nonrenewable sources** cannot be replaced once they are used up. Some of these sources are called fossil fuels. **Fossil fuels** consist of coal, oil, and natural gas, which are burned for heat and used to produce electricity. These products were formed from dead plants and animals, trapped deep in layers of the Earth, by processes that occurred over millions of years. Many people depend on fossil fuels to heat their homes, make vehicles run, and produce electricity. These fuels are the primary source of energy in the world, including the United States, where 81% of its energy is created from fossil fuels.

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Commented [b2]: <http://needtoknow.nas.edu/energy/energy-sources/fossil-fuels/>

Application for Graphic Design: Illustration created of as many features described above; bubble of one color over "Renewable" resources; bubble of another for "Nonrenewable" resources; copy of image used for hot spots to select all renewable and nonrenewable in two questions for assessment to meet state objective.

Image information: [image of power plant; cars in traffic; natural gas on a pilot light at the bottom of a water heater (Shutterstock has these) In a collage type layout]

Image Caption: Fossil fuels are used to create electricity, power cars, and heat our houses

Extracting Fossil Fuels

Since fossil fuels are located deep in the ground, they must be extracted from the earth with machines and other tools. How the fossil fuel is extracted depends on what type it is.

Oil is located in rock formations that are located within the earth’s crust. Large structures called oil rigs are used to drill deep into the earth in order to pump the oil through a very long pipe to the surface. If oil is located in ground that is deep under water, a platform can be built over the area where the oil can be extracted. This oil is then sent to refineries where it is processed into products such as gasoline, diesel, and kerosene fuels.

[images showing land rig (Shutterstock 338662055) and an offshore oil platform (Shutterstock: 525352747) side by side]

Image caption: Oil can be extracted on land or from ground found deep under the ocean.

Natural gas can also be found in earth’s deep rock formation. Natural gas and oil deposits are usually found near one another, and the gas is frequently pumped from the same areas where oil is being extracted. Natural gas can also be found trapped between rock layers. To get natural gas trapped between the rock, the rock is broken open by hydraulic fracturing or fracking for short. **Fracking** is a process where water is sprayed at high pressure to break open the rock. Breaking open the rock allows for the natural gas to flow out to the surface, where it can be piped out for use or stored in tanks.

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[image of natural gas processing plant, shutterstock: 238898095]

Image caption: Natural gas is processed and can be stored in large tanks on the surface.

Coal is extracted through mining or digging it out of the ground. Coal used to be dug out of the ground by workers for hundreds of years. Workers would build a series of mines to get to the coal and then dug it out of the ground. Digging

the coal out was a slow process, while underground explosions and cave-ins made this very dangerous work. Modern technology has greatly improved the mining process. Now, better safety precautions are taken to protect workers, and coal can be removed much quicker by machines from mines thousands of feet below the earth.

*Application for Graphic Design: Graphic with labels showing where each process takes place in the earth layers. Same or similar image used for drag/drop questions where each process is dragged to the different layers where the process is performed. This fulfills Bloom's 1-2 objectives required by the state requirements.*

*Image Information: [image of large coal drill, shutterstock: 68645392]*

*Image caption: Today, large machines are used to extract coal found thousands of feet below the earth's surface.*

### Environmental Impacts of Using Fossil Fuels

Although fossil fuels are the main energy source for people around the world, their use has very negative impacts on the environment around us. When fossil fuels are burned, they produce chemicals that pollute the atmosphere. Some of these chemicals are called **greenhouse gases**. When energy from the Sun heats the Earth's surface, some of this energy bounces back into space. Greenhouse gases trap this energy on the Earth, therefore increasing the heat that is felt on the surface. More pollutants in the air can also block the Sun's rays from reaching the surface. A combination of a global temperature increase and the blocking of sunlight can have a negative effect on plant growth. For plants to grow, they must have sunlight. If plants cannot get enough sunlight, their growth could be stunted or they may not grow at all.

Animals are also affected by climate change caused by the use of fossil fuels. Many animals depend on plants for food. If pollution hinders plant growth, certain animals may not get enough food for survival. As surface temperatures increase and climate patterns change, many animals are losing their habitats essential for their survival. For instance, the average global increase in temperature has increased the melting of ice in polar regions. Polar bears walk along this ice to hunt for food during the winter months, eating very little during the summer. Because more of the ice is melting, there is a shorter time frame in which polar bears can hunt, and a longer time where they cannot get food. This has resulted in population sizes shrinking as more polar bears starve. Scientists predict that nearly two-thirds of the polar bear population will disappear by 2050.

*[image of polar bears on ice floe, shutterstock 603586811]*

*Image caption: Polar bears are having a more difficult time hunting as their habitat is impacted by climate change.*

With higher amounts of pollutants in the atmosphere, humans also feel the effects of heavy fossil fuel use. Evidence of heavy air pollution can be seen in highly populated areas in the form of smog. Smog is a haze produced by smoke and pollution that can be seen over some large cities. This can affect the breathing of individuals who suffer from asthma and other respiratory diseases.

Heavy pollution in the air can come back down to the Earth's surface in the form of acid rain. Acid rain is rain that mixes with the pollutants in the air and falls to earth. As polluted rain water continually washes down over the ground and into bodies of water, it can eventually kill both plants and animals, such as marine birds and fish.

*Application of Graphic Design: No image needed; simple sequential dropdown designed here with "(Dropdown: Greenhouse gases) are chemicals that pollute the atmosphere when fossil fuels are burned. These cause (dropdown: smog), which is a haze that can be seen over large cities. This can cause breathing problems like (dropdown: asthma) in human beings.*

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**Commented [b5]:** <https://www.epa.gov/acidrain/effects-acid-rain>

*[image of Los Angeles, shutterstock: 282917493]*

*Image caption: Smog in cities can affect people with asthma or respiratory problems.*

