

### Follow-up Activities

- Encourage students to research the effect of fossil fuels on the environment, especially in terms of the greenhouse effect and global warming. Students can also track climate changes over the past century. Based upon their research, have students write a proposal that details the importance of reducing the emission of greenhouse gases and strategies for accomplishing this reduction. (See the Environmental Protection Agency web site for more information, [www.epa.gov/climatechange/index.html](http://www.epa.gov/climatechange/index.html).)
- Students can write letters to the local power company to learn more about how fossil fuels are used to generate electricity in your area. A representative from the power company can also make a visit to your classroom to discuss energy usage and conservation in your region.
- Brainstorm a list of things that run on fossil fuels and a list of things that are made from fossil fuels. Compare the lists, and encourage students to discuss how important fossil fuels are for life on Earth. What would life be like without them?

### Suggested Internet Resources

Periodically, Internet Resources are updated on our web site at [www.LibraryVideo.com](http://www.LibraryVideo.com)

- [www.energyquest.ca.gov/index.html](http://www.energyquest.ca.gov/index.html)  
The "Energy Quest" Web site developed by the California Energy Commission presents an "Energy Story," which focuses on the role of fossil fuels as a primary supply of the Earth's energy. Student activities about energy and fuel are also provided.
- [www.teachcoal.org/lessonplans/index.html](http://www.teachcoal.org/lessonplans/index.html)  
The American Coal Foundation offers lesson plans, organized by grade level and by subject, on the formation of coal, the history of the coal mining industry, how electricity is generated from coal and other topics related to this natural resource.
- [www.eia.doe.gov/kids/energyfacts/index.html](http://www.eia.doe.gov/kids/energyfacts/index.html)  
The "Energy Kid's Page" from the Energy Information Administration, a part of the U.S. Department of Energy, discusses the formation and use of fossil fuels, and also offers information on renewable energy sources.

### Suggested Print Resources

- Beech, Linda Ward. *The Exxon Valdez's Deadly Oil Spill*. Bearport Publishing Company, Inc., New York, NY; 2007.
- Miller, Kimberly. *What If We Run Out of Fossil Fuels?* Scholastic, Inc., New York, NY; 2002.
- Morris, Neil. *Fossil Fuels*. Smart Apple Media, Mankato, MN; 2006.

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#### TITLES

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## Fossil Fuels

### Grades 5-8

Students in grade 5-8 classrooms possess a wide range of background knowledge. Student response to this video program is sure to be varied, so the teachers at these grades need all the help they can get! This guide has been designed to help the 5-8 science teacher by providing a brief synopsis of the program, previewing and follow-up questions, activities, vocabulary and additional resources.

**Before Viewing:** Extensive research tells how important it is for the teacher to discover what the students know — or think they know — about a topic, before actually starting a new unit. Therefore, after prompting discussion with the pre-viewing questions, lead your class to create an "Everything We Think We Know About..." list. You may also wish to preview key vocabulary words, and have students raise additional questions they hope will be answered.

**After Viewing:** Have your students share video excerpts that fascinated or surprised them, then challenge your students to prove or disprove the accuracy of the facts they put on their "Everything We Think We Know About..." list. Discuss what else they learned and use the follow-up questions and activities to inspire further discussion. Encourage students to research the topic further with the Internet and reading resources provided.



## Program Summary

Fossil fuels such as coal, oil and natural gas are actually the altered remains of plants and animals that lived millions of years ago. The creation of fossil fuels begins with the plant process called photosynthesis. Plants collect energy from sunlight and use it to produce sugars, which provide food energy for plants and animals. Millions of years ago, countless numbers of dead plants and animals became trapped and buried under layers of mud. When these organisms died, the energy stored in their bodies was buried with them. Tremendous heat and pressure converted these remains into fossil fuels. These fuels, called hydrocarbons, are rich in carbon and hydrogen. When hydrocarbons are combined with oxygen and high temperatures, they release heat energy. This burning process is called combustion. The combustion of coal is commonly used to produce electricity. Oil is often used for powering machines, and natural gas is principally used for heating and cooking.

Coal used today actually began to be created between 300 and 400 million years ago. At that time, the Earth had many warm, humid, swampy areas where huge ferns and giant trees grew. After these plants died, their remains went through a four-stage process of coal formation. Peat, the first stage, is a soft, spongy brown material that, when burned, gives off heat, smoke and pollutants. The second stage is lignite, which is a soft, brown form of coal that also gives off many pollutants when burned. Bituminous coal is the third stage. This type of coal is soft and much cleaner to burn than the earlier stages. Finally, with continued heat and pressure, anthracite coal is formed, which is the cleanest and hottest-burning form of coal.

Petroleum, from the Latin words for “rock oil,” comes from the remains of billions of marine plants and animals. Over millions of years and under great pressure, these remains turned into crude oil, a thick, black, liquid fuel. When crude oil is refined by boiling, many petrochemical products are created, including gasoline, grease, medicines, fabrics and even plastics. Natural gas is created through the same process as oil and is often trapped underground, just above the heavier oil. Natural gas is the cleanest burning of the fossil fuels.

Extracting fossil fuels is both expensive and difficult. Coal deposits can be found near the Earth’s surface in coal cutouts; however, most coal is buried deep, requiring dangerous mining. Oil and gas are trapped between hard rock layers, requiring deep drilling rigs. The Earth’s supply of fossil fuels is quickly being consumed. With shortages and many pollution problems associated with the uses of these fuels, our challenge is to discover and develop alternative sources of fuel.

## Vocabulary

The following words are included for teacher reference or for use with students. They are listed in the order in which they appear in the video.

**fossil fuels** — Energy resources such as coal, oil or natural gas that are created within the Earth from the remains of plants and animals of millions of years ago.

**photosynthesis** — The process by which energy from sunlight is trapped by plants and converted into sugars. Photosynthesis provides the stored energy for the eventual development of fossil fuels. *(Continued)*

**hydrocarbons** — Substances that contain hydrogen and carbon. Fossil fuels are rich in hydrocarbons.

**combustion** — The burning process that results from combining hydrocarbons with oxygen and heat.

**coal** — The fossil fuel that is formed from the remains of trees and plants from 300 to 400 million years ago. There are four stages of coal formation: peat, lignite, bituminous and anthracite.

**peat** — Soft coal that is spongy, smoky and polluting. Peat is the first stage of coal formation.

**lignite** — Soft brown coal that releases a large amount of pollutants when it burns. Lignite is the second stage of coal formation.

**bituminous** — Soft coal that is cleaner burning than peat or lignite. Bituminous coal is the third stage of coal formation.

**anthracite** — The hardest, rarest and least polluting coal. Anthracite coal is the fourth stage of coal formation.

**petroleum** — (From the Latin words for “rock oil”) Also known as oil, this liquid fossil fuel is formed from the remains of billions of marine plants and animals. Over millions of years, these remains were converted to crude oil, which is a thick, black liquid fuel that needs refining.

**petrochemicals** — Products made from petroleum or natural gas. Petrochemicals are used to make medicines, fabrics, building materials and plastics.

**natural gas** — The gas fossil fuel formed from the remains of billions of marine plants and animals through the same process as oil. Natural gas is frequently found with petroleum deposits.

**smog** — A haze that is formed from the pollutants created by burning fuels. The term comes from the words “smoke” and “fog.”

**acid rain** — Rain, snow, sleet or hail that has a heavy concentration of harmful sulfuric and nitric acids. Acid rain forms when pollutants from burning fossil fuels combine with moisture in the air.

## Pre-viewing Discussion

Before students generate their list of “Everything We Think We Know About...” for this topic, stimulate and focus their thinking by raising these questions so that their list will better reflect the key ideas in this show:

- What are fossil fuels? How and when were they created?
- How do you use fossil fuels everyday?
- What are the pros and cons of using fossil fuels?

After the class has completed their “Everything We Think We Know About...” list, ask them what other questions they have that they hope will be answered during this program. Have students listen closely to learn if everything on their class list is accurate and to hear if any of their own questions are answered.

## Focus Questions

1. What process begins the creation of fossil fuels? How does this occur?
2. Name the three basic types of fossil fuels.
3. What are hydrocarbons?
4. Why is combustion necessary for us to take advantage of hydrocarbons?
5. What are some of the principal uses of each type of fossil fuel?
6. How is coal formed?
7. What are the four stages of coal formation? Explain the pros and cons of each.
8. If anthracite coal releases great amounts of heat and few pollutants when it burns, why isn’t it used more frequently as a fuel source?
9. Why is it appropriate that the word petroleum comes from Latin, meaning “rock oil”? How would you describe crude oil?
10. What is the purpose of an oil refinery? Name a number of petrochemicals that are derived from this process.
11. What is the most common natural gas?
12. How do people learn where deep underground deposits of oil and natural gas are located? How are these fossil fuels extracted?
13. Why are oil spills like the one in Valdez, Alaska, problematic for the health of the Earth and its inhabitants?
14. What are the causes of smog and acid rain? Why are they sources of concern for the world?
15. Why do we have to explore alternative sources of fuel?

## Follow-up Discussion

Research indicates that students will retain their previous misconceptions about a topic, in preference to new information, until they actively recognize and correct their own errors. Therefore, it is important to have your students re-examine the facts/beliefs they put on their “Everything We Think We Know About...” list. It might also be helpful to review the list by marking each entry with a “+” or “-” to show which facts were correct and which were incorrect.

Thought-provoking discussions provide a good way to assess the overall depth of student understanding. The following are some suggested discussion topics.

- The United States, with 5% of the world’s population, uses 25-30% of the world’s oil supply. Discuss what might happen if other nations wanted to use oil at such high levels. What can citizens of the United States do to reduce their dependence on oil and other fossil fuels?
- Discuss why fossil fuels are called nonrenewable resources. Brainstorm a list of other nonrenewable and renewable resources.
- Given that your future may be directly affected by the depletion of fossil fuels, if you were given the chance, what would you say to government and industry leaders?