

CLIMATE CHANGE AND OIL IN THE ARCTIC: INTRODUCTION

Petroleum, or oil, is a fossil fuel formed from the remains of prehistoric organisms that settled at the bottoms of lakes and oceans millions of years ago. The remains were covered by sediment and became oil over time due to increasing pressure and temperatures. The United States uses about 700 million gallons of oil every day, and nearly three billion gallons of oil are used by the world each day (NOAA Ocean Service Education, 2011). Petroleum is used to fuel automobiles, heat buildings, pave roads, and make many products such as plastics, medicines, fertilizers, and personal care products.

Oil must be drilled directly from underground or under the sea. Many concerns for local ecosystems arise when drilling for oil, particularly in the arctic. In order to transport oil and drilling equipment, roads must be constructed, which could affect vegetation and the animals that rely on it. If there is an oil spill in the arctic, effects may be drastic. Cleanup may be hindered by weather conditions, and oil may become trapped under ice. Also, oil evaporates more slowly in the arctic. Organisms have longer life spans and produce fewer offspring, so persisting oil may severely affect arctic populations.

A changing climate is also directly affecting organisms in the arctic, particularly by decreasing the amount of sea ice available. An example of an affected organism is the black guillemot, which finds its food, arctic cod, underneath the sea ice. As sea ice retreats, guillemots must travel farther out over the ocean to find food.

KEY WORDS

Oil Production

Oil = petroleum
Fossil fuels = oil, natural gas, coal
Extraction
Refining
Crude oil

Oil in the Arctic

Climate change
Sea ice
Pack ice
Fast ice
Foraging
Feedback loop
Albedo effect

FOCUS QUESTIONS

Oil Production

1. What is fossil fuel?
2. Where does oil come from?
3. How is oil produced?

Oil in the Arctic

1. What is sea ice?
2. How is sea ice changing?
3. What are some specific problems that occur when drilling and transporting oil in the arctic?

LEARNING OBJECTIVES

The students will:

- describe the origin of fossil fuels.
- explain the important role of engineering in gathering and finding oil.
- describe how people use oil in their everyday lives.
- define climate change.
- identify at least two effects of climate change.
- define sea ice.
- identify sea ice changes.
- define albedo effect 1 and 2.
- identify two effects of climate change on animals in the arctic, particularly the black guillemot.
- identify two effects of climate change on plants in the arctic.
- identify two effects of climate change on people living in the arctic.
- define greenhouse effect.
- identify two impacts of drilling for oil in the arctic.
- identify two impacts of an oil spill in the arctic.

MATERIALS

Student lab books with worksheets

- Focus questions
- Lab worksheets

Oil Production

Fish, Fossils, & Fuel Activity (per group)

- 1 slice each of white, wheat, and rye bread
- Gummy candy fish (or other sea animals or plants for illustration purposes; gummy bears will also work)
- Heavy books
- Paper towels
- Magnifying lens
- Clear drinking straws

Oil in the Arctic

Design an Oil Field Activity (per group)

- Geobotanical maps
- Paper
- Pencils/colored pencils

Foraging Activity

- Large open space (such as gym or cafeteria)
- Containers representing summer sea ice (crates, bins, buckets)
- Small containers representing guillemots' nests (baskets, bowls)
- Items representing arctic cod (popsicle sticks, clothespins)

- Cup or bag for each child collecting cod
- Timer or stopwatch

AUDIO-VISUAL MATERIALS

- Computer, projector/monitor, flash drive, screen
- Slideshow: “Climate and Oil in the Arctic”
- Slideshow: “Guillemots”

LEARNING PROCEDURE

See “Lesson 3 Activity Instructions” for details.

- A. “Oil & Climate” slideshow **(15 minutes)**
 - a. Fish, Fossils, & Fuel Activity, Day 1 (Days 2 and 3 to be continued on the following days) **(30 minutes)**
- B. “Climate and Oil in the Arctic” slideshow, slides 1-22 for climate change **(25 minutes)**
- C. Foraging in a Changing Arctic Activity **(30 minutes)**
 - a. “Black Guillemots” slideshow, notes within teacher instructions **(15 minutes)**
- D. Continue “Climate and Oil in the Arctic” slideshow, slides 23-33 for oil **(20 minutes)**
 - a. Designing an oil field activity **(15 minutes)**
- E. Wrap-up discussion **(10 minutes)**
 - a. Discuss the origin of oil and natural gas.
 - b. Review climate change.
 - c. How are the black guillemot affected?
- F. Oil Crossword Puzzle, have students complete it, then go over **(20 minutes)**

STANDARDS

Alaska State Standards:

SA The student will demonstrate an understanding of the processes and applications of scientific inquiry.

(5) SA1.1 asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring and communicating.

(5) SA1.2 using quantitative and qualitative observations to create their own inferences and predictions.

SA1 The student will develop an understanding of the processes of science used to investigate problems, design and conduct repeatable scientific investigations, and defend arguments.

SA2 The student will develop an understanding that the processes of science require integrity, logical reasoning, skepticism, openness, communication, and peer review.

(5) SA2.1 supporting their statements with facts from a variety of resources and by identifying their sources.

SA3 The student will develop an understanding that culture, local knowledge, history, and interactions with the environment contribute to the development of scientific knowledge, and local applications provide opportunity for understanding scientific concepts and global issues.

(5) SA3.1 identifying the limiting factors (e.g., weather, human influence, species interactions) that determine which plants and/or animals survives.

National Science Education Standards

Content Standard A: Scientific Inquiry

All students will develop abilities necessary to do scientific inquiry.

Identify questions that can be answered through scientific investigations.

Design and conduct a scientific investigation.

Use appropriate tools and techniques to gather, analyze and interpret data.

Develop descriptions, explanations, predictions and models using evidence.

Think critically and logically to make the relationships between evidence and explanations.

Communicate scientific procedures and explanations.

All students will gain an understanding about scientific inquiry.

Different kinds of questions suggest different kinds of scientific investigations.

Technology used to gather data enhances accuracy and allows scientists to analyze and quantify results of investigations.

Scientific explanations emphasize evidence, have logically consistent arguments and use scientific principles, models and theories.

Ocean Literacy Standards

1. The ocean is largely unexplored.
 - a. The ocean is the last and largest unexplored place on Earth – less than 5% of it has been explored. This is the great frontier for the next generation’s explorers and researchers, where they will find great opportunities for inquiry and investigation.
 - b. Understanding the ocean is more than a matter of curiosity. Exploration, inquiry and study are required to better understand ocean systems and processes.
 - d. New technologies, sensors and tools are expanding our ability to explore the ocean. Ocean scientists are relying more and more on

satellites, drifters, buoys, subsea observatories and unmanned submersibles.

RESOURCES

Foraging in a Changing Arctic Activity adapted from:

<http://www.polartrec.com/resources/lesson/foraging-fish-in-a-melting-arctic>

“Introduction to Oil and Natural Gas” slideshow and Fish, Fossils, and Fuel Activity from: <http://www.energy4me.org>

<http://oceanservice.noaa.gov/education.html>

National Research Council (U.S.), (1996). *National Science Education Standards: observe, interact, change, learn*. Washington, D.C.: National Academy Press.

Project 2061 (American Association for the Advancement of Science), (2001). *Atlas of Science Literacy*. Washington, DC: American Association for the Advancement of Science: National Science Teachers Association.

FEEDBACK

We value your feedback on this lesson.

Send your comments to: khoffman@pwssc.org

PWSSC Discovery Programs

Prince William Sound Science Center

P.O. Box 705 Cordova, Alaska 99574

907-424-5800

907-424-5820 (fax)

info@pwssc.org

Acknowledgements

This lesson was developed and written for the PWSSC Discovery Room Program with funding from the Oil Spill Recovery Institute.