



Climate Change

Middle Level Lesson Plan

Topic

The ecological effects of specific technologies on both northern New England and broader regions of the earth.

Grade Level 7-8

Overview

The theme of QUEST *Climate Change* centers on scientist Barry Rock's statement, "Climate change is something that has been happening forever." A number of earth system phenomena are considered indicators of climate change – from unusual weather events to changing populations of plants and microorganisms; from atmospheric chemicals embedded in ice cores to oceanic variations such as rising sea levels and changes to the Gulf Stream current. These types of changes can affect almost everyone on the planet.

Introduction

Through this unit of study, students will become more aware of issues related to some of the hypothesized human causes of global climate change. The lessons provide students with an opportunity to examine the broader impact of any technological development – the original purpose(s) of the technology; the benefits of the technology (both intended and unintended); and, finally, the negative impacts, many of which are unexpected.

Time Allotment Five to six 45-minute class periods.

Accessing Prior Knowledge

Students should be aware that people have an enormous effect on other living things. They should also recognize that any form of technology has drawbacks as well as benefits.

Concepts to Clarify

According to *Benchmarks for Science Literacy*, there are some interesting student perspectives on the "risk" that results from the failure of technological systems and who should make decisions relating to those risks. The following represent the types of beliefs expressed by students:

- If the risk of failure involves the possibility of widespread harm, it is unacceptable.
- However, if the risk of failure is to oneself and voluntary, it is considered a part of life and hardly worthy of concern by others.
- If the risk of failure involves harm to oneself and benefits to oneself, then it is of primary interest.

**QUEST: Investigating Our World is a regional public television series
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Because students often believe that scientists and engineers are more capable of making decisions about public issues related to science and technology than the general public, they will accept risks based on a comment rather than analysis. They also believe that scientists and engineers know all the facts and are not influenced by personal motives and interests. This is not always the case. Students need to be helped to understand that there is scientific bias as well as personal bias that sometimes enters in decision making. One way to help them with this is to have them look at conflicting analyses of the same issue.

CONNECTIONS TO THE STANDARDS

Maine Learning Results	New Hampshire Curriculum Framework	Vermont Learning Standards	National Science Education Standards	Benchmarks for Science Literacy
<p>Science Content Standards</p> <p>M. Implications of Science & Technology (5-8)</p> <p>6. Give examples of actions that may have expected or unexpected consequences that may be positive, negative or both.</p>	<p>Earth/Space Science</p> <p>4c. Curriculum Standard: End of Grade 10 (Secondary)</p> <p>Identify... Human-induced factors that contribute to changes in the Earth's systems.</p>	<p>Design and Technology</p> <p>Outputs and Impacts</p> <p>Grades 5-8</p> <p>Students understand that people control the outputs and impacts of our expanding technological activities in the areas of communication, construction, manufacturing, power and transportation, energy, health and biotechnology.</p> <p>7.18.d. Identify the positive and negative consequences of technology.</p>	<p>Content Standards (5-8)</p> <p>2. Understandings about science and technology</p> <p>f. Technological solutions have intended benefits and unintended consequences. Some consequences cannot be predicted.</p>	<p>Chapter 3B: Design and Systems (6-8)</p> <p>2. All technologies have effects other than those intended by the design, some of which may have been predictable and some not.</p> <p>Chapter 3C: Issues in Technology (6-8)</p> <p>5. New technologies increase some risks and decrease others.</p> <p>6. Rarely are technology issues simple and one-sided. Relevant facts alone, even when known and available, usually do not settle matters entirely in favor of one side or another.</p> <p>7. People control technology and are responsible for its effects.</p>



Materials Needed

- TV with VCR
- QUEST *Climate Change* video
- Chart paper and markers
- Student Handout 1: Climate Change Resource List
- Student Handout 2: When I Am 50
- Student Handout 3: *QUEST at Home: Investigating Our Changing World Climate*
- Computer(s) for student use with Internet access

I. Introducing the Concepts

Step 1

Ask students to close their eyes and imagine a world without our modern technological advances, such as petroleum-based transportation options, heating and cooling systems, electricity generation, and machines.

Post a list of these technologies in the classroom in preparation for Step 2.

Step 2

Once students have formed an image of a technology-free world in their minds, prompt them to do some brainstorming. First, have students work alone to write down all of the benefits that humans receive from each of the technologies on the posted list. Next, have students share and discuss their lists with partners or in small groups. Then debrief as a whole class, recording students' responses on new chart paper. Under the name of each technological advance, list both who benefits from the technology and what those specific benefits are. The goal of this activity is both to engage students and to show you the extent of your students' thinking about the positive benefits of certain technological developments.

During the debrief, prompt the class to consider some of the secondary benefits of each technology. Examples might include better health due to quick transportation to hospitals, or a more informed and educated population due to electricity that runs computers, radios, and televisions.

Save these chart-paper records for later activities.



2. Exploring the Concepts

Step 1

Explain to students that they will be learning more about some of the technologies they considered during the previous activity. In particular, they will be learning about some of the effects of these technologies. Begin to explore the notion that many technological advances have provided major benefits to humans while also carrying great risks. Suggest that the most notable risk is global climate instability and its resulting impact on the living world.

Step 2

Ask students to look back at the chart-paper lists from the debriefing activity and to review for themselves the benefits or positive effects of each technology.

Then ask them to think about effects other than those that were intended by the design for each technology. Have students volunteer their ideas about some of these other, unintended effects. Record these ideas on new chart paper. Then ask, "Do you think that these other effects were predictable when the technologies were being developed?" Ask students to provide examples of specific effects to illustrate their responses.

End the conversation by asking, "Do you think that we can predict what will happen over the next 100 or 1000 years as a result of our continuing use of these technologies?"

Step 3

To introduce the video *QUEST Climate Change*, explain that the earth's climate has always been changing. Ask if students know anything about a dramatically different climate in their region that existed about 20,000 years ago. If no one volunteers information, remind the class that a glacier up to two miles deep covered the region now known as northern New England. Mention that many scientists and other people are concerned today about the extent to which changes in the earth's climate, and the rate of those changes, are the result of human activity.

Tell students that the video they are about to watch offers many examples of evidence that the earth's climate is changing. Ask them to record all of the changes that they see as they view the film. Also ask them to note any particular technologies that are associated with each climate change.

Step 4

Show the video. You may need to divide the viewing into two half-hour installments if your class period configuration requires it.

Step 5

Debrief by having students share the information that they noted – the evidence of climate change and the possible causes that were mentioned for each change. Ask the class to share their thoughts and feelings about these ideas. The notion that a specific technology can have a global impact may be



overwhelming to students. While it is important for them to be aware of the impact of human activity on the environment, it is also important that they have the chance to express their thoughts and concerns. Moreover, it is critical that you, as teacher, convey the idea that this unit will help students learn how they, both individually and as a group, can make a positive difference.

3. Developing the Concepts

Step 1

To introduce the next activity, lead a discussion about data. What does the word data mean? How do scientists decide which data to collect? Once scientists have collected data, how do they determine which data are important? How do they use the selected data to make statements about the way the world works?

The purpose of this conversation is to focus on the importance of objectively studying and collecting a body of evidence about a given phenomenon. Remind students about the myth that scientists disagree that the climate is changing.

In the *QUEST Climate Change* video, Scott Ollinger comments that if you assembled the world's scientists today and asked them if they believed climate change was a reality, you would probably find that 99 percent believe that it is. Compare this with the situation 10 years ago, when the split would more likely have been 50-50. Have students consider why the scientific community has come to greater agreement on this issue over the past decade. Lead them to the conclusion that, over time, more data provide more documented and connected evidence of the phenomenon.

Tell students that they will be “studying about the studies.” In other words, they will be exploring the variety of current scientific information that demonstrates the existence of change within various components of our global climate systems.

Step 2

You may wish to preview the list of Web sites on Student Handout 1: Climate Change Resource List. If desired, you can add to this list in order to have the most comprehensive and current source list of evidence of global system change.

Step 3

Arrange students into pairs. Then distribute Student Handout 1. You can choose to have each pair of students select a topic that interests them, or you may simply wish to assign a topic for each pair to research. Appropriate topics might include sea levels, average temperatures, weed populations, asthma cases, atmospheric sulfate and nitrate concentrations, the impact on skiing, fish species distribution, and so on. Student pairs should gather information about climate-change data related to their topics and form conclusions. They will be sharing their findings with the rest of the class.



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Step 4

Have each pair of students prepare a summary of the information they have gathered. Instruct them to include the specific global system component they have researched, the assumed root cause of the phenomenon, and the changes that have occurred within this global system component.

As students report their findings, record them on new chart paper. This record will provide an addendum to the original chart-paper list the class created during the very first activity. Record students' findings according to the following format:

- Title: Name of the technological advance (use the same titles as on the original class list)
- List of side effects (provide examples from the research into global system components that students have just done)
 - For each side effect: Who is affected?
 - For each group that is affected: Put a star beside their listing if students think this group would find this side effect unacceptable or of concern.

Step 5

Conclude this activity by asking students to respond in writing to the following questions:

- What happens when some of these potentially concerned groups or individuals are the same people who might also benefit from the technological advance?
- What happens when some people who might have experienced the benefit(s) of the technological development are not concerned by the resulting changes/side effects?
- Why do you think some people might not be concerned about the impact of technologies on the global climate system? What might be influencing their priorities and actions?

Encourage students to conclude that some people may not see, or truly understand, the side effects of a particular technology if they have not experienced the discomforts resulting from them in their own lives.

4. Synthesizing the Concepts

Note: You may wish to assign the *QUEST at Home* activity sometime before students participate in this final segment of this teaching unit. Or, you may choose to proceed with the next segment and then follow up by making the *QUEST at Home* activity the culminating feature of the unit.

Step 1

Begin by discussing the concept of *scenario* with students. This term may conjure up images from science fiction or other literary works, in which an author has created an entirely imaginary setting within a very



particular time or place. Explain that students will be working with partners to use what they have learned about current global climate changes and their impacts on earth systems to create scenarios that illustrate their own predictions about what the earth will be like when they are 50 years old. Tell the class that, unlike a work of total fiction, their scenarios must be based on their predictions that are drawn from accurate data.

Step 2

Distribute copies of Student Handout 2: *When I Am 50*. Review the instructions together. Allow at least one full class period for student pairs to collect all of the data they need and to outline their scenarios. Allow at least part of another class period for students to complete the activity if necessary.

5. Extending the Concepts

Quest at Home

Distribute copies of Student Handout 3: *QUEST at Home: Investigating Our Changing World Climate*. Review the handout with students before they take their copies home. Agree upon a due date for students to return to class with their findings.

Community Connections

Some local advocacy groups help to connect community members who can work together to reduce climate change. Have students visit the Web sites of some of these organizations to learn how they function. You might even encourage students to consider getting involved with one or more of these groups. Some New England-based advocacy groups are listed below.

The **One Sweet Whirled** campaign, described in *QUEST Climate Change* video, is a joint venture of Ben & Jerry's Ice Cream, the Dave Matthews Band, and a coalition of environmental groups. Its goal is to encourage people to reduce their carbon dioxide emissions. <http://www.onesweetwhirled.org/ireland/pledge.html>

The **Alliance for Climate Action** is based in Burlington, Vermont. In May 2000, the Burlington City Council adopted a plan (called The Burlington Climate Action Plan) to save energy and reduce greenhouse gas emissions. To learn more about the group involved in carrying out this plan and Burlington's five key strategies, visit <http://www.10percentchallenge.org>.

The **Carbon Coalition** is a New Hampshire citizens' group striving for a responsible energy policy. To learn more information about the affiliated New Hampshire groups, go to <http://www.carboncoalition.org>.

The **Forest Watch** group has a great deal of information about the study of the white pine and how it is being affected by ozone. This part of the site is related to the symptoms of ozone on white pine trees. <http://www.forestwatch.sr.unh.edu/news/symptomology.htm>



Career Opportunities

Climate change can be a factor in many careers. Here is a list of some related professions:

■ **Research: scientist, technician, field biologist, data analyst, forester**

The National Oceanic and Atmospheric Administration, Department of Environmental Protection, and various universities (e.g., Cornell, University of Vermont, and University of Maine) have staff and/or faculty members who are conducting research about climate change.

■ **Planners: planner, forester, economist**

State economic developers and state planners consider the impact of changes in state revenues and land use.

■ **Agriculture: forester, tree farmers**

Both local landowners and larger regional landholders work to become more efficient at managing their natural resources, including overall forest management.



Climate Change Resource List

<http://www.onesweetwhirled.org/ireland/learn.html>

This site contains a guide to understanding the various issues related to global warming. The last page on this site has links to a dozen research and information organizations that are working on the issues.

<http://www.10percentchallenge.org/informationscience.php>

This site, an interesting local resource, contains information about the science of global warming and climate change in Vermont.

<http://www.cleanair-coolplante.org/effects>

This site is provided by an advocacy group. It addresses how climate change will affect you and your community.

<http://www.carboncoalition.org>

This site is maintained by a local advocacy organization called Carbon Coalition. This group of New Hampshire citizens is working for a responsible energy policy. The site has information about New Hampshire and how to get involved at a local level.

<http://www.ume.maine.edu/GISP2>

This site has information about the Greenland Ice Sheet Project 2, which provides an example of the effects of climate change.

<http://www.ume.maine.edu/GISP2/DATA/SO4NO3.html>

This site has information about sulfate and nitrate concentrations in the atmosphere from 1750 to 1990. These two gases contribute to climate change.

<http://www.umaine.edu/research/UMTCatStorms.htm>

This site is a resource for examining the categorization of winter storms, which are another effect of climate change.

<http://www.ume.maine.edu/iceage/Research/Contrib/html/contrib9.html>

This site has information about the issues of sea levels and shorelines (as well as people) in the context of quaternary changes.

<http://www.forestwatch.sr.unh.edu/news/symptomology.htm>

This site provides information about a research project on the effects of ozone on white pines that schools can participate in. The project is called Forest Watch: White Pine-Ozone Symptomology.

<http://www.cleanair-coolplanet.org/solutions>

This site is sponsored by an advocacy group involved in finding solutions to global warming. It contains information related to success stories in the Northeast.



When I Am 50

Have you ever predicted the future? Has one of your predictions come true?
On what information did you base this prediction?

In the following activity, you will create a scenario that illustrates what you predict the world will be like when you are 50 years old. Where should you start? How about in the present?

- 1.** Think about your world in northern New England today. Review in your mind the physical features, climate, and natural resources of your region.

Then consider what you really think the world will be like when you are 50. What will the natural world outside your door look like? What about the “designed” world – the realm of technological innovations that have helped us lead healthier and more comfortable lives?

- In your notebook or on the back of this paper, jot down some thoughts in response to the questions above.

- 2.** Now, consider what you’ve learned about global climate change. How might this information help you to think about future scenarios—about changes that could occur to the environment that you have just described?

- In your notebook or on the back of this paper, jot down some notes about the following systems: climate, atmosphere, geography, economy. In what ways could these change life in your region, given our current energy use?

- 3.** Think about how people might or might not alter their energy-using behavior over time.

- In your notebook or on the back of this paper, list some predictions about how peoples’ energy-using behavior might impact the planet by the time you are 50.

- 4.** Finally, you are ready to create your scenario. Using all of your notes from items 1 through 3 above, write or sketch the scenario that you picture for your world when you are 50. Describe this scenario in your notebook or on another piece(s) of paper.

- 5.** When you have finished, share your scenario with your classmates. As you listen to each others’ stories, think about all of the actions that you and your fellow students, either individually or as a whole class, might take to make a difference in the future of our earth’s systems.



Investigating Our Changing World Climate

You're on a QUEST!

According to scientist Barry Rock, climate change is something that has been happening forever. Volcanoes, as well as other natural catastrophes and situations, have always been factors in the world's changing climate. However, as we learned from watching the video *QUEST Climate Change*, a major concern of Rock and other scientists is whether humans have become a major cause of climate change in recent times.

What are some actions that you can take to lower the impact of human activity on the atmosphere and the climate of our planet?

Step 1: What's the problem?

First, you will want to share and discuss what you've learned about climate change with family members. A few good Web sites that can help your family learn more about how our climate is changing as well as possible causes and effects are

<http://www.onesweetwhirled.org/ireland/learn.html>

A guide to understanding global warming:

<http://www.10percentchallenge.org/informationscience.php>

Information about the science of global warming and climate change.

<http://www.cleanair-coolplanet.org/effects>

How climate change may affect you and your community:

Step 2: What can you do about it?

Once you have gathered the facts, you'll want to think about possible solutions. What can we, as individuals and families who live in northern New England, do on our own that will make a difference?

Some examples include:

■ Cut back on home energy use and transportation activities.

There is a "residential calculator" that can help you and your family think about the ways in which you use energy. It also provides ideas about personal changes that your family can make to reduce the amount of carbon being released into the atmosphere due to energy use. To calculate your household's energy use and to learn what you can do to reduce it, visit:

<http://www.10percentchallenge.org/rezcalculator.php>.

■ Buy a "greener" vehicle.

The U.S. Environmental Protection Agency's Green Vehicle Guide gives information about air pollution emissions and the fuel economy performance of different vehicles. The guide uses these values to determine an environmental rating system for cars and trucks. You can compare these values to find the greenest vehicle that meets your family's needs at: www.epa.gov/autoemissions



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■ Share your information!

Once you have investigated these resources at home and learned about what you can do to make a difference on an individual and family level, go back to school and see what your classmates have found. Global problems can seem so big sometimes that it almost feels as if one person can't make a difference. But, as you have learned, just by cutting 10% of your own carbon pollution, you can keep about 1060 kilograms of CO2 out of the atmosphere this year!

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