

# The Potential Consequences of Climate Variability and Change

Educational Product	
Educators	Grades 9-12

# FORESTS



**Planet Watch 2000**

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**T**his learning activity was developed to examine the potential impacts of climate variability and change. Each activity is part of an overall series entitled *The Potential Consequences of Climate Variability and Change*, which includes 1–12 teacher resources. Twelve modules (10 printed and 2 online resources) comprise the set and are presented below:

### **OVERVIEW**

- Too Many Blankets (Grades 1–4)
- Global Balance (Grades 5–12)

### **AGRICULTURE**

- El Niño (Grades 5–8)  
This activity is provided in an online format only and is available at <http://ois.unomaha.edu/casde/casde/lessons/Nino/teacherp.htm>.
- The Great American Desert? (Grades 9–12)  
This activity is provided in an online format only and is available at <http://ois.unomaha.edu/casde/casde/lessons/grass/teacherp.htm>.

### **COASTAL AREAS**

- What Could a Hurricane Do to My Home? (Grades 5–8)
- What Is El Niño? (Grades 5–8,9–12)
- Coral Reefs in Hot Water (Grades 9–12)

### **FORESTS**

- A Sticky Situation (Grades 5–8)
- Planet Watch 2000 (Grades 9–12)

### **HUMAN HEALTH**

- Beyond the Bite: Mosquitoes and Malaria (Grades 5–8,9–12)
- Climate and Disease:A Critical Connection (Grades 9–12)

### **WATER**

- Here, There, Everywhere (Grades 7–8,9–12)

The development of the activities was sponsored by the National Aeronautics and Space Administration and the Environmental Protection Agency, in support of the US Global Change Research Program. The Institute for Global Environmental Strategies implemented the effort. For more information, see <http://www.strategies.org>. For additional resources, please visit <http://teach.earth.com>—Resources for Teaching and Learning about Earth System Science.

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# Climate Variability & Change **FORESTS**

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## **ACTIVITY Planet Watch 2000**



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# Planet Watch 2000



**T**his activity explores the potential impact of climate variability and change on one of Earth's increasingly most vulnerable resources, our forests. Although the activity that follows is designed to tap specific skills and knowledge through scientific inquiry, its broader intent is to stimulate thought about the long-term impacts of a warmer planet.

## **GRADE LEVELS**

Grades 9–12

## **TIME REQUIRED**

Three to four 40-minute class periods

## **OBJECTIVES**

The activity focuses on a specific aspect of the climate variability and change issue—the impact of climate variability and change on New England forests. Its scenario invites students to examine higher level issues of climate variability and change by creating a practical, scientifically sound model to address specific points of a localized socioeconomic situation.

Students will:

- Explore contemporary thought about the issue of climate variability and change;
- Examine the issues as they relate to a specific, socially relevant situation;
- Investigate claims supporting opposing viewpoints;
- Determine whether the issues constitute a realistic problem;
- Analyze scientific evidence about the situation;and
- Present and defend their recommendations for action.

The activity's organization has been designed to mirror the scientific process, and the pedagogical principles employed in its design are constructivist in viewpoint.

Students will:

- Voice their prior understanding of the issues;
- Confront their level of understanding by considering opposing viewpoints;
- Engage in cooperative dialogue with other students to redefine their own position;and
- Present a revised, personal view of the situation,informed by scientific scrutiny.

## **KEY QUESTIONS STUDENTS SHOULD ADDRESS**

1. Can we safely say that the rate of climate variability and change is increasing?
2. What does the evidence say about these changes? Do scientists agree?
3. If the forests of New England alter as a result of climate variability and change, what are potential impacts? Likely areas of impact include fall foliage, tree migration,biodiversity, skiing, fishing, hiking and nature walking, the maple syrup industry, and the timber industry.

## **DISCIPLINES ENCOMPASSED**

An effective strategy for delivering this activity could include allotting several class periods, representing various disciplines. Teachers in each of the following disciplines will readily find relevant ties between the content of the activity and course objectives:

- Ecology
- Environmental Science
- Geography
- Language Arts
- Mathematics
- Meteorology/Climate
- Social Studies
- Technology

## **PREREQUISITE KNOWLEDGE: TEACHER**

- Weather is the state of the atmosphere at a specific time and place.
- Climate is the sum of all statistical weather data for a place or region,or its average

weather, including normal changes in precipitation and temperature over long periods. Climate is determined by the interaction of many factors, including ocean and air movements and the release of gases into the air by living organisms.

- Factors considered in determining weather and climate include air humidity and temperature, types and amounts of clouds and precipitation, pressure exerted by the air, and speed and direction of the wind.
- The most accurate way of tracking recent change in Earth's climate is by examining weather records and comparing them with historical records.
- The health of the world's forests are determined by a complex interaction of biological, chemical, and physical processes. Human activity (some planned and some accidental) has contributed to the degradation of forests in some areas. Local needs for income, fuel, food, and fodder have contributed to this degradation.

- **Overview of Problem-Based Learning—** This activity uses problem-based learning (PBL), whereby groups of students conduct investigations into the potential impacts of climate variability and change on forests. Students will use the standard PBL model, summarized below, to structure their analysis, research, and recommendations. Teachers interested in more information about this model should consult the PBL resources listed in the **Resources: Teacher** section.

Following the PBL model, students will:

- Read and analyze the problem scenario;
- List hypotheses, ideas, or hunches;
- List what is known;
- List what is unknown;
- List what needs to be done and plan the investigation;
- Develop a problem statement;
- Gather information; and
- Present findings and recommendations.

*NOTE: When using the PBL model, the teacher acts more as a coach in helping students investigate the problem. To that end, resources relevant to students' research follow the **Activity**. Teachers may provide these resources to students or have them develop their own list.*

### **PREREQUISITE KNOWLEDGE: STUDENTS**

- Basic understanding of the role of forest ecosystems.
- Basic understanding of climate change.
- Understanding of the Scientific Method.

### **KEY TERMS AND CONCEPTS**

The following terms and concepts will be presented in the following text and activities:

Climate  
Climate variability and change  
Ecosystem  
Global warming  
Greenhouse gases  
Weather

### **RESOURCES: TEACHER**

#### **Climate Variability and Change**

THE TEACHER'S GUIDE TO GLOBAL WARMING is an interactive online lesson that will educate students about this highly debated environmental issue. Students will be given the chance to research global warming with global warming Web sites linked to the lesson, found at:

*<http://weathereye.kgan.com/expert/warming/teachers.html>*

#### **PBL Resources**

Center for Problem-Based Learning. Illinois Math and Science Academy

*<http://www.imsa.edu/team/cpbl/cpbl.html>*

Delisle, R. 1997. *How to Use Problem-Based Learning in the Classroom*. ASCD.

Exploring the Environment Web Page.

*<http://www.cotf.edu/ete/main.html>*

PBL Home Page

*<http://ddsdx.uthscsa.edu/pblast/pblasthome.html#Print>*

Sharan, Y. and S. Sharan. 1992. *Expanding Cooperative Learning Through Group Investigation*. Teachers College Press. New York, NY.

Torp, L. and S. Sage. 1998. *Problems As Possibilities: Problem-Based Learning for K–12 Education*. ASCD.

# ACTIVITY

## Planet Watch 2000

This activity will answer the questions: What is climate variability and change? How is climate variability and change affecting forests?

### **MATERIALS**

- Handouts: *Scenario*, *Problem-Solving Model*, *Resources:Students*, and *Student Activity Sheets*
- Access to school and public library
- Computers with Internet access

### **PROCEDURE**

*NOTE: This activity will be most effectively implemented in cooperative working groups. Student teams should choose, or be assigned, to investigate smaller segments of the larger issues. Scientific investigation of the problem will necessarily involve many different perspectives. Student teams could concentrate on the investigation of one component of the activity. In the final presentation, teams could use a jigsaw approach, with each team presenting a different perspective on the issues.*

#### **Step 1**

Place students into teams of 3 or 4.

#### **Step 2**

Distribute the *Planet Watch 2000 Briefing* and the *Problem-Solving Model* found on the following pages. Each group will read and discuss the *Planet Watch 2000 Briefing*. Remind them that the New England coalition awaits their briefing, which will reflect their best research efforts and well-informed interpretation of the issues at hand.

#### **Step 3**

Ask them to now read the *Problem-Solving Model* to guide them as they develop their brief. Follow the steps and prepare a 5–10 minute presentation. Be sure groups record all the information they research, including a bibliography, on their *Student Activity Sheets*.

#### **Step 4**

Assign groups presentation times.

**PLANET WATCH 2000:  
Dedicated to Preserving Our Planet  
Briefing to Research Associates**

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**SCENARIO**

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***Who Are We?***

Planet Watch 2000 is an international organization devoted to monitoring environmental concerns that affect the global economy.

***How Do You Fit In?***

Although Planet Watch receives the support of many nations, it must frequently rely on volunteers to carry out extensive research and development efforts. Because of growing concern about the state of our planet, Planet Watch is flooded with requests for information on the impact of climate variability and change. Your group has been asked to assist with one of these requests.

A coalition of concerned agencies and groups of business people in New England has requested information on the potential impacts of climate variability and change on their forests. They are asking whether a change of a few degrees in the average temperature over a relatively short period will cause major changes in the forests, impacting citizens' living conditions, economic well being, and social structure.

Models of the current climate trends used by the Intergovernmental Panel on Climate Change indicate that the Earth may warm by 2° to 6° F by 2100. Should these observations be a cause for alarm for the average citizen? For at least this group of citizens, the answer to that question seems to be a resounding "Yes!"

According to Planet Watch's records, a recent scientific study suggested that New England's forests underwent a dramatic change about 10,000 years ago. Over a 50-year period at that time, New England forest species were replaced with trees completely different than those that had inhabited the region. The New England coalition is concerned about the economic and social impacts if another such change were to occur.

Your mission is to conduct an inquiry into these issues and prepare a briefing for the New England coalition. A problem-solving model and several references are included for your use.

## PROBLEM-SOLVING MODEL

1. Read and analyze the problem scenario:
  - Check your understanding of the scenario by discussing it within your team, proceeding in a deliberate manner.
  - Don't be tempted to start thinking about potential solutions or to start looking for information—your team will be more effective in addressing complex scenarios by following Steps 1–7.
2. List hypotheses, ideas, or hunches:
  - You will usually have some ideas or hypotheses about the cause of the problem, or ideas about how to solve the problem.
  - You must list these ideas, hypotheses, and hunches on the *Student Activity Sheet*—they will be supported or refuted as the investigation proceeds.
3. List what you already know:
  - Begin your list with the information contained in the scenario.
  - Add knowledge shared by other group members.
  - Record this information under the heading, “What do we know?” on the *Student Activity Sheet*.
4. List what is unknown:
  - Prepare a list of questions your group thinks need to be answered to solve the problem.
  - Record them under the heading, “What do we need to know?” on the *Student Activity Sheet*.
  - Note that several types of questions may be appropriate. Some may address concepts or principles that need to be learned to address the issues presented. Other questions may be in the form of requests for more information. These questions will guide research that may take place on the Internet/WWW, in the library, or in other out-of-class searches.
5. List what needs to be done:
  - Plan the investigation.
  - List possible actions to be taken under the heading, “What should we do?” on the

*Student Activity Sheet*. Such actions may include questioning an expert, getting online data, or visiting a library to find answers to the questions developed in Step 4. Do NOT go on to Step 6 without a clear plan for investigation—one that includes specific questions that will help focus your research.

- Prioritize the questions you are going to seek answers to, then divide up the questions among your team.
6. Develop a problem statement:
    - A problem statement is a one- or two-sentence idea that clearly identifies what your team is trying to solve, produce, respond to, test, or find out.
    - Record your statement on the *Student Activity Sheet*.
  7. Gather information:
    - You and your team will gather, organize, analyze, and interpret information from multiple sources.
    - Exchange ideas; think about solutions; weigh alternatives; and consider the pros and cons of potential courses of action.
    - Note that, at this point, your team may formulate and test hypotheses about the problem. Some problems may not require hypotheses. Instead, a recommended solution or opinion (based on your group's research data) may be appropriate.
    - Record your information and resources on the *Student Activity Sheet*.
  8. Present findings:
    - Prepare a report or presentation in which you and your group make recommendations, predictions, inferences, or other appropriate resolutions of the problem. Write an outline on your *Student Activity Sheet*.
    - Be prepared to support your positions. If appropriate, consider a multimedia presentation with images, graphics, or sound.

*NOTE: The steps in this model may have to be completed several times. Steps 2–6 may be conducted concurrently, as new information becomes available. As more information is gathered, the problem statement may be refined or altered.*

## RESOURCES: STUDENTS

### Climate Variability and Change

- Since global warming has received increased attention during the last decade as a serious environmental issue, it has been the subject of much debate. Global warming is defined as the warming of the Earth by greenhouse gases emitted into the atmosphere naturally or by mankind. More information may be found at:

<http://weathereye.kgan.com/expert/warming/explain.html>

- The EPA Global Warming Site focuses on the science and potential impacts of global warming or climate variability and change, and on actions by governments, corporations, and organizations.

<http://www.epa.gov/globalwarming/>

- Environmental News: "Study Says 'Scientific Consensus' on Global Warming Treaty Is Just Hot Air"

<http://www.heartland.org/DOCS/14/consencu.htm>

- Environmental News Network Global Warming Special Report—Environmental News Network, Climate Change

<http://www.enn.com/specialreports/climate/>

- Impact of Climate Change on Natural Vegetation

[http://www.meto.gov.uk/sec5/CR\\_div/Brochure97/vegetat.html](http://www.meto.gov.uk/sec5/CR_div/Brochure97/vegetat.html)

### Climate Variability and Change in New Hampshire

- Climate of 1998  
<http://www.ncdc.noaa.gov/ol/climate/research/1998/>
- Seasons of Change: Global Warming and New England's White Mountains  
<http://www.edf.org/pubs/Reports/GWWhtMtns/index.html>
- Vegetation Response to Accelerated Climate Change: A Case Study of the White Mountains of New Hampshire  
[http://www.brown.edu/Departments/Environmental\\_Studies/thesis/ugrad9495/barry.html](http://www.brown.edu/Departments/Environmental_Studies/thesis/ugrad9495/barry.html)
- White Mountains Attractions—National Forest  
<http://www.visitwhitemountains.com/spring98/forest.html>

### The Maple Sugar Industry

Maple sugaring is an important part of the tradition and history of New England. The process of maple sugaring has been handed down from colonial times and continues to play an important role in preserving the economic strength of this region. Sales of maple syrup and other items related to the industry account for a significant portion of the income of the local area.

The following two Web sites provide a background on this vital industry:

- History of the Maple Syrup Industry  
<http://www.maple-erable.qc.ca/history.htm>
- United States Maple Production, 1860–1949  
<http://members.iquest.net/~childers/maple/histprod.html>

### The Timber Industry

The timber industry is an important factor in the economic prosperity of the region. Timber management occurs within the White Mountain National Forest, as well as in forests owned by individuals, large companies, and the state. "Forestry blankets 87% of the state, making lumber New Hampshire's main natural resource. Coos County is the center of the lumbering industry. There are some 5 million acres of commercial timber in the state. The principal species of timber forested include white pine, spruce, fir, hemlock, red oak, sugar and red maple, and white and yellow birch trees. In the past, New Hampshire's timber was used to build Yankee clipper ships and the Concord stagecoaches. More recently, the timber is used to manufacture pulp and paper products, railroad ties, furniture, and fence posts."

- Search under:  
Climate Change and Tree Planting  
<http://www.amfor.org/frames.shtml?corp/carbon.html>
- Forests  
<http://ceinfo.unh.edu/forlinks.htm>
- Forest Research Glossary  
<http://www.fs.fed.us/ne/home/glossary.html>
- Tree Rings: A Study of Climate Change  
<http://www.athena.ivv.nasa.gov/curric/land/global/treestel.html>

## **CONCLUSION**

- Ask students to explain why they agree or disagree with the statement “Global warming is occurring.”
- Discuss with the groups their findings. What evidence have they found?
- What advice would they give concerned citizens in New England?
- Ask the students how and where they could find further information to make a more informed decision.

## **EXTENSIONS**

1. **Set up a debate.** Poll the students to see how many believe that global warming exists. Separate them into 2 groups: those who believe global warming exists (believers) and those who don't (skeptics). The class should then come up with a statement to debate. Give each team time to research their position and prepare their debate.
2. **Greenhouse effect.** In groups, have students research the greenhouse effect. Then each group should be assigned a specific topic; some possible topics are listed below:
  - How the atmosphere has and is changing;
  - How the climate has changed;
  - Natural causes for the greenhouse effect;
  - Human influences on the greenhouse effect;
  - How scientists determine that global temperatures are increasing;
  - Past trends in climate variability and change (prehistorical); and
  - Technology used to study climate variability and change.
3. The following site contains classroom activities:  
<http://www.athena.ivv.nasa.gov/curric/land/global/index.html>

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## Student Activity Sheet: PLANET WATCH 2000

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Names



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1. Hypothesis, ideas, or hunches:



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2. What do we know?



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3. What do we need to know?



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4. What should we do?

*PRIORITY NO.      ACTION*



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5. Problem statement:



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6. Gathered, organized, analyzed, and interpreted information. Be sure to include a listing of all resources used.



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7. Outline for presentation:

# Appendix A

## Bibliography

### **CLIMATE VARIABILITY AND CHANGE**

- <http://weathereye.kgan.com/expert/warming/explain.html>
- <http://www.epa.gov/globalwarming/>
- Environmental News: "Study Says 'Scientific Consensus' on Global Warming Treaty Is Just Hot Air"  
<http://www.heartland.org/DOCS/14/consencu.htm>
- Environmental News Network Global Warming Special Report—Environmental News Network, Climate Change  
<http://www.enn.com/specialreports/climate/>
- Impact of Climate Change on Natural Vegetation  
[http://www.meto.gov.uk/sec5/CR\\_div/Brochure97/vegetat.html](http://www.meto.gov.uk/sec5/CR_div/Brochure97/vegetat.html)

### **CLIMATE VARIABILITY AND CHANGE IN NEW HAMPSHIRE**

- Climate of 1998  
<http://www.ncdc.noaa.gov/ol/climate/research/1998/>
- Seasons of Change: Global Warming and New England's White Mountains  
<http://www.edf.org/pubs/Reports/GWWhtMtns/index.html>
- Vegetation Response to Accelerated Climate Change: A Case Study of the White Mountains of New Hampshire  
[http://www.brown.edu/Departments/Environmental\\_Studies/thesis/ugrad9495/barry.html](http://www.brown.edu/Departments/Environmental_Studies/thesis/ugrad9495/barry.html)
- White Mountains Attractions—National Forest  
<http://www.visitwhitemountains.com/spring98/forest.html>

### **THE MAPLE SUGAR INDUSTRY**

- History of the Maple Syrup Industry  
<http://www.maple-erable.qc.ca/history.htm>
- United States Maple Production, 1860–1949  
<http://members.iquest.net/~childers/maple/histprod.html>

### **THE TIMBER INDUSTRY**

- Search under:  
Climate Change and Tree Planting  
<http://www.amfor.org/frames.shtml?corp/carbon.html>
- Forests  
<http://ceinfo.unh.edu/forlinks.htm>
- Forest Research Glossary  
<http://www.fs.fed.us/ne/home/glossary.html>
- Tree Rings: A Study of Climate Change  
<http://www.athena.ivv.nasa.gov/curric/land/global/treestel.html>

## Appendix B

# Assessment Rubric & Answer Key

### Student Activity Sheet: PLANET WATCH 2000

Answers will vary. Use rubric for grading.

SKILL	Excellent (4)	Good (3)	Satisfactory (2)	Needs Improvement (1)
<b>Assessing the Situation</b>	Develop a clear and concise formulation of potential issues and identify all problem(s).	Develop a clear and concise formulation of some of the potential issues and identify problem(s).	Develop a clear and concise formulation of at least three potential issues but no formulation of a problem to be addressed.	Recognition of some, but not all of the issues involved—no identification of a problem to be addressed.
<b>Action Plan</b>	Present a clearly developed and logical procedure for investigating the situation.	Present clear, but incomplete ideas for investigating the situation, but addresses most major issues.	Present a general, but somewhat vague plan of action which includes at least three potential issues.	Present a plan of action which includes at least two potential issues.
<b>Gathering Evidence</b>	Demonstrate thorough and comprehensive research techniques when gathering evidence on both sides of all issues identified.	Demonstrate thorough but incomplete research techniques when gathering evidence on both sides of any issues identified.	Demonstrate incomplete research techniques when gathering evidence on at least two potential issues both sides of any issues identified.	Demonstrate incomplete research techniques when gathering evidence on at least two potential issues both sides of any issues identified.
<b>Analysis</b>	Reveal a comprehensive understanding of each of the issues involved as well as the interrelationships among those issues.	Reveal a comprehensive understanding of each of some of the issues involved as well as the interrelationships among those issues.	Reveal a reasonable, but incomplete understanding of some of at least three of the issues involved as well as some of the interrelationships among those issues.	Reveal a reasonable, but incomplete understanding of some of the issues involved but an incomplete grasp of the interrelationships involved.
<b>Presentation</b>	Conduct an accurate, fair, and impartial presentation of the issues at hand and an informed, logical explanation of all aspects being investigated.	Conduct an accurate, fair, and impartial presentation of some of the issues at hand and an informed and logical explanation of the aspects being investigated.	Conduct a somewhat accurate, fair, and impartial presentation of some of the issues at hand and a poorly informed and illogical explanation of the aspects being investigated.	Conduct a somewhat accurate, fair, and impartial presentation of some of the issues at hand and a poorly informed and illogical explanation of the aspects being investigated.

## Appendix C

# National Education Standards

*This activity responds to the following National Education Standards:*

### **STANDARDS FOR THE ENGLISH LANGUAGE ARTS**

**Standard 3:** Students apply a wide range of strategies to comprehend, interpret, evaluate, and appreciate texts. They draw on their prior experience, their interactions with other readers and writers, their knowledge of word meaning and of other texts, their word identification strategies, and their understanding of textual features (e.g., sound-letter correspondence, sentence structure, context, graphics).

**Standard 4:** Students adjust their use of spoken, written, and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes.

**Standard 5:** Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes.

**Standard 6:** Students apply knowledge of language structure, language conventions (e.g., spelling and punctuation), media techniques, figurative language and genre to create, critique, and discuss different print and non-print texts.

**Standard 7:** Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and nonprint texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience.

**Standard 8:** Students use a variety of technological and informational resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.

**Standard 12:** Students use spoken, written, and visual language to accomplish their own

purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).

*National Council of Teachers of English and International Reading Association. 1996. Standards for the English Language Arts p.24–46. Urbana, Illinois and Newark, Delaware: National Council of Teachers of English and International Reading Association.*

### **NATIONAL GEOGRAPHY STANDARDS GEOGRAPHY FOR LIFE (9–12)**

**Geography Standard 4: Places and Regions.** The physical and human characteristics of places.

**Geography Standard 7: Physical Systems.** The physical processes that shape the patterns of the Earth's surface.

**Geography Standard 8: Physical Systems.** The characteristic and spatial distribution of ecosystems on the Earth's surface.

**Geography Standard 15: Environment and Society.** How physical systems affect human systems.

*American Geographical Society, Association of American Geographers, National Council for Geographic Education, and National Geographic Society. 1994. Geography for Life National Geography Standards p. 183–222. Washington, DC: National Geographic Research and Exploration.*

### **CURRICULUM AND EVALUATION STANDARDS FOR SCHOOL MATHEMATICS (9–12)**

**Standard 1:** Mathematics as problem solving.

**Standard 3:** Mathematics as reasoning.

*National Council of Teachers of Mathematics. 1989. Curriculum and Evaluation Standards for School Mathematics p. 123–186. Reston, VA: The National Council of Teachers of Mathematics, Inc.*

## **NATIONAL SCIENCE EDUCATION STANDARDS (9–12)**

### **CONTENT STANDARD: K–12**

#### **Unifying Concepts and Processes**

**Standard:** As a result of activities in grades K–12, all students should develop understanding and abilities aligned with the following concepts and processes:

- Systems, orders, and organization
- Evidence, models, and explanation
- Consistency, change, and measure

*National Research Council. 1996. National Science Education Standards p. 115–119. Washington, DC: National Academy Press.*

### **CONTENT STANDARDS: 9–12**

#### **Science as Inquiry**

**Content Standard A:** As a result of activities in grades 9–12, all students should develop:

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

#### **Life Science**

**Content Standard C:** As a result of activities in grades 9–12, all students should develop understanding of:

- Interdependence of organisms
- Matter, energy, and organization in living systems
- Behavior of organisms

#### **Earth and Space Science**

**Content Standard D:** As a result of activities in grades 9–12, all students should develop understanding of:

- Energy in the earth system
- Geochemical cycles

#### **Science and Technology**

**Content Standard E:** As a result of activities in grades 9–12, all students should develop:

- Understandings about science and technology

### **Science in Personal and Social Perspective**

**Content Standard F:** As a result of activities in grades 9–12, all students should develop understanding of:

- Personal and community health
- Population growth
- Natural resources
- Environmental quality
- Natural and human-induced hazards
- Science and technology in local, national, and global changes

*National Research Council. 1996. National Science Education Standards p. 173–204. Washington, DC: National Academy Press.*

## **CURRICULUM STANDARDS FOR SOCIAL STUDIES**

**Strand 3: People, Places, & Environments.** Social Studies programs should include experiences that provide for the study of people, places, and environments.

**Strand 8: Science, Technology, & Society.** Social Studies programs should include experiences that provide for the study of relationships among science, technology, and society.

**Strand 9: Global Connections.** Social Studies programs should include experiences that provide for the study of global connections and interdependence.

*National Council for the Social Studies. 1994. Expectations of Excellence Curriculum Standards for the Social Studies p. 21–30. Washington, DC: National Council for the Social Studies.*

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