Geoscience Public Policy I: Environmental Impacts and Geoscience Education

Michael Wysession
Department of Earth and Planetary Sciences, Washington University, St. Louis, MO 63130

Linda Rowan
External Affairs, UNAVCO, 6350 Nautilus, Boulder, CO 80301

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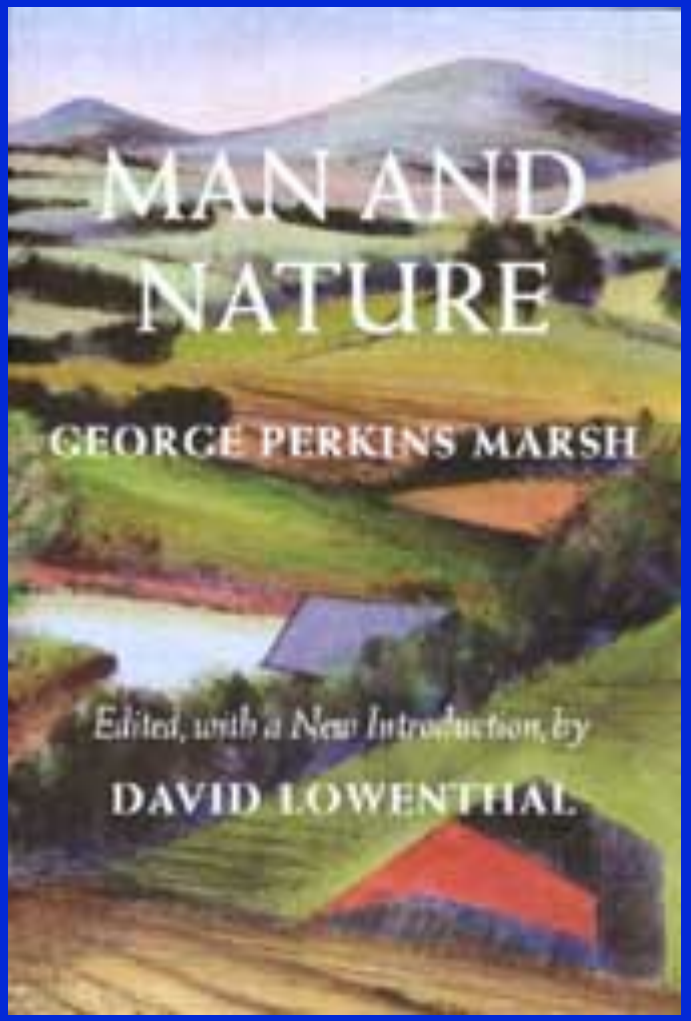
Denver, Co

Ben Franklin:

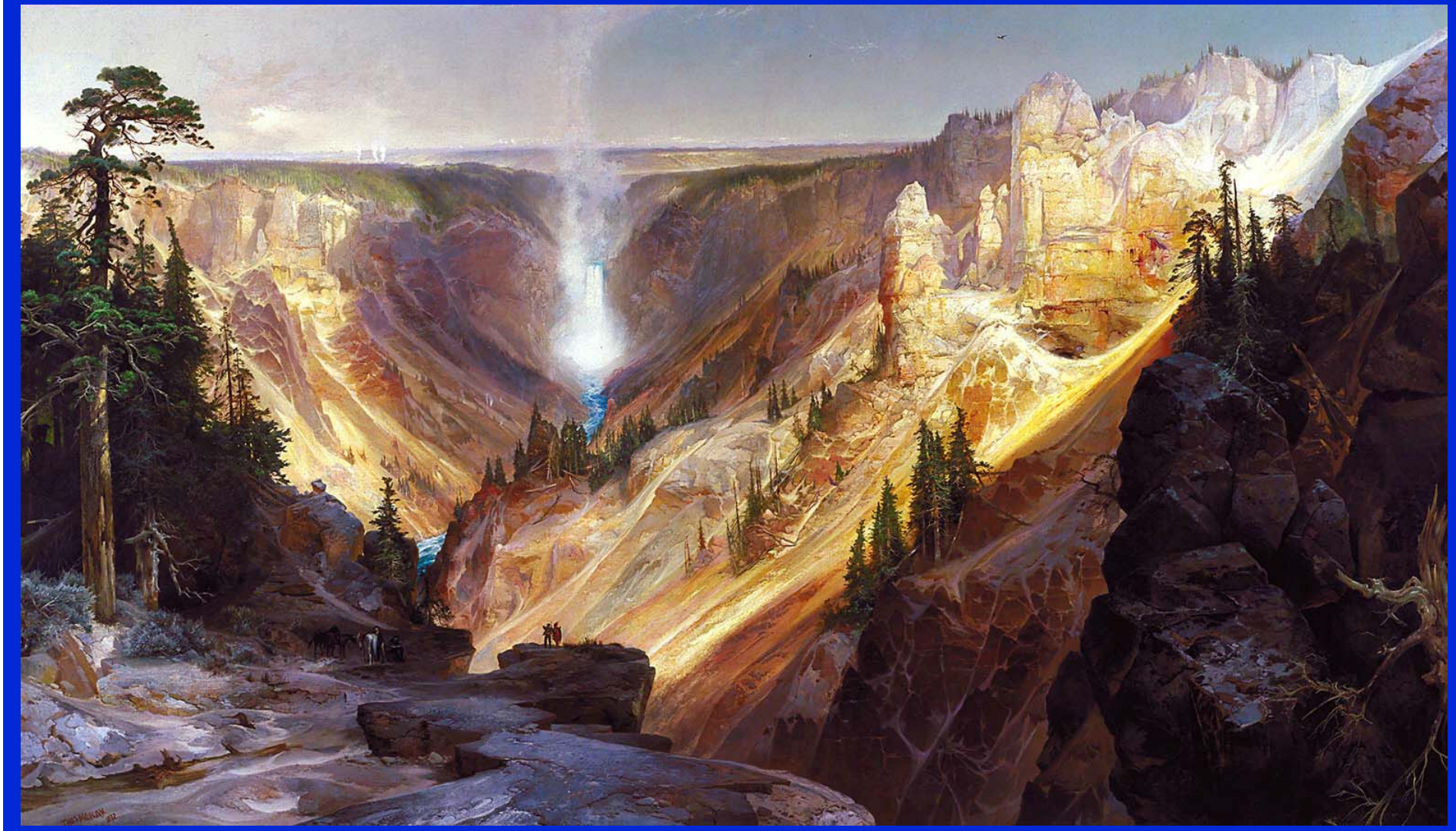
→ petitioned in 1739 to have tanneries and waste dumping removed from Philadelphia's commercial district on the basis of "public rights" (1739)

→ led attempts to regulate waste disposal and water pollution from (1762 – 1769)



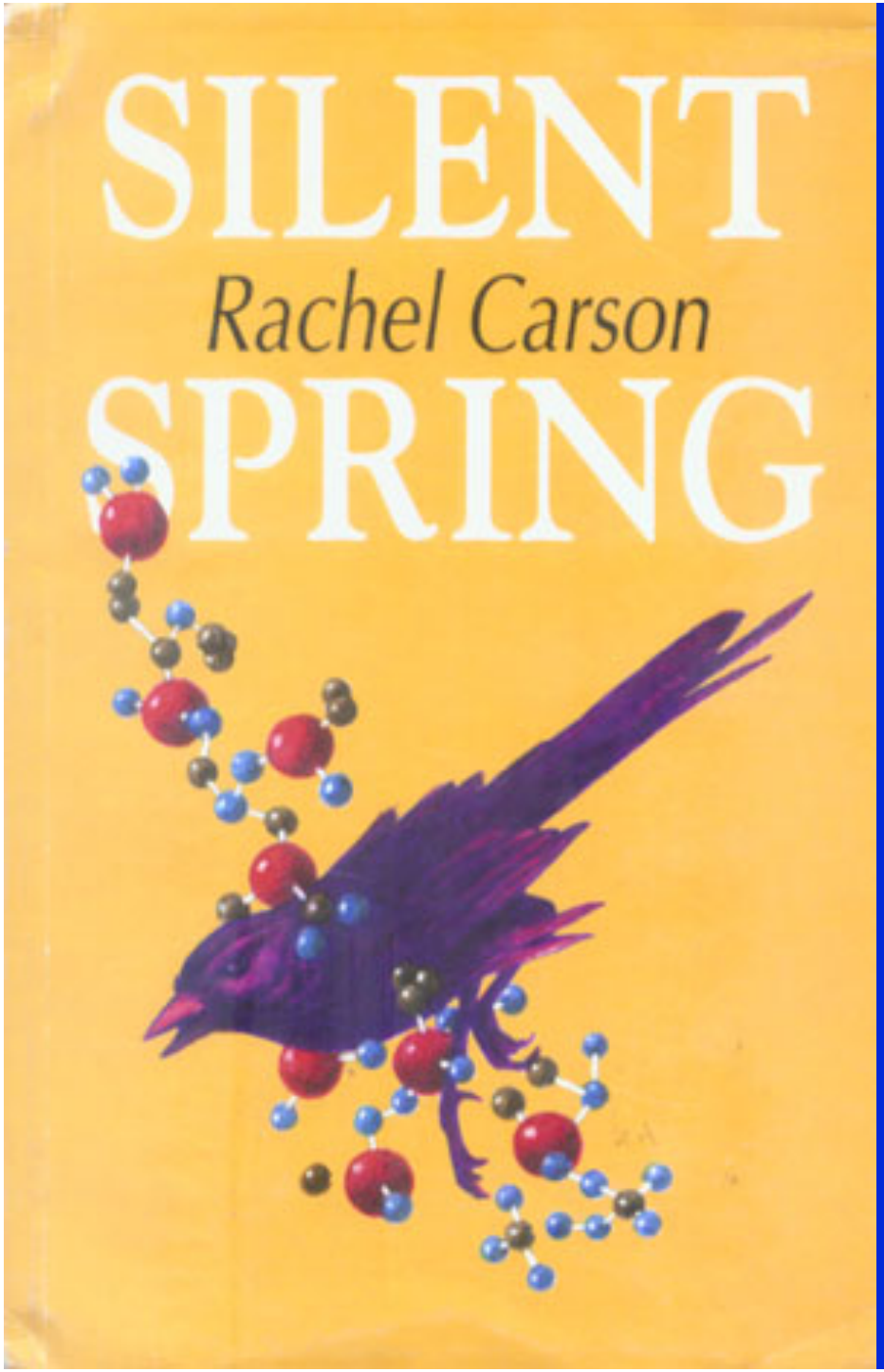
George Marsh:

→ Documented human impacts on the environment in influential book, *Man and Nature: or, Physical Geography as modified by Human Action* (1864)



1872: Yellowstone becomes the first National Park

1872: Also the start of Arbor Day



1962: Rachel Carson,
Silent Spring

1969: Santa Barbara Oil Spill (100,000 barrels)

1969: Last of 13 different fires, starting in 1868, that break out on the Cuyahoga River

1970 (January 1): National Environmental Policy Act passes in the House by a vote of 372-15

→ Aim is to examine and minimize the environmental impacts of government activities

"I think that 1970 will be known as the year of the beginning, in which we really began to move on the problems of clean air and clean water and open spaces for the future generations of America" (President Nixon, 1970)

The NEPA legislations describes the “continuing responsibility of the Federal Government to use all practicable means, consistent with other essential considerations of national policy, to improve and coordinate Federal plans...[so] that the Nation may:

- Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;
- Assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings;
- Attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences;
- Preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity, and variety of individual choice;
- Achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life’s amenities; and
- Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.”

National Environmental Policy Act

Archeological and Historic Preservation Act

American Indian Religious Freedom Act

National Historic Preservation Act

Coastal Zone Management Act

Toxic Substances Control Act

Wild and Scenic Rivers Act

Floodplains and Wetlands

Endangered Species Act

Clean Water Act

Comprehensive Environmental Response, Compensation, and Liability Act

Native American Graves Protection and Repatriation Act

Farmland Protection Policy Act

Research Conservation and Recovery Act

Safe Drinking Water Act

Rivers and Harbors Act

Environmental Justice

Clean Air Act

Important National Air Quality Regulations:

1955: Air Pollution Control Act (Public Law 84-159)
1963: Clean Air Act (Public Law 88-206)
1965: Motor Vehicle Air Pollution Control Act (Public Law 89-272)
1966: Clean Air Act Amendments (Public Law 89-675)
1967: Air Quality Act (Public Law 90-148)
1969: National Environmental Policy Act (Public Law 91-190)
1970: Clean Air Act Extension (Public Law 91-604)
1976: Toxic Substances Control Act (Public Law 94-469)
1977: Clean Air Act Amendments (Public Law 95-95)
1990: Clean Air Act Amendments (Public Law 101-549)

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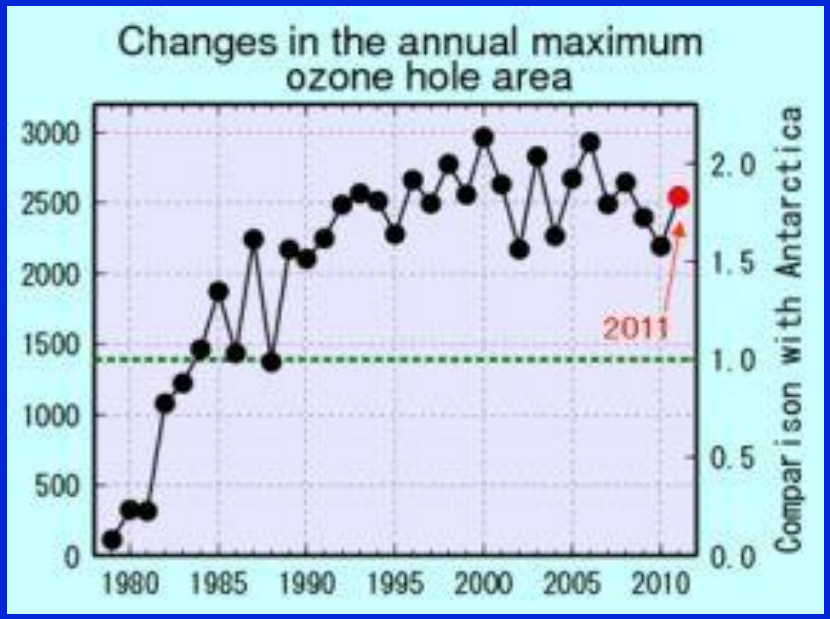
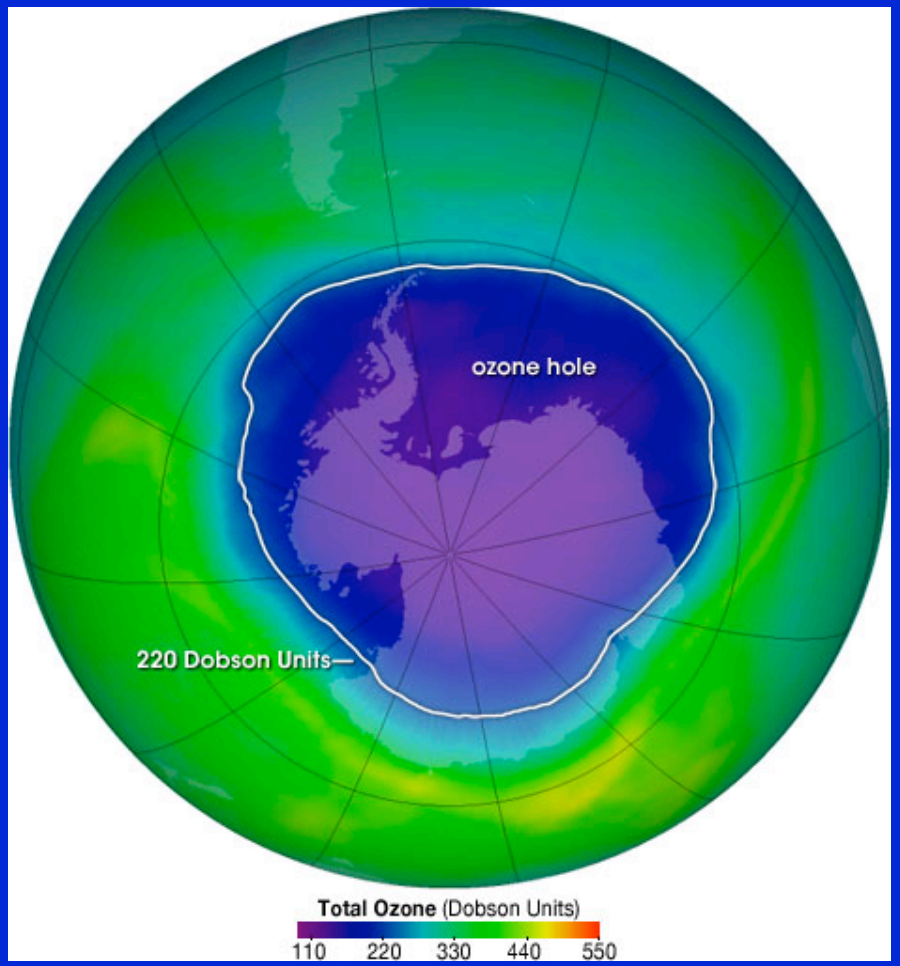
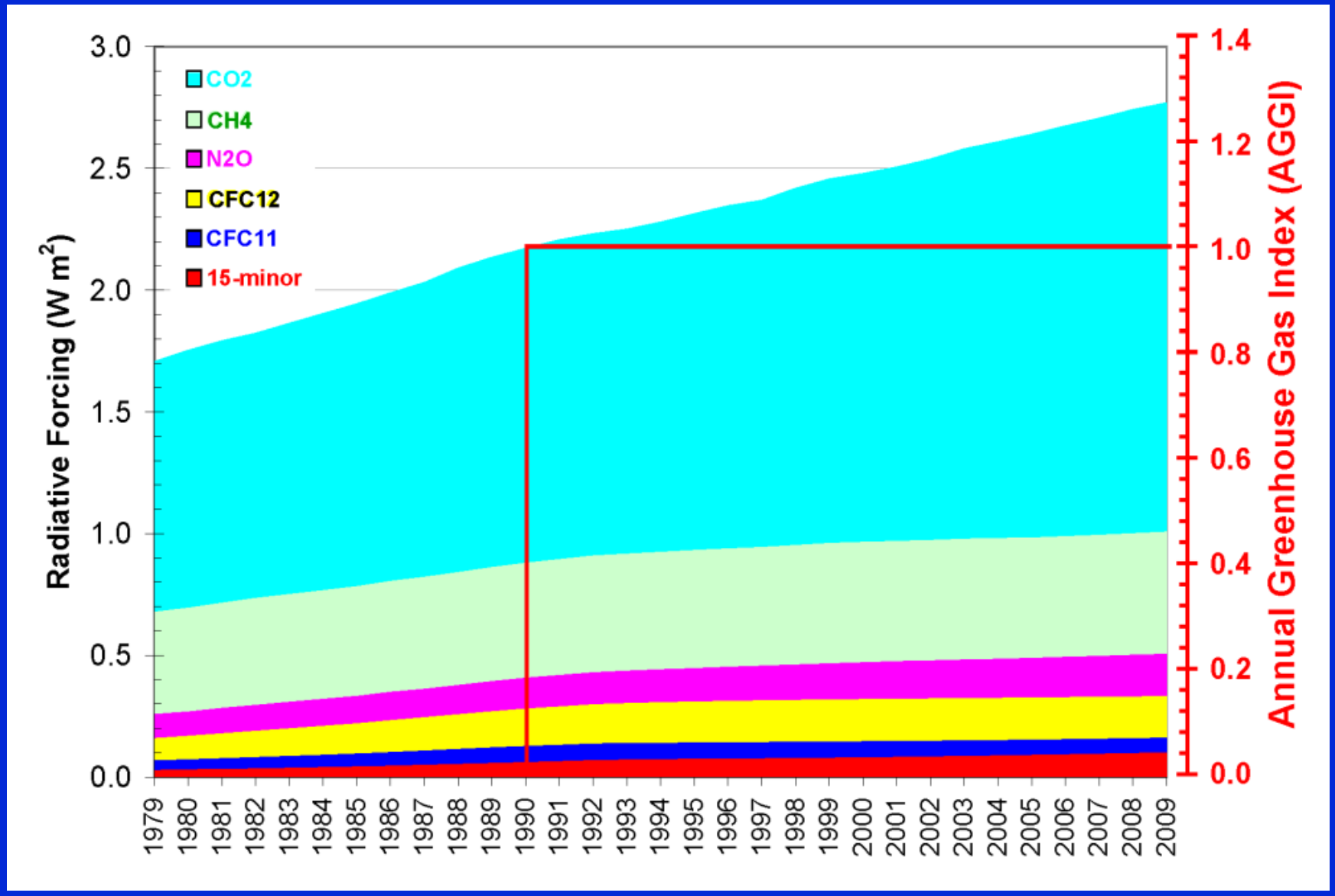
1970 "Clean Air Act": Regulated (1) Particle Pollution, (2) Ground-Level Ozone, (3) Carbon Monoxide, (4) Sulfur Oxides, (5) Nitrogen Oxides, (6) Lead





1990 Clean Air Act Amendments extended the number of monitored pollutants from 6 to 193 and a market-based cap-and-trade approach to reducing them. It also began to phase out chlorofluorocarbons.



2011: EPA begins to regulate specific greenhouse gases as pollutants under the 1990 CAA

A 2011 EPA study estimates that direct financial benefits from the 1990 CAA amendments between 1990 and 2020 will amount to a $2 trillion savings (compared to the $65 billion in the costs of implementation) .

→ These savings are a result of reductions in health problems and loss of workdays.

→ The estimates are that in 2010 alone the enforcement of the CAA prevented more than 230,000 early deaths and 13,000,000 lost workdays

Important National Water Quality Regulations:

1899: Rivers and Harbors Act of 1899 (30 Statute 1221)
1912: Public Health Service Act
1924: Oil Pollution Act
1948: Federal Water Pollution Control Act (Public Law 80-845)
1965: Water Quality Act (Public Law 89-234)
1966: Clean Waters Restoration Act (Public Law 89-753)
1968: Wild and Scenic Rivers Act (Public Law 90-542)
1969: National Environmental Policy Act (Public Law 91-190)
1970: Water Quality Improvement Act (Public Law 91-224)
1972: Federal Water Pollution Control Amendments of 1972 ("Clean Water Act") (Public Law 92-500)
1974: Safe Drinking Water Act (Public Law 93-523)
1976: Toxic Substances Control Act (Public Law 94-469)
1977: Clean Water Act (Public Law 95-217)
1987: Water Quality Act (Public Law 100-4)
1996: Safe Drinking Water Act Amendments of 1996 (Public Law 104-182)

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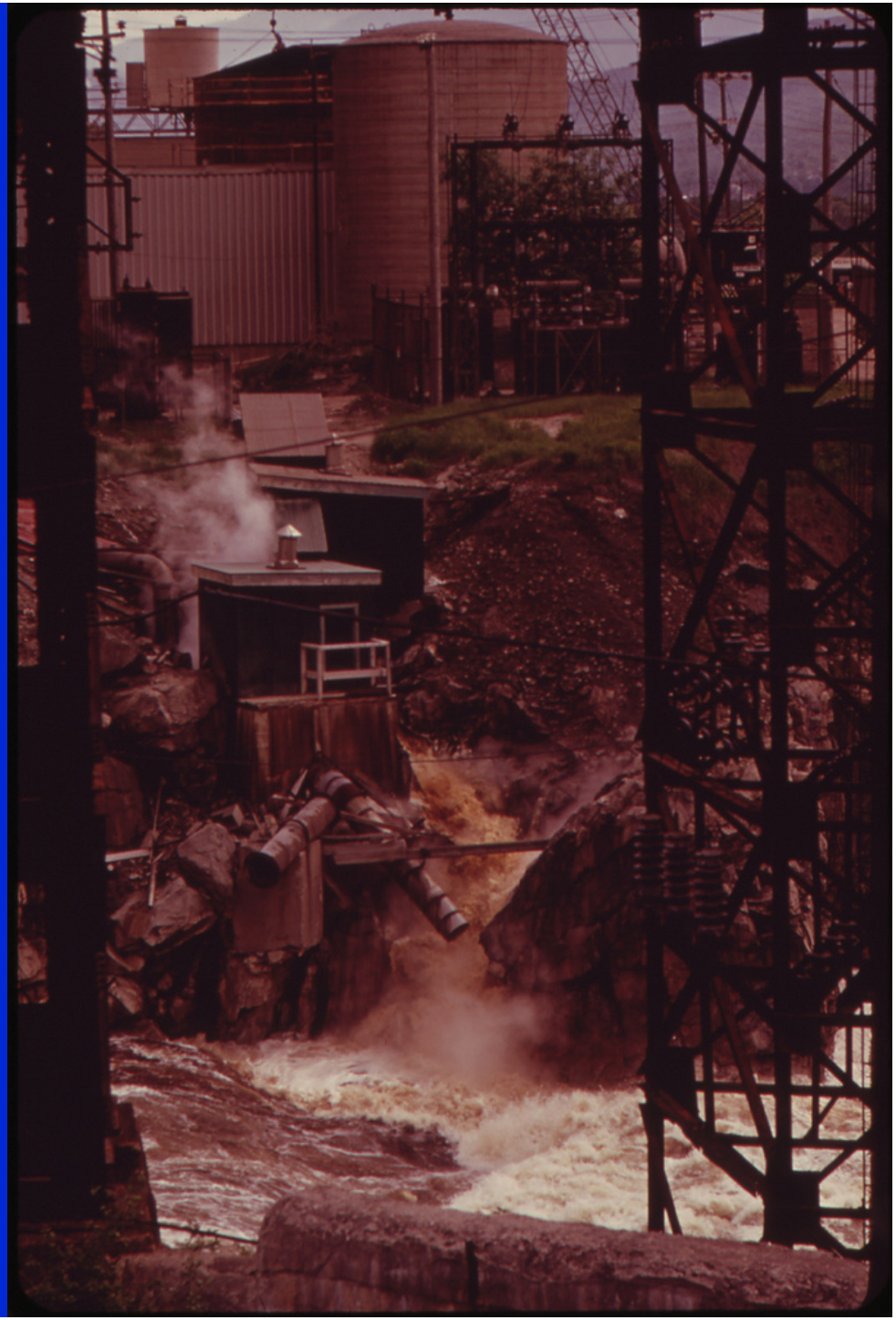
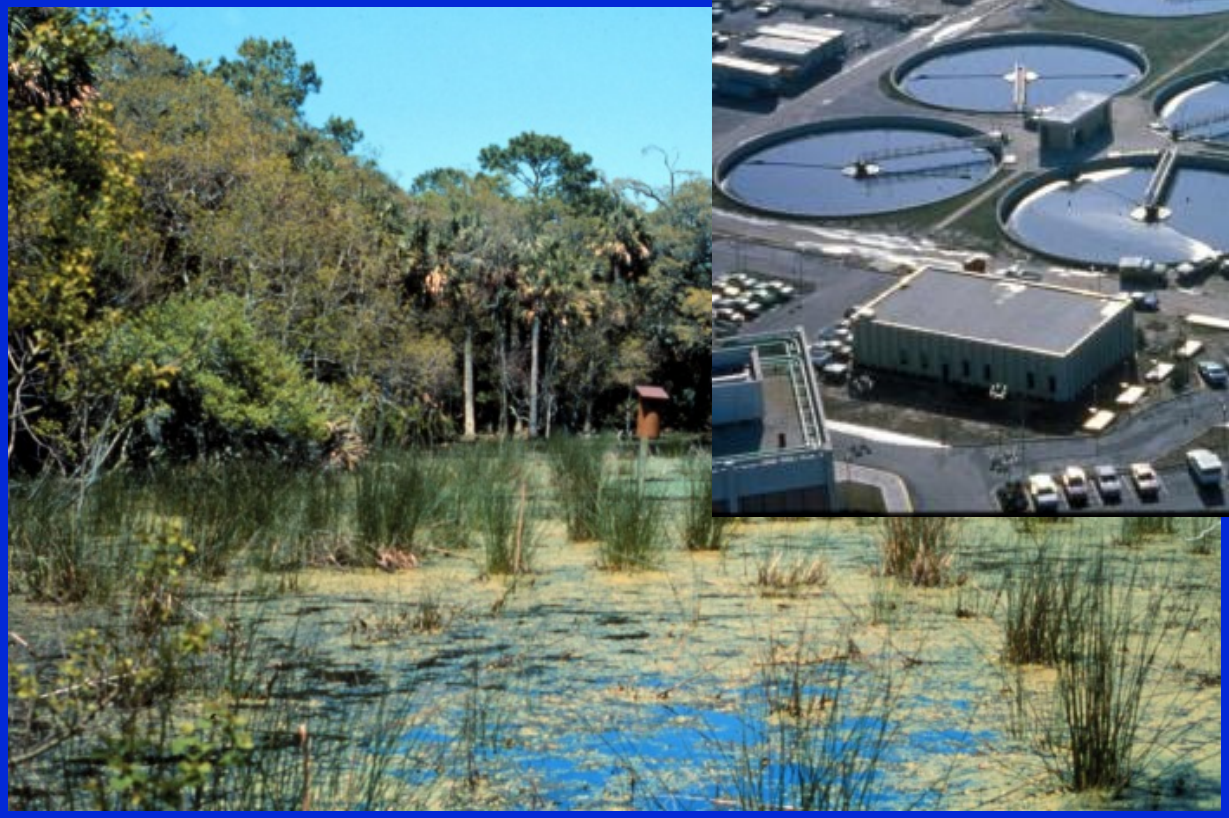
Pollution along the Androscoggin River near the Berlin (NH) Paper Mill



The Androscoggin River today

1977 Amendments to the Clean Water Act:
→ Provided first protection for wetlands



1977 Amendments to the Clean Water Act:

→ Provided first protection for wetlands

→ Provided $18 billion for municipal sewage treatment

1987 Water Quality Act: Addresses nonpoint source pollution

1990 Oil Pollution Act: Provides scientific basis for response, cleanup, and monitoring in the event of an oil spill

→ Passed in response to Exxon Valdez tanker spill

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→ Provided basis for response to 2010 Deepwater Horizon spill

1883 Committee of Ten: Led by Charles Eliot, Harvard University
→ Establishes the first standards for secondary school science education

1965 Elementary and Secondary Education Act:

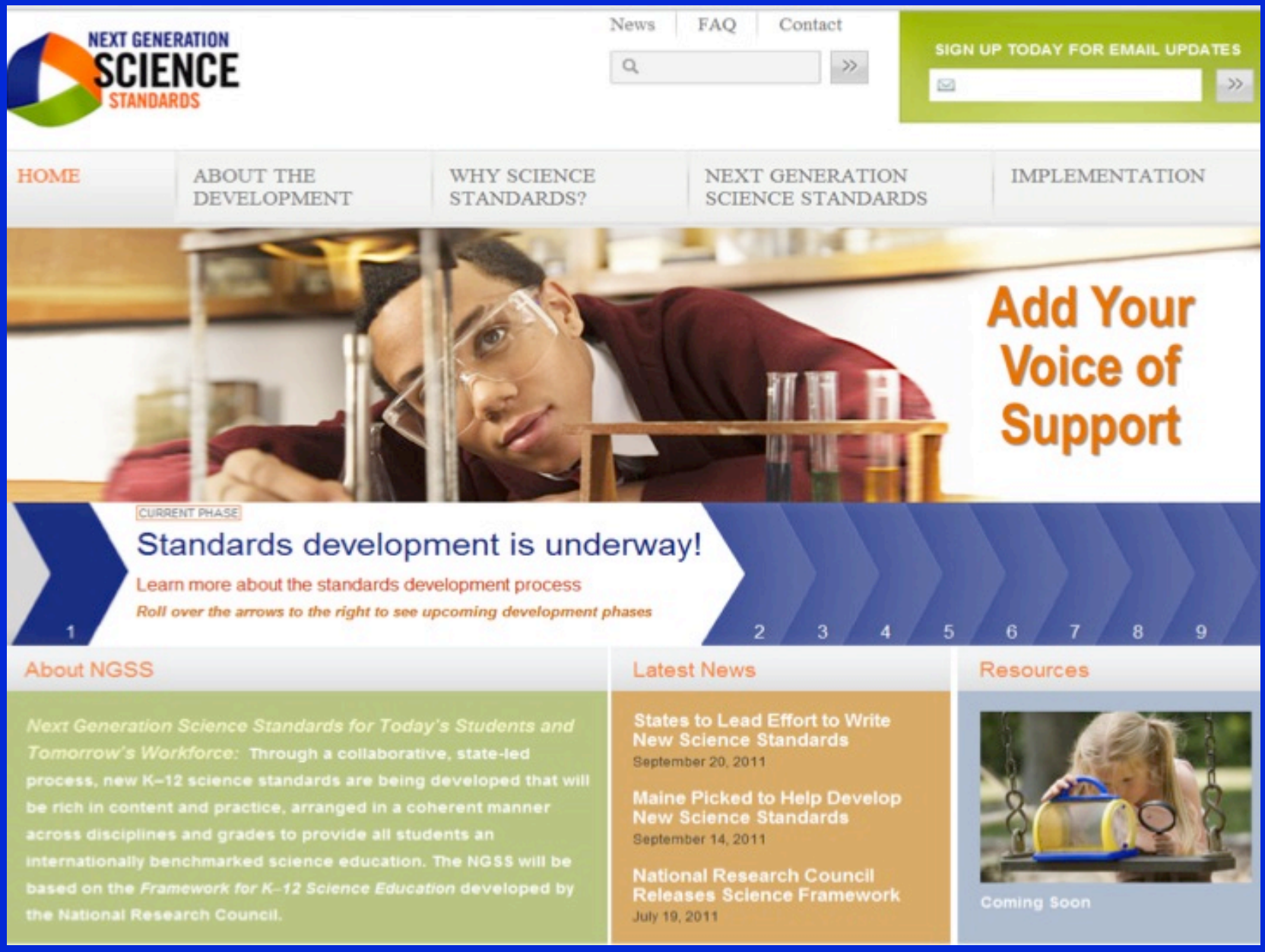
- → Provided funds for primary and secondary education through professional development, instructional materials, support programs, and parental involvement.
- → Title 1 program provided special financial assistance to schools with significant numbers of low-income children.
- → The Act explicitly forbade the creation of a national curriculum

2001 Reauthorization of the ESEA: *"No Child Left Behind"*

→ Only addresses education in the areas of English and mathematics

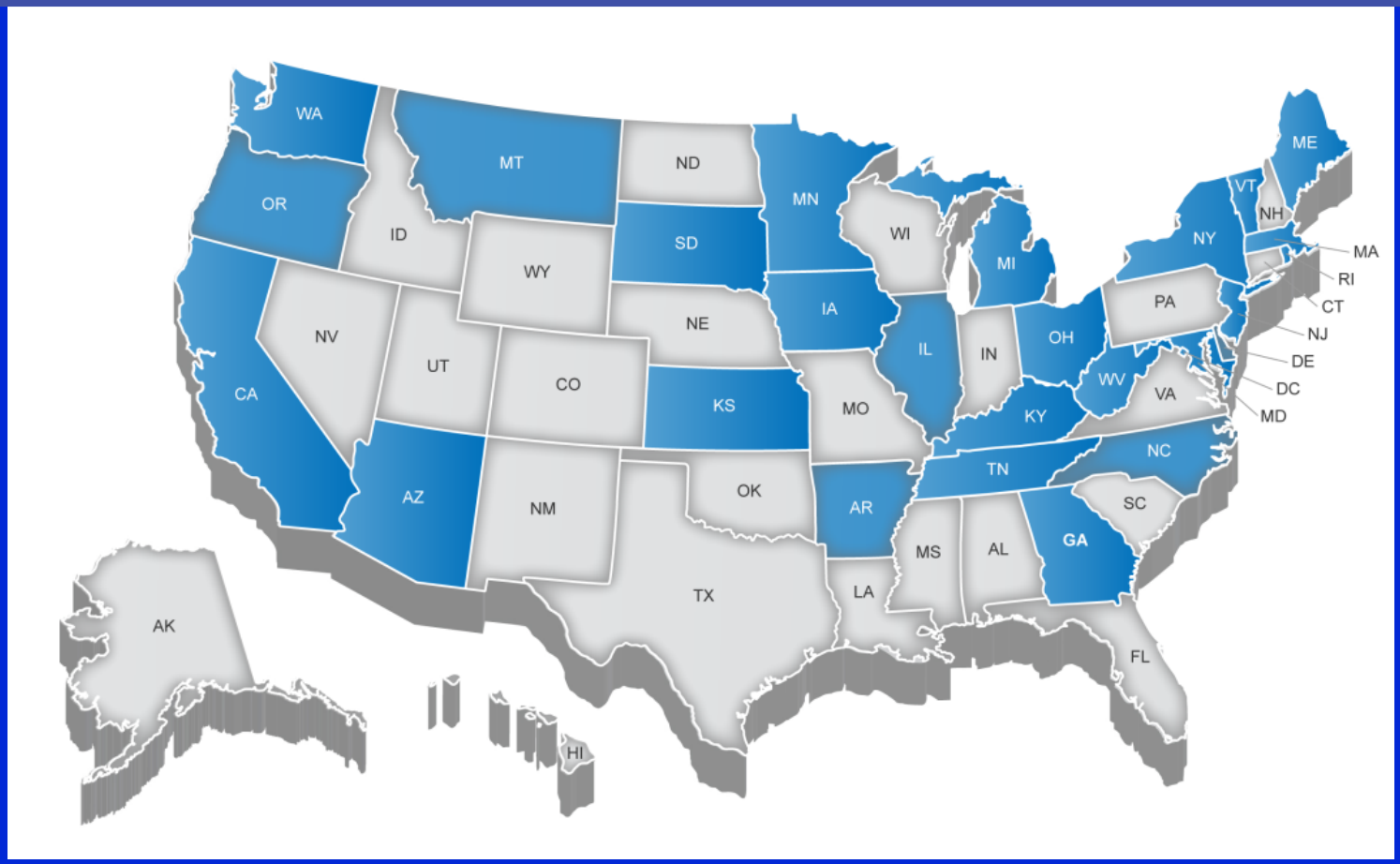
→ Applies financial penalties on schools that do not perform well in the standardized testing of its students

- → Responsible for pushing education towards a more “teaching to the test” approach
- → While progress in mathematics and English has been observed by many testing mechanisms, test scores in other areas including science have dropped due to decreased time and emphasis



April, 2013: Next Generation Science Standards

The NGSS were the result of a "states-led" process



States that have already adopted the NGSS:

California, Delaware, Kansas, Kentucky, Maryland, Rhode Island, Vermont, Washington State

HS-ESS3-1 Earth and Human Activity

Students who demonstrate understanding can:

HS-ESS3-1. **Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.** [Clarification Statement: Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting and soil erosion), and severe weather (such as hurricanes, floods, and droughts). Examples of the results of changes in climate that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific knowledge, principles, and theories.

- Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

ESS3.A: Natural Resources

- Resource availability has guided the development of human society.

ESS3.B: Natural Hazards

- Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations.

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World

- Modern civilization depends on major technological systems.

Connections to other DCIs in this grade-band: N/A

Articulation of DCIs across grade-bands:
MS.LS2.A ; **MS.LS4.D** ; **MS.ESS2.A** ; **MS.ESS3.A** ; **MS.ESS3.B**

Common Core State Standards Connections:

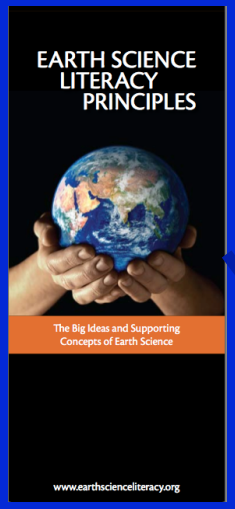
ELA/Literacy -

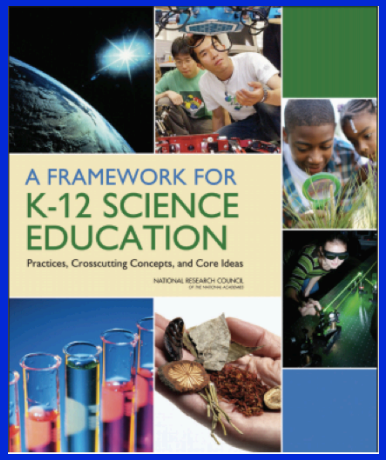
RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. *(HS-ESS3-1)*
WHST.9-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-ESS3-1)

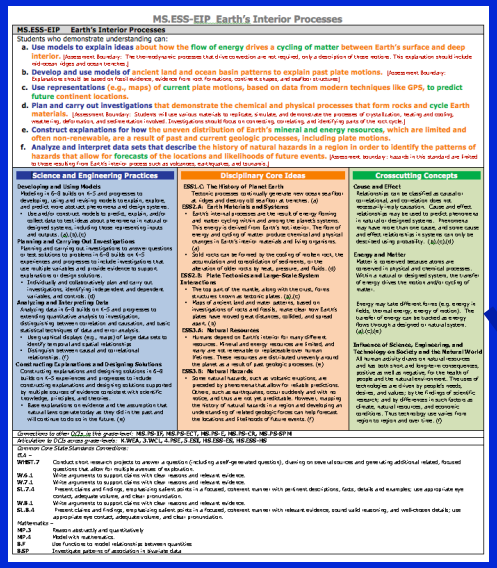
Mathematics -

MP.2	Reason abstractly and quantitatively. *(HS-ESS3-1)*
HSN.Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. *(HS-ESS3-1)*
HSN.Q.A.2	Define appropriate quantities for the purpose of descriptive modeling. *(HS-ESS3-1)*
HSN.Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. *(HS-ESS3-1)*

The NGSS are the result of a multi-step process







- Teacher Development
- Curricula
- Instructional Materials
- Instruction
- Assessment

NEXT GENERATION SCIENCE STANDARDS