



Guidelines for K-12 Global Climate Change Education

Adapted by: by the National Wildlife Federation from the Environmental Education Guidelines for Excellence of the North American Association for Environmental Education

Purpose:

Climate change has become the leading U.S. public environmental concern in the past several years. Even those who considered the overall subject “debatable” just a decade ago have changed their minds as conclusive evidence has come in from all corners of the globe.

This means two things for the state of climate change education in our schools:

- First, there is a significant deficit of global climate change education in our schools because it is deemed controversial in many locations, and that controversy has had a chilling effect on its being treated as a bona fide school subject.
- Second, growing public enthusiasm for addressing climate change may mean that some of the K-12 climate change education efforts that do take place in schools and informal settings now and in the years to come may not always be delivered in accordance with rigorous environmental education practice guidelines. Such guidelines have been developed for the larger subject of environmental education (published by the North American Association for Environmental Education) and are further adapted here for global climate change education. While these overall NAAEE environmental education guidelines are mostly sufficient for addressing the quality of global climate change education, we hope, that further adaptation will foster more directed and higher quality formal and informal education programming on climate change in America.

Part One: Guidelines for K-12 Climate Change Learning

Introduction

Global climate change is a long-term environmental and societal challenge that affects numerous generations of people in every nation around the world. It is subtle in some ways, blatant in others and will exert a powerful and potentially crippling influence on the world. Scientists describe it as the most important and critical environmental concern ever faced in human history. Because of the 40 to 100 year timeframes required to address and reverse climate change, today's students will need a firm educational grounding in its science and solutions.

Providing effective global climate change K-12 education is best done in developmental stages that are grouped according to age levels. These stages are vitally important to climate change education because of the subject's deep underlying complexity. Using the approach and structure of the *NAAEE Guidelines for Excellence*, we recommend that climate change education be carefully designed and arrayed according to age level. This allows for cognitive and problem solving development of the human mind and also makes sense because the subject inherently requires strong and effective building blocks of knowledge and skill.

Educators and parents may also want to take note that the size and extent of the global climate change problem can seem overwhelming to younger children who do not yet grasp all the possibilities for solutions. Younger children also are less able to grasp the potential of collective societal scale action or that individuals can make a useful contribution to such large scale challenges.

Fourth Grade

Overview: Third and fourth grade students think in fairly concrete terms, and for the most part, have a limited capacity for abstract thinking.. This makes concentrating on basic building blocks of climate change knowledge important for this age group. These children also are very curious about the world around them. Global climate change education should offer them opportunities to focus on simple observation and exploration of nature and the environment rather than on more complex issue analysis and problem solving.

Note: While some students in kindergarten, first and second grades may have better developed abstraction abilities than others, the NAAEE guidelines basically recommend that environmental education programs aimed at K-4 students concentrate on third and fourth graders who, on average, are beginning to develop basic conceptualizing ability. This age group needs simplicity and is less able to comprehend complex systems and causal relationships.

According to NAAEE, upon completion of fourth grade, students should have the following:

Fundamental Questioning and Analysis Skills:

- Ability to form basic questions and do simple investigations of nature and the environment.
- Ability to locate, collect and organize simple information on nature, communities and environmental topics.
- Awareness of the need to use reliable information and have some initial skills in judging the merits of information.
- Though learners are not being asked at this level to analyze or construct models, they should understand that relationships, patterns and processes can be represented by models.
- Can develop simple explanations in response to questions they have formed about the environment.



Earth and Environmental Processes and Systems

Physical Systems:

- Ability to identify changes and differences in the physical environment.
- Understanding of the basic concept of atmosphere
- Ability to identify characteristics and changes in matter such as in solids and gases.
- Familiarity with basic forms of energy and how they behave.
- Familiarity with the basic elements of Earth's atmosphere, land and oceans.

Living Systems:

- Understand there are similarities and differences among a wide range of living organisms.
- Understand the basic concept of habitat and that organisms relate to each other and their surroundings.
- Understand that plants and animals have different characteristics and many are inherited
- Understand that living things need some source of energy to live.

Fourth Grade (continued)

Humans and their Societies:

- Understand that people can act as individuals and that groups can influence individual actions.
- Understand that experience and places may be interpreted differently by people with different cultural backgrounds and that conflict is rooted in differing views.
- Understand that people are connected at many levels, including the global level.
- Recognize that change is a normal part of individual and societal life.

Humans and Environment:

- Understand that people are affected by the environment.
- Understand that geographic places differ in their physical and human characteristics.
- Understand that technology is an integral part of human existence and culture.
- Familiarity with some local environmental issues and natural characteristics.

Skills for Analyzing and Investigating Environmental Issues:

- As learners come to understand that environmental and social phenomena are linked, they should begin to explore and form questions around the consequences of issues and can start to observe that there are approaches for resolving issues.
- Understand the importance of sharing ideas and hearing other points of view.

Personal and Civic Responsibility:

- Can identify fundamental principles of U.S. society and understand the basic rights and responsibilities of U.S. citizenship.
 - Have age appropriate and realistic self confidence in their effectiveness and role as citizens.
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Eighth Grade

Overview: Students in this age group can think more abstractly with higher order thinking skills and engage in more creative thinking in general. Compared to K-4 students, they are developing more sophisticated cognitive abilities that let them understand the interrelationships of scientific, environmental and human systems which are essential to an apprehension of global warming science and societal implications. They can learn about basic problems and issues around global warming. This is a period in which learners are well suited to investigate local environments and to learn about the underlying complexity of a subject.

Editor’s Note About “Systems Thinking”: Fifth and sixth graders are often introduced to science via the earth sciences and “general” science. This exposes them in an organized way to overarching concepts including natural systems such as the water cycle, geological processes, solar and energy processes and atmospheric fundamentals. Greater emphasis on describing and apprehending the carbon cycle or climate patterns, for example, will help with learning about global climate change. According to NAAEE, upon completion of eighth grade, students should have the following:

Questioning and Analysis Skills:

- Ability to develop, focus and explain questions that help them learn about the environment and ability to conduct environmental investigations.
- Ability to design environmental investigations and find answers to particular questions – often their own questions.
- Ability to locate and collect reliable information about environmental subjects using many methods and sources.
- Ability to assess and evaluate the strengths and weaknesses of the information and data they are using.
- Can classify and order the data and organize and display information in ways that will help analysis and interpretation.
- Can understand the uses and limitations of models.
- Can synthesize observation and findings into coherent explanations.

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Earth and Environmental Processes and Systems

Physical Systems:

- Understand the basics of the physical processes that shape the Earth and relate differences in physical patterns to their causes.
- Understand basic interconnections among atmosphere, hydrosphere, lithosphere, biosphere and cryosphere.

Eighth Grade (continued)

- Understand ongoing critical cycles that occur in the world, including: solar energy and albedo, the water cycle, changing seasons and atmospheric movement patterns, ocean currents, the carbon cycle, volcanism and plate tectonics, and overall familiarity with the basic elements and interactions of Earth's atmosphere, land and oceans
- Understand the properties of the substances that make up objects and materials found in the environment.
- Have familiarity with energy transfer and transformations and make connections among phenomena such as light, heat, electricity and the motion of objects.

Living Systems:

- Understand that biotic communities are made up of plants and animals that are uniquely adapted to live in particular environments that can be affected by, among other things, a changed climate.
- Understand and describe the importance of genetic variation in species and the possible implications of species extinction.
- Understand major interactions among organisms or populations of organisms.
- Understand photosynthesis and how energy and matter flow among the biotic and abiotic components of the environment.

Humans and their Societies:

- Understand that the way in which individuals perceive the environment is influenced, in part, by individual traits and by group membership or affiliation.
- Be familiar with a wide range of cultures and subcultures; understand that various perspectives about the environment may influence culture.
- Be aware of political and economic systems and ways in which these systems take the environment into consideration.
- Able to identify and explain ways in which the world's environmental societal, cultural and political systems are linked.
- Understand that human systems change over time and that conflicts sometimes arise over differing viewpoints about the environment.

Eighth Grade (continued)

Humans and Environment:

- Understand that human caused changes have consequences for the immediate environment as well as for other places and future times.
- Describe, analyze and make inferences about the characteristics of the various places and explore differences in perceptions and importance of places close to home and around the world.
- Link the human ability to shape and control the environment with our ability to create knowledge and develop new technologies.
- Describe a range of environmental issues at various scales ranging from local and national to global, and understand that people in many places around the world share many of these same issues and are concerned about them locally.

Skills for Analyzing and Investigating Environmental Issues:

- Use primary and secondary sources of information and apply research and analytical skills to investigate environmental issues beginning with those in their own community.
- Use knowledge to identify the consequences of specific environmental issues and actions for addressing them.
- Able to consider the assumptions and interpretations that influence conclusions they and others draw about environmental issues.

Personal and Civic Responsibility:

- Understand that societal values can be both a unifying and divisive force and begin to see themselves as citizens taking active roles in their communities in seeking the resolution of environmental issues.
- Develop a realistic self-confidence in their effectiveness as citizens and that their actions have broad consequences for which they can show responsibility.
- Understand the relative value and efficacy of climate change solutions based on emission reductions, sequestration and natural resource and human adaptation.

Twelfth Grade

Overview: Students in this age group are able to understand the complexity of many environmental subjects and related issues, and most important, to learn how to address them. This is a period when understanding of the science of global warming can be combined with an understanding of what it means to be a responsible citizen who has problem solving skills, can communicate effectively on the subject and can address real issues in the world rather than hypothetical.

Twelfth Grade (continued)

According to NAAEE, upon completion of twelfth grade, students should have the following:

Questioning and Analysis Skills:

- Ability to develop, modify, clarify and explain questions that guide environmental investigations of various types and identify factors that influence the questions they pose.
- Ability to design environmental investigations to answer particular questions about the environment, even developing approaches for investigating unfamiliar types of problems and phenomena.
- Ability to locate and collect reliable information for environmental investigations of many types (includes using technology to collect and display information).
- Ability to apply basic logic and reasoning skills to evaluate the completeness and reliability of the information sources.
- Ability to organize and display information in ways appropriate to different types of environmental investigations
- Ability to create, use and evaluate models to understand environmental phenomena.
- Ability to use evidence and logic to develop proposed explanations that address initial questions and hypotheses.

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Earth and Environmental Processes and Systems

Physical Systems:

- Understand the major physical processes that shape the Earth and relate these processes to the characteristics of the Earth's Surface.
- Can analyze the relationships among atmosphere, hydrosphere, lithosphere, biosphere and cryosphere.
- Understand and analyze large-scale critical cycles that occur in nature, including: distribution of solar energy and albedo, the water cycle, changing seasons and atmospheric movement patterns, ocean currents, the carbon cycle, volcanism and plate tectonics, and overall familiarity with the basic elements and interactions of Earth's atmosphere, land and oceans
- Can apply their understanding of chemical reactions to round out their explanations of environmental characteristics and everyday phenomena.
- Can apply their knowledge of energy and matter to make connections among phenomena such as light, heat, electricity and the motion of objects.

Twelfth Grade (continued)

Living Systems:

- Understand basic population dynamics and the importance of diversity in living systems.
- Understand the basic ideas and the genetic mechanics behind biological evolution.
- Understand that the living environment is comprised of interrelated, dynamic systems.
- Able to account for environmental characteristics based on their knowledge of how matter and energy interact with living systems.

Humans and their Societies:

- Understand the influence of individual and group actions on the environment and comprehend how groups can work to promote and balance interests.
- Understand cultural perspectives and dynamics and apply their understanding to particular contexts,
- Understand how different political and economic systems account for, manage and otherwise affect natural resources and environmental quality.
- Can analyze global social, cultural, political, economic and environmental linkages.
- Understand the functioning of public processes for promoting and managing change and conflict and analyze their effects on the environment.

Humans and Environment:

- Understand that humans are able to alter the physical environment to meet their needs and there are limits to the ability of the environment to absorb impacts or meet human needs.
- Understand “place” as involving humans endowing a particular part of the Earth with meaning through their interactions with the environment.
- Understand that the importance and use of resources change over time and vary under different economic and technological systems.
- Can examine the social and environmental impacts of various technologies and related systems.
- Can converse, write about, and evaluate environmental issues at scales from local to global and understand these scales are often linked.

Twelfth Grade (continued)

Skills for Analyzing and Investigating Environmental Issues:

- Can apply research and analytical skills, investigate environmental issues of all scales and evaluate the consequences of specific changes, conditions and issues to human and ecological systems.
- Can identify and propose action strategies that are likely to be effective in particular situations.
- Can engage other students in peer reviews conducted in the spirit of open inquiry and knowledge that environmental issue investigations can surface deeply held views.

Personal and Civic Responsibility:

- Can plan for action based on research and analysis of an environmental issue and, if appropriate take actions that are within the scope of their rights and are consistent with their abilities and responsibilities as citizens.
 - Able to understand and assess the relative value and efficacy of solutions based on emission reductions, sequestration and natural resource and human adaptation.
 - Possess a realistic self-confidence in their effectiveness as citizens and understand the importance of exercising those rights.
 - Can analyze the influence of shared and conflicting societal values and understand that actions have broad consequences.
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Part Two: Guidelines for Global Climate Change K-12 Educational Materials From NAAEE

Fairness and Accuracy:

- Global climate change educational materials should reflect sound principles and well documented facts and science. Educators should look for materials that are clearly referenced and drawn from current, clearly identified sources of information.
- The information should be presented in language appropriate for an educational experience for students rather than for advocating a point of view or propagandizing. Educators should look for materials that are based on primary sources of data and that are peer reviewed.
- Materials should contain balanced presentation of differing viewpoints, theories and contracting scientific explanations. The materials should list the people who were involved in their development and their organizational affiliations and backgrounds where possible.
- Scientifically and socially credible positions and explanations are should be covered thoroughly in the materials while other positions are mentioned or noted. And the materials communicate areas of consensus among scientists and other experts.
- Openness to inquiry should be encouraged via the materials which should have tools to help learners form and express opinions, explore personal and societal values and have respect for others' opinions.
- Different cultures, races and genders, social groups and ages are included and depicted in respectful and equitable ways.

Depth:

- Materials should be designed for the appropriate age and developmental level of the students and should adhere to learning standards in Part One of these guidelines.
- There should be a focus on presenting concepts rather than a series of facts and should include concepts in the environmental and physical sciences and social sciences. Words and concepts should be defined.
- Ideas should be presented logically within a conceptual framework and interconnected throughout the materials emphasizing depth of understanding more than encyclopedic breadth. They should relate when possible to the learners' lives and offer opportunities to probe more deeply and to construct knowledge through research and discussion.
- The materials should increase the learner's attention to different spatial scales including global effects but also local effects

Guidelines for Educational Materials
(continued)

Instructional Soundness:

- The materials should encourage learner centered instruction that includes students in the design of the learning process and encourages them to build on previous knowledge and undertake their own inquiry.
- The different ways that students learn should be reflected through the materials, which ideally would contain instructional methods adapted to various learning style formats, including research, observation, lecture, discussion, field study, role-play and more.
- The materials should also be relevant to learners, which in turn makes the learning experience more effective. Relating the instruction to students' personal experience or geographic area is one way to make materials more meaningful to students. Offering continuing involvement is another way.
- Instructional soundness also includes materials that expand the learning environment via laboratory and field settings, partnerships with outside organizations, use of experiential learning, linkages to community service and more.
- Instructional soundness for global warming education means materials that are interdisciplinary in design, content and approach.
- Assessment of learner outcomes in ways that are practical and effective should also be a feature of materials.

Usability:

- The materials should be logical and clear spelling out intended audiences, optimal educational settings, intended learners outcomes, equipment needed, time needed, specific step-by-step instructions, and more.
- The materials should be easy to use, be long lived so that replacements and updates are at a minimum and accomplish what they claim.
- Materials should integrate with national, state and local standards and requirements.

Guidelines for Educational Materials
(continued)

Emphasis on Skill Building:

- The materials should support building lifelong skills that enable learners to understand and address global climate change issues. This would include the development and practice of critical thinking skills and evidence-based assessment and different methods of evaluating environmental issues such as risk analysis, cost/benefit analysis, ethical assessments, environmental impact assessment, economic analysis, social impact analysis and cumulative effects.
- Learners should also learn skills about solutions and their applications...

Personal and Civic Responsibility:

- Materials should promote civic responsibility and encourage learners to use their knowledge and skills as a basis for environmental problem solving
 - Materials should provide learners with an opportunity to reflect on their own actions and offer the concept that many individual actions have a cumulative effect.
 - Materials should also help learners see how they have the ability to influence the outcome of a situation and offer a variety of individual and community strategies for citizen involvement and action. The materials should provide examples of successful individual and collective actions.
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