



National Science Teaching Association Position Statement

The Teaching of the Science of Climate Change

Introduction

The National Science Teaching Association (NSTA) acknowledges that decades of research and overwhelming scientific consensus indicate with increasing certainty that Earth’s climate is changing, largely due to human-induced increases in the concentrations of heat-absorbing gases (IPCC 2023; USGCRP 2023). The scientific consensus¹ on the occurrence, causes, and consequences of climate change is both broad and deep (USGCRP 2023). The nation’s leading scientific organizations support the core findings related to climate change, as do a broad range of government agencies, university and government research centers, educational organizations, and numerous international groups (NCSE 2017; AGU 2021; USGCRP 2023). According to the National Academy of Sciences, “...scientific information is a vital component for society to make informed decisions about how to reduce the magnitude of climate change and how to adapt to its impacts” (NAS 2020). Scientific evidence advances our understanding of the challenges that climate change presents and of the need for people to prepare for and respond to its far-reaching implications (USGCRP 2023; Watts 2017).

NSTA recognizes that because of confusion and misinformation, many Americans do not think that the scientific basis for climate change is established and well-grounded (Leiserowitz et al. 2023; van der Linden et al. 2015). This belief, coupled with political efforts to actively promote both the inclusion of unscientific ideas and the exclusion of climate science in science classrooms (NESTA 2011; Branch 2013; Branch, Rosenau, and Berbeco 2016; Plutzer et al. 2016), is negatively affecting science instruction in some schools, districts, and states. Further, while a clear majority of Americans support acting on climate change, most Americans do not believe there is majority support (Sparkman et al. 2022). A recent study showed that as of 2019, less than half of the nation’s middle school teachers thought that a strong majority of scientists (>80%) ascribed recent global warming to human activities (Plutzer et al. 2024), when the actual percentage is much higher, at 97% (Cook et al. 2016).

Active opposition to and the anticipation of opposition to climate change science from students, parents, other subject-area teachers, and/or school leadership are having a documented negative impact on science teachers in some states and local school districts (Plutzer et al. 2016). Some of this opposition has been funded by fossil fuel companies, which have engaged in decades-long denial campaigns, including those targeted at education (Farrell 2016; Worth 2021).

¹ The advancement of a scientific hypothesis to prevailing theory does so within the context of the scientific community, requiring the consensus of the scientific community to advance.

This pressure to remove or replace climate science education sometimes takes the form of rhetorical tactics, such as “teach the controversy,” that are not based on science. Scientific explanations must be consistent with existing empirical evidence or stand up to empirical testing. Ideas based on political ideologies or pseudoscience that fail these empirical tests do not constitute science and should not be allowed to compromise the teaching of empirically based climate science. These tactics promote the teaching of unscientific ideas that deliberately misinform students and increase confusion about climate science.

In conclusion, our knowledge of all the sciences, including climate science, grows and changes through the continual process of scientific exploration, investigation, and informed dialogue. While the details of scientific understanding about Earth’s climate will undoubtedly continue to evolve in the future, a large body of foundational knowledge exists regarding climate science that is agreed upon by the scientific community and should be included in science education at all levels (USGCRP 2024). These understandings include the increase in global temperatures and the significant contribution of human activities to these increases (USGCRP 2023), the significant impacts to Earth’s global systems (particularly weather systems) that result from these temperature changes, and the mitigation and resilience strategies that human societies may choose to adopt in response. Students in today’s classrooms will be the ones accelerating these decisions, which are well underway in communities across the world.

NSTA confirms the solid scientific foundation on which climate change science rests, and advocates for quality, evidence-based science to be taught in science classrooms in grades K–12 and higher education.

Declarations

To ensure a high-quality K–12 science education constructed upon evidence-based science, including the science of climate change, NSTA recommends that teachers of science

- recognize the cumulative weight of scientific evidence that indicates Earth’s climate is changing, largely due to human-induced increases in the concentration of heat-absorbing gases (IPCC 2023; USGCRP 2023);
- emphasize to students that no scientific controversy exists regarding the basic facts of climate change and that any such controversies are based on social, economic, or political arguments and are not science;
- deliver instruction using evidence-based science, including climate change, human impacts on natural systems, human sustainability, and engineering design, as recommended by A Framework for K–12 Science Education (“the Framework”);
- expand the instruction of climate change science across the K–12 span, consistent with learning progressions offered in the Framework;
- advocate for integrating climate and climate change science across the K–12 curriculum both within and beyond STEM (science, technology, engineering, and mathematics) classes;
- teach climate change as any other established field of science and reject pressures to eliminate or de-emphasize climate-based science concepts in science instruction;
- recognize that scientific argumentation is not the same as arguing beliefs and opinions. It requires the use of evidence-based scientific explanations to defend arguments and critically evaluate the claims of others;

- plan instruction on the premise that debates and false-equivalence arguments are not demonstrably effective science teaching strategies;
- help students learn how to use scientific evidence to evaluate claims made by others, including those from media sources that may be politically or socially biased;
- provide students with the historical basis in science that recognizes the relationship between heat-absorbing greenhouse gases—especially those that are human-induced—and the amount of energy in the atmosphere;
- highlight for students the datasets from which scientific consensus models are built and describe how they have been tested and refined;
- recognize that attempts to use large-scale climate intervention to halt or reverse rapid climate change are well beyond simple solutions and will likely result in both intended and unintended consequences in the Earth system (NRC 2015; USGCRP 2017);
- analyze different climate change mitigation strategies with students, including those that reduce carbon emissions as well as those aimed at building resilience to the effects of global climate change;
- seek out resources and professional learning opportunities to better understand climate science and explore effective strategies for teaching climate science accurately while acknowledging related social or political controversies;
- analyze future climate change scenarios and their relationships to societal decisions regarding energy-source and land-use choices; and
- develop students’ ability to understand, communicate, and make informed decisions about climate change and solutions. Students who understand the causes, effects, and implications of climate change are better able to assess evidence and claims about evidence, discuss options, and take well-informed actions.

Necessary Support Structures

To support the work of teachers of science, NSTA recommends that school administrators, school boards, and school and district leaders

- ensure the use of evidence-based scientific information when addressing climate change and climate science in all parts of the school curriculum, such as social studies, mathematics, and reading;
- provide teachers of science with ongoing and sufficient professional learning opportunities to strengthen their content knowledge, enhance their teaching of scientific practices, and help them develop confidence to address socially controversial topics in the classroom;
- support teachers as they review, adopt, and implement evidence-based science curricula and curricular materials that accurately represent the occurrence of, evidence for, and responses to climate change;
- ensure teachers have adequate time, guidance, and resources to learn about the state of climate science and have continued access to these scientifically accurate and pedagogically sound resources;
- resist pressures to promote unscientific views that seek to de-emphasize or eliminate the scientific study of climate change or to misrepresent the scientific evidence for climate change; and

- provide full support to teachers in the event of community-based conflict.

To support the teaching of climate change in K–12 school science, NSTA recommends that state and district policy makers

- ensure that licensure and preparation standards for all teachers of science include science practices and climate change science content;
- ensure that instructional materials considered for adoption are based on both recognized practices and contemporary, scientifically accurate data;
- preserve the quality of science education by rejecting censorship, pseudoscience, logical fallacies, faulty scholarship, narrow political agendas, or unconstitutional mandates;
- understand that demand is rapidly increasing for a workforce that is knowledgeable about and capable of addressing climate change mitigation and building resilience to the effects of climate change; and
- understand that due to our federalized education system, state and local policies are responsible for ensuring the quality of climate change education. Currently, there are numerous state and local leading policies that can serve as models (MECCE and NAAEE 2022).

To support the teaching of climate change in K–12 school science, NSTA recommends that parents and other members of the community and media

- seek the expertise of science educators on science topics, including climate change science;
- augment the work of science teachers by supporting student learning of science at home, including the science of climate change and solutions to its impacts;
- help students understand the contributions that STEM professionals, policy makers, and educators can make to mitigate the effects of climate change, and how they can make decisions that contribute to desired outcomes;
- clarify that societal controversies surrounding climate change are not scientific in nature, but are social, political, and/or economic; and
- help students understand that taking constructive climate action together with other people helps reduce anxiety and build a stronger sense of community.

To support the teaching of climate change in K–12 school science, NSTA recommends that higher education professors and administrators

- design or contribute to curricula or curricular materials that incorporate climate change science into science, related majors, and general education coursework, and that these materials meet social, economic, professional, mathematical, and literary general education goals;
- participate in the professional learning of teachers concerning the science of climate change;
- provide teacher-education students with science content and pedagogy that meets the Framework's expectations for the grade band(s) they will teach; and
- recognize that a solid foundation in Earth system science should be a consideration in student admissions decisions.

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— Revised December 2024

NSTA offers the following background information on the teaching of climate science, with additional resources found at www.nsta.org/climate:

The science of climate change is firmly rooted in decades of peer-reviewed scientific literature and is as sound and advanced as other established geosciences that have provided deep understandings in fields such as plate tectonics and planetary astronomy. As such, A Framework for K–12 Science Education (the Framework) recommends that foundational climate change science concepts be included as part of a high-quality K–12 science education (NRC 2012). Given the solid scientific foundation on which climate change science rests, any controversies regarding climate change and human-caused contributions to climate change that are based on social, economic, or political arguments—rather than scientific arguments—should not be part of a science curriculum. Although climate change is an issue for all generations to solve, students in today’s classrooms are poised to generate and implement viable future solutions developed from a clear understanding of the science of climate change.

The Nature of Science (NOS) and Scientific Decision Making

One of the central components of the Science and Engineering Practices (SEPs) in the Framework is the expectation that students should argue from evidence. Specifically, it states, “Argumentation is the process by which explanations and solutions are reached.” This requires that a person be able to distinguish between opinions and evidence, and between scientific debate and unscientific denial. Good science teaching includes instructing students how to distinguish between opinion and peer-reviewed scientific evidence, helping students recognize common weaknesses in arguments, and explicitly attending to cognitive biases held by others through respectfully providing and receiving critiques about evidence and reasoning.

Controversy and Personal Beliefs

Efforts to properly teach the science of climate change are regularly challenged by those seeking to frame it as being different from other scientific fields, often with claims that it is either “uncertain” or “controversial.” Debate as a form of dialogue can occur in any area of science, but a great amount of scientific consensus has been reached about fundamental understandings in science, and the same holds true for climate science. Any perceived controversies about the fundamental observations related to climate change science come from social, economic, or political domains, not from the scientific community. Teachers should know how to acknowledge student and parental beliefs while clarifying the difference between beliefs and evidence-based understandings. They also need tools for dealing with socially or politically motivated controversies.

The Nature of Deep-Seated Beliefs

A significant barrier to teaching climate change science derives from the cognitive biases we all carry with us. Belief systems do not necessarily arise from logic and evidence, which are the basis of scientific understanding. Belief systems develop from one’s faith, family, and personal emotional experiences. An individual’s desire to be a part of a specific community or group will inform their beliefs and affect their ability to change their beliefs based on the pressures applied by the community or group they belong to or wish to join. Beliefs are more likely to change when analogies, stories, and emotional messaging are used to explain evidence.

The Time Needed for Learning

An interdisciplinary approach is necessary to understand the complexity of most modern science research

and how that science is contextualized in social and psychological issues. Given the human relevancy and transdisciplinary nature of climate change science, it is an excellent source of phenomenon-based storylines through which students can learn all three dimensions of the Framework. Teaching about any form of human impact on Earth systems is most effective when encouraging students to approach the topic from the perspective of designing and revising mitigation strategies and solutions to problems, not just focusing on the problems themselves. Teachers require sufficient time to adequately plan instruction that supports student engagement with the complexity of climate change science, as well as adequate time for student understanding to progress from basic concepts to complex interactions.

Time dedicated to teaching the science of climate change is at risk. A survey of middle school teachers showed that the percentage of teachers devoting class time to recent global warming increased from 65% to 81% from 2014 to 2019 (Plutzer et al. 2024), with alignment of state standards to NRC Framework playing a large role in this. However, this same survey showed that during the same time period, the number of middle school science teachers who gave “equal time to perspectives that raise doubt that humans are causing climate change” increased from 39% to 46%. The fact that nearly half of the teachers surveyed included unscientific climate denialism in their classes represents a dangerous trend of increasing confusion about the causes of climate change.

Responses to Climate Change

The relative stability of the climate over the last 12,000 years has allowed agriculture and civilization to rise and flourish. Broadly available carbon-dense fossil fuels led to the Industrial Revolution and ultimately made our modern way of life possible. The continued extensive use of these same fuels now jeopardizes that very way of life. Human activity has affected the composition of the atmosphere in ways that are altering atmospheric dynamics and changing global and regional climates. The teaching of climate change science should enable learners to strategize solutions to human energy needs, examining multiple costs and benefits. Social and individual decision making will drive the development of new technologies such as solar-based electricity sources and non-fossil-fuel modes of transportation that will in turn reduce costs and allow human societies to modernize. It should be acknowledged that solutions are readily available and already being actively implemented, and policy needs to utilize the science and make decisions to move forward with the scaling up of the solutions to reduce the burning of fossil fuels and remove carbon dioxide from our atmosphere.

Range of Available Solutions and the Vision for Interdisciplinary Policies and Actions

Effective education related to climate change increases the number of students who will be able to participate in a rapidly growing workforce in demand for the construction of a low-carbon economy and climate-resilient communities. The future workforce needs to be prepared for an economy-wide transition to net-zero-emissions energy, transportation, and food systems in the United States. A shift toward renewables is projected to increase the total number of jobs in the energy sector by millions of workers (NCA5-Mitigation 2023). However, there is already evidence of hiring difficulties in energy labor markets (NASEO and EFI 2020), leading to labor supply bottlenecks. Education needs to ensure the future workforce is ready and prepared for the growing number of jobs that enable this rapid societal shift while also equitably addressing existing racial and gender disparities in the workforce.

It should be acknowledged that solutions are readily available, and policy needs to utilize the science and make decisions to move forward with scaling up the solutions to reduce the burning of fossil fuels and remove

carbon dioxide from our atmosphere. Seeking these solutions is consistent with the vision for engineering design in A Framework for K–12 Science Education (2012). The “design-mindedness” of engineering solutions can be a connection and bridge to other K–12 disciplines, as well as serving as a focus for effective STEM/STEAM integration into the curriculum. Different sectors of society need the application of science in climate-resilient infrastructure construction and carbon-neutral energy generation and distribution. As a function of workforce development, education policy should match the rapid changes in energy generation. The workforce necessary to continue the decarbonization trend will increasingly rely on students graduating with a climate solutions-oriented education at middle, high school, and community college levels.

References

- American Geophysical Union (AGU). The Importance of Exploring Earth and Space Science (ESS) Throughout the Educational Experience, AGU Position Statement on K-12 Earth and Space Science Education, 2021. Available at <https://www.agu.org/Share-and-Advocate/Share/PolicyMakers/Position-Statements/K-12-education>.
- Branch, G. 2013. Defending science education: Climate as a second front for biologists. *BioScience* 63 (9): 717–718.
- Branch, G., J. Rosenau, and M. Berbeco. 2016. Climate education in the classroom: Cloudy with a chance of confusion. *Bulletin of the Atomic Scientists* 72 (2): 89–96.
- Cook, J., Oreskes, N., Doran, P.T., Anderegg, W.R.L., Verheggen, B., Maibach, E.W., Carlton, J.S., Lewandowsky, S., Skuce, A.G., Green, S.A., Nuccitelli, D., Jacobs, P., Richardson, M., Winkler, B., Painting, R., and Rice, K. (2016). Consensus on consensus: a synthesis of consensus estimates on human-caused global warming. *Environ. Res. Lett.* 11 048002 DOI 10.1088/1748-9326/11/4/048002.
- Farrell J (2016). Network structure and influence of the climate change counter-movement. *Nature Climate Change* 6(4): 370–374.
- IPCC, 2023. *Climate Change 2023: Synthesis Report*. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 35-115, doi: [10.59327/IPCC/AR6-9789291691647](https://doi.org/10.59327/IPCC/AR6-9789291691647).
- Joshi K (2021). Climate denial still features in fossil fuel-funded education materials. *Renew Economy: Clean Energy News and Analysis*. Available at: <https://reneweconomy.com.au/climate-denial-still-features-in-fossil-fuel-funded-education-materials> (accessed 13 August 2023).
- Leiserowitz, A., Maibach, E., Rosenthal, S., Kotcher, J., Goddard, E., Carman, J., Ballew, M., Verner, M., Marlon, J., Lee, S., Myers, T., Goldberg, M., Badullovich, N., & Thier, K. (2023). *Climate Change in the American Mind: Beliefs & Attitudes*, Fall 2023. Yale University and George Mason University. New Haven, CT: Yale Program on Climate Change Communication.
- MECCE & NAAEE. (2022). Mapping the landscape of K-12 climate change education policy in the United States Monitoring and Evaluating Climate Communication and Education Project and North American Association of Environmental Education.
- NASEO and EFI, 2020. The 2019 U.S. Energy & Employment Report. National Association of State Energy Officials and Energy Futures Initiative. <https://www.naseo.org/data/sites/1/documents/publications/useer-2019-us-energy-employment-report1.pdf>.
- National Academy of Sciences (NAS). 2014. *Climate change: Evidence and causes*. Washington, DC: National Academies Press.
- National Center for Science Education (NCSE). Voices for climate change education. (accessed October 2017).

- National Earth Science Teachers Association (NESTA) 2011. *K–12 climate change education survey*. National Earth Science Teachers Association.
- National Research Council (NRC). 2012. *A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*. Washington, DC: National Academies Press.
- National Academies of Sciences, Engineering, and Medicine. 2020. *Climate Change: Evidence and Causes: Update 2020*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/25733>.
- Plutzer, E., A. L. Hannah, J. Rosenau, M. S. McCaffrey, M. Berbeco, and A. H. Reid. 2016. *Mixed messages: How climate is taught in America's schools*. Oakland, CA: National Center for Science Education.
- Plutzer E., Branch G., and Townley A.L. (2024). Climate change education in U.S. middle schools: changes over five pivotal years. *J Microbiol Biol Educ*. 0:e00015-24. <https://doi.org/10.1128/jmbe.00015-24>.
- Sinatra GM, Hofer BK (2021). *Science Denial: Why it Happens and what to Do about it*. Oxford: Oxford University Press.
- Sparkman, G., Geiger, N. and Weber, E. U. 2022. Americans experience a false social reality by underestimating popular climate policy support by nearly half. *Nature Communications* 13(1). 4779. <https://doi.org/10.1038/s41467-022-32412-y>.
- USGCRP, 2023. *Fifth National Climate Assessment*. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. U.S. Global Change Research Program, Washington, DC, USA. <https://doi.org/10.7930/NCA5.2023>.
- USGCRP, 2024: *Climate Literacy: Essential Principles for Understanding and Addressing Climate Change*. U.S. Global Change Research Program, Washington, D.C., USA. Accessed at <https://www.climate.gov/teaching/climate>.
- Van der Linden, S. L., A. A. Leiserowitz, G. D. Feinberg, and E. W. Maibach. 2015. The scientific consensus on climate change as a gateway belief: Experimental evidence. *PLoS ONE* 10 (2): e0118489.
- Watts, N., et al. 2017. The Lancet countdown on health and climate change: From 25 years of inaction to a global transformation for public health. *The Lancet* 391(10120), 581–630.
- Worth, Katie. *Miseducation: How Climate Change Is Taught in America*. New York, NY: Columbia Global Reports, 2021.

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