



Interdisciplinary Learning Goals for 21st-Century Climate Education

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Abstract

Amid intensifying climate disruptions, states across the U.S. are beginning to require K–12 schools to include climate education. Yet, teachers face challenges in designing meaningful and interdisciplinary learning experiences. This article introduces a set of climate justice learning goals developed through collaboration among teachers, administrators, students, and researchers as part of the Climate Solutionaries Community (CSC) Project. We ground our goals in the Head-Heart-Hands (HHH) framework by emphasizing: 1) scientific and social knowledge (Head); 2) socio-emotional competencies, hope, and agency (Heart); and 3) applied skills for action and community solutions (Hands). By integrating these attributes, secondary educators are able to develop student understanding of climate phenomena and justice issues, while cultivating resilience and empowerment.

Keywords

Climate education; secondary student learning; Head-Heart-Hands framework; community projects; climate justice

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Introduction

Young people today face a lifetime of environmental and social disruption due to the global climate crisis. Educating them on the full scope of this issue can be challenging. States like [California](#), [Connecticut](#), [Oregon](#), and [Illinois](#) have recently required climate education in public K-12 curriculum. However, knowing how to implement this curriculum poses challenges for teachers as they seek guidance on designing meaningful, cross-disciplinary content for their classrooms.

One of these challenges is conceptualizing learning goals that go beyond students practicing rote memorization of scientific language and concepts toward a connection to personal, local, and global aspects of climate phenomena. Relatedly, climate educators have called for pedagogies that emphasize community building, peer motivation, and genuine hope for the future (Hargis, McKenzie, & LeVert-Chiasson, 2021). It is increasingly recognized that the climate crisis encompasses many dimensions of understanding beyond scientific interpretation alone. Addressing this emergency should also include interdisciplinary approaches that integrate content, skills, deep understanding, and empathy help to increase students' awareness of scientific and justice perspectives as they address impending climate emergencies with fortitude and genuine hope to find solutions (Jagers et al., 2019; Ojala 2012). Therefore, we pose this critical question: What climate learning goals can guide secondary teachers in providing middle and high school students with meaningful classroom experiences?

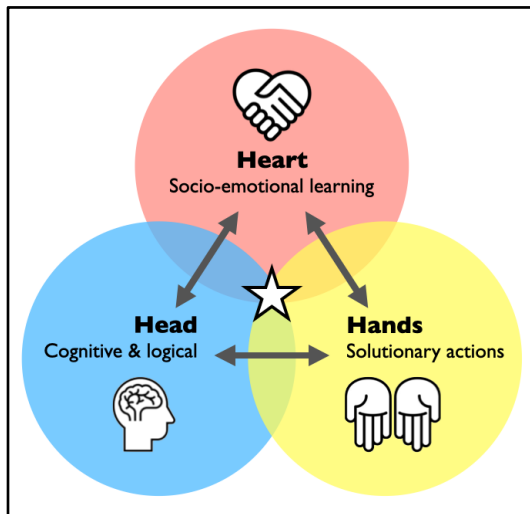
Climate Solutionaries Community Project (CSC) (a pseudonym), teachers, students, site administrators, and university researchers co-created a set of climate justice learning goals. These goals became the foundations for crafting, implementing, and evaluating a climate curriculum that was integrated into and across the curriculum at a high school and one of its feeder middle schools (e.g., Harris et al., 2025). The

purpose of this article is to showcase the goals themselves, the principles that directed their creation, and guidance for applying them in classroom settings.

An interdisciplinary product: Climate justice learning goals

The learning goals were developed utilizing a co-design method that included an extensive brainstorming, design, and revision process (Penuel, 2019; Roschelle, Penuel, and Shechtman, 2006). The diverse, multi-subject and multi-grade level team that engaged in this process is part of the reason the resulting goals are applicable to a range of classes: science, math, English, social studies, PE, and electives. In order to provide an underlying structure for the learning goals, we used the Head-Heart-Hands (HHH) framework from Sipos, Battisti, and Grimm (2008). The HHH framework points to the need for students' understanding of natural and social sciences associated with the climate crisis (Head), support and growth of socio-emotional capacity, empowerment, and agency (Heart), and development of skills necessary for action and community-based solutions (Hands; see Figure 1 below).

Figure 1 HHH model integrating various learning experiences to increase student understanding of ecological, social, and economic justice with regard to the climate change emergency.



Using the HHH framework, the learning goals in the figure below were developed as the team engaged in iterative discussions regarding priorities, wording, and implementation challenges. While there can always be overlap within and between goals, in Figure 2 below, we showcase the learning goals by their Head-Heart-Hands affiliation, and through implementation of these learning goals, we found the heart piece served as a driver for participation.

Figure 2: Climate education learning goals reflecting the Heart-Head-Hands framework. For the full table of learning goals and initial research results from our project, please see Hayes et al. (2024).

HHH	Goal
HEAD	<p>Student knowledge and understanding of climate crisis causes, effects, and solutions. <i>Students understand...</i> <i>(physically- and socially-oriented attributes)</i></p> <ol style="list-style-type: none"> 1. Interconnectedness of systems 2a. Physical causes of climate emergencies 2b. Physical effects of climate emergencies 2c. Physical solutions 2d. Protection and regeneration of ecosystems 3a. Social causes of the climate crisis 3b. Social impacts of the climate crisis 3c. Socially-oriented actions to end the climate crisis
HEART	<p>Student orientation toward climate justice issues and solutions. <i>Students feel...</i></p> <ol style="list-style-type: none"> 4. Radical hope in the face of climate challenge 5. The climate emergency is an important issue 6. Cope with agency 7. Generate empathy, take perspectives of others 8. Build relationships and take actions towards others that lead to reconciliation and healing 9. Recognize their own strengths and existing resilience
HANDS	<p>Skills and competencies. <i>Students are able to...</i></p> <ol style="list-style-type: none"> 10. Critically consume and generate information, critique environmentally unjust systems 11. Carry out socially just actions to mitigate climate crises through both civic engagement and iterative design

Head

To address climate justice and mitigate the climate crisis, students need knowledge and understanding. We drew on Hawken’s (2021) framework from [Regeneration: Ending the Climate Crisis in One Generation](#) to design content-oriented learning goals that illustrate the interconnectedness of causes, effects, and solutions in both the physical and social realms. In the physical realm, students need to understand the primary causes and effects of the crisis and its disruption to global habitats. For example, students might learn how greenhouse gas emissions drive up average surface temperature, which in turn increases extreme weather events such as drought and fires, precipitation and flooding. In the social/political realm, students would demonstrate how political and social factors can drive or constrain emissions through policies, laws,

and consumer action. Addressing not only the physical and the social, but also the interactions between them emphasizes to students and educators the multi-dimensional nature of the climate emergency and provides teachers with a roadmap for developing student learning.

Heart

The learning goals in the Heart category are designed to create spaces where students express how they feel about the climate crisis. Because of the imperative to work together to fix large-scale societal problems like climate emergencies, these goals emphasize the development of relationships and other social-emotional competencies. The Heart learning goals also center students maintaining hope and a sense of agency in the face of the climate crisis. To meet these learning goals, students might practice concrete skills such as building relationships and taking alternative perspectives, as well as more abstract skills such as empathy. They may also need practice processing complex feelings like despair. For example, Heart approaches might involve discussions about the impacts of extreme heat on different professions and demographics (ex., farm workers or the elderly), and projects where students might work with different community members to construct solutions in a respectful and sustainable manner. Each of the Heart goals is written from an assets-based perspective, encouraging students to recognize their strengths and resilience when addressing climate crises and climate justice.

Hands

Students will need skills to enact changes in the real world through planning, engineering, and evaluating various social and physical solutions to the climate emergency. These skills include critical analysis of climate information and solutions, as well as engaging in collaborative, hands-on work to create socially just mitigations for climate disasters. These learning goals are an applied way to develop an understanding of climate crises (Head) and taking solutions-based actions (Hands). For example, CSC students built We Share Solar Suitcases, planted trees for Arbor Day, and wrote letters to their state governor on policy change to address the impacts of extreme heat on farm workers. By combining these skills and competencies, we see a pathway for students to bolster their identities as climate problem-solvers and recognize their own agency and positive impact in behaviorally confronting the issue.

Interdisciplinary Heart Head Hands example

Here we offer an example of how CSC teachers designed interdisciplinary, solutions-focused climate learning (Harris et al., 2025). The unit focused on sea-level rise as an overarching phenomenon and involved teachers from English language arts (ELA), science, social studies, physical education (PE), art, and technology to help students grapple with a set of essential questions aligned with the Head, Heart, Hands model. For example, in ELA lessons, students learned about a coastal community dealing with sea-level rise, developing empathy as they acknowledge vulnerable and displaced populations directly affected by climate change (Heart). In science lessons, students engaged in evidence-based reasoning and discourse on topics like melting ice and thermal expansion (Head). This included students given large translucent tubs they were asked to fill with ice, balls of clay formed to mimic land mass, and toy animals to show what happens when the ice melts and water levels rise, potentially drowning out their animals. In social studies lessons, students were asked to identify local sea-level rise risks and examine how their local government is responding to this challenge (Head and Hands). Art and PE followed up by showing students how to use painting and riding bikes to school as forms of activism (Heart and Hands). What makes all of this interdisciplinary is not just the exploration of ideas within separate subjects, but the anchoring of the unit in a particular phenomenon that shows connections across disciplines and relevance to students' lives.

Conclusion

What we have observed from our co-design team is an extraordinary motivation to collaborate and educate future generations about the reality of the climate emergency, paired with a sense of urgency to ensure solutions provide students with hope for a brighter future. Our efforts have led to increased student understanding, empathy, and actionable skills. Additionally, the learning goals supported a local movement where teachers, working alongside their students and peers, created climate community events such as citizen-science focused school field trips and museum exhibits showcasing student's perspectives on the climate crisis through art. Since CSC teachers embraced and taught toward the same set of learning goals, students were consistently exposed to common concepts and frameworks throughout their educational journey. These learning goals can serve as a guide for schools and teachers seeking to offer students transformational, interdisciplinary, and justice-oriented learning experiences centered on the climate emergency and its impacts.

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