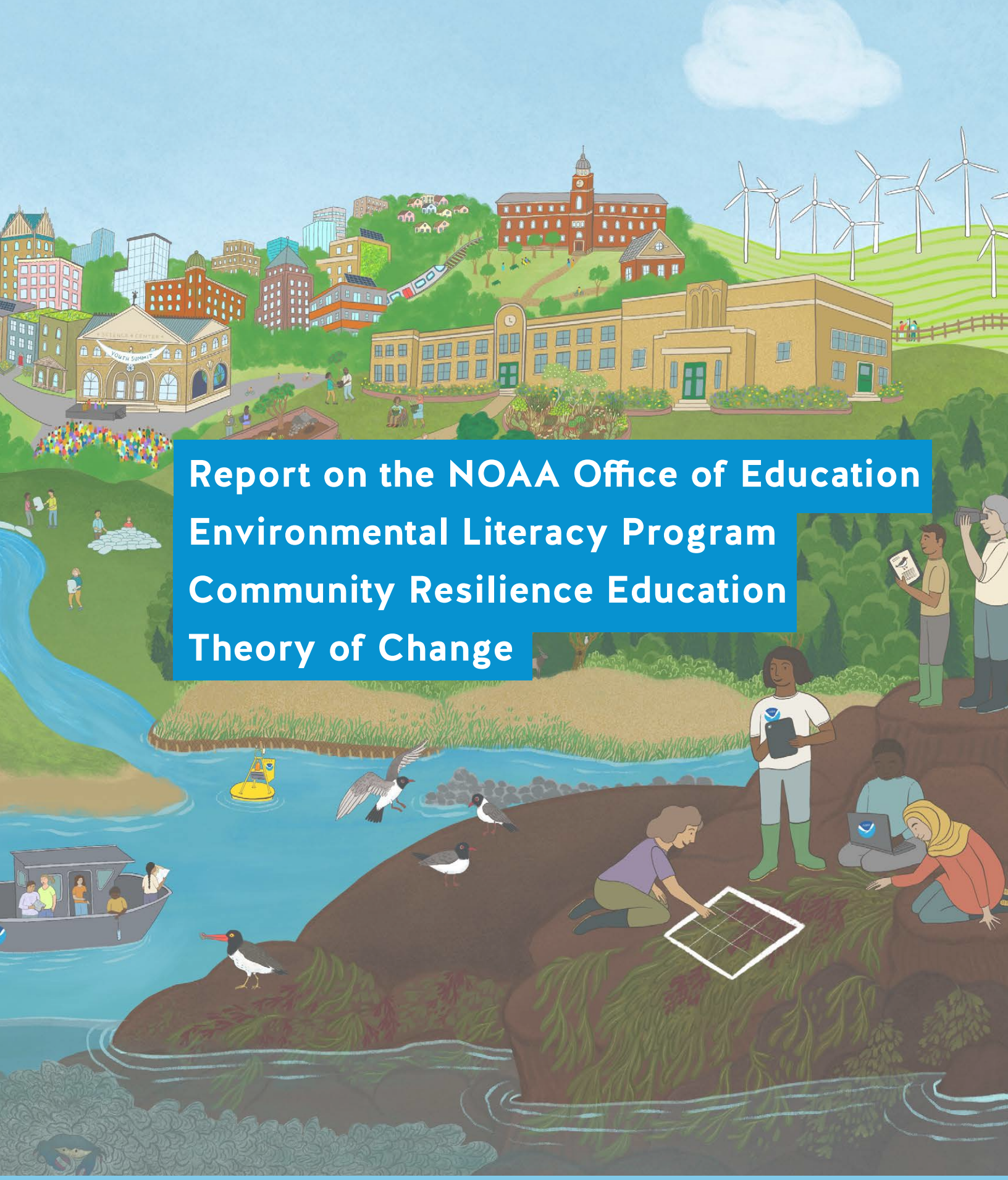

Report on the NOAA Office of Education Environmental Literacy Program Community Resilience Education Theory of Change

National Oceanic and Atmospheric Administration
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Authors: Genie Bey, Carrie McDougall, and Sarah Schoedinger | Version: July 2020

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SECTION II

Literature Review and Assumptions

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Literature Review and Assumptions

The following section summarizes the literature that informed this theory of change, from the articulation of the problem statement to the characteristics critical to the success of community resilience education in achieving the goal of building resilience to extreme weather, climate change, and other environmental hazards. These summaries fall into six thematic clusters:

1. Resilience to Extreme Weather, Climate Change, and Other Environmental Hazards;
2. Science, Technology, Engineering, and Math (STEM) Education, Environmental Education, Social Studies Education, and Related Literacies;
3. Connecting Environmental Literacy and Social-Ecological Resilience;
4. Active Learning, Social Learning, and Co-Production of Knowledge;
5. Equitable Resilience and Climate Justice; and
6. Empowering Agents of Change.

Although there is overlap in the concepts discussed in these clusters, they are grouped because the ideas discussed in each of these sections are most closely related. This literature, as well as lessons learned from the ELP Community of Practice, are the basis for the set of assumptions that explain the relationship within and among the causal pathways of the ELP theory of change.

Resilience to Extreme Weather, Climate Change, and Other Environmental Hazards

Extreme weather, climate change, and other environmental hazards pose serious and increasing threats to human health and safety, the economy, and the environment, particularly under a future with high greenhouse gas emissions. Climate change is projected to increase the frequency and intensity of some extreme weather events (USGCRP 2018). Billion-dollar weather and climate disasters are becoming more frequent and costly in the United States. Specifically, the United States has sustained 265 weather and climate disasters since 1980, where the cost of damages either reached or exceeded $1 billion, with the total cost of these damages reaching a soaring $1.775 trillion. Additionally, despite improvements in forecasting and warning systems, there has also been a rise in the number of deaths associated with these billion dollar events (NCEI 2020). Globally averaged surface air temperatures are now the warmest in the history of modern civilization, with greenhouse gas emissions from human activities being the most significant contributors to the observed warming (USGCRP 2018). As such, emission mitigation and adaptation actions play a direct role in determining future risks and climate impacts.

The environmental hazards that are most relevant to the ELP's work are those that are part of NOAA's mission which include, but are not limited to, severe storms, tornadoes, hurricanes, flooding, heavy precipitation events, persistent drought, heat waves, wildfires, increased global temperatures, acidification of the ocean, and sea level rise. It is important to note the differing temporal component of these hazards. Some of them are acute, short-term events such as severe storms and wildfires, whereas others are chronic stressors such as increasing global temperatures, ocean acidification, and sea level rise that play out over a longer period of time. As a result, different actions are needed to address these different types of hazards. Furthermore, these hazards are interrelated and have compounding impacts, placing some groups at higher risk of climate-related impacts than others (USGCRP 2018).

Many factors contribute to individual and community exposure and capacity to respond to extreme weather, climate change, and other environmental hazards, which range from social, economic, to geographic variables. Risks are often higher for low-income communities, communities of color, other historically marginalized groups, children, and the elderly. Climate change is projected to exacerbate existing socioeconomic inequalities, which can in turn heighten exposure to environmental hazards and other climate-related impacts (USGCRP 2018).

A key strategy to reduce vulnerability to extreme weather, climate change, and other environmental hazards is to bolster community resilience. Community resilience is dependent upon the strength of all aspects of a community, including educational attainment, physical infrastructure, socioeconomic health, social networks, and ecosystem health. Communication across social networks and education are key components of community resilience, where resilience is increased when community members develop an understanding of the current and projected environmental hazards they face, and the actions they can take to both plan for and respond to an event (NRC 2012). The National Research Council highlights that while education and communication about resilience should take place at all scales of governance, these approaches "may be most crucial at the local level, where they strengthen social ties and capabilities, and where local knowledge and trusted relationships can amplify the power of communications" (2012, 134).

Public health is another facet of community resilience. In addition to extreme weather, climate change, and other environmental hazards, pandemics pose serious challenges to communities, and a community's response to a pandemic might share similarities to its response to an extreme weather event. A Presidential Policy Directive (PPD-8) from 2011 entitled "National Preparedness" describes how catastrophic weather events, pandemics, terrorism, and cyberattacks all pose threats to national security (White House and Department of Homeland Security 2011). This policy directive highlights commonalities in responses to these threats. For example, leveraging expertise and knowledge at the community level would be required for both a pandemic and an environmental disaster like a large-scale oil spill. Furthermore, as the COVID-19 pandemic has brought to light, community preparedness to respond to the pandemic has varied across the nation, and health disparities exist wherein low-income communities and communities of color are disproportionately impacted by the virus. Opportunities exist for increasing both communication across social networks and education to better prepare communities for these challenges.

Science, Technology, Engineering, and Math (STEM) Education, Environmental Education, Social Studies Education, and Related Literacies

The definition put forward for community resilience education encompasses a multi-disciplinary effort that involves STEM, environmental, and social studies educational approaches and draws from concepts contained in the definitions of scientific literacy, geographic literacy, climate literacy, and environmental literacy. Environmental literacy is the singular literacy called out in the community resilience education definition and in the program's goals and approaches because it integrates many of the elements of the other literacies.

Environmental Literacy

NOAA has adopted the following definition of environmental literacy: the possession of knowledge and understanding of a wide range of environmental concepts, problems, and issues; cognitive and affective dispositions toward the environment; cognitive skills and abilities; and appropriate behavioral strategies to make sound and effective decisions regarding the environment. It includes informed decision making both individually and collectively and a willingness to act on those decisions in personal and civic life to improve the well-being of other individuals, societies and the global environment (NOAA 2015–2035 Education Strategic Plan). This was adapted from the definition used by the Organisation for Economic Co-operation and Development (OECD) Programme for International Student Assessment (PISA) (Hollweg et al. 2011, 2-3). A primary goal of environmental education (EE) is to develop environmental literacy, with the objective of fostering responsible citizens and stewards of the planet (Roth 1992).

Scientific Literacy

Scientific literacy, as put forward by the OECD PISA is:

> [T]he ability to engage with science-related issues, and with the ideas of science, as a reflective citizen. A scientifically literate person, therefore, is willing to engage in reasoned discourse about science and technology which requires the competencies of:
>
> - Explaining phenomena scientifically – Recognising, offering and evaluating explanations for a range of natural and technological phenomena.
> - Evaluating and designing scientific enquiry – Describing and appraising scientific investigations and proposing ways of addressing questions scientifically.
> - Interpreting data and evidence scientifically – Analysing and evaluating data, claims and arguments in a variety of representations and drawing appropriate scientific conclusions (OECD 2018).

ELP-funded projects are rooted in STEM Education efforts that build scientific literacy in their target audiences, among other educational goals.

Geographic Literacy

Geo-literacy or geographic literacy, put forward by the National Geographic Society, is defined as "the understanding of human and natural systems, geographic reasoning, and systematic decision-making", where "geographic reasoning is the process of making informed, logical decisions based on accurate understanding of the human and natural world around you" (2020). Understanding and taking action to address environmental hazards requires an ability to comprehend spatial data, and is an inherently place-based effort. Therefore, geographic literacy, fostered through social studies education, among other approaches, underpins the ELP's work in community resilience education.

Climate Literacy

NOAA and a large group of other federal agencies reached consensus on the essential components of understanding climate science, and put forth the definition of climate science literacy as:

- Understanding the essential principles of Earth's climate system;
- knowing how to assess scientifically credible information about climate;
- communicating about climate and climate change in a meaningful way; and
- being able to make informed and responsible decisions with regard to actions that may affect climate (USGCRP 2009).

ELP-funded projects are designed to help build the multiple domains of climate literacy as outlined in the Essential Principles of Climate Science (USGCRP 2009).

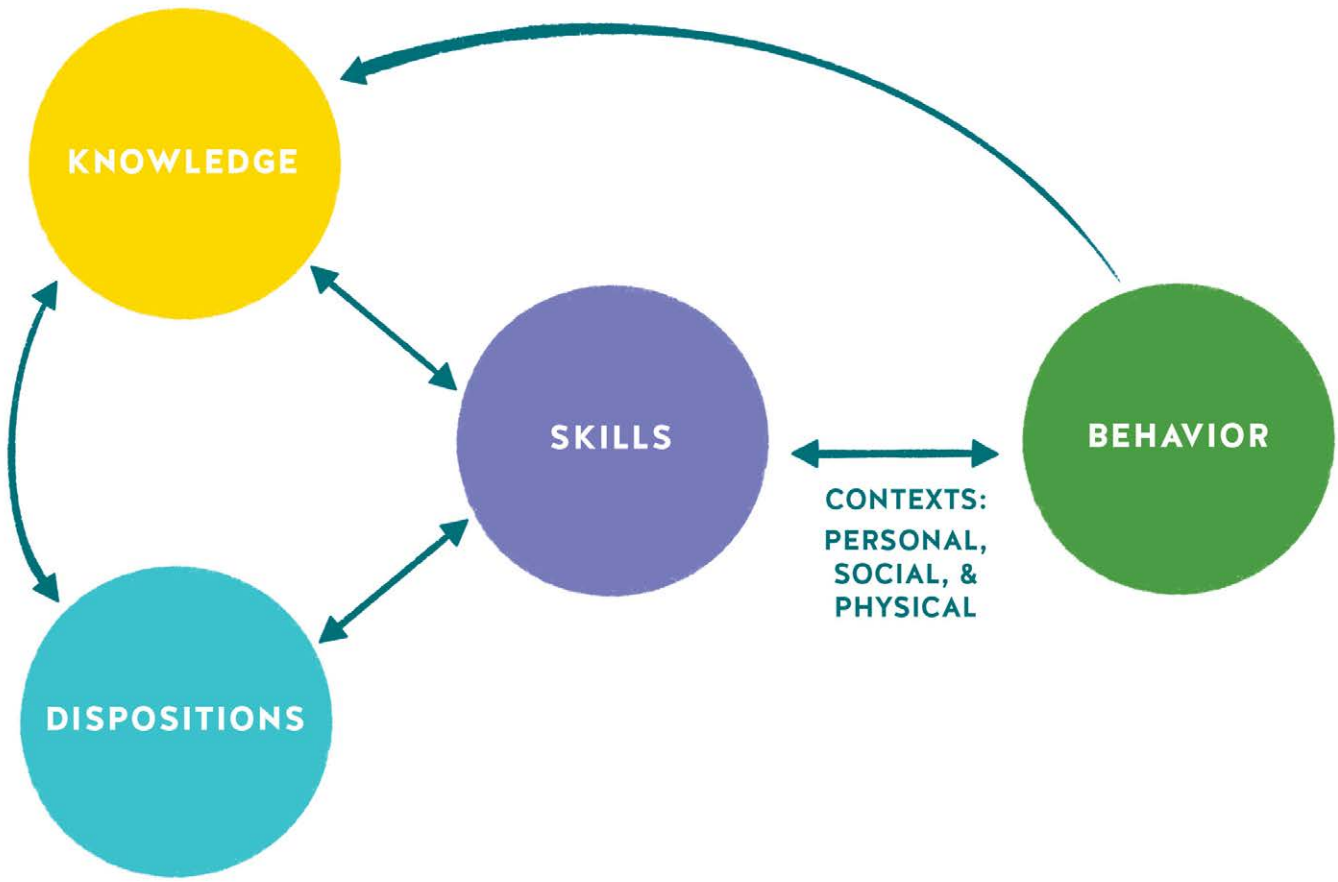
The complexity of addressing the challenges associated with extreme weather, climate change, and other environmental hazards highlights the need for society to have some level of competency within each of these literacies. Building sufficient levels of environmental literacy among community members ensures that they comprehend the complex ways that human and natural systems interact, both globally and locally, and have the required skills, motivation, and confidence to participate in decisions that inform public policy. Decisions about how to build more resilient and equitable communities should be based on scientific and other forms of knowledge (e.g., traditional and community knowledge), and represent the values of society. Such decisions can lead to more robust policies that will be better accepted by society because they truly reflect that society's values (Bozeman and Sarewitz 2011). STEM education, environmental education, and social studies education all contribute to building the needed competencies. These types of holistic and multi-disciplinary approaches are foundational for community resilience education.

Environmental Literacy Exists on a Continuum

While society at large has a tendency to understand literacy as binary—either present or not—all types of literacy exist on a continuum. Environmental literacy changes over time within individuals as a person's beliefs, life experiences, and social influences modify their understanding of and response to environmental issues (Hollweg et al. 2011, 3-11). Additionally, environmental literacy within an individual can exist at different levels of proficiency. Environmental literacy is a complex combination of knowledge, dispositions, skills and behavior that interact and influence each other (Figure 3) (Hollweg et al. 2011). Environmentally responsible behavior is the goal of environmental literacy and it results from possessing degrees of the other three components. Knowledge of an environmental issue is a key component, as are concerns about a given issue and one's willingness to take action. Understanding and caring about an environmental issue are insufficient on their own; one also must possess the skills to apply the knowledge and act on that motivation. These three components are necessary for environmentally responsible behavior and that behavior can, in return, build knowledge and skills in the process of taking action (i.e., learning by doing). It is also important to note that an individual's environmentally responsible behavior is mediated through personal, social, and physical contexts (Hollweg et al. 2011, 3-11 to 3-12).

Assessing levels of environmental literacy involves analyzing the degree to which individuals attain proficiency within each component, and are able to apply their knowledge and skills to decision making on local, regional, national, and global environmental issues (Hollweg et al. 2011, ii). Levels of environmental literacy have been described as three points on a continuum, including nominal, functional, and operational literacy (Roth 1992, 17).

> **Nominal environmental literacy** indicates a person able to recognize many of the basic terms used in communicating about the environment and able to provide rough, if unsophisticated, working definitions of their meanings. Persons at the nominal level are developing an awareness and sensitivity towards the environment along with an attitude of respect for natural systems and concern for the nature and magnitude of human impacts on them. They also have a very rudimentary knowledge of how natural systems work and how human social systems interact with them.
>
> **Functional environmental literacy** indicates a person with a broader knowledge and understanding of the nature of and interactions between human social systems and other natural systems. They are aware and concerned about the negative interactions between these systems in terms of at least one or more issues and have developed the skills to analyze, synthesize, and evaluate information about them using primary and secondary sources. They evaluate a selected problem/issue on the basis of sound evidence and personal values and ethics. They communicate their findings and feelings to others. On issues of particular concern to them, they evidence a personal investment and motivation to work toward remediation using their knowledge of basic strategies for initiating and implementing social or technological change.
>
> **Operational environmental literacy** indicates a person who has moved beyond functional literacy in both the breadth and depth of understandings and skills who routinely evaluate the impacts and consequences of actions; gathering and synthesizing pertinent information, choosing among alternatives, and advocating action positions and taking actions that work to sustain or enhance a healthy environment. Such people demonstrate a strong, ongoing sense of investment in and responsibility for preventing or remediating environmental degradation both personally and collectively, and are likely to be acting at several levels from local to global in so doing. The characteristic habits of mind of the environmentally literate are well ingrained. They are routinely engaged in dealing with the world at large (26).



KNOWLEDGE about environmental issues

- Physical, ecological, social, cultural, & political systems
- Environmental issues & their multiple solutions
- Strategies for citizen participation & action

DISPOSITIONS toward environmental issues

- Attitudes & concern toward the environment
- Assumption of personal responsibility
- Sense of self-efficacy
- Motivation & intention to act

SKILLS related to environmental issues

- Identify & ask relevant questions
- Investigate & analyze from primary & secondary sources
- Evaluate & make personal judgements about them
- Use evidence & knowledge to select & defend one's own position(s) to resolve them
- Create & evaluate plans to resolve them

Environmentally responsible BEHAVIOR

- Involvement in intentional & habitual behaviors, individually & collectively, that work towards solving current issues & preventing new ones

Figure 3. *Components of environmental literacy and their relationship to one another, adapted from Hollweg et al. (2011).*

Collective Literacy

Just as environmental literacy can be understood to exist on a continuum within an individual, there is also a continuum of literacy held within a community. This community-level literacy can be referred to as collective literacy. For instance, the National Academies Committee on Science Literacy and Public Perception of Science asserts that

> Science literacy in a community does not require each individual to attain a particular threshold of knowledge, skills, and abilities; rather, it is a matter of a community having sufficient shared resources that are distributed and organized in such a way that the varying abilities of community members work in concert to contribute to the community's overall well-being (2016, 73).

This community literacy concept has evolved and was further articulated in the 2018 National Academies report Learning through Citizen Science: Enhancing Opportunities by Design, where

> Community science literacy is the capacity of a community to apply, do, and even guide science in ways that advance community priorities. It is a shared capacity, and it depends on and relates to the science learning of individuals as well as the connections, networks and agency that are distributed throughout the community (2018, 4).

Moreover, efforts to advance science literacy to address complex global issues, including climate change, have largely been unsuccessful, as they've been focused on individual behavior change rather than changes at the societal level (Spitzer and Fraser 2020). This concept of a continuum of literacy within a community can be applied to environmental literacy as well as science literacy. The ELP recognizes that for community resilience education projects to succeed, it is important that they aim to build collective literacy rather than equip all members of a community with the same level of literacy.

Connecting Environmental Literacy and Social-Ecological Resilience

Studies highlight that educated communities are less vulnerable to environmental hazards, as they are more likely to be prepared for and recover from disasters (Frankenberg et al. 2013; Muttarak and Lutz 2014; Sharpe et al. 2018). EE has maintained a focus on fostering environmentally sensitive behavior and decision making through the cultivation of environmental literacy. Though EE has evolved to adapt to changes in social and ecological systems over time, with the most recent adaptations incorporating principles of environmental justice, youth development, and democratic participation (Dubois and Krasny 2016, 255), the discipline must continue to adapt to address the unprecedented challenges posed by a changing climate.

Many scholars and practitioners have been exploring ways in which environmental literacy and resilience overlap. The concept of social-ecological systems (SES) resilience is particularly useful in helping one understand how larger communities and systems react and transform in response to disturbance. SES resilience can be defined as "the capacity of a social-ecological system to continually change, adapt, or transform so as to maintain ongoing processes in response to gradual and small-scale change, or transform in the face of devastating change" (Folke, Colding, and Berkes 2001). Adaptive capacity, or the "ability of a person, asset, or system to adjust to a hazard, take advantage of new opportunities, or cope with change" (U.S. Climate Resilience Toolkit 2020), is a particularly important indicator of a social-ecological system's resilience.

Dubois and Krasny highlight that EE can help foster attributes of resilient human-nature systems, namely social capital, adaptive capacity, and collaborative resource management (2016, 257). Furthermore, concepts from learning theory and SES resilience can be coupled to address complex environmental problems. For instance, research highlights that unexpected events can foster transformational learning–meaning a change in an individual or group's perspective–which can potentially lead to changes in behavior (Dubois and Krasny 2017; Sharpe et al. 2018). This idea is parallel to SES resilience theory that suggests that disturbances (e.g., an extreme weather event) create opportunities for transformative approaches to environmental management. Therefore, the similarities between learning theory and SES resilience theory further instill the relevance of EE and environmental literacy in building community resilience in social-ecological systems. Projects funded by ELP offer participants exposure to transformative EE approaches, where projects combine concepts of resilience to climate change with concrete steps for taking action to reduce vulnerability in the communities where they are implemented.

Active Learning, Social Learning, and Co-Production of Knowledge

ELP projects employ active and social learning strategies to engage participants in learning about concepts of community resilience and facilitate opportunities for community-based civic engagement. Active learning refers to a broad range of teaching strategies in which learners interactively participate in the learning process, rather than passively receive instruction. It is a process whereby learners engage in activities, such as reading, writing, discussion, or problem solving that promote analysis, synthesis, and evaluation of information. Cooperative learning, problem-based learning, and the use of case methods and simulations are some approaches that promote active learning (Center for Research on Learning and Teaching 2020). Active learning approaches commonly employed by ELP projects include deliberative forums, citizen science, participatory decision making and mapping exercises, and scenario-based or role-playing activities and games. Social learning is learning that goes beyond the individual to be embedded in social networks (Reed et al. 2010). Active and social learning often go hand in hand.

Deliberative Forums

Active learning is facilitated through a number of key approaches. Deliberative forums serve as opportunities for public participation in democratic decision making, and have proven to be an effective active learning approach in ELP-funded projects. They are highly effective for addressing specific types of challenges such as addressing scientific issues of societal relevance. Deliberative forums are structured events that include focused discussion questions, allowing for participants to respond to and share information relevant to the issue at hand, and discuss trade-offs associated with potential solutions. In the context of the ELP, these community forums have been facilitated in collaboration with local resilience practitioners and policy makers, focusing on specific climate threats and potential solutions to address them. These forums promote participatory decision making and offer an alternative to ineffective top-down approaches to public policy generation. By encouraging diverse community members to share their perspectives and participate in the generation of solutions, scientific research and public policies can better reflect community needs and desires (Bach et al. 2010; Bozeman and Sarewitz 2011). Additionally, community members benefit from participation in deliberative forums by developing literacy of scientific uncertainty, global and place-based environmental phenomena, and potential resilience strategies to reduce local vulnerability to climate impacts (White et al. 2001).

Citizen Science

Another key active learning approach used by multiple ELP-funded projects is citizen science. The Crowdsourcing and Citizen Science Act describes citizen science as:

> A form of open collaboration in which individuals or organizations participate voluntarily in the scientific process in various ways, including:
>
> (A) enabling the formulation of research questions;
>
> (B) creating and refining project design;
>
> (C) conducting scientific experiments;
>
> (D) collecting and analyzing data;
>
> (E) interpreting the results of data;
>
> (F) developing technologies and applications;
>
> (G) making discoveries; and
>
> (H) solving problems (Crowdsourcing and Citizen Science Act 2017).

The National Academies of Sciences, Engineering, and Medicine define citizen science projects as "those that typically involve nonscientists (i.e., people who are not professionally trained in project-relevant disciplines) in the processes, methods, and standards of research, with the intended goal of advancing scientific knowledge or application" (2018, 13). Other terms may be used to describe citizen science, including community science, volunteer monitoring, public participation in scientific research, community-engaged research, participatory action research, and community-based participatory research. The National Academies recognize the use of the term "citizen" as having negative connotations, or invoking contentious debates about citizenship status and who has a right to participate in civic life. However, citizen science is the most widely used and understood term, and is used here to encompass the concepts of the rest.

A report produced by the Center for the Advancement of Informal Science Education's Public Participation in Science Inquiry Group categorizes public participation in citizen science into three main groupings:

> (1) Contributory projects, which are generally designed by scientists and for which members of the public primarily contribute data;
>
> (2) Collaborative projects, which are generally designed by scientists and for which members of the public contribute data but also may help to refine project design, analyze data, or disseminate findings;
>
> (3) Co-created projects, which are designed by scientists and members of the public working together and for which at least some of the public participants are actively involved in most or all steps of the scientific process (Bonney et al. 2009, 11).

The more collaborative forms of citizen science can be especially well-suited to advance goals of justice, equity, diversity, and inclusion in projects. These approaches facilitate interactions between scientists and nonscientists, therefore creating opportunities for sharing diverse ideas and helping equip nonscientists with the knowledge, skills, and abilities to apply the scientific process. In particular, citizen science has the potential to engage and empower historically marginalized communities to participate in scientific research, thereby democratizing the research process (English, Richardson, and Garzón-Galvis 2018, 336). Crucially, opportunities to integrate diverse beliefs, epistemologies, and ideas that have been previously excluded from science "will only be realized if diversity, equity, and inclusion are part of the goals in the design and implementation of citizen science" (NASEM 2018, 18). Citizen science can contribute to increased community science literacy (Hoffman 2020), and can increase transparency and accountability in the scientific process, from developing research questions to data collection and analysis (NASEM 2018). Overall, public participation in science research creates opportunities for more equitable engagement with science, makes research more relevant to participant's daily lives and their communities, and elevates the value of science in society.

Social Learning and Co-Production of Knowledge

Knowledge co-production has grown in popularity as a useful approach to addressing complex challenges of sustainability, climate change adaptation, and resilience planning. Armitage et al. defines co-production of knowledge as "the collaborative process of bringing a plurality of knowledge sources and types together to address a defined problem and build an integrated or systems-oriented understanding of that problem" (2011, 996). Like citizen science, knowledge co-production is recognized as part of a group of emerging participatory and transdisciplinary approaches. These approaches promote equitable interactions between academics and non-academics, practitioners and community members to produce knowledge and solutions to context-specific challenges, rejecting the notion that only scientists have a role to play in conducting research to address social-ecological issues (Norström et al. 2020).

Adaptation to climate change is understood as a process that involves evaluating and negotiating trade-offs, considering the consequences of different options, and information sharing among diverse groups. As such, learning is an essential component of adaptation, with social learning in particular being increasingly identified as a key approach to effective adaptation (Armitage et al. 2011). The concept of social learning has evolved over time from referring to individual learning in social contexts, to learning in collective units, and has been applied to many sectors including environmental education, climate change adaptation, ecological sustainability, and resilience narratives and practice (Sharpe et al. 2018).

Social learning supports the co-production of knowledge, and can be facilitated through opportunities to share knowledge, values, and actions to respond to climate change and extreme weather events. Learning amongst peers, rather than through one-way instruction, can lead to faster and deeper forms of knowledge acquisition and skill-building (Sharpe et al. 2018). Social learning is closely linked to transformational learning, in that it encourages critical reflection that can help stakeholders acknowledge established ways of thinking that may be detrimental, particularly in the context of community resilience and disaster response. This critical reflection can take place at an individual and community scale, and is essential to initiate behavior change toward increasing resilience to climate change (Sharpe et al. 2018).

Moreover, social learning practices allow for community and place-based modes of knowledge generation that evolve over time and are adaptable to the specific needs and desires of a particular community. Place-based, adaptable approaches create opportunities for integration of diverse community values that can lead to transformative changes in public policies and environmental governance. The active learning approaches employed by ELP projects—such as citizen science, deliberative forums, participatory decision making and mapping exercises, and scenario-based or role-playing activities and games—create venues for social learning to take place. Though these approaches differ from one another, they share commonalities in that they bring people together to consider complex scenarios and to work collectively toward a shared goal.

Each of these active learning approaches requires strong facilitation, allowing diverse perspectives to be shared and negotiated. In addition, social learning places strong emphasis on communication, which helps participants cultivate confidence to take part in generating solutions and build trust with one another. If the active learning approach includes involvement with local officials, resilience practitioners, and decision makers, these activities can lead to the creation of public policies that reflect more democratic participation. This is significant, as research analyzing the role that community values play in science policy demonstrates that policies are more robust and socially accepted if they reflect a society's public values[5] (Bozeman and Sarewitz 2011).

It is important to note that social learning at a community level may not always be easy, as it is sometimes difficult to generate solutions when community members hold opposing views. However, creating opportunities for collaborative approaches to addressing shared issues is a sustainable path forward, and diverse perspectives in active social networks can lead to increased community resilience (Sharpe et al. 2018).

5 "A society's 'public values' are those providing normative consensus about (1) the rights, benefits, and prerogatives to which citizens should (and should not) be entitled; (2) the obligations of citizens to society, the state and one another; (3) and the principles on which governments and policies should be based" (Bozeman 2007, 37).

The social networks necessary for these collaborative approaches are considered a facet of social capital. The National Academies of Sciences, Engineering, and Mathematics define social capital as:

> The social networks and connectivity among groups and individuals within a community. [Social capital] includes levels of trust and reciprocity, political engagement, length of residence, volunteerism, religious affiliation, and community organizations and services. Also included is the feeling of belonging to and a sense of place about the community (2019, 14).

While efforts to measure social capital are challenging, experts assert that social capital, along with natural, built, financial, human, and political "capitals", are essential for achieving community resilience (NASEM 2019). Social capital is built in the communities in which ELP projects are implemented through the many social and active learning opportunities created by ELP grantees.

Related to social capital is the concept of social cohesion, or the "extent to which groups and communities cooperate, communicate to foster understanding, participate in activities and organizations, and collaborate to respond to challenges (e.g., a natural disaster or disease outbreak)" (National Research Council 2014, 34). Social cohesion represents the conditions that facilitate civic engagement. Civic engagement can take many forms, and can be understood as the efforts and activities one undertakes to influence civic life through both political and non-political processes (Ehrlich 2000). When social cohesion is present, community engagement in resilience building efforts helps to facilitate buy-in around local priorities and goals related to resilience planning and practices (NASEM 2019). In summary, social learning contributes to building social capital, which bolsters social cohesion and community engagement, which in turn strengthens community resilience.

Equitable Resilience and Climate Justice

Environmental and climate justice scholars, advocates, and practitioners have been instrumental in articulating how low-income communities, communities of color, indigenous and tribal communities, and immigrant communities have long been disproportionately impacted by environmental hazards in the United States (Pulido 2000; Cole and Foster 2001; Morello-Frosch et al. 2002; Brulle and Pellow 2006; Morello-Frosch et al. 2011; Cushing et al. 2015). Climate change exacerbates the existing challenges and injustices faced by these communities (Pettit 2004; Harlan et al. 2015; USGCRP 2018). To build equitable community resilience to extreme weather, climate change, and other environmental hazards, the needs of historically marginalized communities must be addressed. Democratic and inclusive decision-making processes allow for previously marginalized voices to be heard and elevated. Furthermore, climate adaptation and environmental policies should take into account the uneven distribution of risks and cumulative impacts borne by marginalized groups in order to create lasting change (Morello-Frosch et al. 2011; Bulkeley et al. 2013).

Several ELP-funded projects have demonstrated success in engaging historically marginalized communities through partnering with community-based organizations. Community-based organizations are defined as:

> Organizations that are driven by community residents in all aspects of their existence. This means that: the majority of the governing body and staff consists of local residents; the main operating offices are in the community; the priority issue areas are identified and defined by residents; solutions to address priority issues are developed with residents; and program design, implementation, and evaluation components have residents intimately involved in leadership positions (National Community-Based Organization Network 2011).

By partnering with these trusted community groups, ELP project teams are able to reach members of their communities whom they had not been able to previously. Project goals of building community resilience to climate change are most likely to be achieved when they are aligned with ongoing community development efforts.

So what does equitable resilience to climate change look like? Matin, Forrester, and Ensor (2018) assert that equitable resilience "is increasingly likely when resilience practice takes into account issues of social vulnerability and differential access to power, knowledge, and resources; it requires starting from people's own perception of their position within their human-environmental

system, and it accounts for their realities and for their need for a change of circumstance to avoid imbalances of power into the future" (197). The Greenlining Institute's 2019 report Making Equity Real in Climate Adaptation and Community Resilience Policies and Programs provides actionable recommendations for how to integrate social equity into the goals and implementation of policies and grant programs that aim to build community resilience to climate change. These recommendations include embedding equity into program mission, vision, and values; building equity into the process; ensuring equitable outcomes; and measuring and analyzing for equity (The Greenlining Institute 2019). Only when existing inequities and imbalances of power are addressed will communities truly be resilient. The ELP will continue to prioritize equitable approaches to building community resilience to extreme weather, climate change, and other environmental hazards.

Empowering Agents of Change

In recent decades, efforts to educate about climate change have failed to inspire children, youth, and adults to take sufficient action. While there are many reasons for this inaction unrelated to education, most educational approaches to date have had limited effectiveness in inspiring change because they have been too focused on the causes, the global scale of the problem, and impacts too distant from the learners (Flora et al. 2014; Leiserowitz et al. 2019). These challenges highlight the need to improve the public understanding of how climate change can manifest at the community level, and to help community members contextualize how individuals and the places they love could be impacted (Moser and Pike 2015). To complicate matters further, as learners acquire more knowledge about climate change and its impacts, they are often stifled by feelings of hopelessness and anxiety caused by comprehending the magnitude of the impacts and the complexity of the problem (Doherty and Clayton 2011; Ojala 2012; Clayton, Manning, and Hodge 2014).

Emphasizing Solutions and Place-based Relevance

To address these challenges, researchers and climate education experts find that hope serves as a "precondition to action" (Niepold, Poppleton, and Kretser 2018, 17). "Stubborn optimism" and an ability to envision a better future motivate people to take action (Figueres and Rivett-Carnac 2020). Rather than focusing on the causes of climate change, research suggests that climate change communication is more effective and likely to lead individuals to take action if the emphasis is on solutions (Moser and Dilling 2007; Moser 2014). Further, if these solutions address local impacts and emphasize co-benefits of action, educators and climate change communicators are better able to demonstrate the relevance of the issue to their audiences (Moser and Dilling 2007).

Additional research highlights the potential for place-based understandings of climate change to overcome political polarization on the issue, and to help motivate individuals to participate in climate adaptation planning processes (Adger et al. 2013). Significantly, "it is in specific locales where people must live with the consequences of adaptation choices and where people's sense of place can be a motivation or hindrance to action" (Moser and Pike 2015, 112).

Inspiring Youth Engagement

Climate change and its impacts are at the forefront of issues threatening youth. There is an ongoing need to support youth in taking action to make their communities more resilient to climate impacts, specifically by improving their confidence in making climate-smart decisions and taking civic action (Flora et al. 2014). As noted previously, the ELP's shift in focus from climate change education to community resilience education was done to encourage projects to create place-based solutions to address the specific vulnerabilities facing the communities they reach. This new emphasis on solutions empowers project participants, in particular, youth, to take action at the individual, school, and community level.

By equipping youth with the knowledge, skills, and confidence necessary for communicating climate change and its impacts, ELP projects help youth see themselves–and be seen–as leaders in their communities. Confidence and a sense of leadership can help youth recognize their own self-efficacy and agency to make a difference (Clayton, Manning, and Hodge 2014; Kretser and Chandler 2020). Also, it is critical that youth develop the skills to navigate through complex decisions they face now and will face in the future. ELP-funded projects engage youth and empower them to be agents of change within their communities. Funded projects use many approaches to engage youth ranging from youth summits, to student-driven action projects, to facilitating opportunities for youth to interact and partner with stakeholders, local officials, and other resilience practitioners in their communities. Youth can be enthusiastic and imaginative, and when seen as partners in community resilience planning, their potential to influence their families, peers, and communities to make climate-smart decisions may be realized.

Conclusion

As noted in the introduction to this section, many of the concepts explored in this literature review intersect and reinforce each other (e.g., social cohesion and equitable and inclusive community engagement, social learning and collective literacy). All the concepts explored above contribute to community resilience in some way and therefore informed the development of the ELP Community Resilience Education Theory of Change.