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Agency in the Anthropocene - supporting document to the PISA 2025 Science Framework

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Abstract

An important construct to be measured in the Programme for International Student Assessment (PISA) 2025 is the degree to which 15-year-olds are knowledgeable of, concerned about, and able to act on environmental issues as a result of their science education. This document justifies and explains the competencies youth need to address local and global challenges in this epoch of human influences on the planet. Those with agency in the Anthropocene work individually and collectively with hope and efficacy to understand diverse perspectives on socio-ecological systems and to create a more just and resilient future.

Keywords: agency, self-efficacy, student competencies, Anthropocene, environmental education, education for sustainability, climate change education

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Introduction

Human impact is significantly changing Earth's systems (IPCC, 2021[1]). These changes began with industrialisation in the 1800s and have increased exponentially since 1950 (Lewis and Maslin, 2015[2]). While humans may now have the highest living standards and life expectancy ever (Pinker (2018[3]); Rosling, Rosling, and Rönnlund (2018[4])), the overwhelming majority of other living organisms are in crisis—a crisis that is threatening humanity as well. Climate change and biodiversity loss is impacting all species, many irrevocably, and precipitating the sixth mass extinction (Dirzo et al., 2014[5]). Human impact in the Anthropocene has led to significant disruptions to the systems within the biosphere, hydrosphere, geosphere, and atmosphere (IPCC, 2021[1]). Thus, humanity faces an uncertain future. For many people, and young people in particular, climate change is seen as the greatest challenge of our time. To meet this challenge, scientific knowledge and reasoning are essential elements for decision making—individually, communally, and globally—to mitigate impacts and adapt to more sustainable practices and systems (Steffen et al., 2011[6]).

With an increasing population of more than 7 billion people and finite natural resources, the challenges facing our planet include: ensuring clean air and water, providing food security, managing diseases, generating renewable energy, striving for health and wellbeing, and managing our own living choices responsibly to ensure ample resources for all species and future generations (IPCC, (2021[1]); Barnosky et al. (2012[7]); Rockström et al. (2009[8])). Dealing with these challenges, and the many others resulting from human-induced climate change and environmental impact, will require that young people are able to understand and act on contributions from science and technology, alongside other disciplines and knowledge systems (Schipper, Dubash and Mulugetta, 2021[9]).

Scientifically informed 15-year-olds will have the necessary knowledge to evaluate the sources of information about these issues, as well as creative and systems thinking competencies to explore and consider appropriate courses of action to regenerate and sustain Earth's systems (Young et al., 2006[10]). Scientific knowledge is important in informing the decisions and actions that contribute to individuals and communities making informed, sustainable living choices and developing the critical thinking, media literacy, and hopefulness required to address these challenges (Monroe et al., 2019[11]).

In addition, an appreciation of diverse knowledge systems and respect for cultural heritage contributes to potential solutions (Reyes-Garcia et al. (2019[12]): Salomon et al. (2019[13])). Young people need to be aware of how systems of governance and power might frame and impact issues that are social and environmental (Berkes, Folke and Colding (2000[14]); Muller et al. (2019[15]); Young et al. (2006[10])). Young people will benefit from working across generations to address socio-ecological inequities and to create and sustain healthy communities (Thiery et al., 2021[16]). This will require education to support young people to develop an ethic of care and justice (Merrett (2004[17]); Skovdal and Evans (2017[18])) based on a worldview that can be enhanced through a science education that presents an ecocentric worldview, which includes humans as part of the environment rather than separate from it. Such a systems thinking perspective is necessary to look beyond linear relationships and instead consider patterns that support the design and enactment of sustainable living choices. For instance, systems thinking is usefully applied when considering the impact of personal choices (such as whether to adopt a predominantly vegetable-based diet or use public transport); local choices (e.g., working toward reducing

the availability of single-use plastic); community actions (e.g., collaborating with others to engage in civic actions to change the regional transportation system); and global choices (e.g., supporting international policy to reduce fossil-fuel dependence).

Agency will be required for 15-year-olds to enact the necessary changes to meet those goals (OECD, 2019[19]). Agency involves undertaking critical appraisal of complex systemic issues and evaluating whether evidence-based claims on these issues are made by legitimate experts. It involves using this evaluation to make decisions about setting goals to bring about change and how to take responsible action, as well as making decisions by examining and reasoning with the evidence in a scientific way. The ability to make decisions to act responsibly for themselves, and with others, is a measure of agency in the Anthropocene. For example, demonstrating agency in the Anthropocene involves reflecting on personal lifestyle choices and implementing change, influencing others to reflect and change, and providing feedback to organisations and governments about changes required. These actions contribute to better management of resources (such as in circular economies where wastes are eliminated as materials are (re)cycled).

Science education is critical in providing young people with a basic understanding of Earth's systems and their interactions with human systems. Understanding the degree to which these socio-ecological issues are complex and understanding their interactions through the use of appropriate tools (such as systems mapping) is essential to prepare young people to address contemporary challenges, such as mitigating and adapting to climate change. In these uncertain times, young people also need the following set of attitudes and dispositions to work individually, with others, and across generations for systemic change and sustainability:

- **Systems Thinking**, which is the ability to recognise complex interactions among relevant variables and understand the consequences of changes to those variables;
- **Self-efficacy**, which refers to the belief that one can act;
- **Collective efficacy**, which is believing that one's group can meet its goals;
- **Outcome expectancy**, which is the belief that one's actions will make an impact on the issue of interest;
- **Agency**, which is the perception that one influences one's own actions and circumstances; and
- **Hope**, which is the sense that there is a way toward a possible future that is worth achieving

These components are intertwined as the ability to recognise and take action within complex systems requires consideration of how an intervention might improve a situation, the belief that one has the agency and efficacy to take the desired actions, and the belief that achieving one's goals will work toward a more hopeful and desirable vision of the future (Ajzen (1985[20]); Snyder et al. (2001[21])). Moreover, those who believe their group can work effectively tend to have a greater sense of their own self-efficacy (Jugert et al., 2016[22]). Similarly, outcome expectancy is a core element of both hope and efficacy.

Systems thinking skills are important in all forms of science education, and environmental issues provide important examples of the need to consider an issue at the systemic level. Systems can be ecological or social, or a combination of both. While many educators teach young people to identify the components of a system (such as planets and stars or veins and lymph nodes), as well as the function of those components, the interactions among those components often creates new structures and functions. Seeking to understand the system

and complex relationships enables recognition, and potentially mitigation, of how and when changes in one variable in a system can affect others.

Hope in particular has been demonstrated to be an essential attitude for addressing complex socio-ecological issues. Without hope, the belief that the current predicament will not change or improve may result in anxiety, depression, and helplessness (Peterson, Maier and Seligman, 1993[23]). The spatial and temporal scale of contemporary environmental issues such as climate change and biodiversity loss have led to a definition of hope that includes actions that can be taken with others (Li and Monroe, (2018[24]), (2019[25])) or collective efficacy. This arises when individuals work with communities to effect change (Ojala (2012[26]); Li and Monroe (2018[24]), (2019[25]); (Ardoin, Bowers and Wheaton, 2023[27])). Coupling a sense of hope with knowledge about the complexity of interconnected Earth systems will enable environmental and social challenges to be addressed (Ojala, 2012[26]). Key to this outcome is the belief that possible solutions and pathways exist that can be taken by individuals, communities, organisations, businesses, and governments (Li and Monroe, 2019[25]). Thus, measuring whether and to what extent young people have a sense of hope about the future is important in assessing the degree to which they have agency in the Anthropocene.

Box 1. Defining Agency in the Anthropocene

Agency in the Anthropocene requires understanding that human impacts already have significantly altered Earth's systems, and they continue to do so. Young people with agency in the Anthropocene believe that their actions will be appreciated, approved, and effective as they work to mitigate climate change, biodiversity loss, water scarcity, and other complex issues and crises. Agency in the Anthropocene refers to ways of being and acting within the world that position people as part of (rather than separate from) ecosystems, acknowledging and respecting all species and the interdependence of life. Those with agency in the Anthropocene acknowledge the many ways societies may have created injustices and work to empower all people to contribute to community and ecosystem wellbeing. They demonstrate hope, resilience, and efficacy in the face of crises that are both social and ecological (socio-ecological). Moreover, they respect and evaluate multiple perspectives and diverse knowledge systems and demonstrate their ability to engage with other young people and adults, across generations, in civic processes that lead to improved community wellbeing and sustainable futures. Young people with agency in the Anthropocene work individually and with others across a range of scales, from local to global, to understand and address complex challenges that face all beings in our communities.

The Anthropocene

During the time that humans have inhabited the planet, we have become highly capable and, with the aid of technologies, able to dominate most other species and landscapes. Human intellectual development has led to complex social organisation, with a diversity of cultural, political, and economic systems. The intersecting and amplifying impacts of technology, affluence, and population growth have led scientists to describe our current epoch as the Anthropocene, or the Age of Humans, in which human actions are fundamentally altering life and life-sustaining processes on the planet (Crutzen, (2002[28]); Barnosky et al., (2012[7]); Lewis and Maslin, (2015[2]); Steffen et al., (2016[29])). Yet,

humans remain inextricably linked to our environment for survival. We are dependent on other species across a myriad of ecosystems for food, water, air, and materials (Fraser, Mabee and Slaymaker, 2003[30]). Our health and wellbeing are intimately intertwined with those of other species on our planet (Bascompte, 2009[31]).

The impacts of human activity are becoming more extreme, leading the first Global Assessment by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) to conclude that the capacity of natural systems to support human wellbeing is under threat from climate change, biodiversity loss, water scarcity and declining quality, waste pollution, and other ecosystem changes (Ruckelshaus et al., 2020[32]). We are disrupting the ecosystems essential to the livelihood of ourselves and all other species; these disruptions in turn threaten our social, cultural, and economic systems.

Human impact is driving the most profound disruption: climate change. Although the planet's climate has been changing naturally throughout history, the 2021 report of the Intergovernmental Panel on Climate Change (IPCC) concludes, with overwhelming consensus, that "human influence has warmed the atmosphere, ocean, and land. Widespread and rapid changes in the atmosphere, ocean, cryosphere, and biosphere have occurred" (IPCC, 2021[1]). Scientific research documents that these changes stem from increasing concentrations of greenhouse gases (mainly carbon dioxide and methane) in the atmosphere, with the primary sources deriving from processes related to energy generation (Karmaker et al., 2020[33]), transportation (Schäfer and Yeh, 2020[34]), plastics (Shen et al., 2020[35]) and, in some countries, agriculture (Rotz, 2018[36]).

Critically, many ecosystems in all regions have been significantly impacted by human activity and are experiencing widespread, rapid, and intensifying climate change (IPCC, 2021[1]). Scientists are observing changes in the Earth's climate in every region and across the whole climate system. Many of the changes observed in the climate are unprecedented over the past thousands, if not hundreds of thousands, of years, and some of the changes already set in motion—such as continued sea level rise—are irreversible over the next hundreds to thousands of years (IPCC, 2021[1]).

Moreover, climate change contributes significantly to biodiversity loss. Biodiversity is critical to the healthy functioning of ecosystems, ensuring flows of energy and materials, as well as the efficient, effective recycling of waste (Millennium Ecosystem Assessment, 2005[37]). Changes in climate, which lead to variations in factors such as temperature, moisture, and/or mineral availability, along with powerful force events such as floods, fires, and cyclones, pose perilous challenges to the life cycles of many species and, in turn, the species with which they interact, creating risks to survival (Nunez et al., 2019[38]). Although humans have some ability to offset these cascading impacts through technological means, such changes disrupt food production (Ray et al., 2019[39]), affect coastal lives and livelihoods (Nunn and Kumar, 2018[40]), and enhance the threat of myriad diseases (Ellwanger et al., 2020[41]), among other rippling, systemic challenges. Biodiversity loss is also occurring due to several related, compounding factors including, but not limited to, land use change, pollution, and the rampant spread of invasive species (Díaz et al., 2019[42]), which often compete with endemic species for limited resources.

These and other ecosystem disruptions also create sustainability challenges in our social systems and vice versa, many of which contribute to what some scientists envision as evidence that we may be reaching planetary scale "tipping points" or critical transitions as thresholds are reached and crossed (Barnosky et al. (2012[7]); Steffen et al. (2020[43])). For example, climate change impacts vulnerable communities such as small island states where sea level rise, coral bleaching, and intense storms have forced some inhabitants to become refugees, fleeing their traditional lands and homes (Nunn and Kumar, 2018[40]). At the same time, capitalism privileges economic growth, which in many places has significantly

degraded ecosystems. Biodiversity loss impacts cultural identity linked to threatened species (McNamara, Westoby and Chandra, 2021[44]), and declining water quality significantly impacts aquatic ecosystems and food production. Addressing these and other environmental challenges requires understanding of broader systems, including historical policies and actions, power and injustices, and current and future costs and benefits.

Agency is defined as a person's ability to "positively influence their own lives and the world around them as well as the capacity to set a goal, reflect, and act responsibly to effect change" (OECD, 2019[19]). To thrive and flourish with purpose, schools and educational programs can be designed to support young people in developing motivation, hope, self-efficacy, and a growth mindset (the understanding that abilities and intelligence can be developed) (OECD, 2019[19]). A key pathway to achieving these aspirations is through interactive, mutually supportive, and enriching relationships as well as through undertaking successful projects with their peers, parents, teachers, and community.

Moving toward a more sustainable existence will require engaging individuals and communities around the globe in more equitable and inclusive ways, considering a range of socio-economic and political dimensions. As a just world is a more sustainable world, notions of environmental justice invoke a respect between and among species, as well as equality of access to resources (e.g., food, water) among all people. In turn, this leads to a more sustainable world (Temper, 2019[45]). Relatedly, climate justice recognises the differential impact of climate change as well as the fair sharing and equitable distribution of the benefits, burdens, and responsibilities (Routledge et al. (2018[46]); Schlosberg and Collins (2014[47])).

Societal change is necessary to engender these forms of justice, and education is a critical tool for bringing about this change. Education can nurture and support worldviews and dispositions, provide knowledge and competencies for people to engage actively in seeking solutions, equip young people for decision making in daily life, create a platform for developing competencies and efficacy, and make shifts in policy more thoughtful and acceptable. Nowhere are these endeavours more crucial than in schools, where opportunities exist to prepare young people for using evidence to make decisions and explore solutions. Importantly, PISA 2025 will gather evidence for how humans are faring in this essential task by exploring the education of youth at the present time. Similarly, focusing on the socio-ecological competencies and agentic practices of young people may inform pathways to better manage our uncertain futures.

Data from PISA 2006 were used to generate the Green at Fifteen (OECD, 2009[48]) report in which the majority of 15-year-old participants indicated familiarity with environmental issues and purported to feel a strong sense of responsibility for the environment. Masters, Thompson, and Schleicher's (2021[49]) summary of findings from PISA 2018 indicated that nearly 79% of students from across 37 OECD countries were aware of climate change and global warming. Students in other countries returned results that ranged from 40% in Saudi Arabia to 90% in Hong Kong (China). These diverse percentages of student understanding sit alongside 88% of school principals, who reported that both climate change and global warming were issues included in their school curriculum.

Measures of student knowledge and concern were similarly high with 72% indicating that they could explain why some countries suffer more global climate change than others, and 63% could explain how carbon emissions affect global climate change. In all 66 countries that contributed data to the 2018 assessment, 64% of students agreed that looking after the global environment is important to them. Students also reported that they reduced energy consumption at home, read about international social issues, selected products for ethical or environmental reasons, and participated in activities about environmental protection (such as boycotts or petitions). The 2018 data indicate that many 15-year-olds are

environmentally aware and enacting individual sustainable practices. However, those students also indicated a sense of hopelessness or helplessness about global socio-ecological challenges.

In addition to reports of knowledge and awareness, contemporary examples of agency and empowerment in creating meaningful social and systemic change are evident. For example, studies indicate that young people's concern for a sustainable future has been increasing (e.g., Uba (2021[50])). Students demonstrate agency by participating in The School Strike for Climate (SS4C), an international youth-led movement active in 125 countries (Feldman (2020[51]); Bright and Eames (2022[52]); Walker (2020[53])). Through this movement, young people voice their dissent with governmental policy (White et al., 2022[54]), especially the slow turn away from reliance on fossil fuels and the resulting eco-justice conundrums that inequitably impact different parts of the world. This movement evidences the commitment to global socio-ecological change that is needed to ensure a more environmentally healthy, socially just, and economically viable future for all.

Yet, having knowledge about complex and interconnected Earth systems and environmental and sustainability issues is necessary, but not sufficient. Appreciating the relational ways of living as part of our ecosystem, reducing the impacts of exploitative human activity, and demonstrating socio-ecological justice and care for self and others is needed. To develop agency, young people must demonstrate a sense of self (individual) and collective efficacy, working across generations, guided by a sense of actionable hope (Ajzen, (1985[20]); Ryan and Deci, (2020[55]); Schultz, (2002[56])). What we do together can and will make a transformative difference in working toward a more sustainable, thriving society. Data from PISA 2025 about students' self-efficacy and agency regarding socio-ecological challenges and crises are, therefore, essential to understand and plan for the future. (See Non-Cognitive Competency section, below.)

The PISA data contribute to policymaking and educational initiatives that are crucial for addressing the challenges of the Anthropocene. These policies and initiatives have antecedents that have provided an important basis for education; these antecedents are briefly discussed next.

International Policy Context: Setting the Scene

The World Conservation Strategy (WCS) offered nations a framework of priority actions for conserving the ecological resources that enable sustainable development (IUCN-UNEP-WWF, 1980[57]). Education was cited as a critical step in this process, with the WCS emphasising:

> *Ultimately the behaviour of entire societies towards the biosphere must be transformed if the achievement of conservation objectives is to be assured. A new ethic, embracing plants and animals as well as people, is required for human societies to live in harmony with the natural world on which they depend for survival and wellbeing. The long-term task of environmental education is to foster or reinforce attitudes and behaviour compatible with this new ethic (IUCN-UNEP-WWF (1980[57]), p. 46/Chapter 13).*

In the WCS, school curricula were envisioned as one strategy for providing a foundation of information and competencies. Such an approach imagines that the formal, school-based pathway is complemented by out-of-school programs and mass media opportunities designed and intended to increase public participation and involvement in planning, decision making, and resource management implemented with the goal of conserving and sustaining environmental resources (IUCN-UNEP-WWF, 1980[57]).

Building on this platform, in 1987, the United Nations (UN) Brundtland Commission (formerly the World Commission on Environment and Development [WCED]) produced Our Common Future, a report highlighting that achieving these goals for the environment must improve human livelihoods worldwide. Recognising that issues such as poverty, conflict, climate change, biodiversity loss, pollution, water and energy conservation, and other pressing challenges are intimately intertwined, the Commission implored nations to adopt a new vision of sustainable development, defining it as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (WCED (1987[58]), p. 16). This goal necessitates the simultaneous consideration of economic wellbeing, political engagement, social justice, and ecosystem health. Doing so requires the development of systems thinking, which emphasises connections among the variety of variables that contribute to a challenge and explores the relationships among them (Plate and Monroe, 2014[59]).

At the same time, UNESCO and other members of the international community were considering how to make urban areas more liveable, improve adult engagement in urban design, and enhance the ways in which young people experience cities and participate in shaping the urban environment (Chawla, 1997[60]). The Convention on the Rights of the Child set the stage for additional efforts (i.e., Growing Up in Cities, Habitat II) to include young people in land use decisions (Derr, Chawla and Mintzer, 2018[61]).

UN agencies and delegates followed this guidance in creating Agenda 21 in 1992. This manifesto laid out a vision for moving toward sustainability with actionable steps for doing so, including ratifying conventions and protocols to provide international guidance for conserving resources, reducing pollutants, and improving public participation. Agenda 21, while non-binding, leveraged the UN's global platform to motivate local and national action on sustainable development planning, resulting in the 17 Sustainable Development Goals, which have at their core the principles of "people, planet, prosperity, peace, and partnership" (UNF, 2019[62]). The Earth Charter, similarly, is an international declaration dedicated to building a just, sustainable, and peaceful global society in the 21st century (Earth Charter, 2020[63]). It follows four pillars: respect and care for the community of life, ecological integrity, social and ecological justice, and democracy, nonviolence, and peace. Of note is the principle of justice rather than growth.

A common thread among these efforts, education is central in creating a more sustainable future. With an emphasis on schools and communities more broadly to support lifelong learning, education has been envisioned as a pathway to change since the 1972 Stockholm Conference on the Human Environment, continuing through to the UN Decade for Education for Sustainable Development (Buckler and Creech (2014[64]); Wals (2012[65])) and beyond (Reid et al., 2021[66]). Although early visions of the need for pro-environmental behaviours acknowledged the role of the individual's contribution to lifestyle choices (e.g., Stern (2000[67]); Hungerford and Volk (1990[68]); Kollmuss and Agyeman (2002[69])), a growing chorus of scientists, policymakers, educators, and community members are focusing on the importance of working with others to affect policy and practice at every scale, from community to nation to global (Jensen (2002[70]); Jorgenson et al. (2019[71]); Ardoin, Bowers and Wheaton (2023[27])).

Not only does involving young people in these holistic efforts provide them with opportunities to learn competencies for decision making and civic engagement, but also their perspectives and opinions make important contributions to designing and framing their communities, for the present time and looking into the future (Derr, Chawla and Mintzer, 2018[61]). Many opportunities for young people to learn relevant knowledge and participate in community projects can occur in schools (Uzzell (1999[72]); Jensen and Schnack (1997[73])). Informal youth clubs and community organisations, along with

everyday life settings, such as aquariums, parks, and neighbourhoods, among others, form a key part of the learning ecosystem (Reid and Liu (2018[74]); Ardoin and Heimlich (2021[75])).

The COVID-19 pandemic shifted the ways in which young people and communities learn, with families representing an increasingly important element of this learning ecosystem (Takeuchi, Martin and Barron, 2021[76]). The near-immediate and broad pivot to remote learning online prioritised digital access and technological competency development. It also highlighted the disparity between families who could afford to provide educational support and those who could not, for myriad reasons. The opportunity to spend time in outdoor spaces was felt as a priority, especially to those who experienced extended periods of isolation and lockdown.

Pathways to Developing Agency in the Anthropocene

The role of formal education in addressing Anthropocene challenges: Effective practices for the 21st Century

Although none of these efforts assume, nor assert, that young people will single-handedly solve societal challenges related to sustainability, or that schools as institutions play the only pivotal role, they all envision formal education as a critical agent in reaching transformative goals (White et al., 2022[54]). Schools prepare youth in the form of knowledge, dispositions, and competencies to create a foundation for addressing existing social and ecological challenges. Concurrently, they lay the groundwork for developing responsible, reflective, and aware societies that work toward responding effectively to future challenges. In moving the world's population toward socially and ecologically just ways of meeting today's needs, we enhance the likelihood that thriving socio-ecological systems will persist for generations into the future.

To exemplify one particularly complex challenge, climate change, we offer the following detail: With this intertwined, multi-scale issue, arguably the most daunting and important of our time, psychological and learning-science research suggest certain key elements as critical for high-quality education in this domain. Such practices include the following.

Envisioning climate challenges and solutions through a systems thinking lens

What we know about climate change evolves as we learn more about the climate system, how it interacts with other Earth systems, and how we model and track how all Earth systems interact with the technologies, policies, and individual and collective actions implemented and enacted to influence it. The phenomenon of climate change, as well as our approaches to addressing it, are dynamic; thus, as climate scientists learn more about the systems governing the planet's climate and, concurrently, as mitigation and adaptation policies are implemented, we learn more about what works, for whom, under what conditions, and why.

Within this context, curriculum, educational materials, and educators themselves must be flexible, willing, and able to reflect the latest scientific, policy, and socio-economic conditions. They can do so through using both historic and contemporary teaching materials, supporting and facilitating students' engagement in current events, and modelling lifelong learning approaches (Ryan and Deci (2020[55]); Dweck (2013[77])). In this way, schools and educators encourage young people to develop personal and community-scale adaptive capacities (Cinner et al (2018[78]); Arnold et al. (2009[79]);

Henderson and Tudball (2016[80])); support them to develop systems thinking abilities, including making connections across dynamic, multi-scalar landscapes; and enable their ability to find information, discern its quality and relevance, and apply it in shifting contexts. All of these processes are essential for effective climate change education (Monroe et al., 2019[11]).

Recognising, constructing, and using environmental and Earth systems science

In large part, today's ecological challenges are grounded in a variety of environmental and Earth sciences (such as atmospheric science, ecology, hydrology, and oceanography). These fields provide a deep understanding of and appreciation for biotic and abiotic organisms, their ecosystems, and their interactions within a systems perspective (Turnbull et al., 2010[81]). It is critical for young people to understand the ways in which science has improved our knowledge and understanding of Earth's systems.

In addition to knowledge and perspectives derived from scientific principles, other ways of knowing, such as Indigenous practices and views of the world, bring complex, nuanced understanding of local/regional interactions based on traditional perspectives nested within sociocultural beliefs and experiences (Fisher and Parsons, 2020[82]). These ways of knowing derive from, and build on, generations of interacting with the nature-rich world, drawing from evidence and inference, tested through iterative cycles often occurring in the same place over time (Romm, 2017[83]).

People of all ages have found that views of, interaction with, and time spent in nature is restorative (Basu, Duvall and Kaplan, 2019[84]). Not only can time spent contemplating the natural world improve mental health but, by restoring attention, people are able to learn better (Kuo, Barnes and Jordan, 2019[85]). Exploring the local environment enables youth to come to know their community, their ecosystem, and their place (Sobel, 2006[86]) while also increasing their commitment and motivation to improve it.

Recognising that there are various ways of knowing and being able to enter respectful dialogue with those whose worldviews and knowledge systems diverge from one's own are crucial in effective climate change education, given the complexity of the socio-ecological challenges, and the wide range of knowledge and perspectives that bear on proposed solutions. Such competencies and dispositions demonstrate the ability to be self-reflexive, connect with others, and build a sense of community across differences. (See below for more on building self and collective efficacy to work toward solutions.)

Drawing on interdisciplinary perspectives

Although environmental and Earth systems science provide a strong foundation for understanding climate change, they are among many sources of relevant knowledge, competencies, and dispositions for addressing climate-related issues (Monroe et al., 2019[11]). Climate justice, for example, is deeply informed by and grounded in social science and humanities, including disciplines such as philosophy, religion, geography, civics, social studies, language arts, and other perspectives (Stapleton, 2019[87]). The depth and breadth of knowledge, competencies, and dispositions developed through interdisciplinary pursuits provide an avenue for youth to explore the past, current, and anticipated impacts of various actions and policies. They might focus on, for example, the needs of vulnerable populations, requiring knowledge of health disparities and historical inequities; strategies for mitigating and adapting to climate change, requiring knowledge of economics and engineering; policy change, requiring an awareness of governance at the local, regional, and national scales; and stakeholder engagement, necessitating a plan to

address multiple needs and priorities taking into account various values, histories, and cultures involved and impacted (Plate et al. (2019[11]); Adger et al. (2005[88])).

In addition to understanding that various perspectives exist, a robust interdisciplinary education provides young people with tools for deliberation and dialogue. Developing the ability to think critically, to find commonality, and to envision a dramatically different future are also key to effective climate change education. Imagining these future pathways requires the ability to source, coalesce, and recombine in creative ways information from formal (school) and informal settings, including from various media outlets, continuously assessing their credibility in context.

Building efficacy and hope to work toward solutions

Many projections for the future of the planet's ecosystems, and their suitability for humans under various climate scenarios, are bleak (IPCC, 2021[1]). Understandably, it is easy for young people to become anxious and even, at times, apathetic considering the seeming futility and hopelessness of reversing many of the likely changes already underway or on the horizon. Young people may be particularly impacted by such emotions as they are at a point in their lives where they live within constraints set by their family, school, and community (Bright and Eames (2022[52]); Ojala (2012[26]); Ojala et al. (2021[89]); Stevenson and Peterson (2015[90])). Concurrently, they likely have less ability than adults to affect policy change, although this may vary depending on their local, regional, or national context.

Yet, 15-year-olds are also at a pivotal time in life. They are developing key knowledge, competencies, and dispositions that will make an impact not only now, but for decades to come. Merely learning that others are working on the problem and have tested potential solutions builds hope; therefore, it is useful for schools to teach about how to approach solutions to environmental issues as often as they teach about problems. Young people can be active in creating solutions to local issues, an exercise that is engaging and motivating. To achieve this goal, young people learn and begin to practice, sooner rather than later, competencies such as communicating, group processing, critical thinking, assessing evidence, empathising, cooperating, adapting to changing conditions, building coalitions, and other avenues to civic engagement that foster effective collective action (Chawla and Cushing, (2007[91]); (Ardoin, Bowers and Wheaton, 2023[27]). Recognising that they assisted to make a difference to a real problem builds self-efficacy. Moreover, understanding how work is underway to mitigate climate change and that adaptations are well within the capacity of human societies is important. Models that depict a more positive, hopeful, and efficacious path forward are key to supporting young people to see how, when, where, and why their actions can make a difference (Chawla, (2020[92]); Li and Monroe (2018[24]), (2019[25])).

Although making personal lifestyle changes can and likely will continue to be important, community members—especially youth—must learn to work together to make change in a variety of ways on different scales including, but not limited to, impacting policy (Jorgenson, Stephens and White, 2019[71]). In families, neighbourhoods, communities, schools, workplaces, government agencies, and more, young people can contribute their voices along with those of others who call for change on climate-friendly policies. Doing so builds competence and confidence as they conduct research to be able to craft persuasive messages for appropriate audiences. Thus, the suite of competencies that build collective efficacy—group problem solving, collective engagement, deliberation, decision making and conflict management—are essential to youth education as they contribute to actionable hope in a way that builds toward a thriving, sustainable future.

The social scale from individualism to collectivism is important in the Anthropocene. Social knowledge development implies sharing and communicating ideas through group processes and teamwork. The development and sharing of social capital (Aldrich, Page-Tan and Paul, 2016[93]) may provide links to each other and facilitate trustworthiness and collective action in the face of socio-ecological crises, such as are being experienced by small island states in the face of climate change (Petzold and Ratter, 2015[94]). Many socio-ecological issues require interdisciplinary knowledge to understand them, and often teams of specialists will come together across time and space to share their expertise on these issues (Fraser et al., 2011[95]). Social dispositions include collectivist ideas such as social norms, which can both resist and enable change to sustainable practices and are often key to understanding effective action (Cialdini and Jacobson, 2021). For example, the goals of individual choice, comfort, and safety in transportation encourage people to drive large vehicles, which are less sustainable as they use more resources and energy.

The Wingspread Declaration of Principles for Youth Participation in Community Research and Evaluation suggests a series of seven effective practices to ensure a high-quality experience that achieves these educational goals (Wingspread Symposium, 2002[96]). Meaningful action, equal power relationships with adults, the involvement of diverse groups, and partnerships are among these key principles (Derr, Chawla and Mintzer, 2018[61]). Similarly, the Sustainable Development Goals and Earth Charter provide guides and examples for projects and programs that can engage and scaffold youth action for more just and sustainable futures.

Transforming people and place through education

Rather than emphasising an information-only path within a problem orientation, providing young people with opportunities to explore and deepen decision making abilities and offering compelling, relatable examples of champions of change (mentors) can model climate solutions as relevant to daily life (Monroe et al., 2019[11]). Such concrete examples and experiences, especially when explored through educator-led discussions, allow young people to practice engaging in complex topics, negotiating positions, crafting nuanced socio-scientific discourses, and modelling effective civic engagement (Busch, (2016[97]); Reid, (2019[98])). With these experiences, youth are prepared to engage in real-world, locally based, hands-on opportunities for making change, thus building self and collective efficacy through working with others in their community (Lukacs and Ardoin, (2014[99]); Monroe et al., (2016[100])). In this way, they can see the positive outcomes of their efforts by addressing climate- and sustainability-related challenges close to home, working alongside others in their school, community, and neighbourhood. Those connections then can create ongoing participation (Ardoin, Bowers and Wheaton, 2023[27]); Chawla, (2020[92])).

Acknowledging human impacts on the environment and the colonising practices that continue to contribute to contemporary socio-ecological issues exemplifies a critical approach to education that is important (Stevenson, 2008[101]). Such an approach problematises the meaning of place, connections to nature, and, in some countries, colonial practices that have led to immense gains for some people, but often at the expense of other people, other species, and ecosystems. The adoption of decolonising practices is one step to redress this imbalance (Huygens, 2011[102]). These practices are emerging in education (Belgrave, 2020[103]). For example, awareness-raising allows young people to understand the past and the formation of the present to work for a more socio-ecologically just future.

Implementing this vision

Schools play a central and vital role in society: largely responsible for the education of young people, schools work in collaboration with other learning providers, purposeful and incidental, throughout the social-ecological system to create a web of lifelong, life-wide learning experiences (Ardoin and Heimlich, 2021[75]). Within this broader learning landscape, many informal providers and programs offer supports that facilitate development of the knowledge, dispositions, and competencies related to living and participating efficaciously in the Anthropocene. Schools can support and complement these efforts in numerous ways including, but not limited to, building organisational partnerships, hosting after-school clubs, inviting speakers to share their experiences, infusing local examples of issues and solutions into the curriculum, and seeking opportunities for young people to engage in the community, among others (Uzzell, 1999[72]).

Fifteen-year-olds should be equipped not only with a robust knowledge base regarding the social-ecological challenges we are facing but, perhaps more importantly, with a sense of how those challenges came about, why they persist, and the advantages and disadvantages of potential solutions available to humans at this time on the planet. They should be engaged experientially in learning about local environmental issues, as well as be involved in active efforts to work, collectively, to address them. Such engaged, efficacy-oriented, place-based approaches to learning can support young people in developing the competencies involving knowledge, dispositions, and capabilities essential to play a role in moving our global society toward a more likely resolution of socio-ecological and sustainability issues at a range of scales.

Competencies for Agency in the Anthropocene

The Anthropocene represents a time of significant challenge to our social structures and Earth systems. Addressing these challenges will require that we consider several changes: change in the ways that we as humans interact with each other and our environment; change in our environment, overall; change in our technologies; and change in our value systems. A young person growing up into this anthropocentric world requires three essential competencies that underpin the concept of agency in the Anthropocene in PISA 2025—elements of which will be measured by the PISA 2025 Science Assessment defined in Box 2.

Box 2. Competencies for Agency in the Anthropocene

A 15-year-old student who demonstrates agency in the Anthropocene can:

1. Explain the impact of human interactions with Earth's systems.
2. Make informed decisions to act based on evaluation of diverse sources of evidence and application of creative and systems thinking to regenerate and sustain the environment.
3. Demonstrate hope and respect for diverse perspectives in seeking solutions to socio-ecological crises.

Agency in the Anthropocene competencies in action

A range of abilities underpin each of the agency in the Anthropocene competencies listed in Box 2. Those abilities are described in more detail below for each agency in the Anthropocene competency. For each ability within the competency, an Explanatory Note follows. The competencies and their associated abilities are a mix of cognitive and non-cognitive domains, reflecting the nature of agency in the Anthropocene. How these fall into each domain is indicated below.

Competency 1: Explain the impact of human interactions with Earth's systems.

This is a cognitive competency element, which are measured by Science Competency 1 (Explain phenomena scientifically). However, it deliberately focuses on human interactions to explore a student's understanding of human impact with Earth's systems. This competency requires both content and procedural knowledge.

A 15-year-old student who can explain the impact of human interactions with Earth's systems can:

1. Explain physical, living, and Earth's systems that are relevant to the environment and how they interact with each other.
2. Research and apply knowledge of human interactions with these Earth systems over time.
3. Apply this knowledge to explain both negative and positive human impacts with these systems over time.
4. Explain how social, cultural, and/or economic factors have contributed to these impacts.

Explanatory notes about what a student can do in this competency:

1. "Earth systems" refers to understanding "the structure and functioning of the Earth as a complex, adaptive system" (Steffen et al., (2020[43]), p. 54). With roots in systems thinking, ecology, Indigenous thinking, and practices grounded in cycles, this term recognises humans as integral to, not separate from, the environment (Mayer and Armstrong, (1990[104]); Fisher and Parsons, (2020[82])). Earth systems thinking also recognises the interdependence within and between physical and living systems, acknowledging the development from individual disciplinary foci to interdisciplinary and transdisciplinary ideas and global initiatives, as exemplified in efforts such as the Intergovernmental Panel on Climate Change (IPCC, 2021[1]). A young person growing up in the Anthropocene requires knowledge of these Earth systems and how they interact with each other. Steffen et al. (2020[43]) provide a clear picture of these systems and their interactions (see Steffen et al, 2020, p. 61, Fig 3).
2. Since humans (*Homo sapiens*) first emerged on Earth, our species has existed in an interactional relationship with the planet, focused on our need for food, water, materials and energy. Over time, humans have developed from nomadic hunter-gatherers to agrarian settlers to urban dwellers (Larsen and Harrington, 2021[105]). In the process, we harnessed fire, developed plant cultivation and animal husbandry, created artefacts and services through technology, and altered natural systems, both on land and water, for our benefit. We have adopted colonising practices through which we have sought to impose our will and control to satisfy our needs, with less consideration for the needs of the systems within which we exist (Paradies, 2020[106]). Understanding the nature and complexity of these human interactions within Earth's systems is a major educational challenge today, as so

much of how we live does not obviously or immediately connect us with our resource base and our impact on Earth systems. Meeting this challenge requires a young person in the Anthropocene to be able to research and apply knowledge from diverse, credible sources about human interactions, both historical and contemporary, with Earth systems.

3. Human interactions with Earth systems have led to significant positive outcomes for our species. Technological advances have led to dramatic gains in nutrition, health, and longevity, all of which have led to substantial, and increasingly rapid, population growth. Human desire for resources has similarly increased, leading to exploitation of these resources beyond capacity and renewability (Johnson, (1989[107]); Ludwig et al., (1993[108])). For many of these resources, we have acted as though there has been a limitless source, despite the fact that we live on a limited planet. We find ourselves now at many points where competition for dwindling resources is exhausting the supply that Earth systems can reasonably sustain (Millennium Ecosystem Assessment, 2005[37]). Furthermore, our use of resources has created waste materials that can alter Earth's systems. Our continued hunger for resources and production of wastes are degrading these Earth systems, not only threatening the ongoing supply of resources for us (Cherkauer et al. (2021[109]); Pimentel et al., (2004[110])), but also altering the structure and function of these systems with considerable consequences for other species. Attention to the problems our impacts are having within Earth systems has more recently led to regenerative actions, which aim to restore the health of these systems and reduce our further impact upon them. These actions include ecological restoration (Reyes-García et al., 2019[12]) and development of renewable energy and circular economies (Corona et al., 2019[111]). A young person growing up in the Anthropocene needs to apply their understanding of Earth systems and how humans have interacted and can productively interact in the future with them to understand these impacts.
4. All human behaviour is influenced by social, cultural, and economic factors. Much of this behaviour is learned in childhood through family, peers, and societal structures such as education, religion, recreation, and commerce. Values and social norms are developed as a product of these experiences, underpinned by traditions often rooted in interactions with Earth systems (Fisher and Parsons, 2020[82]). These values and norms interact with economic and governance structures to shape our societies. Over time, societies have developed from localised subsistence groups whose survival depended on their indigeneity (local connections with Earth systems) to complex, globalised communities driven by consumerism and self-improvement. These communities are no longer visibly connected to Earth's systems. A young person growing up in the Anthropocene needs to be able to reflect on how social, cultural, and economic factors have influenced their own as well as regional, national, and international human impacts on Earth systems.

Competency 2: Make informed decisions to act based on evaluation of diverse sources of evidence and application of creative and systems thinking to regenerate and sustain the environment.

This competency is both cognitive and non-cognitive. It draws on elements that are measured by Science Competency 2 (Construct and evaluate designs for scientific enquiry and interpret scientific data and evidence critically) and Science Competency 3 (Research, evaluate, and use scientific information for decision making and action). This competency requires content, procedural, and epistemic knowledge.

A 15-year-old student who can make informed decisions to act based on critical appraisal of diverse sources of evidence and application of creative, systems, and intergenerational thinking to regenerate and sustain the environment can:

1. Access and critically appraise evidence from diverse sources and ways of knowing.
2. Evaluate and design potential solutions to socio-ecological issues using creative and systems thinking, taking into account implications for current and future generations.
3. Engage, individually and collectively, in civic processes to make informed, consensual decisions.
4. Set goals, collaborate with other young people and adults across generations, and act for regenerative and enduring socio-ecological change at a range of scales (local to global).

Explanatory notes about what a student can do in this competency:

1. Drawing on diverse ways of knowing can develop understanding of multiple perspectives on socio-ecological crises and to evaluate whether and how these perspectives can contribute toward their resolution. Diverse ways of knowing are challenging to categorise, but include what is often referred to today as western science, regional scientific practices including those from Indigenous communities, and informal knowledge from sources such as social media. Each knowledge type has characteristics that need to be assessed for what they can offer (McMichael et al., 2021[112]). These characteristics are rooted in values and convey different perspectives. The notion of reality becomes blurred as misinformation (alternative conceptions to what is generally understood) and disinformation (false conceptions deliberately espoused to persuade to a values position) are expressed (Freelon and Wells, 2020[113]). Practicing agency in the Anthropocene requires a young person to use critical thinking to appraise information and perspectives for their credibility and utility. This means taking both an objective approach to information sources by examining their validity and reliability through whether it concurs with the consensus on empirical knowledge and/or is based on peer review, and a subjective approach to interpret perspectives based on values and experiences. These approaches together can lead to sound decision making toward actions to resolve socio-ecological crises. Addressing unsustainable practices requires approaches that regenerate ecosystems and highlight socio-ecological justice and power relations. Technological innovation and restorative justice have often been at the heart of these changes. For example, the need to move away from fossil fuel-generated energy in response to the climate emergency has led to the rapid development of wind and solar energy generation. In these cases, having agency in the Anthropocene requires an understanding of fundamental natural principles, such as the conservation of energy, the environmental implications of wind and solar generation, the social licence and cultural acceptance of the structures and processes involved, the economic viability of providing energy by these means, and the political imperative to ensure the transition in energy sources happens (Madurai Elavarasan et al., 2020[114]).
2. Addressing the socio-ecological challenges we face requires systems thinking and creativity (Olsson et al., 2020[115]). The issues are multi-faceted and, whilst individual or small groups may tackle parts of the problem, diverse teams who bring different knowledge and competencies are required. This provides opportunities for young people to engage with peers as well as experts and learn to collaborate in evaluating solutions. These solutions are typically to address challenges that have not been faced before, so creativity and innovation are essential. Regenerating healthy social and ecological systems will require new thinking and technological practices. Solutions need to be critically assessed for their ability to contribute long term to a more sustainable future. A key aspect is to look beyond the symptoms of an issue (e.g., plastic pollution on a beach) to the root causes (e.g., development and use of materials that do not biodegrade in water, disconnected waste management practices, stormwater drainage to the sea, disregard for marine ecosystems, lack of personal responsibility for one's waste) (Jensen and Schnack, 1997[73]). Systems

thinking can offer analysis about how systems may be compromised when unsustainable practices occur (Reynolds et al., 2018[116]). Equally, systems thinking in sustainability demands an understanding of how environmental, social, cultural, political, and economic systems interact in response to an unsustainable practice. This type of thinking also underpins the design of regenerative solutions to unsustainable practices. Young people growing up in the Anthropocene—and indeed all people living during these times—need to think intergenerationally in terms of considering how their interactions within Earth systems may positively or negatively impact future generations and the legacy we leave.

3. Being agentic in the Anthropocene includes having knowledge about the social structures that influence the conditions to be changed (Mirzaei Rafe et al., 2019[117]). This means examining the governance and power systems that influence socio-ecological issues and learning how to address them. This political literacy involves being aware of, and competent in, civic and cultural processes through which decisions are made in specific contexts and the methods of communication that enable participation in decision making (dos Santos, 2014[118]). Enduring, informed decisions that are widely accepted are often made by a process of consensus as evidenced in the practices of many Indigenous societies (Maclean, Robinson and Natcher, 2015[119]) and contemporary democracies, in which a plurality of voices are heard and knowledgeable positions are weighed in consideration of their systemic and intergenerational impact.
4. Today's socio-ecological crises and unsustainable practices can only be resolved by many forms of action-taking. Taking action in the Anthropocene requires efficacy, which refers to a belief in being able to make a difference, personally and collectively (Ajzen, 1985[20]). Efficacy is key as concern alone, while important, is not sufficient to motivate action. Rather, motivation is a function of many cognitive and affective processes, including knowledge about the various aspects of an issue, including the necessary steps to address the issue; care to address the issue; the competencies to take the necessary actions and practice with the potential actions; perception of social norms; and a belief that actions taken related to an issue will be appreciated, approved, and effective (in other words, agency). Actions are intentional and informed and can be indirect, such as protesting and lobbying, or direct, such as ecological restoration or using public rather than private transport options (Jensen and Schnack, 1997[73]). Effective actions require goal setting and careful planning, and should be considered in the cultural context within which they would be taken. For example, in lobbying, this includes knowing how to, who to, and when to lobby to achieve a successful outcome, and ecological restoration includes such factors as choosing appropriate plant species and planting at the right time of year. Effective action also requires collaboration. As many of today's socio-ecological crises are intergenerational, meaning their causes stem from human interactions over preceding generations and their impacts will be felt over succeeding generations, collaborating to take action across generations is essential and more likely to lead to enduring change. Acting locally is important to make a tangible, relevant difference to people's lives, and a multitude of local actions can make a difference regionally, nationally, and globally. For an Anthropocene youth, achieving effective action on socio-ecological crises relies on knowledge of causes of the crises, and the confidence and motivation to act for the future of Earth systems.

Competency 3: Demonstrate hope and respect for diverse perspectives in seeking solutions to socio-ecological crises.

This competency is in the non-cognitive domain and contains elements that are measured by the concept of Science Identity, including epistemic beliefs; dispositions of care and concern toward other people, other species, and the planet; and feelings of efficacy and

agency in addressing socio-ecological crises. This competency requires content, procedural, and epistemic knowledge.

A 15-year-old student who uses an ethic of care and justice, and demonstrates resilience, hope, efficacy, and a respect for diverse perspectives in seeking solutions to socio-ecological crises can:

1. Evaluate actions drawing on an ethic of care for each other and all species based on a worldview where humans are part of the environment rather than separate from it (being ecocentric).
2. Acknowledge the many ways societies have created injustices and work to empower all people to contribute to community and ecosystem wellbeing.
3. Exhibit resilience, hope, and efficacy, individually and collectively, in responding to socio-ecological crises.
4. Respect diverse perspectives on issues and seek solutions to regenerate impacted communities and ecosystems (Reyes-García et al., 2019[12]).

Explanatory notes about what a student can do in this competency:

1. Agency in the Anthropocene requires an ethic of care based on an ecocentric worldview that positions humans within the environment and not separate from it (Nichols, 2020[120]), and relational practices that emphasise belonging to place and people (Cuervo and Wyn, 2017[121]). An ethic is a moral disposition underpinned by values, which in turn influence behaviour. An ethic of care implies a behaviour that positions a person in relation to concern and action for the health and wellbeing of themselves, their family, friends, community, country, and planet. Adopting an ecocentric worldview situates this care in relation to Earth systems and considers the concern and action for all living and nonliving entities within a system. A sense of being in the world is multi-dimensional, spanning the intrapersonal to interpersonal to ecospheric (Sauvé, 2010[122]). In the intrapersonal dimension, a person sees themself in relation to the world. Two common and opposing views are the ecocentric view (see above) and egocentric or even anthropocentric view, which posits that a person sees themself outside of, and often superior to, their natural environment. In the interpersonal dimension, a person sees themself in relation to others, both human and non-human. Agency in the Anthropocene implies ideas of social justice (between peoples) and ecological justice (between species). Lastly, in the ecospheric dimension, a person sees themself in relation to the systems of which they are part. These include the ecosystems that sustain them, the social and the cultural systems in which they engage, and the economic systems that govern their resource use. This poses the question of what it means to be human in the Anthropocene and moves thinking, caring, and acting beyond the individual to others.
2. The positive and negative impacts accruing from human interactions with Earth systems have not been shared equally with all people, and this has led to current socio-ecological crises. These crises are socio-ecological because they entangle social and ecological dimensions. For example, social demand for land for farmers and national economic production in the Amazon is decimating rainforest habitat, which in turn is impacting Indigenous peoples living in the forest, reducing oxygen output and carbon dioxide sequestration. Addressing these crises demands application of the principles of justice such as fairness and equity. These principles are values-based and culturally bound, often reflecting who holds power. The wielding of power within Earth systems has led to exploitative habits, in which those who feel they have more rights to resources exploit those who they feel have lesser rights. This exploitation has been a hallmark of human colonising practices in which the powerful have subjugated the less powerful, exploited their resources

and sought to maintain their dominant position through cultural imposition (Muller, Hemming and Rigney, 2019[15]). These practices may not be widely recognised and are neither just nor sustainable. A young person growing up in the Anthropocene needs to acknowledge these injustices and work to empower all people for community and ecosystem wellbeing.

3. As a young person growing up in the Anthropocene, it could be easy to be burdened by the magnitude of the many socio-ecological crises we currently face. To be agentic in this epoch requires hope and resilience to believe the crises can be overcome and to persist in addressing them. This can exact an emotional toll (Bright and Eames, (2022[52]); Ojala et al., (2021[89])) and youth wellbeing is a key concern. Reports of eco-anxiety, and particularly of climate anxiety (Stanley et al., 2021[123]), are appearing regularly, and young people justifiably feel less hopeful for their futures in the face of the developing socio-ecological crises (Wu, Snell and Samji, 2020[124]). They have not contributed to these crises in any significant way and feel angry toward the adults, whose inaction has led to the crises and continues to be ineffective in addressing them. Yet to be without hope and resilience in the face of these crises is to consign Earth systems to a downward spiral. The leadership of today's youth will be crucial in tomorrow's world. For these reasons, the development of hope and resilience among young people is critical. Tracking whether they have a sense of hope about the future should include understanding whether and to what extent young people believe solutions are possible and pathways exist that can create solutions for environmental challenges that can be taken by individuals, communities, organisations, businesses, and governments (Li and Monroe, 2019[25]). The measure is confounded, however, by whether the individual believes the problem to be serious enough to warrant a solution. A low level of belief about possible solutions could mean the individual is anxious about the future and believes solutions are unlikely to be found or believes a remedy is not necessary because the problem does not exist. Coupling this sense of informed hope with knowledge of environmental issues, often discussed in notions of action competence, will determine the degree and types of hope necessary to overcome environmental problems (Ojala, (2012[26]), Jensen and Schnack, (1997[73])). Unlike locus of control, which is a generic sense of one's ability to influence one's own future, self-efficacy and perceived control are context specific. One could easily believe in one's own ability to conserve water at home, for example, but not affect water availability in their community. There are a number of ways to categorise environmental actions, such as with Stern's (2000[67]) descriptions of environmental activism (e.g., active involvement in organisations and political advocacy), public non-activist support (e.g., supporting and accepting public policies), and private actions (e.g., purchase, conservation, and disposal of products) (Blankenberg and Alhusen, 2019[125]). In addition, the influence of public opinion is more likely to affect behaviours that can be observed and judged by others compared to those that are hidden from view (Byerly et al., 2018[126]). Finally, behaviours can be one-time purchases or habitual, as well as more or less convenient or costly. We recommend that a scaled assessment cover a suite of actions that are possible for 15-year-olds to accomplish, that are easier and harder, personal and collective, and public and private. Several strategies that could be used as a guide have been published (Alisat and Riemer, (2015[127]); Olsson et al., (2020[115])).
4. Acknowledging and respecting the many perspectives about our environmental crises, based on values that may range from cultural to economic (Salomon et al., 2019[13]), is crucial to permit dialogue and exchange, to learn about and from others, and to reach a consensual decision on ways forward. A positive outcome of global mobility has been the interchange of cultures through different knowledge bases and values that have provided opportunities to negotiate regenerative solutions that seek optimal outcomes for all species and communities. A young person growing up in the Anthropocene needs to be aware and

respectful of diverse perspectives and how they can collectively contribute to the resolution of socio-ecological crises.

Initial Draft Reporting Scales

In the Anthropocene, people believe that their actions will be appreciated, approved, and effective regarding socio-ecological issues and crises such as climate change, biodiversity loss, water scarcity, and other pressing issues. The construct of agency in the Anthropocene can be used to develop a scale of achievement from the 2025 PISA data. The competencies that can be assessed, as described above, contain both cognitive and non-cognitive elements.

Cognitive scale

This section elaborates a draft proficiency scale based only on the cognitive elements to be measured by the Science Assessment Framework, using a four-point scale (high, medium, basic, and low; Table 1). The scale will be revised in light of student performance on the field trials and actual test. It should be noted that not all of the competencies of agency in the Anthropocene defined above can be measured by the cognitive test. Instead, items from the science cognitive test that have an environmental focus and match the description of the competencies above will be used to construct a scale that is a measure of elements of agency in the Anthropocene. The non-cognitive attitude questionnaire will measure other elements independently.

Table 1. Suggested scale for cognitive Agency in the Anthropocene competencies

Level	Descriptor
High	At a high level, students can draw effectively upon scientific ideas to explain what Earth systems are, how they function, and how they interact with each other using knowledge of high cognitive demand. They can identify and explain how human activity has had both negative and positive impacts with these Earth systems over time by accessing and critically appraising evidence from diverse knowledge systems and sources on these impacts. They can identify and explain social, cultural, and economic factors that are relevant to these impacts. Students can evaluate and suggest potential solutions to socio-ecological crises caused by human impact using their knowledge of science and systems thinking. They can explain how such solutions can impact current and future generations. Students can provide justifications using combinations of environmental, social, cultural, and economic reasons for decisions and actions that can be taken to resolve environmental challenges and crises.
Medium	At a medium level, students can draw upon scientific ideas to explain what Earth systems are, how they function, and/or how they interact with each other using knowledge of at least medium cognitive demand. They can identify and explain how human activity has had either negative or positive impacts with these Earth systems over time by accessing and appraising evidence from more than one knowledge system or source regarding these impacts. They can identify social, cultural, and economic factors that are relevant to these impacts. Students can evaluate and/or design potential solutions to socio-ecological crises caused by human impact using their knowledge of science and systems thinking. They can explain how such solutions can impact them and their family. Students can provide a justification, using combinations of one or two of environmental, social, cultural, and economic reasons, for decisions and actions that can be taken to resolve environmental challenges and crises.
Basic	At a basic level, students can identify what some Earth systems are and explain how they function using knowledge of low cognitive demand. They can identify simple and common examples of how human activity has had negative or positive impacts within these Earth systems over time, using evidence from only one knowledge system or source. They can identify a limited number of social, cultural, and/or economic factors that are relevant to these impacts. They can suggest one potential solution to a social and environmental crisis caused by human impact using systems thinking. They can explain how such solutions might impact

Level	Descriptor
	them. Students can provide a simple justification, using one environmental, social, cultural, or economic reason, for decisions and actions that can be taken to resolve environmental challenges.
Low	At a low level, students can identify an Earth system and explain how it functions using knowledge of low cognitive demand. They can identify a simple and common example of how human activity has had negative or positive impacts within this Earth system over time. They can justify this using one piece of evidence. They can identify a social, cultural, or economic factor that is relevant to these impacts. They can suggest one potential solution to a socio-ecological crisis caused by human impact using systems thinking. They can explain how such a solution might impact them. Students can provide a simple justification, using one environmental, social, cultural, or economic reason, for decisions and actions that can be taken to resolve an environmental challenge.

Competencies in context

Table 2 illustrates how the three competencies may be developed and assessed through the context of five socio-ecological crises.

Table 2. Agency in the Anthropocene competencies across five examples of socio-ecological crises

Competency	Explain the impact of human interactions within Earth's systems	Make informed decisions to act based on evaluation of diverse sources of evidence and application of creative and systems thinking to regenerate and sustain the environment	Demonstrate hope and respect for diverse perspectives in seeking solutions to socio-ecological crises
What a student can do	Explain Earth systems and their interactions Explain human interactions with Earth systems Explain positive and negative human impacts within Earth's systems Explain social, cultural and economic factors that influence these impacts	Access and critically appraise evidence Apply systems thinking and creativity to solutions Engage in civic processes for decision making Act for change	Demonstrate an ethic of care and socio-ecological justice Demonstrate hope, resilience, and personal efficacy Demonstrate respect for diverse perspectives and negotiate solutions
Climate change	Enhanced greenhouse effect interaction with ocean and land ecosystems Historic and contemporary carbon emissions by human activity Impacts of climate change on human and natural systems Mitigative and adaptive strategies for climate change	Evidence of a relationship between greenhouse gas levels and climate change impacts Carbon reduction solutions from systems thinking perspectives Work with others to identify, design, and enact carbon reduction strategies at a local and/or regional scale	Concern for climate justice for humans and non-humans Hope and efficacy for carbon emissions reduction, resilience to climate change impacts Consensual decision making on renewable energy security
Biodiversity loss	Human population growth has led to	Human impacts on species habitats	Ecocentric values—humans are just one

Competency	Explain the impact of human interactions within Earth's systems	Make informed decisions to act based on evaluation of diverse sources of evidence and application of creative and systems thinking to regenerate and sustain the environment	Demonstrate hope and respect for diverse perspectives in seeking solutions to socio-ecological crises
	ecosystem change Food webs, interdependence, and keystone species Changes in land use Ecosystem services	Advocacy for non-humans Work with others to identify, design, and enact strategies that maintain and restore biodiversity at a local and/or regional scale	amongst species Indigenous beliefs about species Value of species restoration work Consensual decision making on protected ecological areas
Water availability and quality	Hydrological cycle and its interaction with land and oceans Quantity and uses of water by humans Water quality impacts on the environment Water management and conservation	Human impacts on water availability and quality Evaluate and design solutions for rainwater capture, water retention, and distribution Work with others to conserve water and restore waterways	Cultural values for water Water justice across communities and nations
Energy supply	Ways in which energy can be stored, transferred, and dissipated within systems Energy conservation Non-renewable and renewable energy sources Renewable energy technology desirability and cost structures	Evaluate and design solutions for energy efficiency Work with others to transition away from fossil fuel-using systems to renewable sources of energy	Energy equity Resilience in the face of energy shortages
Waste management and pollution	Life cycle analysis of materials—circular economy Degradability of materials due to their composition Plastics pollution (the ocean gyre): microbeads (awareness of use and products) and microfibres (synthetics in clothing)	Impact of material waste on the environment Evaluate and design solutions for waste reduction and management	Consumer values Ethical choice regarding low environmental impact products Social programs to limit plastic use (e.g., plastic bags)

Competencies at scale

The competencies (Box 2) act across temporal and spatial scales, which provide opportunities that can energise youth to work on a variety of meaningful issues. Table 3 provides an illustration of applying a spatial scale using two of the socio-ecological crises in Table 2.

Table 3. Applying a spatial scale to two socio-ecological contexts from Table 2

Anthropocene Challenges	Local	Regional/National	Global
Climate change	Examine household energy use Product consumption Transportation patterns Waste disposal	Alternatives to economic reliance on carbon-emitting industries such as renewable energy generation Implementing adaptive agriculture Coastal migration in response to sea-level rise Human health effects of changing disease, heat, wildfire, and storm events	Human migration from areas of drought or flooding Assisted migration of plant and animal species Positive and negative impacts of industrialisation and globalised economics Sea-level rise impacts on island nations
Biodiversity loss	Urban development patterns Impacts of invasive species Processes of ecosystem restoration Human population increases Local loss of species Agricultural monocultures	Impacts of deforestation Threatened species recovery plans National parks and marine reserves Introduced species management	Impacts of overfishing Positive and negative outcomes from agrochemical use Marine mammal harvesting and protection Biosecurity systems

Assessment for the Environmental Scale

This scale will be constructed using content, procedural and epistemic knowledge questions in the science framework that are clearly related to any science that can be of an environmental or ecological nature. A similar assessment of environmental competence was done in 2006 for the 'Green at Fifteen Project'. Because of the cognitive focus of the science test, it will only be possible to measure Competency 1 and Competency 2. To measure the agency in the Anthropocene construct fully, however, it will also be necessary to ask questions about the following—elements of which will be asked in the non-cognitive questionnaire:

- The science needed to respond to claims about environmental/health issues made by people or interest groups on the bases of other values/knowledges (e.g., responding to a person who refuses vaccination on the basis of there being a percentage of people who develop serious side effects, or who argues that a number of vaccinated people have died).
- Identifying the science knowledge, including possible investigations, relevant for responding to different positions on environmental/health actions, including deciding on personal actions (e.g., identifying the science research needed to respond to the range of perspectives from farmers concerned about re-introduction

of top predators into a local national park, or in deciding about culling introduced species such as brumbies. The question might, for instance, involve matching science investigations with a list of concerns or claims).

- Identifying which of different positions in an environmental controversy are scientifically based, and which are based on other knowledges and values.
- Weighing different alternatives given the science knowledge relevant to a personal or community health/environmental issue (e.g., should I use plastic cups in catering for a large party, or glass cups and wash them in a dishwasher?). The science would relate to the energetics of dishwashing, water and detergent use, recycling figures on plastic, and so on. It might simply ask which ideas are relevant for the decision.
- Identifying from a list the socio-ecological considerations that legitimately frame scientific research in an area (e.g., in scientific developmental research into mobile phones technical design, which issues might be expected to frame decisions, and what sort of principles are involved [economic, cultural, ethical, environmental]? How might one think about the sourcing of rare metals from exploitative practices, the costs of extraction, the possibility of recycling of materials, the advertising campaign associated with the phone, the opinion of uses on phone colour, and so on?).
- Predicting the consequences across different parts of the socio-ecological system that would flow from particular decisions (e.g., given mapping of a complex system relating to an aquifer on which a community depends for water and livelihood, and which the broader population uses in multiple ways, but that is increasingly contaminated by pesticides from agriculture, predict what environmental consequences might flow from a particular decision related to water or pesticide use that might depend on knowing the pathways through related economic/recreational systems leading back to environmental impact).

Assessment Items

The assessment of the competencies of agency in the Anthropocene is challenging in written, standardised assessment strategies. This section presents descriptions of some areas of valuable exploration if developing agency in the Anthropocene in young people and includes some possible test items (example 1–3). The following three assessment options are suggestions that exemplify how such assessment might be achieved.

The following themes illustrate possibilities for future assessment items:

- The importance of top predators such as the dingo (similar context to bears, wolves, or sharks) demonstrates knowledge about food chains and webs, ecosystems, as well as the societal impacts of the reintroduction of these species via stakeholder analysis (opinions). See example 1.
- Analysis of the questions ‘Should we eat meat?’ or ‘Should we import lamb?’ requires data to analyse to be able to draw conclusions. Questions such as these (with provided data) enable assessment of ethical considerations as well as data analysis. See example 2.
- Exploring the concepts of waste and pollution, questions around the circular economy, and life cycle analysis including knowledge about energy and matter explore knowledge as well as agency in the Anthropocene. See example 3.

- Plastic pollution impacting albatross and shearwater species across the world (and many other ocean feeding birds) as plastic is collected and fed to young by parents. The gut of the bird fills with indigestible plastic where the bird can extract no nutrition and dies of malnutrition. Emaciated albatross carcasses reveal large stomach contents of plastic.

Example 1: Top Predators

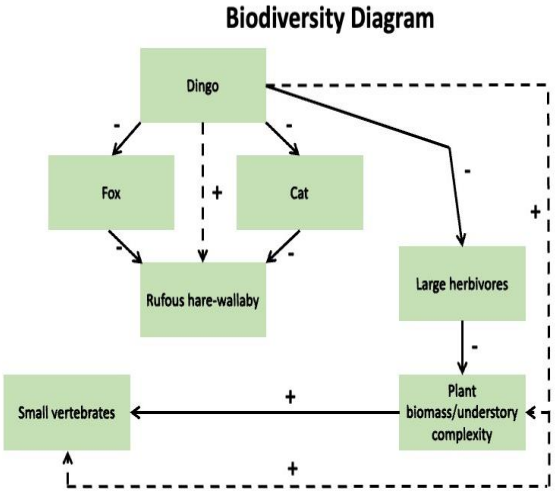
Top predators 1

In the Gariwerd National Park, Australia, the introduction of predators such as fox or cat has changed the biodiversity.

It has been suggested that reintroducing the Australian native dog (dingo) would help restore the balance of the ecosystem.

The diagram shows how reintroducing the dingo might do this.

Figure 1. Biodiversity Diagram



Source: Adapted from (Glen et al., 2007[128]). Evaluating the role of the dingo as a trophic regulator in Australian ecosystems. *Austral Ecology*, Vol. 32. pp. 492-501.

— Direct Effect of Reintroducing Dingos
---- Indirect Effect of Reintroducing Dingos
The '-' sign shows a negative effect on population; for instance, the fox population decreasing because the dingo preys on foxes.
The '+' sign shows a positive effect on population.

Top predators 2

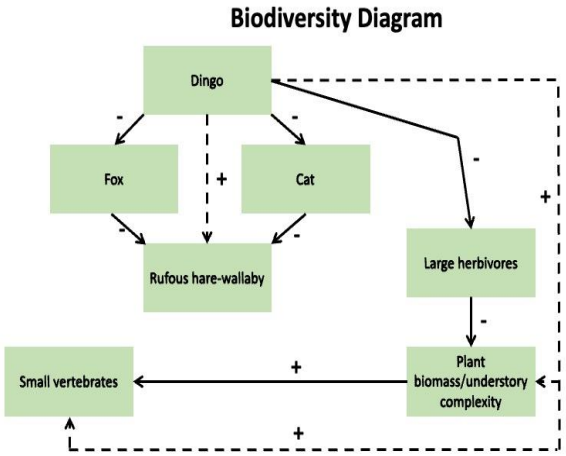
Q1 Select which one or more of the following effects are shown by the diagram if dingos are reintroduced:

- Rufous hare-wallaby populations will decrease
- Small vertebrate numbers will increase
- Large herbivore numbers will decrease
- Plant biomass will increase

Q2 Which one or more of the following are shown by the diagram?

- Fox and cat populations will decrease because they are preyed on by the dingo
- The rufous hare-wallaby will increase in numbers so numbers of foxes and cats will increase
- Dingos will have direct effects on numbers of foxes and cats and large herbivores
- Dingos will have only indirect effects on plant biomass and small vertebrates
- Plant biomass will increase because dingos will reduce the numbers of herbivores

Figure 2. Biodiversity Diagram



Source: Adapted from (Glen et al., 2007[128]). Evaluating the role of the dingo as a trophic regulator in Australian ecosystems. *Austral Ecology*, Vol. 32. pp. 492-501.

— Direct Effect of Reintroducing Dingos
---- Indirect Effect of Reintroducing Dingos
\- Negative Effect
\+ Positive Effect

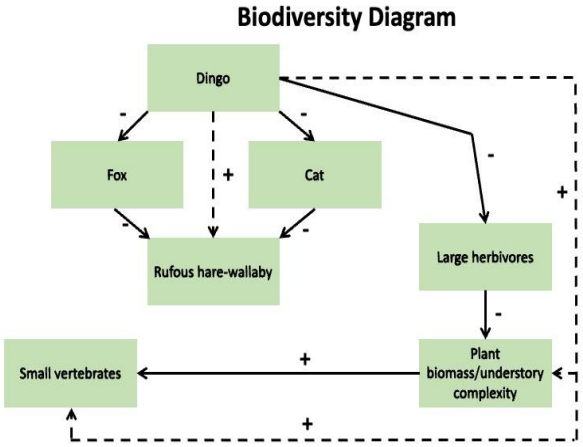
Top predators 3

There is opposition to the suggestion from farmers and other locals. Farmers fear the dingos will attack sheep on their farms.

Q3 The following objections have been written into newspaper reports. Which of these could be scientifically investigated?

- Dingos are just wild dogs and pests
- Dingos carry disease that can be dangerous to cattle
- Dingo predation will endanger the koala population
- Dingos will breed and kill too many other animals in the park

Figure 3. Biodiversity Diagram



Source: Adapted from (Glen et al., 2007[128]). Evaluating the role of the dingo as a trophic regulator in Australian ecosystems. *Austral Ecology*, Vol. 32. pp. 492-501.

— Direct Effect of Reintroducing Dingos
---- Indirect Effect of Introducing Dingos
\- Negative Effect
\+ Positive Effect

Top predators 4

Q4 In debating this issue, which of the following statements could be made drawing mainly on biological evidence (S), and which could be made drawing mainly on other types of knowledge or evidence (O):

- Introducing dingos will not be as successful as introducing wolves elsewhere because wolves were introduced in very different environment conditions
- The dingo should not be considered a native species because it was originally brought into Australia by the Indigenous population
- Dingos, if allowed to roam in packs, regulate their own numbers and should not pose a danger to farm animals
- Dingos have important cultural value for the Australian Aboriginal people who run the park

Top predators 5

Q5 The following statements are made by different people involved in the controversy. Identify, for each statement, whether it represents: a statement based on scientific evidence or ideas (S) OR represents other sets of values that are important to the issue (O):

- The introduction of top predators would restore ecological balance
- Dingos are traditional to the Australian Aboriginal people who managed the land previously and reintroduction will restore this tradition
- Dingos will threaten the livelihood of the farming community and lead to local businesses becoming bankrupt
- Dingos are beautiful dogs and deserve a place to roam
- Studies show that the Gariwerd biodiversity is declining
- Dingos are nasty killers who love nothing more than to eat sheep

Top predators 6

Sources of evidence

Consider the various sources below that have made statements about the reintroduction of dingos.

Q6 Identify those sources that you think could be trusted to report reliable scientific information.

- Scientific studies of biodiversity in the area reported in peer-reviewed scientific papers
- An article discussing the science, in a local farmers magazine
- An article in the local magazine for tourists about the park and the issue
- A government report that summarises relevant scientific reports from reputable journals
- A blog post that describes stories of dingos and their behaviour in different parts of the country
- A Twitter post about the issue that describes the failure of top predator introductions around the world

Example 2: The environmental impact of meat eating

Celia and Anton are discussing whether, for environmental reasons, they should consider reducing the amount of meat in their diet and switch to a more vegetable-based diet. They consider the following information:

> *It takes 326 sq metres to produce a kg of beef, 12 sq metres to produce a kg of poultry meat, 2.8 sq metres for rice, and less than 1 sq metre for many vegetables.*

Celia and Anton are aware that, to maintain health, the food they eat needs to contain an appropriate balance of macro-nutrients: protein, carbohydrates, and fats as well as a variety of trace nutrients.

Q1. What is the major food type provided by eating meat?

Q2. Name a plant-based food that could also provide the same food type.

The environmental impact of eating meat 2

Anton argues that beef comes from cows and that breeding cows for meat poses a threat to the environment.

Q3 Tick those reasons that might justify Anton's argument:

- Cows take a long time to grow to full size
- Cows produce methane, which is a greenhouse gas
- Cows require more land for the amount of food they produce, compared to vegetables
- Cows are sacred animals in some societies
- The skin of cows is useful for leather

The environmental impact of eating meat 3

Celia says: "Traditionally, humans have been omnivorous, consuming both meat and food such as grains, legumes, fruits. Meat, as part of a diet, delivers important food types and trace nutrients."

Anton replies: "An informed vegetarian diet can provide all these foods, too! Since the world's population is expanding, we need to reduce our forest clearance to provide pasture for cows and use our agricultural land more efficiently."

Q4 Which of the following claims concerning 'should we eat meat?' can be justified using scientific evidence (S), and which is based on other types of knowledge or values (O)?

- Our teeth are designed to eat meat
- Some of our ceremonies involve eating meat and need to be maintained
- A vegetarian human diet can provide all the macro-nutrients and trace nutrients we need
- Meat tastes good, we should not give it up
- There is not enough available land to sustain current levels of meat production for a growing population
- Food production—especially meat production—is a major contributor to greenhouse gases, for instance through cows producing methane
- Meat is much more expensive than vegetables
- Meat is a ready source of many of our nutritional needs
- Meat production requires the extensive use of fertilisers; the overuse of fertilisers can pollute the land
- To maximise efficiency of production, hormones and drugs are sometimes used to make animals grow quickly and to keep them healthy in closely confined spaces; these drugs and hormones in the meat can negatively affect the health of people

Example 3—Life cycle analysis

Your school would like to install new tables so students can eat lunch outdoors. The students have been asked to select the criteria for selecting the best tables. The choices have been narrowed down to the following:

- Plastic tables made from recycled soda bottles, shipped from the only factory in the region, 500 miles away.

- Wooden tables made from locally harvested wood that is treated with chemical preservatives, 20 miles away.
- Concrete tables made from plentiful, locally mined limestone and gravel, and built by refugees, 20 miles away.

The production and shipping of each type of table uses fossil fuels and generates carbon dioxide as below (provide chart of emissions in CO_2 equivalents). Plastic—medium high, wood—low, concrete—high.

Questions

1. Which table contributes the least to climate change? (wood)
2. Which table minimises waste? (plastic)
3. Which table utilises renewable resources? (wood)
4. Which table is the most socially equitable in its production? (concrete)

Check the three most important criteria in making a sustainable choice for which table (plastic, wood, concrete) to purchase:

- Cost
- Repairability
- How long it will last
- Contribution to climate change
- Contribution to air and water quality
- Recyclability vs disposability
- Whether students can decorate them
- The ethics of the company that makes it
- Whether the table company contributes to education
- Whether students will help make the decision
- How far they are shipped

Published non-cognitive scales of relevance

The two scales below have been included to provide examples of ways that hope and action can be measured with young people. These scales have been tested and applied.

Table 4. Climate Change Hope Scale (CCHS)

1	I believe people will be able to solve problems caused by climate change.	-3	-2	-1	0	1	2	3	X
2	I believe scientists will be able to find ways to solve problems caused by climate change.	-3	-2	-1	0	1	2	3	X
3	Even when some people give up, I know there will be others who will continue to try to solve problems caused by climate change.	-3	-2	-1	0	1	2	3	X
4	If everyone works together, we can solve problems caused by climate change.	-3	-2	-1	0	1	2	3	X
5	I am willing to take actions to help solve problems caused by climate change.	-3	-2	-1	0	1	2	3	X
6	I believe more people are willing to take actions to help solve problems	-3	-2	-1	0	1	2	3	X

	caused by climate change.								
7	I know that there are things that I can do to help solve problems caused by climate change.	-3	-2	-1	0	1	2	3	X
8	I know what to do to help solve problems caused by climate change.	-3	-2	-1	0	1	2	3	X
9	Climate change is beyond my control, so I won't even bother trying to solve problems caused by climate change.	-3	-2	-1	0	1	2	3	X
10	Climate change is so complex we will not be able to solve problems that it causes.	-3	-2	-1	0	1	2	3	X
11	The actions I can take are too small to help solve problems caused by climate change.	-3	-2	-1	0	1	2	3	X

Note: -3/3 = strongly (dis)agree; -2/2 = (Dis)agree; -1/1 = Slightly (dis)agree; 0 = Neutral; X = I do not think the climate is changing.
Source: Li, C. and Monroe. M.C. (2018). Development and validation of the climate change hope scale for high school students. *Environment and Behavior*, 50(4): 454–479.

Table 5. Environmental Action Scale (EAS)

In the last six months, how often, if at all, have you engaged in the following environmental activities and actions?	Never (0)	(1)	Sometimes (2)	(3)	Frequently (4)
1. Educated myself about environmental issues (e.g., through media, television, internet, blogs).					
2. Participated in an educational event (e.g., workshop) related to the environment.					
3. Organised an educational event (e.g., workshop) related to environmental issues.					
4. Talked with others about environmental issues (e.g., spouse, partner, parent(s), children, or friends).					
5. Used online tools (e.g., YouTube, Facebook, Wikipedia, MySpace Blogs) to raise awareness about environmental issues.					
6. Used traditional methods (e.g., letters to the editor, articles) to raise awareness about environmental issues.					
7. Personally wrote to or called a politician/government official about an environmental issue.					
8. Became involved with an environmental group or political party (e.g., volunteer, summer job).					
9. Financially supported an environmental cause.					
10. Took part in a protest/rally about an environmental issue.					
11. Organised an environmental protest/rally.					
12. Organised a boycott against a company engaging in environmentally harmful practices.					
13. Organised a petition (including online petitions) for an environmental cause.					
14. Consciously made time to be able to work on environmental issues (e.g., working part time to allow time for environmental pursuits, working in an environmental job, or choosing environmental activities over other leisure activities).					
15. Participated in a community event which focused on environmental awareness.					
16. Organised a community event which focused on environmental awareness.					
17. Participated in nature conservation efforts (e.g., planting trees, restoration of waterways).					
18. Spent time working with a group/organisation that deals with the connection of the environment to other societal issues such as justice or poverty.					

Source: Alisat, S. and Riemer, M. (2015). The environmental action scale: Development and psychometric evaluation. *Journal of Environmental Psychology*, 43, 13–23. https://doi.org/10.1016/j.jenvp.2015.05.006

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