Planetary health learning objectives: foundational knowledge for global health education in an era of climate change

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Planetary health is an emerging field that emphasises that humans depend on a healthy Earth for survival and, conversely, that the sustainability of Earth systems is dependent on human behaviours. In response to member demands for resources to support teaching and learning related to planetary health, the Consortium of Universities for Global Health (CUGH) convened a working group to develop a set of planetary health learning objectives (PHLOs) that would complement the existing ten CUGH global health learning objectives. The eight PHLOs feature Earth system changes, planetary boundaries, and climate change science; ecological systems and One Health; human health outcomes; risk assessment, vulnerability, and resilience; policy, governance, and laws (including the UN Framework Convention on Climate Change and the Paris Agreement); roles and responsibilities of governments, businesses, civil society organisations, other institutions, communities, and individuals for mitigation, adaptation, conservation, restoration, and sustainability; environmental ethics, human rights, and climate justice; and environmental literacy and communication. Educators who use the PHLOs as a foundation for teaching, curriculum design, and programme development related to the health–environment nexus will equip learners with a knowledge of planetary health science, interventions, and communication that is essential for future global health professionals.

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Introduction

Global health is an interdisciplinary, interprofessional field of teaching, research, and applied practice that focuses on how governments, civil society organisations, and other stakeholders from countries of all income levels and geographies work together to identify and implement solutions for shared health concerns.[1] One of the dominant global health challenges of the 21st century is climate change.[2] Increased heat and extreme weather events that exacerbate non-communicable diseases, expand the distribution of vector-borne pathogens, and worsen food insecurity, are threatening to halt or reverse the great gains in population health that have occurred in recent decades.[3] In addition to climate change, the health of humans and animals is threatened by various other worsening environmental problems, including persistent chemical pollutants, land use changes that increase the likelihood of pandemics, and biodiversity loss.[4,5] There is an urgent need for students in global health and other health-related disciplines to learn more about climate change and other global environmental health issues.[6–11]

Planetary health is an emerging field that emphasises that humans depend on a healthy Earth for survival and, conversely, that the sustainability of Earth systems is dependent on human behaviours.[12,13] The Planetary Health Alliance, which counts hundreds of universities among its members, defines planetary health as "a solutions-oriented, transdisciplinary field and social movement focused on analysing and addressing the impacts of human disruptions to Earth's natural systems on human health and all life on Earth". Earth's natural systems include all abiotic aspects of the environment. Life on Earth includes humans, domestic animals and wildlife (both aquatic and terrestrial), plants, microbes, and all other biotic components of ecosystems. Planetary health has come into favour within the global health community as a prioritised model for education, advocacy, and activism about the health–environment nexus. However, because planetary health is a nascent field that draws on disciplines spanning the sciences and humanities, few educators have familiarity with all its domains.

Various discipline-specific frameworks have been developed for teaching why global systems changes are occurring, how those changes are adversely affecting the health of humans and ecosystems, and how various groups are responding to these unfolding crises. Veterinary and agricultural schools typically teach these concepts using a One Health lens, which emphasises the interconnectedness of human health, animal health, and plant, environmental, and ecological health, or related lenses, such as conservation medicine and EcoHealth.[14–16] Many medical schools now offer coursework and training on climate medicine and other dimensions of climate change and health; public health schools embed these concepts within courses on global environmental public health; and other units within colleges and universities teach these concepts as part of sustainability studies and other interdisciplinary programmes that apply a global perspective to the connections between humans and their environments.[17] Educators aiming to cover the full spectrum of planetary health issues can draw on all of these models when they teach about the intersection of global environmental change and human health.

The Consortium of Universities for Global Health (CUGH) is the world's largest academic global health network. Established in 2008 with funding from the Bill & Melinda Gates Foundation and The Rockefeller

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For more on **planetary health and the Planetary Health Alliance** see https://www.planetaryhealthalliance.org/

Panel 1: **Consortium of Universities for Global Health recommended global health learning objectives, 2024 version**

1. Values: describe the history, values, and functions of global health
2. Globalisation: explain how travel, trade, and other aspects of globalisation contribute to health, disease, and health disparities
3. Socioeconomics: summarise the economic, social, cultural, and political contributors to individual and population health
4. Environment: examine the connections between human health and environmental health, including considerations of water, sanitation, air quality, urbanisation, ecosystem health, and climate change
5. Ethics: discuss the relationship between human rights and global health
6. Health-care systems: compare the financing and delivery of medical care in countries with different types of health systems and different income levels
7. Governance: examine the roles, responsibilities, and relationships of the agencies and organisations involved in prioritising, financing, and implementing public health interventions locally and internationally
8. Epidemiology: compare the burden of disease, disability, and death from infectious diseases, reproductive health issues, malnutrition, non-communicable diseases, mental health disorders, and injuries in countries with different income levels
9. Interventions: identify evidence-based, cost-effective, sustainable interventions for promoting health and preventing illness across the lifespan from the prenatal period through older adulthood
10. Evaluation: evaluate policies that seek to solve major population health concerns and achieve health equity

Foundation, CUGH has grown to include more than 190 institutional members across more than 30 countries, individual members from many additional universities and colleges worldwide, and an online community with more than 40 000 subscribers. One of the organisation's priorities is supporting the creation and dissemination of high-quality resources for global health education. There is substantial demand for these tools as dozens of CUGH-member universities offer graduate degrees and concentrations in global health,[18–20] more than a hundred colleges and universities offer undergraduate degrees and minors in global health,[21,22] and a large proportion of institutions of higher education offer at least an introductory course on global health. To be responsive to member demands for resources to support teaching and learning related to planetary health, CUGH convened a working group to develop a set of planetary health learning objectives that are specifically designed for use within the context of global health education.

Learning objectives and competencies are complementary but distinct educational concepts.[23,24] Learning objectives are specific, focused, measurable statements about what learners will know and be able to do at the end of a class; they typically feature verbs such as compare, explain, and summarise that emphasise factual and conceptual knowledge. Competencies define the set of knowledge, skills, and attitudes that learners are expected to achieve across an entire curriculum; they typically feature verbs such as create, design, and demonstrate that emphasise application of procedural knowledge, and they are often focused on preparing students and trainees for success in the workforce.

CUGH's existing tools for educators include a set of ten global health learning objectives (GHLOs) that equip students with foundational knowledge and a list of interprofessional competencies for global health practice that span 11 domains.[21,25–27] The GHLOs feature mostly lower-level verbs that describe achievements that learners should be able to demonstrate by the end of an introductory course (panel 1). The interprofessional competencies, by contrast, typically require the application of concepts to work in clinical settings. For example, the GHLOs call for learners to be able to "discuss the relationship between human rights and global health", whereas the competencies require the ability to "apply the fundamental principles of international standards for the protection of human subjects in diverse cultural settings". Similarly, the GHLOs call for learners to "evaluate policies that seek to solve major population health concerns and achieve health equity", whereas the competencies require the ability to "design context-specific interventions based on a situation analysis". The GHLOs can be attained through classroom-based study, but many of the interprofessional competencies can only be mastered through professional practice.

The GHLOs and the CUGH interprofessional competencies mention environmental health and concepts related to social justice, but they engage only superficially with planetary health. Global health education frameworks developed by other academic groups have similar gaps in coverage of planetary health concepts.[28] Our goal as a CUGH working group was to develop a set of planetary health learning objectives (PHLOs) that enable learners already familiar with foundational global health principles to gain crucial knowledge about planetary health science, interventions, and communication.

Methods

A Delphi process was used to develop the PHLOs.[29] Panel members were selected by the core members of the working group based on their experience in planetary health, global health, environmental education, or a combination of these, and their active involvement in CUGH committees, participation in Teach Global Health summer institutes, or both (Teach Global Health is a non-profit organisation that provides professional

development workshops for global health educators). The panellists represent various disciplinary and professional backgrounds and come from and work in multiple world regions.

As a starting point for identifying the planetary health knowledge domains that are most important for global health courses and curricula, the core team reviewed frameworks for environmental health education that have been developed by professional groups in medicine and public health. The Global Consortium on Climate and Health Education provides a lengthy list of competencies for medical and public health practitioners.[30] The Association of Schools and Programs of Public Health recommends climate change and health competencies that emphasise practical skills that supplement the core competencies of public health degrees.[31] The Planetary Health Alliance promotes principles and values related to education about global environmental health concerns, such as understanding how governance processes unfold and being aware of how structural inequities affect vulnerability to the health effects of environmental change.[10,32–35] We also examined research from other groups, such as those focused on climate and health literacy and on health promotion and climate change.[36,37] We supplemented our reviews of published educational frameworks with examinations of the learning objectives used by courses within our own institutions and at other schools, looking for the themes that were expressed most frequently.

After the core members of the research team compiled a preliminary list of planetary health domains, an iterative review process was used to prioritise domains for the PHLOs and to gather recommendations for the phrasing of learning objectives for each domain. In each of several rounds of review, all coauthors were invited to mark each draft statement as acceptable or unacceptable and to submit alternative language for each proposed learning objective. Between each round of review, the core team collated the feedback and, if necessary, communicated with individual panellists about how competing proposals could be merged into revised draft statements that were acceptable to all contributing parties. To minimise bias, the identity of panellists was known only to the core team until all rounds of feedback were complete and consensus had been achieved based on all contributors deeming each statement to be acceptable. After all panellists had indicated their approval of the final set of 8 PHLOs, CUGH leaders reviewed and approved the PHLOs.

Results and discussion

The eight PHLO domains include: Earth system changes; ecological systems; human health outcomes; risk assessment; governance; actions; ethics; and communication. The domains and their associated learning objectives are presented in panel 2. The following paragraphs provide an explanation of each of the PHLOs along with citations of some salient publications within each domain.

Panel 2: **Consortium of Universities for Global Health recommended planetary health learning objectives, 2024 version**

1. Earth system changes: identify the natural and human-generated causes of altered biogeochemical flows, climate change, biodiversity loss, environmental pollutants, land-system change, freshwater change, ocean acidification, atmospheric aerosol loading, stratospheric ozone depletion, and other global environmental changes
2. Ecological systems: describe how the ecosystems formed by human, domestic animal, wildlife, plant, and other biotic populations are affected by human actions across trophic levels, geographies, and time
3. Human health outcomes: explain how extreme temperature and precipitation events, reduced air and water quality, population displacement, and other global changes increase incidence, prevalence, and mortality from infectious diseases; malnutrition; respiratory, cardiovascular, and other non-communicable diseases; sexual and reproductive health issues; psychosocial health disorders; and injuries
4. Risk assessment: analyse how economic, social, cultural, political, environmental, technological, and health systems affect ecosystem and human vulnerability and resilience to environmental change
5. Governance: evaluate how local, national, and international laws and policies have contributed to environmental problems and solutions
6. Actions: compare the roles and responsibilities of governments, the commercial sector, civil society organisations, communities, and individuals in promoting conservation, restoration, mitigation, and adaptation related to environmental change
7. Ethics: articulate the principles of intragenerational, interspecies, and intergenerational environmental justice
8. Communication: demonstrate environmental and health literacy by accessing, evaluating, and communicating reliable scientific information about global environmental change

PHLO 1: Earth system changes

Earth system science encompasses the physical, chemical, and biological processes that cycle energy, water, carbon, nitrogen, phosphorus, and other materials within and between the planet's geosphere (land), hydrosphere and cryosphere (water), atmosphere (air), and biosphere (living things). Numerous frameworks have identified alarming Earth system changes that have already occurred or could occur in the near future. The Planetary Boundaries framework identifies nine Earth system processes that are critical for planetary stability and have already been severely disrupted by human actions: biosphere integrity, including biodiversity; climate change, measured as a function of carbon dioxide concentrations and radiative forcing; novel entities, such as plastics

pollution; biogeochemical flows, especially nitrogen and phosphate; land-system change, such as decreased forested land; freshwater change; ocean acidification; atmospheric aerosol loading; and stratospheric ozone depletion.[38] The Earth System Boundaries assessment includes a similar set of eight biophysical boundaries: phosphorus, nitrogen, groundwater, surface water, natural ecosystem area, functional integrity, climate, and aerosols.[39] The Tipping Points model identifies more than two dozen environmental stressors that could irreversibly change Earth's systems, such as the death of warm water coral reefs, the collapse of ice sheets, the thawing of the permafrost in the northern hemisphere, and the collapse of the North Atlantic Subpolar Gyre.[40] The scientists serving on the Intergovernmental Panel on Climate Change and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, which operate under the auspices of the UN, have expressed very high confidence that these global climate changes are due to human activity.[41,42] Some scientists have proposed that these changes are so substantial that they represent a new geological epoch dubbed the Anthropocene.[43] Global health students should acquire at least a basic understanding of the science of Earth system changes—including climate change—and the role of human activities in driving the widespread changes to Earth system processes.[43]

PHLO 2: Ecological systems

An ecosystem encompasses all the living things in a specific location and the environments that those biotic populations live and interact in. Humans benefit from many ecosystem services, including provisioning services (including products such as food, fresh water, and solid fuels); regulating services (such as pollination and water purification); cultural services (including non-material recreational, aesthetic, and spiritual benefits); and supporting services (such as soil formation and nutrient cycling).[42,44] Human behaviours that affect the environment or organisms at any trophic level—higher-level consumers (carnivores), primary consumers (herbivores such as insects), producers (plants), or decomposers—can disrupt the structures and functions of ecosystems in ways that can lead to biodiversity loss and ultimately to ecosystem collapse. Accelerating extinctions, groundwater depletion, mountain glacier melting that reduces freshwater availability, intolerable heat, and other risk tipping points could have considerable adverse effects on ecosystem sustainability in the coming decades.[45] Global health students should understand ecological science at a level that enables them to apply a One Health lens to examinations of the interdependence of human, animal, plant, and ecological health.[46–49]

PHLO 3: Human health outcomes

Higher temperatures, extreme weather and precipitation events (including a greater frequency of intense tropical cyclones in some places and severe droughts in others), sea level rise, and associated problems such as air and water pollution, reduced agricultural productivity, and increasing allergens, can increase the risk or severity of a wide range of human health issues. These health problems include: vector-borne diseases such as malaria and dengue, cholera and other water-borne infections, *Salmonella* and other food-borne infections, and other infectious diseases; chronic respiratory diseases (including asthma and allergies), cardiovascular diseases, and other non-communicable diseases; malnutrition; mental health conditions such as anxiety disorders and depressive disorders; and injuries from wildfires, floods, and other natural disasters as well as from increased violence associated with resource limitations and population displacement.[50] These events also impair the ability of health systems to provide high-quality, accessible, preventive, diagnostic, and therapeutic medical services.[51] Global health students should be able to describe the causal pathways that lead from Earth system changes and impaired ecological systems to increased rates and severity of disease, disability, and death.

PHLO 4: Risk assessment

Climate change, natural disasters and extreme weather events, biodiversity loss and ecosystem collapse, and natural resource crises can damage critical infrastructure (such as hospitals, clinics, schools, residential structures, water and sanitation systems, and transportation networks); disrupt access to health-care services, pharmaceuticals, and other tools for health; increase food insecurity due to reduced agricultural and aquacultural productivity and diminished nutrient content in foods; and force mass involuntary migration.[3,52–54] These events also increase the complexity of environmental, socioeconomic, and geopolitical polycrises.[55–57] For individuals and communities, risk exists at the intersection of hazards (such as extreme heat, storms, floods, drought, and wildfires); exposures (such as geographical location, housing quality, and occupation); and vulnerabilities (such as discrimination related to socioeconomic status, race, ethnicity, gender, age, and disability).[50] Resilience is the capacity to anticipate and manage changing circumstances, minimise the risk of and damage from adverse events, and recover from crises.[58–60] Communities lacking economic resources, social capital, and effective governance are more vulnerable and less resilient to climate change and environmental hazards.[61] Global health students should be able to explain the various factors that affect the vulnerability and resilience of individuals, communities, nations, institutions, and systems to environmental change.

PHLO 5: Governance

Governance encompasses the structures and processes that enable local and national governments and intergovernmental organisations to establish and enforce

laws and policies, provide services, and protect human rights. Laws define enforceable standards of behaviour, regulations clarify how laws will be implemented, and policies guide procedures and practices. Environmental crises on a global scale require coordinated responses by all nations to ensure that laws, regulations, and policies at all geopolitical levels are moderating rather than exacerbating environmental problems. The most prominent international treaty related to planetary health is the UN Framework Convention on Climate Change that came into force in 1994 after ratification by nearly all UN member states. The signatories agreed to additional actions to reduce greenhouse gas emissions through both the 1997 Kyoto Protocol, which was in effect from 2005 to 2020, and the 2015 Paris Agreement, which came into effect in 2020. At the 2023 UN Climate Change Conference, the signatories agreed to increase their attention to the health effects of climate change policies.[62] A global treaty on plastics pollution is under consideration.[63] The effectiveness of international agreements depends on participating countries following through on their commitments by passing and enforcing national and local laws that protect and repair the environment, even if those laws place economic and other burdens on companies and individuals.[64–66] Global health students should be able to explain the need for global governance for health and the environment and be able to evaluate the positive and negative climate, environmental, and health effects of local, national, and international laws, regulations, and policies.

PHLO 6: Actions

The UN's *2030 Agenda for Sustainable Development*, the foundational document for the 17 Sustainable Development Goals for 2016–30, expanded the definition of sustainability from the three Es (ethics or equity, environment, and economics) to five Ps (people, planet, prosperity, peace, and partnerships).[67–69] The agenda emphasises that national governments have primary responsibility for enacting and enforcing laws, and that regional and local authorities, international organisations, the business sector, philanthropic organisations, volunteer groups, academia, other non-state actors, communities, and individuals play key roles in advocating for and effecting change.[69] Some planetary health interventions exist at the policy level, including mitigation policies that reduce human effects on environments (such as governmental policies that require manufacturers to reduce greenhouse gas emissions) and adaptation strategies that governments, corporations, health systems, and communities use to prepare for changing environmental conditions; some seek to prevent ecosystem degradation through conservation efforts; some repair damaged ecosystems through restoration projects; and some relate to individual and organisational choices, such as the decision to reduce consumption, repair and reuse items rather than throwing them away, and recycle waste.[70] Many planetary health interventions have ancillary benefits (also called co-benefits) for human health.[71] Global health students should be able to identify the ways that various groups have damaged Earth systems and ecosystems and compare the responsibilities those and other groups have for promoting, funding, and implementing planetary health interventions.

PHLO 7: Ethics

Ethics are standards of human behaviour that are based on shared values and morals. Human rights are freedoms and entitlements that are due to every living person. Health equity is an ethical and human rights principle calling for all people to have the opportunity to be as healthy as possible,[72,73] and environmental equity calls for all people to have equitable access to natural resources and healthy environments and to bear a fair share of the burdens associated with climate change.[74] Environmental justice and climate justice seek to create environmental equity and climate equity through action, starting with calling attention to the ways that historical, institutional, and structural power imbalances have caused disadvantaged communities to experience discrimination, exclusion, and unfair burdens from environmental problems.[74–78] The three Is of climate justice call for: intragenerational justice for today's countries, communities (including Indigenous populations), and individuals; interspecies justice that does not privilege humans over other animals; and intergenerational justice that does not privilege today's people over future generations.[79] Global health students should be able to apply equity, justice, and other ethical principles to considerations of planetary health problems and solutions.

PHLO 8: Communication

Literacy describes both the general ability to read and process information and the domain-specific knowledge necessary to understand, interpret, and communicate information.[80] Health literacy requires knowledge of health and health-care systems; the ability to access, process, use, and disseminate health information; and the confidence and skills to apply health knowledge and information towards improving and maintaining personal health.[81] Environmental literacy includes ecological and environmental knowledge, an attitude of responsibility for environmental protection and improvement, and the ability to engage in environmentally responsible behaviors.[82,83] Planetary health literacy integrates health literacy, environmental literacy, and information skills related to other dimensions of planetary health.[84] Global health students should be able to find, understand, and evaluate reliable information about planetary health; engage with diverse communities' perspectives about the science and effect

of climate and environmental changes; apply planetary health information to the self-assessment of beliefs, attitudes, and behaviours; and use written, oral, visual, and digital communication methods to advocate for planetary health to various audiences.

Conclusion

These eight PHLOs are intended to familiarise global health students with key planetary health facts and concepts. They are not meant to be a comprehensive list of everything that global health students should learn about the field. The PHLOs are written to be appropriate for an introductory course on planetary health taught from a global health perspective, so they do not focus on the development of skills for professional practice. Instructors using the PHLOs might opt to enhance their courses by integrating experiential and applied learning into their teaching plans, and programmes might opt to upgrade the learning objectives to ones that promote higher-order thinking by replacing low-level verbs such as identify, describe, and explain with ones such as prioritise, assess, and design.[23] We expect that the PHLOs will need to be updated regularly in the coming years as global health and planetary health mature as academic disciplines and as researchers from across academia discover more about the science of environmental change and the effects of these changes on the health of humans, animals, and ecosystems. We hope that these eight PHLOs provide a foundation for teaching, curriculum design, and programme development that will equip learners with crucial knowledge about global and planetary health.

Contributors

KHJ, CEW, and KM conceived of and designed the study. All authors contributed to the development of the learning objectives. After reaching consensus on the wording of the PHLOs, all authors contributed to drafting and revising the manuscript. KHJ coordinated the writing process; KHJ and CEW led the editing process.

Declaration of interests

We declare no competing interests.

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